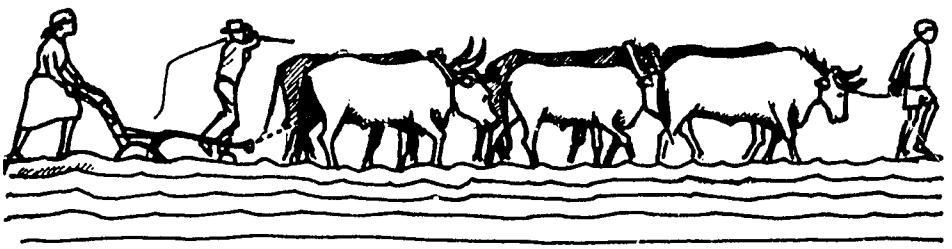
AGRICULTURAL TECHNOLOGY IMPROVEMENT PROJECT (ATIP)



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AGRICULTURAL TECHNOLOGY IMPROVEMENT PROJECT

(ATIP)

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DEPARTMENT OF AGRIC. RESEARCH
MINISTRY OF AGRICULTURE
BOTSWANA

MID-AMERICA INTERNATIONAL
AGRICULTURAL CONSORTIUM
(MIAC)

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FORWORD

The format of this report has been changed from previous years. It is hoped that this will make it easier for readers to look at the sections which they are particularly interested in. The four parts are as follows:

Part I: Executive Summary
Part II: Summary of Activities, September 1986-August 1987
Part III: Workplan, September 1987-August 1988
Part 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.

Also an attempt has been made as to continue the format adopted last year of reducing the amount of empirical material reported on the survey and trial work. This material is available in papers listed in the appendix.

Since the Annual Report is being produced a little late this year it contains some information that became available after August 1987.

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*
* IMPORTANT NOTE *
*
* IN THE ANNUAL REPORT SEVERAL REFERENCES ARE MADE TO THE *
* PROPOSED MOVE OF THE USAID FINANCED FARMING SYSTEMS *
* ECONOMIST AND AGRONOMIST FROM MAHALAPYE TO SEBELE. *
* THE POSITIONS THAT IT WAS PROPOSED THEY WOULD FILL AT *
* SEBELE WERE AGRICULTURAL SYSTEMS ECONOMIST *
* AND FARMING SYSTEMS LIAISON AGRONOMIST. *
* THIS PROPOSED MOVE HAS NOT BEEN APPROVED. *
*
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GLOSSARY

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
CBF	Contour Bed Plowing
CIMMYT	International Maize and Wheat Center
CPO	Crop Production Officer
CRSP	Collaborative Research Support Program
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
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
KSU	Kansas State University
LAC	Livestock Advisory Center
LBDR	Labor Based Drought Relief
LOP	Life of Project
MOA	Ministry of Agriculture
MDP	Molapo Development Project
MIAC	Mid-American International Agricultural Consortium
RELO	Research Extension Liaison Officer
RAO	Regional Agricultural Officer
RIIC	Rural Industry Innovation Center

RMFI	Researcher Managed and Farmer Implemented
RMRI	Researcher managed and Implemented
RSU	Rural Sociology Unit
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
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, espeically in terms of linkages between FSW and extension and on-station research. It has also been emphasized that there is a need to analyse 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, bopefully the welfare of farming families.

The current contract with MIAC was due to expire on December 1st, 1897. Due to representations on the part of the Government of Botswana (GOB) and USAID/B the contract with MIAC has been extended to September 28th, 1990. This has been made possible due to the availability of unspent funds. No new funding is been 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.

1.2 PERSONNEL

There were no changes in USAID technicians directly working in ATIP during the reporting year. However, there are changes now taking place. Dr. R. Hill is taking the place of Dr. C. Trent, the research and extension liaison officer (RELO), who is leaving on December 1st. Dr. R. Gray, animal scientist at Francistown will be leaving in the near future and a replacement is currently being recruited. The replacement will be employed as an extension animal scientist continuing some of the same work that is currently being undertaken.

Two other changes are underway. Mr. C. Bernhardt, Head of the Seed Multiplication Unit (SMU) at the Department of Agricultural Research (DAR) is being paid from ATIP funds for a two year period beginning in April 1987. At the end of his contract it is anticipated the position will be localized. Also as a result of a favourable External Evaluation Panel Review, INTSORMIL has been recruiting for a second position. This position which is a soil management specialist is being offered to Dr. N. Persaud.

In terms of counterparts, there is currently a shortage. Four individuals have recently departed for long-term training. The shortage of two agricultural economists prompted the Division of Planning and Statistics (DPS) to provide two Peace Corps Volunteers (Bock (Ms) and Caplan). In

addition the animal scientist and RELO also lack counterparts. In terms of the counterparts in the field, housing still continues to be a major issue causing low morale amongst the Batswana staff. It is difficult to see how this issue can be resolved.

With reference to the support staff all the T4 positions except one have been filled, while a number of Industrial Class positions have been given up and compensation made in the form of additional funds in the Casual Labour Votes. Besides the INTSORMIL External Evaluation Panel Review, there were Executive Visits and also a visit by the MIAC Board of Directors. Two people came here under a Strengthening Grant (Memorandum of Understanding) given to Kansas State University and Alabama A & M University, and four short-term consultants were used. Eight consultants have currently been proposed for the coming year. However it is likely that these will be shortened in number as a result of a further discussions.

1.3 TRAINING

During the reporting year ATIP funded individuals away on long-term training consisted of six at the BS degree level and three at the MS degree level. A further six people at the MS degree level are expected to be sent away for training during the next year.

Under the terms of the original agreement GOB agreed to sponsor 15 person years of long-term training. Two have been sent off for training at the BS degree level and further four (3 MS and 1 BS) will depart during the coming year.

Eight individuals went on a short-term training courses during the reporting year while in-service training workshops were held for over a 100 other individuals. During the coming year a number of individuals will be sponsored for short-term training and it is also planned to hold in-service training workshops for a substantial number of other staff in the Ministry of Agriculture.

1.4 LIAISON BETWEEN RESEARCH AND EXTENSION

The RELO was heavily involved in research extension liaison activities throughout the year. Components of these involved: numerous meetings with research and extension staff; encouraging extension staff to attend farmer field days held in the ATIP villages; sitting on a number of committees; helping in the organization of Crop Production Officers meetings at which research staff were present; helping to get Agrifacts revised, printed and distributed, and; spearheading efforts to get information from farming systems projects into the newly created farming systems page in Agrinews. Also towards the end of the period he helped get a new newsletter established within DAFS called The Link. With reference to other activities he continued to help organize and coordinate the farming systems inter-project meetings, and played an important role in getting the in-service training programme established for ADs. He also helped in getting the crop specialists to write extenson materials. During the year also a MacIntosh desk top publishing system was purchased for the Agricultural Information Division to facilitate the production of Agrifacts, Agrinews, etc, in a timely manner. Plans for next year are basically the

same.

Other staff also spent more time in meeting with regional extension staff to discuss research plans and progress, and in informing ADs in the ATIP villages of the work being undertaken. Where feasible these ADs were encouraged to be present at the farmer group meetings. Farmer group meetings are seen by ATIP as a way to bridge the gap between research, extension and farmers. Increased efforts will be made during this next year for all ATIP staff members to spend more time in efforts to bridge the obvious gap between research and extension.

1.5 RESEARCH ACTIVITIES

1.5.1 ACTIVITIES, SEPTEMBER 1986 TO AUGUST 1987

The figures in Table 1.1 indicate that the drought coinciding with ATIP's existence continued during the fifth year of the project. There was very little rain from January onwards. Obviously this had a serious negative impact on the trials. The results from this last year have reinforced ATIP's view that there is no one technology package that can be expected to work every year. Rather, in order to develop practical recommendations that farmers can adopt in the very harsh climatic environment in which they operate, it is desirable to have a number of technological options for farmers differentiated in a number of ways, not only by the resource requirements, but also by the type of soil and according to how the year develops, so that the sequential decision making mode intuitively used by farmers can be more closely emulated.

Collaborative work between experiment station based scientists (e.g., INTSORMIL, Groundnut Specialist, Cowpea Programme, etc.) and the ATIP teams continued. However, as was true in the previous year, the degree of collaboration was not as great as would be desirable because of the very poor nature of the rainfall distribution at Mahalapye. Collaboration with Francistown was obviously more limited because of the considerable distance between Sebele and Francistown.

In terms of collaborative work the deep-ripping trials carried out in Mahalapye, Francistown and Sebele have now been concluded. In Francistown and Mahalapye it appears that deep-ripping has little potential under existing management conditions. A major issue is the necessity of including a practical and effective weed control component that can be adopted by farmers.

A summary of the studies, trials and surveys undertaken in the Francistown and Mahalapye areas is given in Tables 1.2 and 1.3.

1.5.1.1 MAHALAPYE

As has been the trend in the previous years relatively little time was spent on diagnostic studies. However, one study involving site characterization along with multi-year data analysis, did help provide useful insights into the benefits to be expected from double plowing, phosphate fertilizer and several row planting systems.

TABLE 1.1: MONTHLY RAINFALL (MMS) AT MAHALAPYE AND FRANCISTOWN, 1982-87/a

MONTH	MAHALAPYE 30 YEAR AVERAGE	MAHALAPYE 1982-1983	MAHALAPYE 1983-1984	MAHALAPYE 1984-1985	MAHALAPYE 1985-1986	MAHALAPYE 1986-1987	FRANCISTOWN 30 YEAR AVERAGE	FRANCISTOWN 1982-1983	FRANCISTOWN 1983-1984	FRANCISTOWN 1984-1985	FRANCISTOWN 1985-1986	FRANCISTOWN 1986-1987
July	2	0	2	0	0	1	0	0	0	0	0	0
August	3	0	1	0	0	0	1	4	12	0	0	0
September	10	0	0	5	0	0	8	0	0	0	0	12
October	31	85	20	34	44	64	24	63	89	34	33	66
November	65	51	99	45	10	62	62	24	123	76	14	67
December	77	35	64	30	67	62	102	39	84	49	49	61
January	85	49	58	58	7	36	99	61	5	137	34	68
February	71	30	13	26	71	15	84	42	20	134	33	31
March	54	46	97	45	14	12	46	42	146	18	59	7
April	30	22	6	0	59	14	26	108	17	0	112	0
May	7	6	1	5	0	0	11	6	0	0	0	0
June	1	5	0	0	0	0	2	0	0	0	0	0
TOTAL	435	329	361	248	272	266	464	389	496	448	334	312

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

TABLE 1.2: STATUS OF SURVEYS AND TRIALS, ATIP MAHALAPYE, 1986-87 SEASON

STAGE	SURVEY OR TRIAL	TYPE	SECTION	DATE	STATUS
DESCRIPTIVE/DIAGNOSTIC:					
	Site Chacterisation Study	ST	6.1.1	Oct 86-Sep 87	Implemented; 50 sites
	Regional Verification Survey	SU	6.1.2	———	Replaced by AHAP/DR Survey
	AHAP/DR Assessment Survey	SU	6.1.3	Dec 86-Oct 87	Added; 41 households
DESIGN:					
	Chicken Management Study	SU	6.2.1	Apr 87-Jun 87	Implemented as planned
	Row Planting Studies	SU	6.2.2	Oct 86-Jun 87	Partially implemented
RMFI:	Water Harvesting Development	TR	6.2.3	Oct 86-Jun 87	Implemented; 2 farms
	Water Conservation System	TR	6.2.4	Aug 86-Jun 87	Implemented; 2 sites
TESTING:					
RMFI:	Commercial Steps in Technology	TR	6.3.1	Sep 86-Jun 87	Implemented; 5 sites
	Hand Replanting	TR	6.3.2	Dec 86-Jun 87	Implemented; 8 sites
RMFI:	MPE Production Intensification	TR	6.3.3	Jun 86-Jun 87	Implemented; 8 farms
RMFI:	Double Plowing	TR	6.3.4	Oct 86-Jun 87	Implemented; 14 farms
	Groundnut Seed Treatment	TR	6.3.5	Nov 86-Jun 87	Added; 17 farms
	Sorghum Variety Trial	TR	6.3.6	Nov 86-Jun 87	Added; 19 farms
	Hand Furrow Planting	TR	6.3.7	Nov 86-Apr 87	Added; 11 farms

SU = Survey. ST = Study. TR = Trial.

TABLE 1.3: STATUS OF SURVEYS AND TRIALS, ATIP FRANCISTOWN, 1986-87 SEASON

STAGE	SURVEY OR TRIAL	TYPE	SECTION	DATE	STATUS
DESCRIPTIVE/DIAGNOSTIC:					
	System Monitoring:				
	Cropping	SU	7.1.1	Sep 86-Aug 86	Implemented as planned; 29 farmers
	Livestock	SU	7.1.1	Sep 86-Aug 87	Implemented as planned; 29 farmers
	Market Participation	SU	7.1.1	Sep 86-Aug 87	Limited to cropping inputs & sales
	Small Stock and Grain Prices	SU	7.1.1	Sep 86-Aug 87	Implemented as planned; 6 sources
	Environmental	ST	7.1.1	Sep 86-Aug 87	Rain and temp. data collected
	AHAP and Drought Relief	SU	7.1.1	Sep 86-Aug 87	Implemented; 57 farmers
	Plowing Labour	ST	7.1.1	Sep 86-Aug 87	Implemented; 35 farmers
RMFI:	Blood Parameters of Goats/Donkeys	ST	7.1.2	Sep 86-Oct 86	Implemented as planed; 78 animals
DESIGN:					
	Chicken Management	SU	7.2.1	Sep 86-Apr 87	Implemented as planned; 12 farmers
TESTING:					
RMFI:	Tillage System Trial	TR	7.3.1	Sep 86-Aug 87	Implemented on 2 farms
	Forage Cultivar Evaluation	TR	7.3.2	Nov 86-Aug 87	Not implemented due to drought
RMFI:	Double Ploughing Trial	TR	7.3.3	Sep 86-Jun 87	Implemented on 5 farms
	Winter Stall Feeding of Cattle	TR	7.3.4	Apr 87-Dec 87	Not implemented due to drought
	Goat Production	TR	7.3.5	Sep 86-Aug 87	Implemented as planned; 20 farmers
	Cropping Systems Studies	TR	7.3.6	Sep 86-Aug 87	Implemented as planned; 6 farmers
RMFI:	RMFI Options Testing/Farmer Groups	TR	7.3.7	Sep 86-Jun 87	Implemented as planned; 97 farmers
DISSEMINATION:					
RMFI:	Crop Residue and Forage Crop Prog.	TR	7.4.1	Sep 86-Aug 87	Implemented; 3 farmers
	Supplemental Mineral-Mix Prog.	TR	7.4.2	Sep 86-Aug 87	Implemented; 2 farmers

SU = Survey. ST = Study. TR = Trial. CONT = Continuing

The main focus of team activities was on researcher and farmer implemented trials. The research implemented trials basically addressed the design involving improved water management systems, assessment of the yield benefits of tillage planting systems under different soil, rainfall and implementation environments, and interactions between soil moisture and the success of hand weed planting.

Although the number of farmers participating in the farmer implemented double plowing trial decreased slightly, those participating in other farmer implemented trials increased relative to earlier seasons. Farmer groups were used in implementing farmer implemented trials addressing hand furrow planting, groundnut seed treatment, and a comparison of sorghum varieties. A promising response was obtained in terms of seed treatment and there was some interest in the new sorghum variety (BOT 79), but little success or interest was generated with reference to hand furrow planting. Farmer groups were again confirmed as being a valuable format for reviewing farmers problems and providing information about various assistance programmes.

The clearest recommendations coming out of the season included the following: double plowing should be targeted to sites with deep, high water holding capacity soils; farmers should gap fill by hand planting; phosphate fertilizer should be applied at sites where high soil moisture status can be expected; and groundnut seed should be treated with Captan. Also the season reinforced the view that row planting needs to receive increased attention.

1.5.1.2 FRANCISTOWN

Apart from some economic and technical monitoring work little descriptive or diagnostic work was undertaken during the last year. As was true last year increasing emphasis was devoted to testing type work.

The blood parameter study of goats and donkeys was completed. It was concluded that, under the environmental conditions in which goats and donkeys are living, there was some value in mineral supplementation for donkeys but not for goats. Other goat work also indicated that the indigenous Tswana breed had potential for improvement, a view that was endorsed by others at a DAR sponsored workshop on goats. At this meeting a decision was made to organize a breeding programme on the Tswana goat rather than using imported exotic breeds. With reference to other livestock related work, forage crops had little success in this very dry year. Thus cooperation with ALDEF was not as great as would have been desirable. More promising was the importation of Kenyan donkey collars and an investigation of the ox yoke developed by the Farm Machinery Development Unit at Sebele. Donkey collars and ox yokes are currently being manufactured at the Rural Industry Innovation Centre in Kanye for more widespread testing during this coming year. Agrifacts on animal draft power was written by the ATIP animal scientist and farm machinery specialist at DAR. It was approved for publication and has been disseminated.

During the year there was a great deal of emphasis put on testing technology with options testing farmer groups. Ninety-seven farmers in three villages participated in these activities attempting a total of a 142 trials. They were asked to select any innovation or package of innovations that they wished to test. The types of innovations suggested included: tillage/water

conservation techniques; planting method options; crop priorities, combinations and rotations; and manure and fertilizer technologies. Farmers' selections tended to concentrate mainly on a few of these. More than a 100 double plowing trials, for example, were undertaken while 20 trials involved testing the rotary injection planter.

The double plowing trials indicated that while double plowing does give a consistent per hectare yield benefit, the technology is not sufficient to produce reasonable yields under a severe lack of rainfall and therefore it is not probably not profitable under such situations. While it is a fairly useful technology under moderate to good rainfall in Botswana, further work is required on technologies (such as water harvesting systems) that can provide some protection against drought.

The rotary injection planter elicited a great deal of interest and as a result 25 have been made at the Rural Industry Innovation Centre for widespread testing this coming year.

1.5.2 PROPOSED ACTIVITIES, SEPTEMBER 1987 TO AUGUST 1988

A summary of the proposed studies, trials, and surveys for Mahalapye and Francistown is given in Tables 1.4 and 1.5. There will be, if approved, a transfer of two staff, from Mahalapye to Sebele.

1.5.2.1 NEW POSITIONS AT SEBELE

It is proposed that a farming systems research liaison agronomist and an agricultural systems economist will be stationed at Sebele. Both will continue to be involved in some backstopping activities at Mahalapye and in writing results up from past work.

The activities of the farming systems research liaison agronomist will involve: helping to strengthen the linkages between FSW and other MOA programmes; providing technical support and liaison for farming systems agronomists; contributing to the dissemination of information on FSW, and; helping to improve the linkage between on-station and on-farm research programmes. In addition there will be collaborative work with other groups including the SACCAR Land and Water Management Research Project, as far as research is concerned. Collaborative work anticipated will be on component practices and on rainfall runoff studies.

The agricultural systems economist will, it is anticipated, help provide an input into commodity oriented economic analyses, provide support for project planning, preparation, development and evaluation issues, and provide analysis of issues relevant to the adoption of technologies by farmers that could be submitted to the DAR for submission, if appropriate, to the MOA Policy Committee.

1.5.2.2 MAHALAPYE

As implied, above the 1987/88 season will be a transition year for the Mahalapye team. However, activities planned still build on earlier investigations. A number of modifications will take place. The use of

TABLE 1.4: PROPOSED SURVEYS AND TRIALS, ATIP MAHALAPYE, 1987-88 SEASON

STAGE	SURVEY OR TRIAL	TYPE	SECTION	DATE	SAMPLE SIZE	INVESTIGATOR MAIN	CO.	FINAL TESTING
DESCRIPTIVE/DIAGNOSTIC:								
	Problem Identification studies							
	Site Characterization Study	ST	12.2.1	Sep 87-Apr 88	40-50 farms	AG		1987-88
	Weed Problem Study	ST	12.1.2	Sep 87-Jan 88	40-50 farms	AG		1988-87
	Row Planter Assessment	ST	12.1.3	Aug 87-Jun 88	15-20 farms	AG		1987-88
DESIGN AND TESTING:								
RMF1:	Development Of High-							
	Potential Sites	TR	12.3.1	Aug 87-Jun 88	12 farms	AG	FM	1988-89
RMF1:	Row Planting Systems							
	Assessment And Promotion	TR	12.3.2	Aug 87-Jun 88	45 farms	AG/EXT	FM	1988-89
TESTING:								
RMF1:	Rotary Injection Planter Trial	TR	12.4.1	Oct 87-Jun 88	9 farms	FM/EXT/AG		1987-88
RMF1:	Sorghum Variety Trial	TR	12.4.2	Oct 87-Jun 88	6 farms	AG		1987-88
RMF1:	Dual Purpose Cowpea Variety Trial	TR	12.4.3	Oct 87-Jun 88	12 farms	FM/EXT/AG		1987-88
RMF1:	Forage-Cowpea Variety Trial	TR	12.4.4	Oct 87-Jun 88	12 farms	FM/EXT/AG		1987-88
RMF1:	Groundnut Hilling-							
	Undersowing Trial	TR	12.4.5	Oct 87-Jun 88	12 farms	FM/EXT/AG		1987-88

SU = Survey. ST = Study. TR = Trial. EXT = CPO/AG. FM = Ag. Economist. AG = Agronomist.

TABLE 1.5: PROPOSED SURVEYS AND TRIALS, ATIP FRANCISTOWN, 1987-88 SEASON.

STAGE	SURVEY OR TRIAL	TYPE	SECTION	DATE	SAMPLE SIZE	INVESTIGATOR MAIN	CO.	FINAL TESTING
DESCRIPTIVE/DIAGNOSTIC:								
	System Monitoring:							
	Cropping	SU	13.2.1	Sep 87-Aug 87	30 farmers	FM	AG	CONT
	Livestock	SU	13.2.1	Sep 87-Aug 88	30 farmers	FM	AP	CONT
	Seed Stock and Grain Prices	SU	13.2.1	Sep 87-Aug 88	5 sources	FM	AP	CONT
	Environmental	ST	13.2.1	Sep 87-Aug 88	Variable	AG		CONT
DESIGN:								
	Mobatsana/Mokubilo Pilot-							
	Communal Grazing Project	ST	13.2.1	Sep 87-Aug 88	Variable	AP,FM		
TESTING:								
RMF1:	Water Harvesting Trial	TR	13.3.1	Sep 87-Jun 88	3 farmers	AG	FM	1988-89
	Agro-Forestry/Alley Cropping	TR	13.3.2	Nov 87-Aug 88	6 farmers	AP	AG	1988-89
RMF1:	Double Ploughing	TR	13.3.3	Sep 87-Jun 88	6 farmers	AG	FM	1987-88
	Evaluation of Triple Purpose-							
	Cowpeas vs. Dolichos Lab-Lab	TR	13.3.4	Sep 87-Jun 88	12 farmers	AP	FM	1988-89
	Goat Production	TR	13.3.5	Sep 87-Jun 88	30 farmers	AP	FM	1989-90
	Cropping Systems Studies	TR	13.3.6	Sep 87-Jun 88	6 farmers	AP	FM	1988-90
RMF1:	Evaluation of Improved-							
	Donkey Harnesses and Ox Yokes	TR	13.3.7	Sep 87-Jun 88	20-30 farmers	AP	FM	1987-88
	Evaluation of Rotary							
	Injection Hand Row Planter	TR	13.3.8	Sep 87-Jun 88	20-30 farmers	AG	FM	1987-88
	RMF1 Options Testing							
	with Farmer Assessment Groups	TR	13.3.9	Sep 87-Jun 88	100-150 farmers	AG	FM	CONT
	Evaluation of Hand							
	Water Pump	TR	13.3.10	Sep 87-Aug 88	4-6 farmers	AP	FM	1987-88

SU = Survey. ST = Study. TR = Trial. FM = Ag. Economist. AG = Agronomist. AP = An. Scientist. CONT = Continuing.

farmer groups will be increased and two types of groups will be formed: small special purpose and larger general purpose groups. The general purpose groups will be used to manage four types of farmer managed and farmer implemented trials including dual purpose cowpea varieties, cowpea forage varieties, rotary injection planters, and groundnut hilling-undersowing trials.

Also resources will be allocated the support of the multi-regional research activities initiated by Sebele based researchers. For example, collaborative trials will be set up with the Sebele sorghum, groundnut, and cowpea programs.

Two major themes underlying the research program will be land and water management and the assessment of row planting systems. There will be close collaboration with the farming systems research liaison agronomist at Sebele and the Land and Water Management research project as far as the rainfall runoff management studies are concerned.

1.5.2.3 FRANCISTOWN

There will be continuing emphasis on testing type work rather than descriptive activities undertaken in earlier years. The primary focus will continue to be an integrated programme to study specific interventions from the technical and economic stand point in order to facilitate comparisons between interventions. The team will emphasize collection of plot level technical and economic data, as a basis for developing budgets on different systems or trials, so that comparative analyses can be made.

The agronomy work will continue to focus on water conservation and improved tillage/planting systems, with some additional work on reducing the risk of total crop failure through improving crop systems. Also examination of potential of useful but not crucial interventions will continue through farmer group activities.

With reference to work in the livestock area, descriptive work will continue on the identification of production parameters of goats, and design activities will focus on the development of a pilot communal grazing project in collaboration with the extension service. Testing work will centre on management systems of goats, fodder crops and improved donkey harnesses and ox yokes.

With reference to farm management there will be continued analyses of the descriptive/diagnostic work already collected and the integration of this data with technical information. There will also be close collaboration with the agronomy and production work in order to provide economic analyses of the design testing trials. Work will be continued on technical and economic monitoring to identify long-term system changes.

1.6 OTHER PROFESSIONAL ACTIVITIES

ATIPs staff attended many formal and informal meetings organized within GOB. Also staff members gave invited lectures at Botswana Agriculture College and the University of Botswana. All staff members were involved with seeing many visitors to DAR and DAFS.

A large number of papers were written during the year containing analyses of research results. Also many were prepared for meetings, workshops and conferences, both inside and outside Botswana. In total three externally published papers were produced, three working papers, 18 miscellaneous papers and 17 progress reports.

It is planned that activities such as those discussed above will continue next year as linkages are strengthened through communication, both of a verbal and written nature.

PART II

SUMMARY OF ACTIVITIES, 1986-87

CHAPTER 2: PERSONNEL

2.1 PROFESSIONAL STAFF

There were no changes in the long-term ATIP staff financed under the MIAC/USAID/GOB agreement during the reporting staff (Table 3.1). All the staff except one (Trent) have agreed to stay on beyond the end of the current contract which terminates on December 1, 1987. However, one other person (Gray) will be leaving the project sometime during the first half of 1988. With respect to replacements, Hill, formerly of Oklahoma State University, will take the place of Trent. He arrived on the 14th of November. A search for a replacement for Gray has started. In terms of housing, two staff members are living in Gaborone plus two staff members in Mahalapye, occupy Government housing, while three staff members at Francistown are in private housing rented by GOB.

In terms of the INTSORMIL CRSP, the agronomist (Carter) has continued in his position while a soil management specialist (Perreaud) has recently been recruited. With reference to these positions, both receive local support under the ATIP project. Government housing is available for these individuals.

In addition, starting in April 1987, for a two year period, salary support commenced for Bernhardt, head of the Seed Multiplication Unit (SMU) in DAR. At the end of this period staffing of SMU will be completely localized.

In terms of the counterparts, Jonas (Ms) has departed on overseas long-term training in August 1987. Due to a shortage of staff it has been impossible for the Rural Sociology Unit in the Division of Planning and Statistics to replace her. Therefore currently there is a shortage of counterparts on the project. Makhwaje, a student of Seale hayne in England, spent his practical training working with Gray for a few months. Currently Gray, Baker, Trent and Norman all lack counterparts in the field. The two Peace Corps Volunteers (Buck (Ms) and Caplan) have been very important in helping to overcome these deficiencies.

A continuing concern, which has been reported for the last two years, is the apparent lack of incentives for Batswana staff in ATIP. All staff work long hours in the field but there seems to be little in the way of a reward system for such work. Counterparts sometimes live under difficult conditions. Housing, for example, continues to be a major morale depressing issue for many counterparts. Government housing has simply not been available for them in Mahalapye and Francistown. It is difficult to see what can be done about resolving this issue which was pointed out as a major problem in the Second Mid-Term Evaluation. With reference to the incentive problem it is also difficult to see what can be done to resolve it but it will need to be addressed if farming systems work (FSW) is to be successfully institutionalized in Botswana, and if Batswana are going to be willing to devote their careers to this type of work. In the Second Mid Term Evaluation the housing issue for counterparts was viewed as being the responsibility of USAID and GOB. Although both institutions have indicated regret about being able to do nothing about it, does not help the situation as far as the counterparts are concerned.

TABLE 2.1: PERSONNEL ON THE ATIP PROJECT SINCE ITS INCEPTION/a

(A). CURRENT

NAME	DISCIPLINE /POSITION	ACADEMIC LEVEL	RANK	STATION	DATES OF ASSOCIATION START	END
USAID TECHNICIANS:						
Norman, D.W.	Ag. Econ.	Ph.D	-	Sebele	Aug. 1982	-
Siebert, J.C.	Agronomist	Ph.D	-	Mahalapye	Sept.1982	-
Baker, D.C	Ag. Econ.	Ph.D	-	Mahalapye	Oct. 1982	-
Heinrich, G.	Agronomist	Ph.D	-	Francistown	Aug. 1983	-
Trent, C.	Extension	Ph.D	-	Gaborone	July 1985	-
Gray, R.	Animal Sc.	Ph.D	-	Francistown	July 1985	-
Worman, F.	Ag. Econ.	Ph.D	-	Francistown	July 1985	-
COUNTERPARTS:						
Mouiakgotla, E.	Agronomist	MS	-	Mahalapye	Aug. 1982	-
Tjirongo, M.	Ag. Econ.	BS	-	Mahalapye	Sept.1982	Study Lv.
Masikara, S.	Agronomist	CA	-	Francistown	Sept.1983	-
Mahabile, W.	Animal Sc.	B.Sc	-	Francistown	Sept.1983	Study Lv.
Ramolemane, G.	Agronomist	B.Sc	-	Gaborone	Sept.1983	Study Lv.
Seleka, T.	Ag. Econ.	BA	-	Francistown	Sept.1983	Study Lv.
Tibone, C. (Ms)	Ag. Econ.	BA	-	Mahalapye	Sept.1983	Study Lv.
Lesotlho, J.	Rural Soc.	BA	-	Mahalapye	Sept.1984	Study Lv.
Jonas, C. (Ms)	Rural Soc.	Cumb.	-	Mahalapye	Jan. 1986	Study Lv.
Mabongo, B.	Ag. Econ.	BS	-	Francistown	Jun. 1986	-
PEACE CORPS VOLUNTEERS:						
Bock, S. (Ms)	Ag. Econ	BS	-	Francistown	Sept.1986	-
Caplan, A.	Ag. Econ.	MS	-	Mahalapye	Sept.1986	-
ADMINISTRATIVE ASSISTANT:						
Selelo, L. (Ms)				Sebele	Mar. 1983	-
OTHERS:						
Mahilo, C.	Enumerator		T5	Shoshong	Sept.1982	-
Okaile, K.	Enumerator		T5	Makoro	Sept.1982	-
Dira, D.	Extension		T4	Mahalapye	Oct. 1982	-
Mogotsi, G.	Driver		Ind. C1	Mahalapye	Oct. 1982	-
Monyane, P. (Ms)	Computing		T5	Sebele	Feb. 1983	-
Monyadiwe, 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	Marapong	Oct. 1984	-
Bagai, B.	Extension		T4	Matobo	Oct. 1984	-
Nkhutslang, R.	Enumerator		GA6	Matobo	Oct. 1984	-
Serumola, R.	Enumerator		GA6	Makwate	Oct. 1984	-
Temba, M.	Enumerator		GA6	Matobo	Oct. 1984	-
Tshabadira, R.	Driver		Ind. C1	Francistown	Oct. 1984	-
Mapena, L. (Ms)	Extension		T5	Makwate	Jan. 1986	-
Gaobone, K. (Ms)	Messenger		Ind. C1	Francistown	Jul. 1986	-
Molapisi, M.	Typist		S4	Francistown	Jul. 1986	-
Bani, I.	Enumerator		GA6	Shoshong	Sep. 1986	-
Motsokono, O.	Driver		Ind. C1	Francistown	Oct. 1986	-
Batshani, P. (Ms)	Enumerator		GA6	Marapong	1986	-
Moabi, D. (Ms)	Extension		T5	Marapong	Jan. 1987	-

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

TABLE 2.1: CONTINUED/a

(B). PAST

NAME	DISCIPLINE /POSITION	ACADEMIC LEVEL	RANK	STATION	DATES OF ASSOCIATION START	END
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
COUNTERPARTS:						
Monyatsi, T.	Ag. Econ.	MS	-	Mahalapye	Aug. 1982	Dec.1984
Moremedi, G.	Agronomist	BS	-	Gaborone	Dec. 1982	Jul.1986
ADMINISTRATIVE ASSISTANT:						
Mophuting, N. (Ms)				Sebele	Sept.1982	Jan.1983
OTHERS:						
Motlhokodise, B.	Enumerator		Trainee	Shoshong	Sept.1982	Mar.1984
Keipeile, W.	Extension		T4	Shoshong	Oct. 1982	Jul.1985
Mmopi, ?.	Driver		Ind. C1	Francistown	Sept.1982	Jul.1985
Moile, P.	Driver		Ind. C1	Francistown	Jul. 1985	Sep.1986
Sibanda, D. (Ms.)	Enumerator		GA6	Marapong	Oct. 1983	Dec.1985
Clifford, J. (Ms.)	Typist		S3	Francistown	Sept.1983	Jul.1986
Mosojane, R.	Extension		T4	Mahalapye	Oct. 1984	May 1987

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

2.2 SUPPORT STAFF

The support staff situation has been reasonably satisfactory during the current reporting period with all except one of the T4 positions being filled -- although currently one is filled at the T5 level. Because many of the industrial class enumerator positions were being filled on a contract basis, which is contrary to government regulations, an agreement was reached with the Chief Arable Research Officer (CARO) in the Department of Agricultural Research, that five Industrial Class enumerators and one office cleaner positions would be given up on the understanding that compensatory funds would be made available under casual labour to employ such people.

2.3 ATIP RELATED VISITORS AND CONSULTANTS

Table 2.2 lists the names of the individuals whose visits were very closely linked with ATIP during the previous year. The main reason for them coming to Botswana was to interact with ATIP or INTSORMIL staff. They can be divided into three types of visits. They were as follows:

(a).INTSORMIL External Evaluation Panel Review. As a result of this review, which was held in March, a decision was made to continue the INTSORMIL program in Botswana and to continue recruiting for a second

INTSORMIL position. The significant link of INTSORMIL with ATIP in Botswana was viewed positively.

(b).Executive Visitors. Four executive visitors looked at the project during November 19xx. They had an opportunity to visit the various field locations. Although there was not much to see in the field it provided them an opportunity for getting a visual impression of the areas where the project worked. The four individuals representing the

TABLE 2.2: VISITORS AND CONSULTANTS CLOSELY RELATED TO ATIP ACTIVITIES, SEPTEMBER 1986-AUGUST 1987

PURPOSE	NAME	AFFILIATION	TIME STARTED	APPROX. LENGTH
External Evaluation Panel Review of INTSORMIL:				
	Dr. A.B. Maunder	Pioneer Seed Company	Mar.	1 Week
	Dr. B. Gebrehiden	CIMMYT	Mar.	1 Week
Executive Visiters:				
	Dr. V. Larson	KSU	Nov.	10 Days
	Dr. D. Good	KSU	Nov.	10 Days
	Dr. M. Johnson	KSU	Nov.	10 Days
	Dr. J. Sje	KSU	Nov.	10 Days
MIAC Board of Directors:				
	Mr. J McKinsey	U. of Miss	Feb.	1 Week
	Dr. R Arnold	U. of Nebr	Feb.	1 Week
	Dr. G. Vollmar	U. of Nebr	Feb.	1 Week
	Dr. J. Scott	Iowa State U.	Feb.	1 Week
	Dr. R. Mitchell	U. of Miss	Feb.	1 Week
	Dr. M. Nolan	U. of Miss	Feb.	1 Week
	Dr. W. Woods	KSU	Feb.	1 Week
	Dr. V. Larson	KSU	Feb.	1 Week
Memorandum of Understanding:				
	Dr. R. Mann	KSU	Mar.	2 Weeks
	Dr. J. Riley	KSU	June	2 Weeks
Consultants:				
	Ms. C. Carter	-------	July	6 Weeks
	Dr. A. Hansen	U. of Fla.	July	5 Weeks
	Dr. D. Esslinger	U. of Miss	June	3 Weeks
	Mr. D. Styles	-------	July	6 Mos.

Vice Provost for International Programs, two Heads of Departments and the Professional Backstopper in agricultural economics were important in building up support for the project at Kansas State University.

(c).MIAC Board of Directors. This visit by eight Deans of Agriculture and Directors of Agricultural Programs of MIAC institutions took place in February. It included trips to the field locations. The trip was very important in informing both the directors and the MIAC institutions about the project. They left bein, very supportive of the project and with the conviction that the project should continue. Undoubtedly their support was a factor in ensuring the continuation of ATIP under MIAC auspices.

(d).Extension of the contract. The Campus Coordinator of ATIP and the Executive Director of MIAC both visited the project twice during the current reporting year. Both visits of the Campus Coordinator and one of the visits of the Executive Director were in connection with negotiations for the extension of the ATIP contract. The major contract negotiations took place in September 1987.

There were two visits under the memorandum of understanding between Kansas State University and Alabama A and M University. Such visits are designed to strengthen the capacity of the participants for international work and, where possible, are also designed to help contribute to ongoing programmes in the countries that they visit. The visits that took place were as follows:

(1).Extension. This March visit was undertaken by an Area Extension Director from Kansas and involved working with Trent in DAFS.

(2).Goats. The June visit by the animal scientist, recently appointed as Head of the Animal Science and Industry Department at Kansas State University, involved working with Grey in the general area of livestock, with specific reference to goats.

Both visits took about two weeks each. Reports were produced by both individuals but these should not be viewed as short-term consultancy reports. These were reports on their activities and impressions based on their short visits.

Finally there were four short-term consultancies fully funded under the ATIP project. These were as follows:

(a).Mrs. C. Carter, Librarian. She was employed to help reorganise the library at the Department of Agricultural Research (DAR). This was an important job since the main librarian was away on training. A lot of progress has been made, but much still remains to be done. The work under this consultancy was spread out over several months.

(b).Dr. A. Hansen, Anthropologist, University of Florida. This was a repeat consultancy, for a five week period during July and August 1987. Basically it involved running short courses for enumerators from the Division of Planning and Statistics and from the various

farming systems projects. These courses were well received by the enumerators. In addition, some time was spent with the Rural Sociology Unit helping them in their work. A report on the consultancy was produced.

(c).Dr. D. Esslinger, Information Specialist, University of Missouri. This involved a three week consultancy in June. Two courses on technical writing were held, one for staff in the Department of Agricultural Field Services (DAFS) and the other for staff in the DAR. About 20 individuals attended each course. These were evaluated as being very successful. A report was written on the consultancy and is available on request. Also a proposal was written on terms of what might be done in the future.

(d).Mr. D. Styles, Agricultural Extension, formerly Botswana Agricultural College. This consultancy which is covering a six-month period starting in mid-1987 is to help in developing the in-service training program recently reestablished in DAFS.

CHAPTER 3: ADMINISTRATION

3.1 ADMINISTRATIVE TASKS

Administration obviously still continued to occupy a great deal of time during the reporting period. Obviously such tasks are complicated by having team members located in four different places (Francistown, Mahalapye, Sebele and Gaborone), by ATIP having to develop close working relationships with three different agencies in the Government of Botswana (DAR, DAFS and DPS) and having to relate to the requirement of the GOB, USAID/B, the Contracting Agency MIAC and the lead institution, Kansas State University.

Nevertheless the major responsibility for administration still continued to be borne by the Team Leader and Deputy Team Leader. It is difficult to see what further can be done to cut down the proportion of time each spend on administrative tasks. The issue is that personal interventions by one or the other often seem to be necessary in resolving problems that arise. However of some help has been the increasingly regular visits by the Peace Corp Volunteer from Francistown (Bock, Ms) who has helped a lot with facilitating the final dissemination of reports.

With reference to accounts under the control of ATIP the following changes have taken place during the reporting year:

(a).Reimbursement of the Research and Operations Support Vote (Line Item 51/403/03). This vote refers to funds that are provided for the project by USAID/B through GOB. Although the process of getting the documentation together and getting reimbursement from AID has not been very much more efficient during the current reporting period, USAID/B has relaxed the necessity of getting complete statements on the past accounts prior to establishing a new project implementation letter authorising GOB to spend further funds on the account. This has been a great help and should facilitate the smooth operation of the project.

(b).Revolving Accounts. Revolving accounts earlier established at Francistown, Mahalapye, have now been supplemented with one at Sebele. This has greatly facilitated expenditure on those items that are reimbursed directly by the Field Support Office of USAID/B. Also the accounts have now been made sufficiently large to be able to cover expenses while claims are being processed.

(c).The FSU Revolving Account. The FSU Revolving Account, due to it not being used very much currently has been reduced to the equivalent of about $US2,000. It is likely that it will stay at this level for the time being.

In order to improve efficiency there are three areas that have received particular attention during the last year. All these have been facilitated through the cooperation of USAID/B. Details are as follows:

(a).Equipment Purchases. Until recently there were two ways to purchase equipment: either through the research and operations support vote

which means using GOB procedures in purchasing locally, or through the line item which was placed in the MIAC/USAID contract agreement enabling equipment to be purchased through Kansas State University. Under the latter arrangement bids have to be obtained and sent to the USA for consideration. Although Kansas State University has been very cooperative in enabling equipment to be purchased locally -- as long as bidding requirements were fulfilled and proper justification was made -- there are inevitably delays in obtaining approval. Now however, USAID/B is going to allow equipment purchased locally to be purchased with funds outside the contract held under the project within USAID/B. This will greatly simplify the purchasing procedures and speed up the approval process.

(b). Preparation and Circulation of Papers. A major bottleneck in producing materials developed by ATIP for dissemination has been problems of producing materials in the final format and, photocopying them and mailing them. During the last year a daisy wheel printer has been purchased together with a photocopier for making multiple copies. Also a mailing list has been set up on a database on the Apple III microcomputer. These three factors have greatly improved the efficiency in which the material is produced and disseminated.

(c). Short-term Training. Procedures for sending people on short-term training have been simplified as far as USAID/B is concerned. Although per diem and tuition costs can be met under the project air fares still have to be paid by GOB. However, apart from this approval for such training has greatly been simplified and currently is operating smoothly. Also the concept of invitational travel for more senior GOB staff under which air fares can be paid for by the project has been accepted in principle by USAID/B.

There has been continuing streamlining of administrative tasks through the use of the Apple microcomputers. For example, leave entitlements, vote records, ATIP library lists and equipment inventories are all kept on disks for quick updating.

A new project car has been purchased (Toyota Cressida station wagon) while the old one (Peugot Super Seven station wagon) is being confined to running locally.

3.2 THE SECOND MID TERM EVALUATION

As was reported in last year there was during 1986 a Second Mid-Term Evaluation. A number of items requiring action arose out of the evaluation report. An indication is given in Table 3.1 concerning what action has been taken with respect to the various items. Cross references are made in terms of the relevant sections in the current report where these items are discussed.

3.3 COST EXTENSION TO THE CONTRACT

One of the recommendations coming out of the Second Mid-Term Evaluation was that consideration should be given to the extension of the ATIP project using funds that had been allocated to the project but not used.

Consequently a proposal was drawn up by USAID/B for this to be implemented. With the support of USAID/B agreement was eventually reached for an extension of the ATIP project and for MIAC to continue being the contractor. A technical proposal for the extension of the MIAC contract from December 1, 1987 to September the 28th 1990 was drawn up by the Team Leader of ATIP. This document went through several iterations as a result of discussions with GOB officials, USAID/B officials, the MIAC representatives and the ATIP team members. This was used as an input into drawing up the contract between USAID/B and MIAC. This has now been signed and therefore the project will continue until September 28th, 1990. It is anticipated that there will be no more funds being allocated to the project over and above what was originally budgeted. There are still a number of issues outstanding which will be clarified over the coming months but considerable progress has been made. A revised log frame was drawn up in the technical proposal. This revised log frame will provide the basis for the operation of the project over the extension period.

TABLE 3.1: ATIP -- ACTIONS RECOMMENDED BY THE SECOND MID-TERM EVALUATION TEAM

	ACTION REQUIRED	RESPONSIBILITY FOR ACTION	DATE ACTION TO BE COMPLETED	ACTION TAKEN
1.	One or more qualified Batswana should be assigned to the RECU when the present RELO counterpart goes for long-term training.	MOA/AID	8/86	No progress
25.	The GOB should establish a system for more timely submission of AID payment vouchers.	MOA/AID	9/86	Some progress
6.	Suitable housing should be provided for all professional Batswana assigned to the ATIP field team.	MOA/AID	9/86	No progress
11.	USAID and MIAC should seek additional funds for long and short-term training for FS related positions.	MIAC/AID	9/86	Sections 10.1, 10.2
16.	The project should employ additional administrative assistance and computer help for the COP.	MIAC/AID	9/86	Section 9.2
24.	AID should determine what local currency expenditures are eligible for project funding, articulate this to ATIP and establish suitable reimbursement procedures with the GOB.	AID	9/86	Not ATIP responsibility but no progress
27.	Project funded participant trainees in the U.S. should be kept fully informed about current ATIP activities and operations.	MIAC	9/86	Monthly letter initiated Section 11.1.1
21.	Project funds should be provided to complete the AGRIFACTS update and facilitate the publication and distribution of AGRIFACTS and the Extension handbook.	AID/ATIP	10/86	Sections 5.2.3, 11.2.2.4
18.	The ATIP project should provide funds to enable its professional staff to attend and participate in regional and international seminars and workshops.	AID	11/86	Agreed in contract extension
2.	Alternative strategies for institutionalising or gaining greater acceptance of FSR should be developed.	ATIP	12/86	Objective modified in contract extension
3.	The current placement of the RECU under the Crop Production Division of DAFS needs to be reassessed. The positioning and status of the RECU needs to be elevated -- so that it can more realistically perform its research, extension and training coordination role.	MOA/AID	12/86	Notion shelved in contract extension

TABLE 3.1: CONTINUED

	ACTION REQUIRED	RESPONSIBILITY FOR ACTION	DATE ACTION TO BE COMPLETED	ACTION TAKEN
4.	Every member of the ATIP team should be responsible for establishing good linkage relationships between research and extension.	ATIP	12/86	Sections 5.2.1, 11.3.2, 12.6.2, 13.5.2, etc.
5.	A qualified Motswana should be assigned as counterpart to the ATIP COP.	MOA/AID	12/86	No progress
7.	ATIP should establish better working relationships with on-station researchers.	ATIP/MOA	12/86	Sections 6.5.3, 7.5.1, 11.3.3, 12.6.3, 13.5.3
10.	Remaining GOB long-term training funds should be programmed primarily for professional training of extension staff.	MOA/ATIP	12/86	Sections 4.1, 10.1
12.	Training in the FS approach to research and extension should be included in the BAC curriculum.	MOA/ATIP	1/87	Section 5.1.5
14.	Data gathering, management information systems and computer training should be provided for Batswana counterparts on the FS teams and also appropriate RSU staff.	ATIP	3/87	Sections 11.1.5, 11.4.2.3, 13.5.4
22.	The DPS should recognize the planning and policy assistance possibilities offered in the FS perspective aspects of the ATIP project, and participate more fully in FS teams efforts.	MOA	3/87	Section 11.4
26.	The question of expanding FS work into commercial farming areas should be addressed in the upcoming Agricultural Sector Assessment.	MOA/AID	6/87	Agricultural Sector Assessment still pending
9.	Institutionalisation of Farming Systems should be considered during the upcoming Agricultural Sector Assessment	MOA	6/87	Agricultural Sector Assessment still pending
1.	ATIP needs to articulate FSR better to decision makers at the senior levels in the MOA.	ATIP	6/87	Sections 10.2, 11.4
19.	Channels should be established for ATIP to provide useful and timely information for DPS planning and policy decision making.	MOA/ATIP	6/87	Section 11.4

TABLE 3.1: CONTINUED

ACTION REQUIRED	RESPONSIBILITY FOR ACTION	DATE ACTION TO BE COMPLETED	ACTION TAKEN
15. The COP should spend more "quality" time interacting with the ATIP FS field teams.	COP/MIAC	6/87	Sections 5.1.1, 11.1.2
13. In-service FS training should be provided for RSU/DPS and DAFS staff, especially DAOs and ADs.	ATIP/MOA	12/87	Sections 4.3, 10.3
17. ATIP should develop an instructional guide on suitable FS methodologies for Botswana's unpredictable and difficult growing conditions.	ATIP	12/87	Sections 11.1.4, 11.4.2.2, 13.5.5
23. The funding for Bean/Cowpea CRSP participant trainees should be continued until completion of their degree programme	AID	12/86	Done
28. To assist in the U.S. institutional development in the area of international agriculture, MIAC should consider campus appointment for the highly trained and field experienced ATIP staff upon completion of their Botswana assignments.	MIAC/AID	12/87	No progress
20. The ATIP should consider moving some of its field staff to Sebele to interact with station research and backstop FS field teams.	ATIP/MOA/AID	6/88	Sections 11.3, 11.4

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

Fifteen person years of long-term degree training were approved by GOB as a part of the government's commitment to the ATIP contract. The following six MOA staff members were tentatively selected for participation beginning 1987-88:

C. Jonas (Ms.)
M. Modise
R. Kgotlele
D. Nkane
E. Senyatso
L. Tabona

The Academy for Educational Development (AED) is helping GOB in the placement of these individuals.

TABLE 4.1: LONG TERM PARTICIPANT TRAINING SINCE INCEPTION OF PROJECT

PARTICIPANT	LOCAL AFFILIATION	QUALIFICATIONS	TRAINING PLANS: TRAINING	INSTITUTION	DEP./RET.
ATIP SPONSORED:					
Gaosegelwe, P.	AHDP, DAR	DA 1975	BS (Agronomy)	KSU	1/83 - 7/85
		BS 1985	MS (Agronomy)	KSU	8/85 - 12/87
Mohive, F.	DAO, DAFS	DA 1977	BS (Agronomy)	KSU	1/83 - 12/85
Monyatsi, T.	ATIP, DPS	BSc 1981	MS (Ag. Econ.)	KSU	1/83 - 12/84
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 1982	BS (Ag. Econ.)	ISU	8/83 - 12/85
		BA 1985	MS (Ag. Econ.)	NMSU	1/86 - 12/87
Lesotlho, J.	ATIP, DPS	DA 1983	BS (Rural Soc.)	Oh.SU	1/86 - 12/88
Luzani, J.	ATIP, DAR	DA 1983	BS (Agronomy)	KSU	1/86 - 12/88
Mahabile, W.	ATIP, DAR	B.Sc 1984	MS (Animal Sc.)	KSU	1/86 - 12/87
Motswasele, P.	ATIP, DAR	DA 1985	BS (Agronomy)	Miss.SU	1/86 - 12/88
Seleka, T.	ATIP, DAR	DA 1983	BS (Ag. Econ.)	Ok.SU	1/86 - 12/88
Tibone, C.	ATIP, DAR	DA 1983	BS (Ag. Econ.)	Ok.SU	1/86 - 12/88
Ramolemane, G.	ATIP, DAFS	B.Sc 1982	MS (Agronomy)	KSU, NMSU	8/86 - 6/88
Sebinyane, A.	LUO, DAFS	Cert. BS	BS (Cartography)	SW Miss. U	6/87 - 8/90
GOB SPONSORED:					
Jonas, C.	ATIP, DPS	Comb.	BS (Rur. Soc.)	U of Miss.	8/87 - 8/90
Nkane, D.	DAFS	BSc	MS (An. Sci.)	Pr. View U	1/87 - 7/89

Through the efforts of the RELO, two staff members from the Agricultural Information Service, L. Dikgang, and D. Mokubung were granted scholarships by the Ministry of Education to pursue BS degree programmes in Agricultural Journalism in the USA.

An additional staff member from the Division of Land Use, A. Sebinyane, was selected for BS study in Cartography in the USA. His studies will be sponsored through ATIP project's funds.

The seven students currently pursuing degree programmes in the USA. continue to make progress.

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

PARTICIPANT	LOCAL AFFILIATION	QUALIFICATIONS	TRAINING PLACE		
			TRAINING	INSTITUTION	DEP./RET.
OUTSIDE COUNTRY:					
Sigwele, M.	ANDP, DPS	MS	FSAR Workshop	U. Zimb.	Mar. 1983
Tjirongo, M.	ATIP, DPS	DA	FSAR Workshop	U. Zimb.	Mar. 1983
Tlale, B.	Director DAFS	BSc	Visit US Institutions		7/83 - 8/83
Masikara, S.	ATIP, DAR	CA	CIMMYT Workshop	Malawi	May 1984
Monyamane, P.K.	Hort.,DAR	?	Vegetable Course	USDA	1/84 - 2/84
Mochise, M.	DAFS	?	Grain Storage	KSU	6/84 - 7/84
Lesothlo, J.	ATIP, DPS	DA	CIMMYT Workshop	Zambia	Nov. 1984
Ramolemana, G.	ATIP, DAFS	BSc	FSAR Workshop	U. Zimb.	3/85 & 9/85
Masikara, S.	ATIP, DAR	CA	Agronomy Course	ICRISAT	9/85 - 3/86
Luzani, J.	ATIP, DAR	DA	MSTAT Workshop	Swaziland	June 1985
Jones, C.	ATIP, DPS	Cmnt.	FSAR Workshop	Gambia	Apr. 1986
Otsitsewe, G.	CPO, DAFS	DA	FSAR Workshop	U. Zimb.	Feb. 1987
Ramaribana, K.	DAO, DAFS	DA	FSAR Workshop	U. Zimb.	2/87 & 9/87
Jones, C.	ATIP, DPS	Cmnt.	CIMMYT	Lusaka	May 1987
Mosupi, P.	CPO, DAFS	BSc	Quelea Control	CSU	July 1987
Mosarwe, D.	CPO, DAFS	DA1	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
IN BOTSWANA:					
4 Clerical Staff	ATIP, DAR		Word Processing	F'town	May 1984
5 Counterparts	ATIP		Daisy Statistics	F'town	May 1984
2 Staff	DAR		Daisy Statistics	F'town	May 1984
18 Staff	DAFS, BAMB,		Grain Storage	Sebele	Sep. 1984
25 Enumerators	DPS		Enum. Workshop	Gaborone	July 1987
25 Enumerators	Farming Systems		Enum. Workshop	Mahalapye	July 1987
38 Specialists	DAR, DAFS		Writing Workshop	Sebele	July 1987
80 Senior staff	DAR, DAFS		Trng. Trainers	Sebele	July 1987

4.2 SHORT TERM TRAINING

K. Ramaribana, DAO, Bobonong, participated in the CIMMYT sponsored Farming Systems workshops held at the University of Zimbabwe in Harare, February and September, 1987. O. Otsitsewe, Crop Production Officer attended the first one but due to a car accident was unable to attend the second. ATIP provided funds for course costs and CIMMYT provided travel funds.

Two crop production officers from DAFS, P. Mosupi and D. Mosarwe, participated in a Quelea Control workshop in July conducted by Colorado State University at Fort Collins, Colorado. ATIP provided funds for course costs.

Four staff from ATIP also attended short courses sponsored by CIMMYT and ILCA.

4.3 ON-THE-JOB-TRAINING

Considerable amounts of on-the-job training were conducted during the year. Workshops on writing for publication were conducted for research and extension staff members in June. Thirty-eight staff members participated. The workshops were conducted by ATIP consultant Dr. D. Esslinger, Assistant Agricultural Editor from the University of Missouri.

ATIP consultant, Dr. A Hansen, University of Florida conducted two one week workshops in agricultural research for MOA enumerators in July. One workshop was conducted for enumerators in the Division of Planning and Statistics and the other for farming system projects enumerators. Fifty staff members participated.

The RELO, in cooperation with the DAFS Training Officer and the National Training Committee planned and conducted orientation training in July for 60 professionals who are or will be training regional extension staff members to conduct in-service training for agricultural demonstrators. To date 56 regional staff members have been trained by the professionals. One of the greatest values of the AD inservice training programme is the train-the-trainer concept. With this approach the regional and district staff receive intensive training by experts and thus increase their own competence in subject matter and extension methods. The RELO conducted a training session on "time management" for RAOs in July. The RAOs will teach the topic in the AD inservice training programme.

Farmers' field days continued to be held in the ATIP villages.

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CHAPTER 5: SEBELE/GABORONE ACTIVITIES, SEPT. 1986 - AUG. 1987

5.1 TEAM LEADER, SEBELE

Ag. Economist: D. W. Norman

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

5.1.1 WORK WITH ATIP TEAM MEMBERS

More time was spent during the current reporting year working with team members at Mahalapye and Francistown, in visiting the work in the field, and in discussing issues. Unfortunately the plan for a person from each team to spend a few days at Sebele each month did not really materialize. This was due to a combination of reasons. Although definitely more time was spent in the field, towards the end of the reporting period after the finish of the rains, fewer visits took place. However, this was supplemented by more frequent ATIP meetings. At least six have been held within the last six months at varying locations including Francistown, Mahalapye and Sebele. 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.

5.1.2 MICROCOMPUTERS

Work involved has continued to be the following:

(a).Providing a service function to other project members and sorting out problems with reference to software and hardware.

(b).Accepting responsibility when needed, for supervising entry of data from surveys and trials on a hard disk at Sebele, after which data were down loaded into files suitable for analysis on the Apple IIe machines at Mahalapye and Francistown.

(c).Providing training for the microcomputer operators at Sebele.

In addition during the past year SMU records have been entered on files on the Apple III microcomputer. These files were designed on the basis of discussions with the Head of SMU and are updated on a weekly basis. This provides an important service for SMU including as it does information on seed received, seed dispatched, balance of seed, and financial records.

The equipment and software packages remain basically the same as last year. The microcomputers have been working very satisfactorily and most of the problems with reference to the software packages have been resolved.

However, many of these machines are now becoming quite old and need replacing. Consequently a decision was recently taken to replace them over time with IBM compatible machines. These are to be the Sperry desk model and Zenith portable microcomputers. Initial orders for these (3 Sperrys and 4 Zeniths) have recently been placed and delivery is expected shortly. Of the three Sperry machines currently ordered, one will be given to APRU and another to DPS. In order to facilitate the transfer of data from the Apple to the IBM compatible machines and vice versa, the biometrician in DAR is helping in working out how this can be done. The decision to change to these machines is in line with a recent decision made by DAR.

5.1.3 ARAP/DROUGHT RELIEF ASSESSMENT SURVEY

The National Food Strategy Group requested a survey to be undertaken in the areas where farming systems projects are located, on the impact of the ARAP and Drought Relief programs. Since four farming systems teams were involved, a great deal of time was spent in helping to bring about a concensus on the questions to be asked and the format of the questionnaire. In the end very similar formats were used by FSSR, by a former EFSAIP team member in the Gaborone area and by ATIP in Mahalapye and Francistown. The survey questionnaire was initially put on the microcomputer at Sebele as was the data resulting from the surveys in all the areas. Initial reports on the surveys undertaken by ATIP are given in Sections 7.1.1 and 6.1.3. FSSR in conjunction with the former EFSAIP area around Gaborone have already produced a joint report which has been submitted to the National Food Strategy Group.

5.1.4 CONTRACT EXTENSION PROPOSAL

As was indicated in Section 3.3 a great deal of time was spent during the last six months drawing up a technical proposal which was used as a basis for extending the contract to September 28th, 1990.

5.1.5 OTHER PROFESSIONAL ACTIVITIES

These included the following:

(a).Six lectures given at Botswana Agricultural College (EAC) and three at the University of Botswana on farming systems work.

(b).Two talks given at the bi-annual Crop Production Officers meetings.

(c).Participated in a panel discussion on "Incentives for the Development of the Arable Sub-Sector: the Small-Scale Farmer hosted by the Botswana Agricultural Society.

(d).Attended many meetings in Botswana, some as a committee member.

(e).Spent time talking to many visitors to Botswna.

(f).Four trips made outside the country during the reporting period. In June Norman returned to Kansas State University to discuss the technical proposal (as above, see Sections 3.3 and 5.1.4). In July

he participated in a "Farmer Participatory Methods Workshop" held at the University of Sussex in the UK. In October he was invited to give a plenary address at the Annual Farming Systems Symposium which was held for the first time this year at the University of Arkansas, and at the beginning of November he participated in the Third Annual Food Security Conference hosted by the University of Zimbabwe for the SADCC countries. At all the meetings except the first, invited papers were given sometimes written in conjunction with co-authors. There was no cost to the project for any of these trips except the first one to Kansas State University.

5.2 RESEARCH EXTENSION LINKAGE, GABORONE

RELO: C. Trent

The primary objective of the Research Extension Liaison Unit (RELU) is to increase the two-way flow of information between research and extension through whatever means that might be appropriate. The following activities were designed and carried out during 1986 - 87 to accomplish the annual objectives.

5.2.1 VISITS WITH EXTENSION AND RESEARCH STAFF

Visits to Regional and District Field Services' officers were made throughout the year. Individual conferences were held with RAOs, DAOs, DAFS, ADs, CPOs, APOs and LUOs.

Individual visits with research staff members at Sebele, Maun, Mahalapye, Francistown, Goodhope and Pelotshetlha served as a tool for sharing field problems with the research staff.

5.2.2 MEETINGS AND CONFERENCES

The RELO attended and participated in monthly AD management meetings in the Central and Francistown Regions. Major items discussed were farming systems work and the long-term AD in-service training programme.

The RELO assisted in the organization and development of regularly scheduled bimonthly Crops Division Staff meetings. Communications within the Division have improved greatly since the meetings were initiated.

The RELO assisted with the planning of the December and October Crop Production Officers' conferences which were held at the Denman Rural Training Centre. DAR staff participated in the conference. The conferences provide an opportunity for a sharing of information between researchers and extension workers.

The RELO participated in a SADCC Extension Directors' conference in Gaborone and presented a paper on "Research Extension Liaison." It

seems that most of the SADCC countries recognize the importance of strong ties between research and extension and that these ties need to be strengthened.

The semi-annual conferences for farming systems staff were held in Sebele in October, 1986 and at Pelotshetlha in March, 1987. The October meeting dealt with the institutionalization issue and the March meeting offered an opportunity for the different farming systems groups to observe the activities being carried out by the Farming Systems Southern Region (FSSR) project.

The arable research conference, normally held in September, was rescheduled and held on the 14-15th of October. The RELO was responsible for promoting attendance by RAOs and CPOs.

The RELO attended ATIP field days and farmers' group meetings in the Central and Francistown Regions.

The RELO attended and participated in field days at the Central Agricultural Research Station in Sebele and the research station at Goodhope.

The RELO met regularly with the National Training committee during the year. The long-term inservice training programme for ADs was finalized and initiated.

Ad hoc conferences were held during the year with the Director, DAFS; Director, DAR; Chief Arable Research Officer; and Field Service Division Heads.

A great deal of the RELO's time was spent in individual conferences with staff members planning for long-term degree programmes and short-term training.

Individual conferences were held with the Academy for Educational Development (AED) staff regarding admission and placement of long-term degree participants.

The RELO attended and participated in regularly scheduled meetings of the ATIP staff and in most cases, prepared the agenda.

The RELO participated in the annual meetings of ARAP and ALDEP.

5.2.3 AGRIFACTS

Efforts continued toward getting Agrifacts revised, printed and distributed. Fifteen revised and new Agrifacts were received from the Government Printer and distributed to the field staff.

Through the efforts of the RELO, a computer operated table-top typesetting - graphics - wordprocessing unit has been purchased through the ATIP project for use by ATIP and the Agricultural Information Division. When the new equipment has been installed and the staff properly trained, the printing of Agrifacts as well as other extension publications will be speeded-up considerably.

5.2.4 EXTENSION PUBLICATIONS

In an effort to get more agricultural research information to the field, the RELO has worked closely with the Crop Production staff in the development of a planned publication programme. Each Crop Production Officer on the headquarters staff has authored the areas in his or her speciality on which field staff need information. Some work has begun on leaflets, circulars and bulletins. The RELO has written a leaflet on extension methods which is ready for editing.

A research newsletter for DAFs field staff was discussed within the Crops Production Division and it was agreed that one should be implemented. A letterhead for the newsletter has been developed with the title of The Link. Some short articles for the newsletter have been prepared by CPOs. It was agreed that before any article on research is printed in the newsletter it must be approved by the researcher concerned. This arrangement will force communications between extension and research.

5.2.5 AGRINEWS

Agrinews is a 16 page monthly publication of the Agricultural Information Service. It is distributed to approximately 8000 people each month. It is the one medium that reaches all Ministry of Agriculture personnel.

In an effort to report the activities and results of farming systems work in Botswana the farming systems projects negotiated an agreement with the head of the Agricultural Information Division for a farming systems page in Agrinews with its own special heading. The various farming systems teams submit short articles and photos for use in the section. Articles are submitted to the RELO who works with the editor in preparing the articles for publication. Farming systems teams have begun to submit feature articles in addition to items for the farming systems page. The coverage of farming systems work in agrinews has increased the awareness of researchers and extension workers as to the objectives and purposes of the farming systems approach.

5.2.6 FARMING SYSTEM INTER-PROJECT ACTIVITIES AND COORDINATION

A proposal for institutionalizing farming systems work in Botswana was presented to the Directors of DAR and DAFs as well as the Chief Agricultural Economist in 1985. No action was taken on the proposal until late 1986. The RELO arranged for the two directors to present a symposium on the institutionalization issue at the October meeting of farming system teams. In essence, the directors stated that approval for institutionalization of farming systems type of work was, perhaps, premature and more time was needed to evaluate the results of farming systems work.

The RELO, along with other members of the ATIP team attended the

February 1987 meeting of farming systems groups held at Pelotshetlha. All arrangements were made by the FSSR staff. The meeting focussed on the on-farm research being conducted by FSSR. The RELO presented the idea of a Farming Systems Newsletter to be used as a tool for telling the farming systems story. Participants felt that a better approach would be a farming systems column or page in Agrinews. It was decided that the team leaders and the RELO would contact the Head of Agricultural Information Division and present such a proposal to him. He agreed that a farming systems page would be appropriate and that space would be provided. The farming systems page is now a regular feature of Agrinews. Coordination is the responsibility of the RELO.

The RELO visited and toured the Molapo Development Project at Maun in July.

CHAPTER 6: ATIP MAHALAPYE ACTIVITIES, SEPT. 1987 - AUG. 1986

USAID: D. Baker (Agricultural Economist)
J. Siebert (Agronomist)

GOB: C. Jonas (Rural Sociology Unit, DPS
Departed on Study Leave August, 1986)
E. Modiakgotla (Arable Crops Division, DAR)

PCV: A. Caplan (Agricultural Economist)

During the 1986-87 season, relatively little time was spent on diagnostic studies. However, two valuable studies were carried out. A Site Characterization Study, along with multi-year data analysis, led to valuable insights about the expected benefits from double plowing, phosphate fertilizer, and several row planting systems. In response to a request from the Director of Agricultural Research, a survey was carried out on the ARAP and DR programs.

The primarily focus of team activities was on research and farmer implemented (RI and FI) trials. RI trials addressed: (a) the design of an improved water management system; (b) an assessment of the yield benefits of tillage-planting systems under different soil, rainfall and implementation environments; and (c) interactions between soil moisture and the success of hand replanting.

The number of farmers participating in an FI Double Plowing Trial decreased slightly, but the number of farmers participating in other FI trials increased relative to prior seasons. Farmer groups were used to manage FI trials addressing hand furrow planting, groundnut seed treatments, and a comparison of sorghum varieties. There was an excellent response to seed treatment and some interest in the new sorghum variety (BOT 79), but little success with or interest in hand furrow planting. The groups were again a valuable format for reviewing farmers' problems and providing information about the assistance programs.

Increased attention was given to farmer participation and dissemination activities. A substantial amount of time was spent analyzing data from this and earlier seasons, and preparing reports.

The clearest recommendations emerging out of the season are as follows: double plowing should be targeted to sites with deep, high water holding capacity soils; farmers should gap fill by hand planting; phosphate fertilizer should be applied at sites where high soil moisture status can be expected; and groundnut seed should be treated with Captan. The season reinforced the view that row planting needs to receive increased attention.

6.1 DESCRIPTIVE AND DIAGNOSTIC STAGE

6.1.1 WITHIN FIELD SITE CHARACTERIZATION STUDY

Objective: 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 chose 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 1986-87 season. Nearly 50 field sites were studied with all having been part of ATIP crop production trials at some time over the past five seasons.

Characterizations were carried out in two separate activities. A farmer questionnaire was administered by project staff to farmers hosting field trials. Direct verification measurements were made by a team of project staff.

The farmer questionnaire was developed to determine if this approach would be adequate to provide sufficient characterization of field sites for on-farm research and extension programs. Farmers possess considerable technical knowledge of their fields but may not have the experience to relate their observations to what research or extension are seeking.

Issues addressed in the farmer questionnaire relate to both hydrology and physical soil characteristics of the field. Issues include productivity under drought and heavy moisture, surface infiltration and internal drainage and natural water drainage both on and near the field.

Detailed measurements on site characteristics were carried out by a team of project staff. Six sample holes were usually made per site. Soil texture was estimated at different horizons of the site profile using simple "texture by feel method" criteria. Soil pH, soil depth and color, highly variable and indicative of production potential, were also assessed. Infiltration rates were assessed on a sub-sample of sites. Surface water

run-on following rainfall was also estimated on the same sub-sample.

Water holding capacity values for the soils were obtained from texture ratings. The relationships of texture rating with "water holding capacity" (percent volumetric) and with "available water" for crop growth use (percent volumetric) were calculated from data on hardveld soils of eastern Botswana published by the Soil Management Support Services consultancy, 1986. The relationship between texture ratings and water holding capacity is remarkably good. The relationship between texture and available water is weaker but still usable in characterizing our farm sites.

Infiltration rates were measured using a double ring infiltrometer. Most infiltration measurements were conducted over a three to five hour period. Initial rates into relatively dry soil surfaces as well as steady rates obtained after the entire soil profile is wet were recorded.

Results: Results from this study have been used to evaluate outcomes from the Double Plowing Trial, the Commercial Steps in Technology Trial, the High Potential Site Development Trial and the Water Harvesting Development. Analyses show that soil depth, higher soil pH and higher water holding capacity contribute to improved responses to several inputs. The level of naturally occurring water run-on improves the water status of the soil as well as the response to phosphate fertilizer.

Results from this study also 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 accumulate and produce heavy clay flood zones. At the high points in this "cantena", 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 sufficient water holding capacity to justify an important 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/water harvesting, possibly before planting, should be the emphasis on these sites.

Effectiveness of the farmer questionnaire in assessing sites was limited. Answers given by farmers were obviously given in the context of the range of situations found in the area. As an example of the problem that this poses, farmers participating in the High Potential Site Development in Makwate village indicated areas that were water run-on sites during rainfall. Yet, even with moderately heavy storms, little run-on was observed. Slopes in the Shoshong area, on the other hand generally, produce run-off/run-on with moderate rain showers.

6.1.2 REGIONAL VERIFICATION SURVEY

Objectives: The objectives were to verify farming systems trends in the Central Agricultural Region and to determine whether farmers are interested in the types of practices being investigated.

Justification: The idea was to provide support for the observations and findings of the Mahalapye team with respect to farming systems trends and the most promising practices being investigated. A verification survey is a standard procedure in social science research.

Approach: A small formal or informal survey of farmers was to be administered in six villages. The primary topics were to be:

(a).Changes in traction use and draft access.
(b).Changes in fencing.
(c).Participation in and assessments of the ALDEP, ARAP and Drought Relief programs.
(d).Perceptions related to double plowing and row planting.
(e).Perceptions of post-establishment management practices.
(f).The impact of drought on households.

Results: The proposed survey was not carried out for the following reasons:

(a).Following a request from the Director of Agriculture Research, the team collaborated on a country-wide ARAP/DR Assessment Survey. This survey took the time which was to have been allocated to the Regional Verification Survey. Many of the objectives of the Verification Survey were met through the ARAP/DR Survey.

(b).The need for an end-of-project verification survey was vitiated by the extension of the project for three years.

(c).None of the Batswana counterparts were available to participate in the survey when it might have been carried out in late winter. Jonas (Ms) and Tjirongo were on study leave, and Modiakgotla was on sick leave.

6.1.3 ARAP/DROUGHT RELIEF ASSESSMENT SURVEY

Objectives: The objectives were to:

(a).Characterize the farming population with reference to equipment ownership, cattle assets, and traction use trends.
(b).Determine patterns of participation in ARAP, Drought Relief and ALDEP.
(d).Assess the impact of the programs on arable farming.
(c).Elicit farmers' views on the programs.

Justification: A substantial amount of time and financial resources are committed to ARAP, DR and ALDEP. Nevertheless, there is no mechanism for evaluating the impact of the first two programs. Therefore, the Director of Agricultural Research (responding to a request from the MFDP) asked the farming systems economists to collaborate on a multi-regional ARAP/DR Assessment Survey.

Approach: Two meetings were held to discuss issues and hypotheses. FSSR circulated a list of topics to address. ATIP drafted a questionnaire. Two additional meetings were held to discuss and revise the questionnaire. ATIP prepared one final questionnaire on behalf of FSSR and Farrington (Sebele economist, a former EFSAIP team member). After some additional pretesting, a slightly modified questionnaire was used by ATIP. The collaborators at each location determined their farmer selection procedures.

In Mahalapye, farmers in Shoshong and Makwate were randomly selected from the 116 farmers who participated in the 1983 Crop Management Survey. Those 116 farmers had, in turn, been selected using random procedures -- so the sample should be representative of the respective villages. In Makoro, no sampling frame was available. Therefore, the ATIP village staff arbitrarily selected a few "typical" farmers from each of several areas. (Selection procedures for Tutume District are described in Section 7.1.1.)

The survey was administered in April and May. Data were coded in each field location and sent to Sebele for processing. After data entry and verification, the data were downloaded and sent to both locations for data analysis.

Results: An analysis of results by village was carried out in October. The analysis focused on: (a) characteristics of the sampled population, (b) major differences between the Mahalapye and Francistown samples, (c) program participation, and (d) an assessment of the programs. Selected findings covering both locations are given below. Complete results will be presented in a progress report, to be distributed by the end of December. In-depth analysis, including data from the Gaborone and Southern Regions, is planned for early next year.

(1). Population Characteristics

A total of 98 households were interviewed. By village, the distribution was: Matobo (18 households), Mathangwane (20), Marapong (19), Shoshong (13), Makwate (15), and Makoro (13). The characteristics of these 98

households were as follows:

(a).Sex of head: 58% male headed.

(b).Large stock ownership: 11% had no cattle; 42% had 1-15; 29% had 16-40; 18% had more than 40. 32 owned donkeys. The average number owned was 6.5 donkeys.

(c).Equipment ownership: 8% owned tractors. 89% owned at least one plow. 11% owned no equipment.

(d).Traction use. Sources of draft in 1986-87: 57% used owned traction, 12% used borrowed or coop traction, 43% hired. 17% used more than one type. 5% did not plow. Type of draft in 1986-87: 17% used donkeys, 50% used cattle, 43% used tractors. 15% used more than one type.

(e).Row planting: only 15% had done any row planting since the drought began.

(f).Seed availability. 71% had bought seed within past 5 years; 50% bought cowpeas, 46% bought maize, 44% bought jugo beans, 36% bought groundnuts. Even with purchases and the government programs, 45% still had shortages of cowpeas, 46% had shortages of maize, 57% had shortages of jugo beans, 51% had shortages of groundnuts.

(g).Weeding: 85% weeded in 1986-87. 73% hired labor to help with weeding.

(h).Fields: 73% had one field, 27% had two fields. Fencing (primary field): 53% had wire fencing, 13% had wire and bush fencing, 18% had only bush fencing; 16% had no fencing. 35% had made fencing improvements during the drought. Destumping (primary field): 26% had a completely destumped field, 23% had a nearly destumped field, 22% had less than half destumped, 22% had little destumping, and 14% had no destumping. 66% had done some destumping since the drought began. 85% still have land that needs to be destumped.

(i).Post-harvest grazing: 28% reported grazing by owned animals, 56% reported grazing by owned and other animals; 16% reported grazing by other animals only. 61% said that cattle and donkey damage continues to be a problem, 78% said wildlife damage is still a problem, and 76% said smallstock damage is still a problem.

(j).Water resources: 46% owned their own water resource at either the lands or the cattle post. 41% had made improvement in the water resources used (not just owned) by the household since the drought began. 61% said more improvements are needed.

(k).Fodder: 87% said they would have bought subsidized fodder, if it had been easily available.

Three major implications emerge from the description of the farming population:

(a).The sampled population appears to be representative with respect to gender of head, wealth, and traction use patterns -- based on national

data and previous ATIP surveys. In addition, there is enough diversity in the population with respect to gender, wealth and traction use to enable additional analysis based on these household characteristics. Such an analysis should provide useful insights into program participation patterns.

(b). Enough households had hired traction, hired weeding, done destumping, erected wire fencing and improved their water resources to create an adequate sample for assessing the role of the assistance programs with respect to these activities. However, too few households had row planted to enable an analysis of row planting assistance.

(c). A majority of households continue to face seed shortages, and need to hire traction, erect wire fencing, destump more land, and improve water resources. Therefore, the various assistance programs are still needed.

(2). Major Differences Between Locations

Some important differences were identified between the Tutume District villages and those located in the Mahalapye area. All the proportions shown below are significantly different at a 99% confidence levels as measured by a Chi-square statistic.

(a). Used owned traction in 1986-87: Mahalapye - 27%; Tutume - 67%.
(b). Used ARAP for own plowing (of those using owned traction): Mahalapye - 23%; Tutume - 71%.
(c). Used cattle for plowing in 1986-87: Mahalapye - 15%; Tutume - 75%.
(d). Used tractors for plowing in 1986-87: Mahalapye - 59%; Tutume - 23%.
(e). Used ARAP for hiring plowing: Mahalapye 74%; Tutume - 40%.
(f). Would have plowed less area without ARAP: Mahalapye - 68%; Tutume - 14%.
(g). Not have enough seed during past five years: Mahalapye - 93%; Tutume - 65%.
(h). Primary field is completely destumped: Mahalapye - 54%; Tutume - 7%.
(i). Did destumping since the drought began: Mahalapye - 85%; Tutume - 52%.
(j). Hired labor for weeding: Mahalapye - 58%; Tutume - 83%.

Even after a partial analysis, the survey shows there are substantial differences between the ATIP locations which impact on the need for different ARAP/DR programs. For example, fewer farmers in Tutume faced seed shortages or said they would have plowed less area in the absence of ARAP assistance. Therefore, the ARAP subsidies are not as necessary for maintaining the level of crop production activity in Tutume District as they are in the Mahalapye area. Instead, the government paid farmers for their own plowing labor and provided supplements to already existing seed supplies. On the other hand, the Tutume farmers have a greater need for assistance with weeding labor, destumping and fencing.

The survey also revealed differences between locations which could affect farmers' responses to a double plowing recommendation. In Tutume, farmers rely on owned cattle traction, have relatively little land which is completely destumped and may face a weeding labor constraint (indicated by the amount of hiring for weeding). These conditions have been identified in past ATIP reports as being exactly those which are most conducive to

acceptance of the double plowing recommendation. Matangwane village reflects these characteristics to the least extent and, correspondingly, is the village where there appears to be less interest in the double plowing recommendation. Obviously, cross locational differences need to receive increased attention and analysis.

(3). Program Participation

The government has done a good job publicizing most of the numerous farmer assistance programs. More than 80 percent of the respondents said they had heard of each of the main programs. The best known programs were: ARAP plowing and seeds, Drought Relief school feeding and clinic rations, Labor Based Drought Relief (LBDR) projects, and ALDEP donkeys. The least known program was the fodder subsidy.

There was great diversity in the level of participation in the different programs. The programs with the greatest participation were not agricultural assistance programs. In the Mahalapye area, for example, 39 of 41 households had participated in school feeding and 39 had received clinic food rations. Thirty-one had participated in at least one LBDR project. The most commonly used agricultural programs were ARAP and DR seed distribution (affecting around 85% of households) and the ARAP and DR plowing subsidies (around 80% of households). ARAP weeding was used by around half the households.

Among the programs which permanently affect farmers' resources, the most common was Drought Relief destumping, followed by ALDEP fencing and ALDEP plows.

Few households had taken advantage of the following programs: ARAP fertilizer, ARAP or DR row planting, ALDEP or ARAP water resource improvement, fodder subsidies, ALDEP traction, or any ALDEP equipment except for plows. The reasons for low participation need to be examined.

(4). Programs Assessment

The survey was designed to determine whether the inputs provided through the programs were actually used by farmers, and to elicit farmers' views on the programs.

Based on fragmentary evidence, it would appear that the ARAP program had increased the level of cropping activity, even if not the level of crop production. For example, 26 percent of the households plowed all their land last season, compared to 16-17 percent during the previous four years of the drought. Ninety percent planted all of the area which was plowed under ARAP and DR; and 36 percent would have plowed less land if it were not for the plowing subsidies. More than 70 percent planted all the seed they received. Seventy-five percent planted all the area destumped under the various programs. Three quarters of those using the programs to make water resource improvements would not have made the improvements without the programs.

Most farmers using the programs expressed satisfaction, although there was some evidence that problems are increasing. For example, 79 percent received their seed on time in 1986-87 but this was down from an average of around 90 percent during earlier years. More than three-quarters of the respondents said the quality of hired plowing done through the programs was

good, but many also said that finding people to do the plowing was becoming difficult.

In the preliminary analysis, farmers' assessments of the programs were only analyzed for the Mahalapye area villages. Farmers were asked to indicate which programs had benefited them the most, which seeds they want next year, and which programs they most want next year. With reference to past benefit, the programs were ranked as follows (based on inverse weighting -- 3 points for top ranked down to 1 point for third ranked for each respondent): ARAP plowing, LBDR, ARAP seed distribution, DR clinic food ration, DR destumping, ALDEP fencing, ARAP weeding, DR school feeding, and ALDEP plows. With reference to seeds wanted, the most commonly cited was cowpeas, followed in order by sorghum, jugo beans and maize. Few mentioned millet. By far, the main program wanted for the coming season is ARAP plowing, followed by ARAP seeds. ALDEP donkeys was the most wanted ALDEP program.

The respondents provided a surprisingly large number of recommendations on how the programs might be improved; too many in fact to say there is a consensus on any particular recommendations. However, the most commonly cited recommendations were: (a) increase the number of crops included in the seed program -- particularly cowpeas and jugo beans, (b) increase the LBDR wage rate, and (c) increase the number of tractors for tractor hiring (by buying and stationing government tractors in villages). The additional recommendations will be documented in the forthcoming progress report.

6.2 DESIGN STAGE

6.2.1 CHICKEN MANAGEMENT STUDY

Objectives: The objective was to identify ways to improve chicken management.

Justification: Any interventions which can lead to an increased offtake of both eggs and chickens for home consumption should improve the welfare of farmers. Unfortunately, no clear options are known for improving chicken management.

Approach: Options for improved chicken management were explored via four routes: (a) discussions at farmer group meetings, (b) reviews of secondary sources, (c) a rapid appraisal survey, and (d) analysis of the 1985 Livestock Practices Survey. These activities were organized and pursued jointly with the Francistown team.

Results: The review of secondary sources was carried out in April and May. The rapid appraisal survey was carried out in May and June. Findings from the secondary sources and the rapid appraisal survey were used to interpret relationships identified in the 1985 Livestock Practices Survey. A draft report was prepared in July and circulated for comments. The report will be issued as a progress report before the end of the year.

The report begins by summarizing the various government programs which provide support for small-scale commercial producers. Next, findings on chicken management from the 1985 Livestock Practices Survey are summarized. Information is provided on flock demographics, reproduction patterns, gender responsibilities for tending and management, management practices, and primary uses. It is shown that chicken management is a female activity and that the main use of chickens is for home consumption of meat and eggs. Chickens generally are managed in a "free ranging" system, although most farmers provide water and feed.

Following the survey results, four topics are discussed (primarily relying on secondary sources and the rapid appraisal survey): penning, feeding, watering and health management practices. Potential interventions in these areas are discussed.

The report presents three general conclusions: (a) there are some potential interventions even in the free ranging system but few farmers are aware of the options, (b) poorer farmers will benefit disproportionately from improvements in chicken management, and (c) there needs to be a logical division in chicken research between APRU ranches and the on-farm research teams. With respect to the division of research responsibilities, the report recommends that APRU needs to assess the responses of various Tswana breeds to alternative management levels. On-farm research should concentrate on labor using interventions (such as penning, shelters for brooding hens, or improved watering) rather than purchased inputs. Finally, on-farm research should be conducted by comparing a complete system of improved management versus the traditional low management system, since component changes cannot be easily introduced in the free-ranging system.

6.2.2 ROW PLANTING STUDIES

Objectives: The main objectives were to:

(a). Evaluate problems encountered by farmers when first trying row planting.
(b). Identify and prioritize testable hypotheses about managerial and technical options for row planting.

Justification: Essentially every time farmers (or Agricultural Demonstrators) have been asked about which practices they feel are most promising or that they most want to try, row planting has been the single most dominant response. Because of farmer interest, introduction and promotion of row planting would ordinarily be a top priority. However, four seasons of research on row planting have produced mixed results.

Intuitively, it can be seen that row planting offers several advantages to farmers who choose to follow an extensive orientation in their crop production and who have sufficient draft and other relevant resources. Row planting can provide the easiest method of control over plant population and spacing on a large scale. Row planting, correctly implemented, can give the farmer a quick and reliable plant emergence response to good moisture conditions. Row planting generally provides a very substantial savings in seed to the farmer.

Several options have been explored for row planting during the past four seasons and some require further investigation. No single option stands out as the most important issue affecting the acceptability of row planting or the outcome of row planted plots. Further exploration of options was required, in order to develop guidelines for on-going research on row planting in the Central Agricultural Region.

Approach: Studies on row planting were conducted in four different activities: an exploratory survey, assessments on farmer implemented row planting, farmer implemented design studies on row planting options and researcher implemented row planting.

The exploratory and assessment work were only done in the current research villages. Most of this activity took place in Makoro and Makwate.

Most farmer implemented comparisons of row planting options were not done due to the mid and late season drought. The early end to the rains cut short all plowing and planting activities in the 1986-87 season. One farmer in Makwate did compare harness arrangements for donkeys pulling a single row planter. One farmer in Makoro tested row markers for the Safim single row planter. None of the row spacing comparisons were implemented.

Researcher implemented comparisons involving row planting were implemented at five locations (these are reported under The Commercial Steps In Technology Trial — Section 6.3.1).

Results: A major constraint to row planting in all three village areas is access to row planting units. Only three single row planters are owned by farmers in Makwate and only one single row unit is owned in Makoro. The workplan for 1987-88 includes activities that address this issue.

Farmers still learning to row plant with single row units tend to overseed with both the Safim and Sebele units. With good emergence, these stands need to be thinned. This is something most farmers are reluctant to do. Overseeding also defeats a primary purpose of row planting which is to achieve appropriate plant stands without labor intensive post-establishment management. This point, along with other extension advice, will be disseminated to farmer groups working with row planting in Makwate and Makoro during the 1987-88 season.

Row planting, as is traditional broadcast single plowing, is often carried out on inadequate soil moisture. For traction owners, this problem can be better avoided. Planting in good soil moisture is an important element of good row planting.

Farmers indicated that two row planter units provided better quality row planting on most seedbeds achieved by traditional farmers than did single row planters. Results from the researcher implemented Commercial Steps In Technology Trial support this indication. Two row units generally are not available and are too costly to be considered for purchase by most farmers. The old reliable S-90 two row unit is no longer available.

Row planting in researcher implemented comparisons achieves, on average, a 40 percent increase in grain yield over traditional broadcast and single

plowing when both systems are targeted for good planting moisture.

6.2.3 WATER HARVESTING DEVELOPMENT

Objective: To design and install a system of channels and ridges that will increase the flow of water run-off/run-on from macro-catchment areas off a field to selected high production potential sites on a field.

Justification: In spite of less than average rainfall in all seasons that ATIP Mahalapye has worked in Shoshong, Makwate and Makoro, significant run-off has been observed on numerous occasions both on and adjacent to many fields. Levels of run-off depend on several factors including characteristics of the catchment area above and on a field site, intersity of rainfall, etc. In general, catchments in the parts of the research area are conducive to run-off. Ground cover is minimal and slopes are long.

Unfortunately, rainfall intensities have not been recorded during the research period. It can be noted, however, that showers of 20 mm or more in a twenty-four hour period will generally produce run-off in some areas. During the past four seasons, 4.4 such showers have been recorded per rain gauge per season — based on data from 143 rain gauge seasons.

Farmers have also indicated that there is a regular occurrence of water flow along natural drainage lines even in drought years. Farmers have expressed a strong interest in attempting to harvest water from the natural water channels that run near or through their fields.

Approach: Two water harvesting networks were designed and implemented. The initial design work involved participation of host farmers, project researchers and officers from the Soil Conservation Unit of DAFS. Installation of the water harvesting apparatus was handled by Soil Conservation in cooperation with ATIP staff.

Water run-off was directed to selected field sites and distributed through the plot by the use of channels and ridges. In the Shoshong design, naturally occurring run-on was intercepted by the channel and distributed through the target areas of the field. In the Makoro design, channels diverted water flow that would not normally have passed over the field on to the target site. The distribution of water over the site was aided by the construction of ridges around the site so that some level of flooding should occur. A small gradient within the plot aided drainage of excess water from the plot.

Results: Grain yield in the water harvest plots at Shoshong in which fertilizer had not been applied was more than 1.0 ton sorghum/ha. Little water run-on occurred in 1986-87 at the Makoro site and grain yield in the water harvesting plots was less than .5 ton sorghum/ha. Sorghum production at Shoshong was obtained from a highly vegetative type variety which certainly limited grain yield. Weed control was incomplete in the plots which also affected yield. It was clear that the soil moisture status remained good in the plots for the entire season in spite of drought conditions.

It was not clear, however, how effective the water harvesting apparatus had been in improving the soil moisture status over what would have occurred naturally. Control areas adjacent to the water harvest blocks produced nearly the same grain yield at both Shoshong and Makoro as did the water harvest blocks themselves. It appears that ridges constructed to hold water in the blocks also served to retain water in the control areas.

It should be noted that grain yields in and near the water harvest block far exceeded yields on other areas of the same fields (ie., 1 ton/ha. versus 0.29 ton/ha. at Shoshong and 0.43 ton/ha. versus 0.05 ton/ha. at Makoro).

Two major technical problems with the water harvest development surfaced during the past season. First, heavy storms generate such volumes of run-off water that it becomes quite costly to construct adequate water control structures. This problem is compounded by the fact that the water control structures concentrate run-off which creates serious erosion hazards at strategic points in the system. Second, distribution of water in the water harvest plots is very uneven and difficult to manage in the type of systems tested.

Results from the first season's work on water harvesting were encouraging. Several modifications in the design of the systems used should improve their usefulness.

(a).Channels constructed to carry water should be more carefully placed on a lightly graded contour (ie., 0.02 percent grade). This will slow the flow of water, permit better water distribution and reduce the erosion hazard.

(b).Water harvest plots, enclosed by ridges, should also be placed along contour lines. This will permit better distribution of water within the plot. Even though many farmers may have reservations about abandoning their traditional plowing patterns in favor of contour plowing, this will be required for successful water harvest management at a majority of farm sites.

(c).Water harvesting designs must be easily replicable on many farm sites. Networks tested in 1986-87 were specially designed for the hydrological circumstances of the two host farms. Replicability can be increased by working entirely on the contour as discussed above and by reducing the size of the catchment utilized to supply water to the site. Large catchments can produce volumes of water that are unmanageable or require more sophisticated water control structures. In many cases, micro-catchments (catchment area is located on the field itself) can generate sufficient quantities of run-off to be useful for improving the crop production potential.

6.2.4 WATER CONSERVATION SYSTEMS' COMPARISON TRIAL

Objective: The objective is to evaluate several sorghum tillage-planting-fertilizer systems that are designed to improve water harvesting and/or conservation. Primary focus was on a comparative assessment of the Sanitas deep rip/water harvest tillage system.

Justification: Because of low and erratic rainfall, Botswana arable research has focused on tillage-planting systems that conserve and in some cases harvest rainfall. DAR asked ATIP to help evaluate under farm conditions a tillage system involving deep ripping and micro-catchment water harvesting. If found appropriate for Botswana conditions, such a tillage system could be implemented under a government program during the winter months with farmers planting on the rip lines following spring rains.

Nine different systems were tested on three field sites in 1985-86. Results indicated that water conservation can be improved with the Sanitas' system but that major problems exist in terms of weed control and maintaining good tilth/aeration in the rip line. This system was modified for 1986-87 to address these problem areas.

Approach: This trial was implemented on two soil types -- loamy sand and sandy clay -- with six basic treatments compared. Treatments included:

(a).Standard single plow-planting.
(b).Double plowing (broadcast).
(c).Early plowing with row planting following a later planting rain.
(d).Plow strips spaced 1.5 meters apart plus row planting.
(e).Sanitas' deep ripping system plus rotary injection row planting.
(f).Deep ripping plus cultivation plus tractor row planting.

The Sanitas' system for this season was modified to include a wider rip line intended to improve tilth, and use of a scraper to control weeds between the rip lines without damaging the molded micro-catchments.

Results : Plantings in this trial were relatively late due to problems associated with weed control prior to planting in the Sanitas' plots. Weed growth under this system proved too great to be controlled by the tractor drawn scraper implement designed at Sebele for this purpose. Hand hoe weeding of the Sanitas' plots to prepare them for planting required between 250 and 300 person-hrs/ha.

Under drought, these late plantings generally failed to produce grain yield. Double plowing and the row planting system produced the best crop growth. For the second season, growth was exceedingly poor in the rip line systems.

Two seasons' testing of these systems have indicated that the Sanitas' system fails to provide adequate weed control through the tillage operation. The scraper unit designed for weeding in the system would require very timely use and even then is unable to control certain weed species (i.e., Sida cordifolia) . This problem alone makes the system unacceptable for nearly all resource poor farmers in the traditional sector of the Central Region.

In both seasons' testing, tilth at planting and during crop development has been restricted in the rip line. A wider rip line appeared to provide little benefit over the 1985-86 version of the system. This tilth problem is in part related to lack of moisture caused by excessive weed growth.

Based on the combined evaluation by all locations involved in this trial,

the Sanitas' system has not been recommended by DAR for promotion to farmers.

6.3 TESTING STAGE

6.3.1 COMMERCIAL STEPS IN TECHNOLOGY TRIAL

Objectives: The objective has been to evaluate individual recommendations as well as combinations of recommendations in tillage-planting-phosphate for sorghum production. This trial is focused on assessing the effects of technologies and the technology times physical environment interaction and does not consider farmer management directly.

A specific objective for year three of this trial was to significantly add to the number of season times soil type environments for which these technology combinations have been tested.

Justification: It is important to determine which interventions work technically and with what level of reliability. In this context, the interaction of recommendations may be just as important as are individual recommendations. Results for this trial to date have permitted a much more comprehensive screening of different technology combinations than would have been possible in the farmer implemented format.

The primary clients of this activity are project and other DAR researchers themselves. Contributions from this trial have been used in designing both the High Potential Sites Development and Double Plowing activities and have helped determine the agenda vis-a-vis row planting.

Approach: Tillage-planting systems and phosphate fertilizer were tested in a factorial experiment at five locations in 1986-87. Three sites were implemented by tractor and two by animal traction. Two tractor sites and one animal traction site were on soils with high production potential in terms of soil depth and water holding capacity. No significant water run-on occurred at any of these sites. The tillage-planting systems tested include:

(a).Traditional single plow-planting.
(b).Plowing and row planting on one day.
(c).Plowing, seedbed preparation and row planting on one day.
(d).Double plowing.
(e).Early plowing with row planting following an intervening planting rain.
(f).Early plowing with seedbed preparation and row planting on the later date.

Results: Over a three year period, fourteen environments have been included in this trial. These environments can be classified as:

(a).One with heavy soil and with good planting and post-planting moisture.
(b).One with heavy soil and with poor planting moisture and delayed emergence of more than six weeks.

(c).One with heavy soil and with good planting moisture and poor post-planting moisture.
(d).One with deep loamy soil and with late planting but good moisture before and after planting.
(e).One with deep loamy soil and with fair moisture at planting and crusting conditions post-planting.
(f).Two with deep loamy soil and with good planting and post-planting moisture.
(g).One with deep loamy soil and with good planting and poor post-planting moisture.
(h).One with sandy shallow soil and with good planting and post-planting moisture.
(i).One with sandy shallow soil and with poor planting moisture and delayed emergence of more than six weeks.
(j).Two with sandy shallow soil and with fair moisture at a late planting and poor conditions post-planting.
(k).Two with sandy shallow soil and with good moisture at planting and poor conditions post-planting.

Grain yields for traditional plow-planting under drought conditions have averaged 320-350 kg sorghum/ha for both sandy and heavier soil types. This figure provides a reasonable estimate of yield potential when planting is targeted for good soil moisture but other factors such as post-establishment weeding only correspond to traditional norms.

The addition of early tillage (i.e., plowing before the planting rains) to the system increases the yield by 60 percent on the heavier textured soils but makes no impact on sites with more sandy soils. Systems in the early tillage category include double plowing and early plowing followed by row planting.

Use of a two-row planter drawn with a tractor resulted in a 40-50 percent increase in grain yield over single plow-planting on all soil types. Only a small benefit was observed with row planting by animal drawn single drawn planters.

Early plowing followed later by row planting showed the highest potential for grain yield benefit of any system tested. At the same time, this system fails about 60 percent of time, even in dry years, because of excessive weed control problems when weeding is handled in the traditional manner. This weed control problem would be manageable with mechanical inter-row cultivation.

The addition of phosphate fertilizer provides economic benefit only when soil type and tillage system combine to make soil moisture adequate. Grain yield benefits from phosphate of 45, 32 and 35 percent were observed with early plowing plus row planting on all soils, traditional on heavier soils and double plowing on heavier soils, respectively. The benefits of phosphate application reached economically viable levels only with early plowing on the heavier soil types (i.e., double plowing and early plowing plus row planting).

In seasons similar to those of 1984-87, sorghum yields of approximately 1 ton/ha can be expected from a early plowing plus row planting plus phosphate system on the heavier (i.e., high potential) soil types. This estimate only depended on soil type and the tillage-fertilizer system used. They were not

dependent on the concentration of water due to water harvesting.

6.3.2 HAND REPLANTING

Objectives: The objective was to compare the percent field emergence and returns to labor when hand replanting sorghum, millet, cowpeas, groundnuts and maize in good and poor soil moisture environments.

Justification: In most broadcasted plots, there are gaps where few or no plants emerge. This represents a loss of the investment made in plowing that land. One option farmers might consider is investing a small amount of seed and labor in order to gap fill by hand planting.

Over a series of years, the Mahalapye team has been exploring options for hand replanting. Among the best results were obtained when using a hand jab planter for cowpeas during the 1984-85 season. Generally favorable results were again obtained during the 1985-86 season when using the Sanitas hand planter for sorghum and millet.

In the previous trials, there was no systematic comparison of the different crops which might be hand planted. Also, no information was generated on the impact of planting soil moisture on the emergence of different crop/varieties. Therefore, a trial comparing crop-varieties planted under different levels of soil moisture was needed to determine an appropriate recommendation for hand replanting.

Approach: A split plot design with two replications was used. The main block was crop-variety. Six crop-varieties were included: Segaolane sorghum, Serere 6A millet, ER-7 cowpeas, Blackeye cowpeas, Sellie groundnuts, and KEP maize. The first three were planted using the Sanitas push planter. The latter three were planted using a hand jab planter.

Each plot was split into three planting dates -- each date to represent a different level of soil moisture (determined by the number of days after a profile soaking rain). All plantings were made in December. The first two plantings were made on good to intermediate soil moisture in all three villages (within seven days of a rain). The last planting was made into drying soils (more than ten days since the last rain) in all three villages.

The trial was planted at nine sites. Most farmers assumed responsibility for plowing and (in principle) for weeding. ATIP staff did the planting and most harvesting. Planting times were recorded on the first two planting dates (a total of 36 plots per crop).

At planting, seeding rates were monitored and recorded. The number of seeds planted was determined on the basis of 100 seed weights. At four to six weeks after planting, emergence stand counts were taken. With this information, the percent field emergence was calculated.

Three harvest measurement procedures were required:

(a).ER-7 and Blackeye were fully harvested and the pods left with farmers. After threshing, the seed was weighed by village staff. Several hundred plants of each variety were randomly sampled and, after drying, weighed in order to determine a dry matter yield per plant.

(b).The number of surviving groundnuts plants was counted in alternate rows. The number of plants was then converted to a per hectare basis. Thirty plants were randomly selected from each plot. The pods were weighed and, after drying, threshed. The threshed groundnuts were then weighed to determine a yield per plant. Several hundred plants were harvested and dried, to estimate a per plant dry matter yield.

(c).For maize, sorghum and millet, harvest stand counts were taken on alternate rows. The counts included: plants, productive plants, average height of plants, and the number of mature, green, harvested and grazed heads (cobs). In practice, there were few green, harvested or grazed heads (cobs). A sample of 40 heads (cobs) were randomly selected from each plot (if there were that many in total). The heads were threshed and weighed to determine a yield per plant. This was used, in conjunction with the stand count, to calculate a grain yield per hectare.

Results: This trial represents the last in which hand planting for gap filling will be formally investigated. The results from this trial will be presented in conjunction with the results from the 1984-85 and 1985-86 trials in a working paper. Selected results from this year's trial are presented below.

TABLE 6.1: PLANTING AND EMERGENCE RESULTS, HAND REPLANTING TRIAL, MAHALAPYE AREA, 1986-87

	SEGAOLANE	SERERE	BLACKEYE	ER-7	KEP	SELLIE
Seeding Rate (kgs/ha)	7.0	4.4	8.4	30.2	17.0	13.9
Planting Time (hrs/ha)	8.4	8.5	26.8	7.4	27.4	26.4
Emergence Stand ('000 plants/ha):						
Good Moisture	108.1	106.8	30.6	81.3	31.8	33.2
Poor Moisture	75.0	75.5	21.6	39.7	26.3	28.5
All	97.1	96.4	27.6	67.4	30.0	31.6
Percent Field Emergence:						
Good Moisture	38.2	22.4	59.5	30.2	77.1	73.3
Poor Moisture	26.0	15.7	75.4	13.8	62.5	69.7
All	34.2	20.1	64.8	24.8	72.2	72.1

Information on seeding rates, planting times, emergence stands and percent field emergence is presented in Table 6.1. Seeding rates were close to the targeted range for Segaolane, Serere, Blackeye cowpeas and Sellie groundnuts. The rate for KEP maize was slightly above target and that for ER-7 cowpeas was more than twice the desired rate. The seed hole on the Sanitas planter was too large (but no mid-season adjustment was made since it would have confounded the planting dates analysis).

Planting times were three times as great for the hand jab planter, compared

to the Sanitas planter. Neither planter was difficult to use on a small plot basis but would have been arduous for large areas.

The results on stand establishment have been grouped for the first two plantings since the soil moisture was quite similar for those plantings. Acceptable stands were obtained for all crops. However, too many plants were established for all three crops planted with the Sanitas planter, particularly on the days planted when there was good soil moisture. On days with little moisture, the average number of plants was good but the stands were erratic. Because the seed is placed on the surface, plantings made with the Sanitas planter were very susceptible to drying soil moisture conditions. The drop off in percent field emergence between wet and dry planting conditions was especially notable for ER-7.

The relatively high and stable percent field emergence of Sellie groundnuts warrants special attention. Groundnuts are expensive and seed often is a constraint. The percent field emergence in this trial was nearly three times that achieved by farmers when broadcasting groundnuts during this past season (see below).

At this point, only a preliminary analysis has been completed on the yields actually achieved in the trial. A summary of the yields and returns to labor are presented in Table 6.2. The highest yields were obtained for the three crops planted at high populations -- Segaolane, Serere and ER-7. Based on field observations, the yields shown for Blackeye and Sellie groundnuts may understate the actual yields by as much as 50 percent. Nevertheless, the returns to the labor invested in hand gap filling are substantially above the urban minimum wage rate for all crops but maize.

TABLE 6.2: YIELDS AND RETURNS TO PLANTING LABOR, HAND REPLATING TRIAL, MAHALAPYE AREA, 1986-87

	SEGAOLANE	SERERE	BLACKEYE	ER-7	KEP	SELLIE
Yield (kgs/ha):						
Good Moisture	290.1	234.8	91.3	178.3	10.8	66.1
Poor Moisture	87.8	138.5	86.3	112.1	10.8	62.4
All	232.2	205.1	90.5	166.0	10.8	64.8
Return to Plant Labor (Pula per hour):						
Good Moisture	10.85	8.74	1.53	9.72	-0.13	3.47
Poor Moisture	3.05	5.07	1.43	5.20	-0.13	3.22
All	8.62	7.61	1.52	8.88	-0.13	3.39

In summary, the data again support a recommendation to farmers that they should gap fill by hand planting. If no special planter is available, they should be able to obtain similar results for groundnuts and Blackeye cowpeas by hand hoe planting. Groundnuts should be planted until mid-December and thereafter Blackeye or ER-7. If a push planter (e.g., Sanitas planter) is available, farmers should plant sorghum or millet. The Ministry of Agriculture should give attention to improving the push planter (to better regulate seeding rates) and then addressing the potential for local manufacture.

The main drawback for the large seeded crops (Blackeye, maize and groundnuts) is the time required for jab planting. The main problems with the push planter are poor control over seeding rates and shallow seed placement. These problems all can be overcome through use of the IITA designed rotary injection planter. This planter will be examined in the coming season. Nevertheless, some attention should still be given to the push planter because it is lighter (and therefore easier to use when filling small gaps in widely dispersed parts of the field) and is less expensive to produce.

6.3.3 PRODUCTION INTENSIFICATION AT HIGH POTENTIAL SITES

Objectives: Objectives that extend over a multi-season horizon were to:

(a). Implement a series of intensified production schemes at high potential sites in order to determine their yield potential for circumstances of the current season.
(b). Determine farmer acceptance of increased production inputs at high potential sites.
(c). Determine the level of water harvesting required to justify an intensification scheme for low resource cropping.
(d). Prepare an enterprise budget for intensified production schemes at high potential sites.

The emphasis was on objectives (a) and (b) in the first season. Specific additional objectives for the 1986-87 implementation of this trial dealt with evaluating components of intensified production. These objectives were to:

(a). Evaluate the incorporation of crop residues for the purpose of promoting water conservation and soil structural development at high potential sites.
(b). Evaluate levels of added phosphate under the anticipated higher moisture situation at high potential sites.

Justification: Most of the rationale behind high potential site development came from observations on the natural variation occurring in crop productivity within fields. Site effects often dominate any improved agronomic practice tested on the field. An early soil study conducted in the ATIP Mahalapye research area also showed that there is nearly as much within field variation for several important soil fertility factors as there is variation between fields within a village area (see Section 6.5.1, ATIP Research Paper Number 1). Within field variability for crop production potential is further accentuated by topography and the resulting variable water supply, and by variation in water holding capacity.

Even though it is assumed that crop responses to phosphate and other inputs are more likely under production systems designed to promote water conservation, many of the fertilizer as well as water conservation responses are erratic. This has been particularly observed under farmer implemented tillage and planting (see Section 7.1.3.5, ATIP Annual Report Number 2). More recently, results from 12 trial site-seasons of researcher implemented sorghum production comparisons including water conservation tillage and

phosphate have shown four site-seasons with a significant benefit from water conservation tillage and six site-seasons with a significant benefit from phosphate. However, all four site-seasons with responses to water conservation were also among those showing a significant response to phosphate.

This trial on production intensification at high potential sites is based on a strategy of combining factors to ensure that water is not limiting with higher levels of other inputs that should have important marginal returns under good moisture conditions.

Approach: Treatment comparisons included stover incorporation where stover was standing in the field at winter plowing time and three levels of single superphosphate fertilizer (0, 20 and 40 units P/ha). Standard across all sites were winter and spring plowing, thinning/gap-filling as appropriate to achieve approximately 60,000 plants per hectare, and early weeding.

Winter plowing, phosphate and stover incorporation were researcher implemented. Plow planting, thinning/gap-filling and weeding were farmer implemented.

This trial was designed to improve understanding of the technical and managerial problems associated with the intensified production package. A total of eight sites were selected in the three village research areas. Two of the eight farmers did not control draft and/or labor for plow-planting on their own schedule but this did not appear to limit the potential of intensified production at these sites.

Results: Even in drought seasons, grain yield levels at high potential sites averaged about 0.50 ton per hectare without addition of phosphate or stover. This compares with an average of 0.14 ton per hectare for the remaining portions of these fields.

Evaluations of the eight sites selected for this study show that due to inadequate soil moisture storage capacity and weak water run-on potential, three sites could not be classified as high potential.

Stover incorporation at the high potential sites improved yield but this benefit was not significant. Yield increases averaged about 100 kg per hectare with the incorporation of stover. Because incorporation was late in the season and quantities added were relatively small, the impact of stover was only to be as a mulch and conduit for water infiltration. Under this strategy, the cost of stover incorporation is small and should be encouraged even if the returns appear negligible.

The addition of phosphate fertilizer was very substantial at all high potential sites. Forty kg P/ha increased grain yields to near one ton/ha. The added benefits to the farmer, after subtracting the costs of the fertilizer and its application, came to 16 Pula/ha.

Analyses on the main factors contributing to grain productivity at high potential sites shows that natural topography generating water run-on and the addition of phosphate fertilizer are most important. The level of naturally occurring water harvesting far exceeded the effect of winter

tillage in determining grain yield during this dry season.

6.3.4 DOUBLE PLOWING

Objectives: Two objectives of this farmer implemented trial were to:

(a). Improve the grain yield return to double plowing by targeting for sites within fields according to a set of hypotheses related to problem conditions or high water holding capacity of the soil.
(b). Evaluate the net economic benefit of double plowing when targeted to selected sites.

Objectives added specifically for year five of the Double Plowing Trial work were to:

(a). Substantially increase the number of observations on double plowing versus standard practice on sites meeting the target criteria.
(b). Increase the level of farmer management for implementation of these comparisons.

Justification: A decision to test double plowing on a large scale was based on mixed but sometimes very good results from previous ATIP trials. Trial results from 1985-86 for double plowing can give some support to several hypotheses on where this recommendation could fit. These hypotheses are based on solving rainfall infiltration problems in irregularly plowed soils, control of several perennial weeds and improving moisture infiltration before planting on soils with the capacity to store that moisture (i.e., high water holding capacity). More observations are needed before these hypotheses can be fully supported as recommendations.

Approach: The approach was similar to that used in 1985-86. There was greater emphasis this season, however, on implementing comparisons at specific target sites. Cooperating farmers were asked to implement only a single comparison of the trial in 1986-87. Plot size and shape was also be modified to meet the requests of several participating farmers that plots be larger and shaped as long narrow rectangles similar to normal plowing units.

Farmers were requested to include a traditional broadcast/ plough check on the day of first plowing (T1) in addition to the double plowed (DP) and the traditional broadcast/plow check for the planting day (T2). The addition of the T1 plot provided a direct measurement of the opportunity cost for sole plowing without planting in the economic assessment of double plowing.

Results:

(1). Agronomic Analysis

In this past season double plowing once again provided farmers with benefits in terms of grain yield and weed control (i.e., weeding labor savings) over single plow-planting. In spite of targeting for high potential sites, the percent yield benefit remained, as in previous seasons, approximately 50-60 percent over the single plow check planted on the same day. Grain yield

levels for all plots were higher, though, than in previous years.

The rainfall pattern of this season favored early season moisture conservation because of drought occurring in mid and late season. This type of moisture conservation was achieved by both the double plow system and by early single plow-planting. Evidence for this was the fact that the single plow-plant check planted on the day of first plowing, produced nearly as much grain yield as did the double plowing. Weed control continued to be much better in the double plowing plots, though. The benefits of early plowing, plow-planting or sole plowing, have now been observed in every season of the ATIP research program.

Results from 71 comparisons of double plowing versus single plow-planting have been implemented by farmers in the Mahalapye area over the past five seasons. These results provide several indications of what outcomes should be expected.

(a).The level of farmer acceptance and the type of implementation (e.g., early versus mid season) vary greatly according to village. Shoshong village, which has generated some excellent double plowing benefits, has not shown much interest in this type of tillage recommendation. Makwate village has given much better levels of implementation but results have not been very positive due to poor soil types.

(b).In spite of fairly good early season rainfall, there have not been many opportunities for first plowing at a time when the farmer would choose not to also plant.

(c).Apart from the earliness of plowing affecting both double plowing and single-plow planting, deeper soil depths, higher soil pH and oxen traction were found to increase the advantage of double plowing over a single plow-planting.

(d).The agronomic advantages offered by double plowing extend to heavy weed prone areas, especially infested with perennial weed types, and to virgin land or land with no recent plowing history.

Double plowing is not recommended for:

(a).Highly manageable soils which readily generate good tilth with one plowing (i.e., most sandy soils)
(b).Shallow soils which can not store sufficient moisture to be able to take advantage of the water conservation benefits of double plowing.
(c).Most plow-plantings with the first plowing begun late in the season.
(d).Land that still retains the plowed condition of the previous season.

(2). Economic Analysis

In the trial design, the first plowing on the DP plot and the T1 plot were plowed as a single acre. Similarly, the second plowing on the DP plot and the T2 plot were plowed as a single acre. This design was used in order to determine plowing times which reflect farmers' practices and to facilitate farmer implementation. However, as a result, plowing times were recorded only according to the first and secoud plowing. This does not affect the economic analysis since ATIP data indicate there is no significant reduction

in plowing time on DP plots compared to SP plots.

Plowing times were recorded for 14 implementations. The first plowing averaged 13.8 hrs/ha. Plowing was done with an average of 2.4 people, therefore involving 31.9 person hours. The second plowing took 13 hrs/ha, again with 2.4 people -- or a total of 30.9 person hours. Most implementations were made with donkey traction using a single furrow plow. Plowing with a single furrow plow took 14.2 hrs/ha compared to 11.9 hrs/ha for people plowing with a double furrow plow. Plowing with oxen took 10.5 hrs/ha compared to 14.5 hrs/ha with donkeys.

Weed burden estimates were recorded at all sites but reliable weeding labor data are available for eight trial implementations (24 plots). The average weeding time for T1 plots was 48.8 hrs/ha, for T2 plots was 32.7 hrs/ha, and for DP plots was 14.7 hrs/ha. Thus, there was a large reduction in weeding time on DP plots. However, a comparison of T2 versus T1 plots suggests that part (perhaps a large part) of the reduction is due to the fact that DP plots were plowed later than T1 plots.

As in prior seasons, a partial budget analysis was carried out to determine the net gain associated with double plowing. The analysis of one hectare DP versus one hectare SP takes into account yield differences, the extra plowing and harvesting time on the DP plot, and the extra weeding time on the SP plot. When DP is compared to T2, the net gain was P34.06 per hectare based on a yield increase of 52 percent (337.1 kgs/ha for DP versus 221.7 kgs/ha). (Grain is valued at 43 t/kg, labor at 38 t/hr, seed at 30 t/kg, and equipment depreciation at P1.50/ha.) The net gain was achieved with an extra labor investment of 37 hours. When only the extra post-planting labor is costed, and the benefit is expressed as a ratio to the required plowing labor, the return to the extra plowing labor was P1.44.

When DP is compared to T1, the net gain was only P8.36. This analysis is relevant if one assumes the latter planting operation is added to the traditional system, rather than the early plowing operation. The net gain is based on a yield increase of only 8 percent (337.1 versus 313.1 kgs/ha) and is almost entirely due to a reduction in weeding labor.

If farmers do not face a land or weeding labor constraint, they have the option of planting both the T1 and the T2 plots, instead just the one DP plot. In an analysis of T1+T2 versus DP, there is a labor saving of 114 hours (66.8 weeding, 47.2 processing), a seed saving of 6 kgs, and a reduced equipment depreciation estimated to be P1.50. However, the DP system gives 236 kg less grain, resulting in a net loss of P54.96.

In summary, farmers who use owned traction and can DP without reducing the area plowed and planted (by plowing when planting could not be done or because there is a land constraint) should double plow. In this season, it is questionable as to whether the reduction in yield due to a partial weeding of two hectares would be as great as the gap between the DP yield and the yield from two traditional plots. Therefore, the previous ATIP argument that farmers facing a weeding labor constraint should double plow did not apply in the Mahalapye area this past season. Farmers using owned traction who can only DP by reducing the area which could be planted, should double plow only if one of the special field situations identified in the technical analysis above pertains. Farmers who hire traction, the majority in the Central Region, should not double plow.

If the government wants to obtain the 50 to 75 percent yield increase which is consistently obtained with double plowing, it appears that a subsidy on the extra plowing will be required for most farmers. The alternative uses of the funds required for the subsidy should be examined before a decision is made to implement such a subsidy.

6.3.5 GROUNDNUT SEED TREATMENT TRIAL

Objectives: To determine whether farmers should treat their groundnut seeds with a fungicide before planting.

Justification: Groundnuts are expensive. Previous researcher implemented research has shown that the percent field emergence of groundnuts is increased by the use of a fungicide seed treatment. It is necessary to confirm the benefit on farmers' fields and to quantify the value of the benefit before a general recommendation can be made.

Approach: Farmers were given 666.7 grams of untreated Sellie seed and the same amount of seed treated with Captan. Farmers set their own plot size and made all management decisions. However, all plots were broadcast planted on the same acre, on the same day. Emergence stand counts were taken by ATIP staff.

Results: The trial was correctly planted by 17 farmers. Results on plant population, plots size, seeding rate and percent field emergence are summarized in Table 6.3.

TABLE 6.3: EMERGENCE RESULTS, GROUNDNUT FUNGICIDE TREATMENT TRIAL, MAHALAPYE AREA, 1986-87

	UNTREATED	TREATED	T/a	SIG.
Plants (per ha)	12,025	14,306	1.80	.97
Plot Size (sq. m.)	442	505	1.44	.95
Seeding Rates (kgs/ha) (kgs/ha)	18.6	17.0	1.42	.95
Percent Emergence/b	19.4	25.3	3.66	.99

a.Based on a paired t-test with 16 degrees of freedom (17 paired observations).
b.Number adjusted for *in vitro* seed viability (estimated to be 95%).

The data show that farmers could have attained the same population as on the untreated plots with 4.06 kgs less seed per hectare, if they used treated seed. At local trade prices (approximately P2.00 for groundnuts), this is equivalent to a seed cost saving of P8.12. The cost for treating seed is 1.9 thebe/kg. Therefore, the cost for treating the 14.5 kgs of seed (18.6

minus 4.1 kgs) would have been 27.6 t/kg. This is a benefit-cost ratio of 29.4.

Given the saving in seed cost, for such a low cash investment, it should clearly be recommended that farmers treat their groundnut seeds. Support systems for distributing seed fungicide in small quantities need to be examined.

6.3.6 SORGHUM VARIETY TRIAL

Objectives: To assess the relative performance of Segaolane, BOT-79, 65-D and Marupantsi sorghum when planted by farmers using the traditional broadcast planting system. To determine farmers' reactions to the four varieties.

Justification: Farmer implemented (FI) trials can be used to provide information to on-station researchers about the performance of new varieties in on-farm conditions. Such trials also facilitate farmer exposure to new varieties, creating an opportunity for farmers to provide feedback to on-station researchers.

The Sebele sorghum program has been considering the release of a selected sorghum variety — BOT-79. Following discussions with L. Mazahni, it was decided to "pre-test" procedures for FI varietal assessment trials by comparing BOT-79 to three released varieties — Segaolane, 65-D and Marupantsi. The trial allowed a more systematic assessment of these varieties than had previously been possible through surveys.

Approach: Farmers were given 333.3 grams of each variety and were asked to plant the seed in adjacent plots on the same acre (planted on the same day). The ordering of the four plots was randomized and farmers were given maps showing the ordering for their trial. Other than ordering the plots, all management and implementation was left to the farmers (including plot size, timing of planting, whether and when to weed, etc.).

Emergence stand counts were taken by ATIP staff. Harvest stand counts were taken on a sub-set of plots to determine the number of productive plants, average plant height, and the number of heads per productive plant. Farmers harvested the plots and threshed the heads. ATIP staff weighed the grain.

Approximately six to eight weeks after harvesting was complete, farmers were asked to rank the four varieties with respect to the following characteristics: most plants established, most drought resistant, least affected by aphids, least time to mature, most grain produced, largest heads, largest grain size, easiest to thresh, easiest to stamp, best taste for porridge, best taste for beer, best color, and best overall.

Results: The trial was correctly implemented by 19 farmers. Eleven farmers obtained some yield. Harvest stand counts were taken on five of the eleven harvested trials. A summary of results is presented in Table 6.4.

TABLE 6.4: EMERGENCE AND YIELD RESULTS, SORGHUM VARIETY TRIAL, MAHALAPYE, 1986-87

	SEGAOLANE	65-D	BOT-79	MARUPANTSI
Plot Size (sq. m.)/a	327	332	338	322
Emergence Stand ('000 plants/ha)	46.5	32.8	28.1	31.2
Yield (kgs/ha):				
All Plots	129	96	199	83
Harvested Plots	224	166	173	143
Harvest Counts:/b				
'000 Plants/ha	60.2	43.6	43.4	40.4
Percent Productive	53	56	25	35
Height (cms.)	76	68	70	66
'000 Heads	36.2	27.7	11.5	14.2
Heads/Plant	1.13	1.14	1.07	1.00

a.Plots size, emergence stands and yields are based on 19 fields.
b.Harvest counts are based on five fields.

Plot sizes were approximately the same for all varieties. The number Segaolane plants established was nearly 50 percent higher than for the other varieties. There was no significant difference among the other varieties.

All yields were low, due to drought and the abandonment of several sites. Segaolane yielded the best, followed by BOT-79. However, the estimate of BOT-79 yields based on farmers' harvesting may overstate yields relative to the other varieties. At the five sites where harvest counts were taken, only 25 percent of the BOT-79 plants were productive. The heads per productive plant ratio was also lower for BOT-79 compared to either Segaolane or 65-D. On the other hand, BOT-79 did have large heads with large grains. Unfortunately, the head samples were not correctly threshed and weighed.

There were two objectives in asking farmers to rank the varieties. One was to compare farmers' perceptions with direct measurements made on stand establishment and yields. The second was to determine which varieties had the most desired grain characteristics. With respect to the first issue, the farmers did not report that Segaolane established better than the other varieties, but did notice that Segaolane and Marupantsi are more drought tolerant than the other two varieties. They also said (accurately) that Marupantsi takes longest to mature and gave the lowest yield. 65-D was noted to have the smallest heads and the smallest grain size, both of which are viewed as negative features of 65-D.

BOT-79 was viewed as an intermediate variety with respect to most growing and yield features. However, BOT-79 was top ranked with reference to threshing ease, porridge taste, and color. (No one had made beer with any of the varieties.) Segaolane was seen as the easiest to stamp. 65-D was viewed as being difficult to stamp and having the worst taste. Overall, Segaolane was the top ranked, followed by BOT-79. 65-D was by far the lowest ranked.

Based on the results of this limited trial, there is no reason BOT-79 could not be released. On the other hand, there would appear to be few reasons why it should be released, since Segaolane is still overall a superior variety. BOT-79 does have some desired consumer characteristics which might be of advantage to the Sebele sorghum program. (It should be noted, however, that the consumer taste results in this study differ from those of the Sebele program — and the reasons for this need further attention.)

Perhaps the clearest conclusion from the trial is than 65-D is not well liked. This confirms results from earlier ATIP surveys in the Mahalapye area. A substitute quick maturing variety, with processing and taste characteristics more approximating Segaolane or BOT-79, would benefit Mahalapye area farmers.

6.3.7 HAND FURROW PLANTING TRIAL

Objectives: To determine whether farmers should invest time in hand furrow planting maize and groundnuts.

Justification: Groundnut and maize stand establishment is erratic in the traditional system and the percent field emergence often is unacceptably low. One potential option for farmers is to hand furrow plant. This is a popular planting technique in countries such as Zambia but is not commonly used in Botswana. Hand furrow planting, if beneficial, would be a relevant practice for poor farmers since no additional implements are required.

Hand furrow planting was first investigated in the 1982-83 season. There was no establishment benefit relative to broadcasting for sorghum. In addition, hand planting was difficult with small seeds and farmers showed no interest in the practice.

The concept of hand furrow planting was revived in the 1985-86 season in response to observed establishment problems with large seeded crops, including maize, groundnuts, sunflower, and cowpeas. Eleven farmers planted two to several crops comparing hand furrow planting and broadcasting. There were no benefits for sunflower, jugo beans or groundnuts. Slightly better stands were obtained by hand furrow planting ER-7 cowpeas and KEP maize. However, the benefits were not substantial and farmers again expressed little interest in the practice.

It was felt that a final attempt should be made to establish a benefit from hand furrow planting, and to stimulate interest in practice, before the option is abandoned.

Approach: The proposal to try hand furrow planting was made to more than 40 farmer group members. Less than a third of the farmers agreed to try hand furrow planting, and only 13 trials were correctly implemented (by only eight farmers) — six for KEP maize and seven for ER-7 cowpeas.

The trial involved a simple comparison of hand furrow planting half an acre versus broadcasting the other half an acre. Farmers were given 666.7 grams of maize for each of the broadcast and the hand furrow plots. For the maize

trial, farmers were given two lots of 500 grams. Farmers determined the plot size, implemented the trial, and made all management decisions.

ATIP staff made emergence stand counts. Farmers harvested the plots on their own.

Results: The plot sizes for the hand furrow and broadcast plots were almost the same, so the seeding rates were as well. The farmers' seeding rates were approximately 15.5 kgs/ha for maize and 13.5 kgs/ha for cowpeas.

The average maize emergence populations were 9,200 plants/ha for hand furrow planting versus 12,850 for broadcasting. The coefficients of variation for emergence populations were 62 percent for hand furrow planting versus 58 percent for broadcasting. The average cowpea emergence populations were 11,200 plants/ha for hand furrow planting versus 13,900 for broadcasting. The coefficients of variation for emergence populations were 78 percent for hand furrow planting versus 86 percent for broadcasting. None of the differences in emergence populations or the coefficients of variation of emergence populations were statistically significant.

Because there were no differences in the populations established or the variability of the populations, yield data were not collected.

In summary, hand furrow planting again resulted in no benefit relative to the broadcasting system. It was difficult to interest farmers in even trying hand furrow planting. There is no evidence that the practice should be promoted or, if promoted, that farmers will respond. Unless new information comes to light, ATIP should abandon further investigations of hand furrow planting and the extension service should not recommend hand furrow planting.

6.4 DISSEMINATION

6.4.1 FARMER GROUPS

Objectives: The objectives were to expose farmers to a range of relevant, improved practices; facilitate FI trials and farmer discussions; and assess group management procedures.

Justification: Farmer groups are valuable to researchers because of their contributions to trials' management, and for obtaining farmer assessments of trials. From farmers' perspectives, the groups are valuable because of the exposure to new ideas and practices. In this sense, the groups are the main vehicle (aside from kgotla meetings) through which ATIP disseminates proposals to farmers.

Approach: During the first few group meetings, six activities were initiated:

(a).Each farmer was asked to review his or her farming situation and to identify any particular problems encountered.

(b).Farmers were encouraged to participate in the three proposed FI trials. Trial objectives and implementation procedures were outlined and seed was distributed to farmers volunteering for each trial. It was emphasized that these were tests, not demonstrations of proven ideas.

(c).Farmers were also encouraged to try three previously tested options on their own. The options included thinning, gap filling and double plowing. These options were periodically discussed but little pressure was exerted to get farmers to try the options.

(d).The RI hand replanting trial was introduced. The concept of replanting was discussed and some group members were asked to provide plots for the trial. The goal was to stimulate interest in replanting.

(e).It was proposed that one or two volunteers per village should try to implement an untested but potentially useful option as a demonstration to other groups members. The suggested options included growing annual forages (combined with harvesting and drying crop residues), compound garden plots, goat housing, and winter stall fattening.

(f).The government assistance programs were explained and farmers were encouraged to take advantage of the programs for which they qualified.

Starting with this initial set of activities, the emphasis given to each activity during the year was determined in iterative manner, based on an assessment of the farmers' interests.

Results: Group meetings were held on a monthly basis throughout the season in Shoshong, Makwate and Makoro. The memberships of the groups remained the same as in the 1985-86 season, except one member was added in Shoshong and two were added in Makoro. The group in Makwate continued to be large and less cohesive than the other groups.

Periodically during the season, guests came to different group meetings to observe or to address the groups on special topics. For example, A. Mayeaux reviewed groundnut production practices with the Makoro group. Similarly, toward the end of the season the Mahalapye Pasture and Fodder Officer (DAFS) addressed the group on the harvesting and use of crop residues. A highlight of the season were the field days held in Makwate and Makoro in April. Farmer group members in Shoshong were taken to the Makoro field day.

With respect to the six activities identified above, there were mixed results. All farmers seemed willing to review their farming situations. This was particularly useful during the early part of the season when there was much variability in the amount of farming activity. However, the reviews stimulated little discussion and less emphasis was given to the reviews later in the season.

There was a good response to the proposed FI trials, except for hand furrow planting (discussed above). There were more implementation errors this season than last because only two meetings had been held by the time many

trials were implemented. It appears that even simple trials need to be explained at least twice if implementation (including plot layout and seeding rates) is to be left up to farmers. The greatest problem with the FI trials was harvest measurement. An attempt was made to rely on farmer harvesting. Farmers were reasonably successful in keeping the yields from different plots separate, but the village staff were not efficient in getting threshed samples weighed. Also, no adequate equipment is available for weighing samples.

There was little success in getting farmers to try the "proven" options on their own. As the options were discussed, a vast majority said they would try them, but few did so. It appeared that in the absence of active promotion and subsidies, the farmers did not feel confident that the benefits would justify their time investment. This year's experience in the Mahalapye area would suggest that merely proposing options to farmers (without free inputs) is not a viable approach for getting a large number of farmers to test an option (unless, perhaps, the benefits of the option had been clearly demonstrated to farmers in prior seasons).

The farmers who hosted the RI trial were quite cooperative. A few farmers whose own plots were poor did not help very much with the weeding. All farmers were tolerant of frequent field visits and seemed interested in the trial outcomes.

There was little success in the demonstrations of unproven options. Two farmers planted annual forage plots but none systematically harvested crop residues. None of the other demonstrations was implemented. Again, it appeared that in the absence of active promotion and staff involvement, the farmers just had too much to do to implement the proposed demonstrations.

The farmers were quite interested in obtaining information about the various assistance programs. In several cases, farmers who were not taking advantage of programs did so after ATIP staff told them about program features. The success in disseminating information about the assistance programs suggests that the group format will be quite effective for disseminating technologies which are as clearly beneficial to farmers as are the current assistance programs.

6.4.2 FARM PLANNING CASE STUDIES

Objectives: The objectives were to develop farm plans for selected ATIP cooperators in order to explore the advantages and disadvantages of an individual farm planning strategy for dissemination activities in Botswana.

Justification: In the farming systems approach, dissemination of particular recommendations is usually focused on groups of farms with similar circumstances. This may not be feasible in Botswana because there is so much diversity among farms. Individual farm planning has proven successful in the United States, but is generally dismissed in Africa as being too expensive. By attempting to prepare a small number of farm plans, the procedures for preparing farm plans can be examined and assessed for their relevance in the Botswana context.

Approach: Approximately six farm plans were to have been prepared, based on data collected during the prior four seasons of research.

Results: Farmers were selected and the process of assembling data from various past surveys was started. However, during the season, it became apparent that an assessment of the benefits of individual farm planning was irrelevant. The DAFS does not currently have enough well-trained extension officers to carry out a farming systems approach, let alone an individual farm planning approach to extension. Therefore, the farm planning activity was abandoned. The data assembled for farm planning could, with some additional processing, be used to develop mathematical programming models for the purpose of policy analysis.

6.5 OTHER PROFESSIONAL ACTIVITIES

6.5.1 ON-FARM RESEARCH METHODOLOGY MATERIALS

The preparation of research methodology materials was identified as a priority activity in the second external project evaluation. The 1986-87 workplan proposed that the Mahalapye team would collaborate on the preparation of a research methodology manual with the Francistown team and the ATIP Team Leader. A project decision was taken to prepare the methodology manual during the 1987-88 season.

Seven contributions were made toward the development of on-farm research methodology training materials during the season:

(a). POPCO/FSSP Case Study. The training case study, based on Mahalapye research methods, was redrafted and shortened — to make it useable by audiences with little training or experience in on-farm research. There are now two sections to the case. The first section presents information on the role of agriculture in national development, and the diagnostic and testing activities of the team between 1982 and 1985. Eighteen tables are included, covering the most significant research findings, and the main features of the on-farm research methodology are discussed. The second section reviews adaptations in experimentation and monitoring during the fourth season.

The case is now being edited for external publication by H. Feldstein. In its present state, the case could be used for in-country training of research counterparts, extension subject matter specialists, on-station researchers, or BAC students.

(b). Baker dissertation. The second chapter of Baker's dissertation summarizes the research procedures used by the Mahalapye team, and identifies the distinctive features of the research approach. The final chapter includes an assessment of the research methodology. An early draft of the thesis gave an assessment of the farming systems approach, in general, and discussed the contributions of farm management economists in on-farm research. With some editing, most of this material will be included in the research methodology manual.

Because of the potential value of the thesis in disseminating research findings as well as assessing research methodology, a copy of the thesis was distributed to the ATIP offices in Francistown, Mahalapye and Sebele. In addition a copy was ordered for the BAC library.

(c).Group papers. Baker prepared a paper on group activities in the Mahalapye area and presented it at the 1986 KSU Farming Systems Research Symposium. In collaboration with Norman, Henrich, Worman, Jonas and Masikara, a paper discussing and comparing group experiences at both locations was later prepared. The latter group paper was presented by Norman to a conference on farmer participation held at IDS Sussex. The four USAID technicians substantially revised the group paper, for publication in the journal Experimental Agriculture.

ATIP is now internationally recognized as a leader in the use of farmer groups to facilitate farmer participation in on-farm research. The farmer group papers will serve as the basis of an important chapter in the methodology manual.

(d).Book chapter. Baker and Norman have collaborated on the preparation of a paper on "The Farming Systems Research and Extension Approach to Small Farmer Development." The paper reviews the rationale for the farming systems approach, summarizes research procedures, and gives an assessment of the approach with reference to contributions and limitations. An abridged version of the paper will be included in an upcoming book on small farmer development. The unabridged version will be distributed as an ATIP paper since it represents a concise overview of the farming systems approach. The paper could be used for training at BAC or the University of Botswana. It would be valuable to use the paper as the basis of a seminar at Ministry headquarters. Sections of the paper will be included in the methodology manual.

(e).Labor time prediction paper. A draft paper was prepared on "Prediction of Sorghum and Millet Harvest and Threshing Time for Use in the Economic Analysis of On-Farm Trials." The paper showed that a reasonable prediction equation could be developed for harvesting and threshing time using the amount harvested and the harvest stand count as explanatory variables. The paper will soon be distributed as a progress report paper.

In anticipation of the methodology manual, a prediction equation was also estimated for weeding labor as a function of the month of planting, days from planting to weeding, and percent weed coverage. The results of this analysis will be incorporated into the above paper, to form a labor time prediction chapter in the methodology manual.

(f).Farming systems perspective paper. A brief paper was prepared for an ATIP team meeting on "Rethinking the Farming Systems Perspective (FSP) in Relation to ATIP FS Work." The paper reviewed currently accepted terminology for different types of FS activities. The objective was to help ATIP research officers to better understand the conceptual distinctions in the objectives and methods of different on-farm research activities. The paper will serve as the basis of a chapter in the methodology manual.

(g).Guidelines to on-farm trials and demonstration procedures. A paper was prepared on guidelines for conducting demonstrations. The paper was presented to a national CPO conference (see below). Additional guidelines were developed at an in-service CPO training meeting held in June 1987. The paper and additional guidelines will serve as the basis of a chapter in the methodology manual.

6.5.2 SUBJECT MATTER REPORTS

The workplan proposed that a series of reports would be prepared, based on past resource and plot monitoring, subject surveys, and technical studies. Draft reports have been prepared on the following topics:

(a).Trading trading network and prices. The report gives information on the availability and prices of agricultural commodities and the main inputs used in arable production. Trading activities and business problems are discussed. The report concludes that the trading network makes a major contribution to farmer welfare due to provision of consumption items and that there is an acceptable level of price integration. Input availability was identified as a key problem, particularly for small villages. Product evacuation channels are non-existent, or at least are not functioning during the drought. Farmers would indirectly benefit from steps taken to provide training in business management.

(b).Draft arrangements. The report gives an overview of the types of draft arrangements used in Shoshong and Makwate and discusses the rights and obligations associated with different types of inter-household draft arrangements. It is shown that households hiring traction cannot be expected to adopt recommendations requiring multiple tillages or timely tillage operations. However, households which borrow traction have essentially the same control over timing as do households using owned traction. Many decisions about the use of traction resources are subject to inter-household agreements, and this needs to be considered when assessing the potential impact of proposed interventions.

(c).Livestock practices. The report summarizes information on herd/flock composition, inventory change patterns, reproduction patterns and practices, worker categories responsible for tending and management, husbandry practices, and major uses of each type of livestock — for cattle, donkeys, chickens and smallstock. High mortality, particularly of offspring, was identified as a key problem area. There may be some opportunities for reducing mortality through supplemental feeding and improved parasite control, since levels of management in both areas were below recommended standards. The survey showed that milk consumption needs to receive relatively greater attention (compared to sales and meat consumption).

(d).Village groups and voluntary organizations. The report reviews recent research on village institutions in Botswana and summarizes the results of an investigation into village organizations in Shoshong and Makwate. The review of institutional research showed that most village organizations are making few contributions to village

development. The Shoshong and Makwate research showed that local organizations in those villages suffer from the same problems identified for village organizations elsewhere in Botswana. Based on the review of local organizations, guidelines on organization management were developed and presented.

(e). Cart ownership. The brief report gives information on cart acquisition, cart values, and cart use patterns. Most carts were donkey carts. The average current value was P309, approximately 75 percent of the acquisition price. The main cart activities were gathering firewood and water for household use, and transporting household members and goods between the village and lands areas. Seventy percent of the respondents had used their carts for collecting firewood on a fee basis, but few other activities had been done for hire. Carts could be used more than they currently are. All cart owners recommended that carts should be included in ALDEP.

(f). Tractor ownership. The report gives information on tractor acquisition, value, use patterns, and maintenance. It is shown that tractors are tremendously underutilized, mainly because most tractors are in poor condition. Some steps are required to increase the availability of spares and tractor repair services.

(g). Food consumption patterns. Prior information on the main dishes consumed in Shoshong and Makwate is briefly reviewed and then an analysis of food consumption frequencies and the sources of food items is presented. Significant differences in food consumption frequencies were identified for several commodities in relation to season, village and cattle assets. There were also significant differences in the amount of sorghum and maize meal consumed and the sources of food items associated with village, season and household assets.

(h). Agricultural extension. The reports gives a brief historical perspective on extension in Botswana, summarizes the results of the 1983 AD Survey in the Central Region, and characterizes the findings of four recent national extension studies. Recommendations are given on how to improve the effectiveness of extension agents. One main recommendation is that extension priorities -- village development themes -- need to be established for each extension area taking into account four key characteristics: the types of traction used, distance to nearest lands, amount of wire fencing, and percent of farmers using early plowing and row planting. These variables tend to distinguish progressive arable farming areas from those which are less progressive.

(i). Arable farming decision making. Synthesizing findings from several surveys, this report gives information on cropping objectives, perceptions on the most important crops, desired sorghum varietal characteristics, factors influencing the timing of plowing, traditional crop production practices, perceptions of recommended practices, traditional post-harvest practices, perceptions of major farming problems, and gender roles in decision making. Implications for future technology development research are discussed.

The above draft reports will be circulated for internal review before the end of the year. As indicated in the workplan for the agricultural systems

economist, the reports will be finalized and published during the first half of 1988.

6.5.3 LINKAGES

The team gave increased emphasis to establishing closer linkages with farmers, and with GOB research and extension officers. Attention was also give to developing linkages with various regional research programs. Little progress was made in establishing linkages with planning and policy. The main activities which contributed to improved linkages were as follows:

(1). Farmers

Farmer participation was increased through the farmer groups. In addition to the regular farmer group meetings, periodic meetings were held with all farmers participating in ATIP trials. In March 1987, farmer field days were held in Makwate and Makoro villages.

(2). Extension

Siebert attended a national CPO conference in December 1986, at which he presented a paper (see below). In June, Siebert conducted an in-service training session for CPOs. The session developed guidelines to be given to ADs on how to plan and conduct on-farm trials and demonstrations. The guidelines were distributed to CPOs to be used when training ADs.

The AD in Makwate regularly attended the farmer group meetings. There was no AD based in Makoro. The AD in Shoshong was replaced in September and the new AD did not attend group meetings despite several invitations.

All district and regional extension officers, as well as several local ADs, were invited to attend the field days held in Makwate and Makoro. Most of the district and regional officers did in fact attend one or both of the field days.

(3). On-Station Research

At least one representative from the Mahalapye team visited Gaborone on a monthly basis throughout the year. Since June, three to four visits have been made each month. During most visits, discussions were held with one or more on-station researchers.

Team members participated in two DAR seminars, a workplan meeting relating to crop rotations and soil fertility, the annual on-station field tour, and the annual research review meetings.

The team collaborated on the DAR multi-regional trial to assess the Sanitas' strip tillage system, and other water harvesting/conserving tillage systems.

In support of the Sebele oilseeds program, the team asked farmer group members to implement the groundnut seed treatment trial. A. Mayeux, head of the program, attended one group meeting in order to explain the trial.

Discussions were held throughout the season on trial outcomes and priorities for future research.

The Director of Agricultural Research, the Chief Arable Research Officer and several additional on-station researchers participated in one or more field reviews of the Mahalapye on-farm trials.

(4). Regional Research Programs

Collaborative work was initiated with the Land and Water Resource Management Programme of the Southern African Centre for Cooperation in Agricultural Research (SACCAR) in June, 1987. A soil moisture monitoring unit, funded by the SACCAR project, has been set-up to work with the Mahalapye team. Under this collaboration, major water management trials and measurement studies have been designed for the Shoshong area.

The Mahalapye team hosted, for one day, a technical sub-committee on soil conservation of SARCUS. The farming systems research program was reviewed and Shoshong research areas were visited.

The Mahalapye team hosted, for one day, soil scientists participating in the International Soil Correlation Workshop co-sponsored by Land Utilization Division of DAFS and by Soil Management Support Services of USAID Washington. De criptions of use patterns were presented of several soil types under study by the workshop.

(5). Planning and Policy

The team's collaboration on the ARAP/DR Survey was the only definite step taken toward establishing better linkages with planning and policy.

6.5.4 RESEARCH AND EXTENSION MEETINGS

The following out-of-country meetings were attended by members of the Mahalapye team:

(a). While on home leave, Baker attended the 1986 KSU Farming Systems Symposium. A paper was presented on farmer groups and the involvement of women in on-farm trials. Mahalapye trial procedures were introduced and discussed at a workshop on informal trial designs. A meeting was held with H. Feldstein, editor of the POPCO/FSSP Case Studies Project. Several visits were made to the Department of Agricultural Economics. The annual meeting of the Farming Systems Support Project was attended.

(b). Siebert and Baker attended a Food Security Research Methodology Workshop held at the University of Zimbabwe in March 1987. Both made presentations. A paper was distributed on "Research Relating to Household Food Security Analysis Carried Out by an On-Farm Team of the ATIP Project in the Mahalapye Area." A trip report was written and circulated. The trip report clarified differences between farming systems research and food security analysis.

(c). Jonas (Ms) attended a CIMMYT networkshop on intra-household dynamics in farming systems research, held in Lusaka in May 1987. A draft trip report was prepared before Jonas (Ms) left on study leave. The report will be finalized and circulated before the end of the year.

The following in-country meetings were attended:

(a). Siebert attended the Crop Production Officers Conference held in Gaborone in December 1986. A paper was presented on "On-Farm Trials and Demonstrations: Some Design Guidelines from the Farming Systems Research Botswana Experience."

(b). Modiakgotla and Siebert attended the "National Training Course on Reclamation and Management of Deteriorated Soil" held in Gaborone in March 1987. A paper was presented on "Water Harvesting and Soil Conservation in Dryland Farming."

(c). Baker, Caplan, Dir., Jonas (Ms), Modiakgotla and Siebert attended the Farming Systems Inter-Project Meeting and field research review hosted by the FSSR in the Southern Region in April 1987.

(d). Caplan, Jonas, Modiakgotla and Siebert attended the annual ALDEP Staff Management Meeting held at the Mahalapye RTC in May 1987. Siebert presented a paper on "Technology Research Briefs."

(e). Baker, Caplan, Modiakgotla and Siebert attended the DAR Weeds Workshop held at BAC in June 1987. Siebert presented two papers: "Tillage-Planting Methods Effects on Weed Development" and "Weed Development in the Traditional Cropping System." Baker presented a paper on "Weed Control During Drought."

(f). Caplan, Modiakgotla and Siebert attended a meeting and tour at RIIC in August 1987.

(g). Baker, Caplan and Siebert attended the ATIP/DAR Double Plowing Seminar held at BAC in September 1987. Siebert presented a paper on "Technical Aspects of Double Plowing in On-Farm Trials."

(h). Baker, Caplan, Modiakgotla and Siebert attended the Farming Systems Inter-Project Meeting held in Gaborone in October 1987.

(i). Baker, Caplan, Modiakgotla and Siebert attended the Division of Arable Crops Research Annual Meeting in October 1987. Siebert made a presentation on selected results from tillage-planting systems research. Modiakgotla made a presentation on high potential site development. Baker made presentations on: groundnuts seed treatment, thinning, hand planting, delayed emergence monitoring, hand furrow planting, and the 1986-87 sorghum variety trial.

CHAPTER 7: ATIP FRANCISTOWN ACTIVITIES, SEPT. 1987 - AUG. 1986

USAID: R. Gray (Animal Scientist)
G. Heinrich (Agronomist)
F. Worman (Agricultural Economist)

GOB: B. Mabongo (Agricultural Economist, DPS)
S. Masikara (Agronomist, DAR)

PCV: S. Bock (Ms) (Agricultural Economist)

7.1 DESCRIPTIVE AND DIAGNOSTIC STAGE

Descriptive and diagnostic studies have centered on monitoring farming activities and on analyzing data collected previously.

7.1.1 ECONOMIC AND TECHNICAL MONITORING SURVEYS AND STUDIES

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

(a).Crop environment, 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).Small stock and grain prices.
(e).Agricultural Government Subsidy Programs

Justification: Since arable agricultural production in Botswana fluctuates greatly from year to year, due in large part to the harsh climatic environment and government policies, more than one or two years are required to adequately describe crop production activities. Livestock enterprises also fluctuate with climatic conditions and policy changes, 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.

Approach: To provide system monitoring information, several data collection methods have been utilized. For environmental information, daily readings of rainfall amounts and temperatures were taken. Cropping and animal management practices, livestock inventories, and market participation were assessed through periodic questionnaires administered to the households which participated in the Multiple Visit Survey (1983-1985). Small stock and grain prices have been collected from six village sources on a monthly

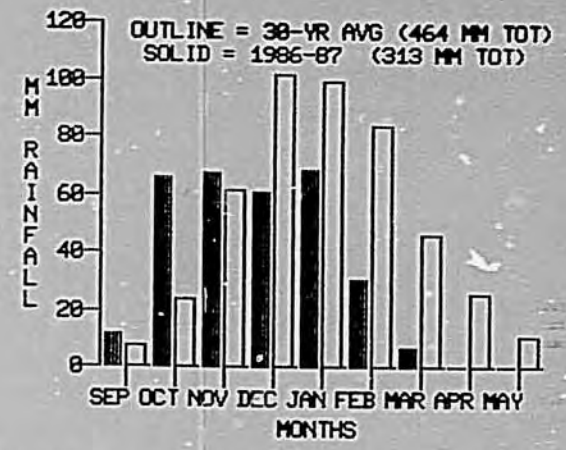

FIGURE 7.1: RAINFALL, 30 YEAR AVERAGE AND 1986-87, FRANCISTOWN AREA

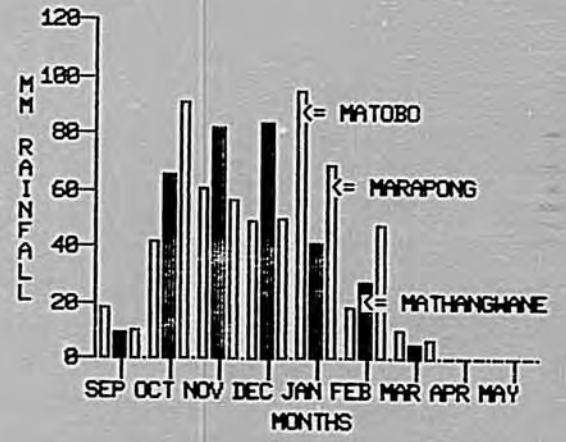

FIGURE 7.2: RAINFALL BY VILLAGE, FRANCISTOWN AREA, 1986-87

basis. A special one time survey was used to assess farmer participation in government drought relief programs.

Results: Results of on-going monitoring activity are reported by subject area.

(1). Environmental Monitoring

On 8th April 1987, Botswana's President, Dr. Quett Masire declared the country drought stricken for the sixth year in a row. This declaration underlines the major importance of rainfall in Botswana agriculture. For the Francistown area, average cropping season rainfall for the three villages was 67 percent of the 30 year average (Figure 7.1). However, from February 1st on, only 38 mm of rain fell, 20 percent of the normal rainfall during the major part of the growing season (Figure 7.2). The poor distribution of rainfall had a detrimental impact on farm productivity for all ATIP trials.

Monthly maximum and minimum temperatures for Matobo are reported in Table 7.1, as an example of the temperatures in the district.

TABLE 7.1 RECORDED MONTHLY AVERAGE MAXIMUM AND MINIMUM TEMPERATURES (CENTIGRADE), MATOBO, 1986-87

	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
Av. Max	33.3	33.6	34.7	33.0	36.0	36.0	36.8	36.8	32.5	20.1	19.0	21.4
Av. Min	12.6	16.1	18.4	18.9	19.3	20.1	19.3	17.2	13.7	12.7	10.7	15.4

(2). Cropping System Monitoring

The normal Mid-Season and End-of-Season Cooperators' Survey given in the past three years was modified this season to accommodate the ARAP (Arable Rainfed Agriculture Program) and Drought Relief Assessment Survey. Because the ARAP and Drought Relief Survey covered some of the material normally covered in the Cooperators' Survey, it was decided to modify the Cooperators' Survey so that the same farmers were not answering the same questions twice. The complete results of the combined surveys for the cooperator farmers will be published at a later date as a Progress Report.

Based on a preliminary analysis of the surveys for the original 30 cooperator farmers only, several tentative findings are of interest. The overall change in lands planted from the 1985-86 season to the 1986-87 season was minimal. The range was quite extreme, however, as it ran from one farmer planting 10.2 hectares more than last year to another farmer who planted eight hectares less than last year. Very little destumping or fencing was done during this past year compared to the 1985-86 season.

Most of the plowing this year was done in December and the primary draft used was cattle. Half of all the farmers owned their own draft and about a

quarter owned and hired draft in combination. Very few farmers depended solely on hiring draft power, although 48 percent of the cooperator farmers did use the ARAP or Drought Relief program to hire someone to plough at least part of their fields.

Sorghum was, again this year, the most favored crop. Millet was the second most planted crop, followed by maize and then cowpeas. A little more than half of the farmers said they did not have enough seed. The majority of these farmers were from Matobo. Most of the farmers said they did not have enough groundnuts or jugobeans. Sixty-nine percent of the farmers purchased seed. They most often purchased sorghum and watermelon seeds.

In Marapong, a substantial number of people double plowed. They also did more replanting and thinning than did farmers in the other villages. In all of the villages, a large proportion of the farmers weeded their lands at least once. No one, however, harvested their entire lands planted. The majority of the farmers harvested less than one quarter of the planted lands. As can be expected the yields during this past season were substantially less than the average yield for the last four years.

All of the farmers listed poor rains as the reason for the lack of yields. After this, bird and livestock damage were listed as major factors causing low crop production.

TABLE 7.2 GENERAL SURVEY RESULTS, FRANCISTOWN COOPERATOR FARMERS, ARAP AND DROUGHT RELIEF ASSESSMENT SURVEY, COOPERATORS' SURVEY, 1986-87/a

	VILLAGE				SEX OF HH		CATTLE OWNERSHIP				
	MATO	MATH	MARA		MALE	FEMALE	0	1-15	16-35	36-70	MORE THAN
Number of Farmers	29	10	10	9	18	11	4	11	9	3	2
% Hiring Tractors for Plowing	48	30	40	55	44	55	75	45	33	66	50
Area Harvested (%)											
All	0	0	0	0	0	0	0	0	0	0	0
More than 3/4	7	0	0	22	11	0	0	0	12	0	50
3/4 - 1/2	14	0	11	33	11	20	0	9	25	0	50
1/2 - 1/4	11	0	0	33	6	20	0	18	0	33	0
Less than 1/4	46	50	78	11	50	40	75	45	38	67	100
None	21	50	11	0	22	20	25	27	25	0	0
Sorghum Harvest (Kg/family):											
1986-87	18	10	15	27	16	23	5	14	15	32	50
Average 1983-87	336	174	337	514	371	302	36	181	347	253	1951

a.MATO=Matobo, MATH=Mathangwane, MARA=Marapong, HH=Head of Household

Every farmer participated in some type of government program. The most popular program by far was the plowing component of ARAP. Other widely used programs included seed distribution through Drought Relief, weeding payments

through ARAP, and plough purchase subsidies from ALDEP. A high percentage of the surveyed population participated in the Labor Based Drought Relief Projects, School Feeding, and Child Rations programs.

Table 7.2 above shows some general survey results. It includes the percentage of farmers who hired someone to plough for them, the part of total area that was harvested, the sorghum production for the 1986-87 season and the average sorghum production for the past four years to use as a comparison.

(3). Livestock Inventory

Livestock inventory data were collected from 30 farmers, 10 each in the villages of Marapong, Matobo and Mathangwane, Tutume Agricultural District, from 1984 to 1986. Cattle numbers increased from 741 to 777 head for a 4.8 percent increase. Calves born per year averaged 17.4 percent of beginning inventories. Offtake averaged 4.7 percent and deaths 5.9 percent per year. Goat numbers increased dramatically during the three year period. The beginning inventory of 368 goats increased to 876 goats, for an increase of 138 percent. Kids born annually represented 65.4 percent of beginning inventories. Offtake of goats averaged 17.0 percent and deaths averaged 17.1 percent per year. Chicken numbers increased from 417 to 482 birds or 15.6 percent. Chicks hatched annually represented 172.6 percent of beginning inventories. Annual offtake was 38.5 percent and losses from all causes averaged 159.2 percent of beginning inventories. Donkey numbers increased from 42 to 55 head and sheep numbers increased from 14 to 46 head over the three year period. Further details may be found in ATIP Progress Report PR F87.3.

(4). Agricultural Marketings and Prices

Monitoring of agricultural markets and prices in the three villages has continued through the price and quantity purchased data collected from businesses on a monthly basis. To date no grain has been sold to commercial enterprises by farmers in the three villages.

Smallstock sales have been monitored on a monthly basis. From October through February there were 22 goats purchased by businesses in Mathangwane with prices averaging P31 and ranging from a low of P25 to a high of P40. In Matobo, from September 1986 through August 1987, 130 goats were purchased with prices ranging from P18 to P58 and averaging P37.

(5). ARAP/Drought Relief Assessment Survey

The ARAP and Drought Relief Survey came about when the National Food Strategy Group requested that the Farming Systems Projects evaluate the impact of the government agricultural drought relief programs. ATIP Francistown economists participated in the development of this survey along with economists from ATIP Mahalapye, the Southern Farming Systems Research Program, APRU, Ngamiland Development Program, and the ATIP team leader. It was given to our 30 cooperator farmers, as well as 30 other farmers selected from the 1982 baseline census in the same manner as the original 30. The results will be analyzed in conjunction with results from Mahalapye and a consolidated report prepared. Some preliminary comparative results are

given in Section 6.1.3.

(6). Plowing Labor Study

The objective of this study was to gain some insight into plowing times and how it was affected by traction type, number of animals, equipment, plough depth, soil moisture, and soil texture. Thirty five plowing times were taken from the three villages. The majority of these observations were with cattle traction, as this was the predominant form of traction in these three villages. One of the more interesting things about this study was how the plowing time was affected by the number of animals involved. If a farmer used two more oxen, that is a span of six oxen instead of a span of four, then he/she could cut the plowing time almost in half. More details about this study can be found in ATIP PR F87-4.

7.1.2 BLOOD PARAMETERS OF GOATS AND DONKEYS STUDY

This was a cooperative project between the National Veterinary Laboratory, Gaborone, District Veterinary Office, Francistown and the ATIP Francistown. A complete report of the study can be found in ATIP Working Papers WP-8 (Donkeys) and WP-9 (Goats).

Objectives: The objectives of this RMRI study were to:

(a). Determine normal values for certain blood parameters in both goats and donkeys.
(b). Determine monthly and seasonal changes in blood parameter values of both species.
(c). Determine if blood parameter values are changed when the animals are fed supplemental amounts of mineral-mix.
(d). Encourage field collaboration among researchers from different disciplines in Botswana.

Justification: There is very little information in the scientific literature which gives values for various blood constituents of goats and donkeys growing under Botswana environmental conditions. Animal diets in Botswana are definitely very low in their content of certain required nutrients. This is especially true for the mineral, phosphorus, which is being supplied in supplemental mineral-mix.

Approach: Blood samples were taken monthly from animals in two donkey herds and five goat herds receiving supplemental mineral-mix in Mathangwane. Animals in two donkey herds and five goat herds not receiving supplemental mineral-mix served as control animals. Collection of blood samples began in October-November 1984 and continued for two years (October-November 1984 to September-October 1986).

Whole blood and heparin blood samples were sent to the National Veterinary Laboratory, Gaborone by overnight train packed on ice in an insulated container. At the laboratory, the serum was taken off and examined for

phosphorus, copper, urea and total protein by spectrophotometry and for calcium and magnesium by atomic absorption spectrophotometry. Red and white cell counts were done with the heparin blood using a coulter counter.

A total of 50 goats and 28 donkeys were initially included in the study, but the numbers declined slightly during the course of the study due to sales, deaths and unavailability of animals at bleeding time.

Donkey Results: Blood levels of P, Ca, Mg, total protein, urea and red and white blood cells were examined monthly for two years in Botswana donkeys in an attempt to establish normal values and to evaluate the effect of mineral supplementation with an equal parts mixture of salt and dicalcium phosphate. Overall mean levels observed for the parameters were: P 3.79 ± 0.97 mg/100 ml, Ca 10.07 ± 2.11 mg/100 ml, Mg 2.07 ± 0.65 mg/100 ml, Cu 154.63 ± 63.27 ug/100 ml, total protein 8.02 ± 1.16 g/100 ml, urea 39.38 ± 10.65 mg/100 ml, RBC count 5.04 ± 1.19 millions/cu mm and WBC count 9.86 ± 3.07 thousands/cu mm. Supplemented donkeys showed significantly higher levels of Ca and RBC counts and lower levels of P, total protein and urea than did the control animals. The observed means fell within the normal ranges quoted in the literature with the exception of Cu and urea which were higher and Ca and RBC counts which were lower. It was concluded that mineral supplementation of this kind may be useful especially for working donkeys as it appears to increase the numbers of RBC's.

Goat Results: Blood levels of P, Ca, Mg, total protein, urea and red and white blood cell counts were examined monthly for two years in Botswana goats in an attempt to establish normal values and to evaluate the effect of mineral supplementation with an equal parts mixture of salt and dicalcium phosphate. Overall mean levels observed for the parameters were: P 4.96 ± 1.46 mg/100 ml, Ca 8.66 ± 1.40 mg/100 ml, Mg 2.59 ± 0.71 mg/100 ml, Cu 120.91 ± 65.70 ug/100 ml, total protein 8.13 ± 1.49 g/100 ml, urea 44.39 ± 17.47 mg/100 ml, RBC count 11.14 ± 2.21 millions/cu mm and WBC count 14.42 ± 4.24 thousands/cu mm. Supplemented goats showed significantly higher levels of Ca. P levels were significantly lower in supplemented goats during the first year. Supplemented goats also showed significantly lower levels of total protein and urea than did the control animals. Reproductive performance was not significantly different. All observations fell within the normal ranges quoted in the literature with the exception of urea which was a bit high. It was concluded that mineral supplementation of this kind did not improve goat performance under the environmental conditions imposed upon them in this study.

7.2 DESIGN STAGE

Design activities during this year were limited to a single informal study conducted jointly by the Animal Scientist and the Agricultural Economists with ATIP Mahalapye.

7.2.1 CHICKEN MANAGEMENT

This study was conducted in both the Francistown and Mahalapye areas. See

Section 6.2.1 for the findings of this study.

7.3 TESTING STAGE

Emphasis has continued on the integrated testing of potential interventions in order to asses both technical and economic feasibility.

7.3.1 TILLAGE SYSTEM TRIAL

This RMRI trial was being repeated for the second year in Francistown.

Objective: The objective was to test a series of tillage treatments to determine which ones had the greatest biological and economic benefits within Tutume Agricultural District.

Justification: A tillage system which involved a fall deep ripping, land shaping and applications of fertilizer (the Sanitas system) was proposed to the Government of Botswana as a way to dramatically increase crop production in Botswana. Funding was available to the government to implement this system as a farmer assistance package on a large hectarage. Before recommending the system for implementation, DAR wished to test the system in several areas across the country. At the same time, comparisons were to be made with other tillage systems in regards to productivity and cost effectiveness. These tillage systems were likely to be most acceptable to farmers with a fairly high resource base. However, since all of the systems being compared involved water conservation methods, examination of the systems was consistent with ATIP's program focus. ATIP Francistown therefore undertook to collaborate with other sections of the DAR in testing these systems. There was a basic set of four systems being compared at the main research station (Sebele), at ATIP Mahalapye (see Section 6.2.4) and at ATIP Francistown. At ATIP Francistown, several additional treatments were added to the basic set, to compare a broader range of options.

Approach: These trials were conducted as RMRI because of the heavy equipment required (in some cases) and because of the complexity and range of treatments. To facilitate management logistics, the trials were conducted only at two locations on different soil types in Mathangwane.

The trial package included the seven tillage systems listed below:

(1).Traditional check — seed broadcast and plowed down.
(2).Double plowing — Spring plough, broadcast and re-plough.
(3).Spring plough, row plant after one rain.
(4).Double plough, row plant — Spring plough, re-plough, row plant.
(5).Band plough — plough a band, 1 meter wide with 1 meter between bands. Then broadcast and plough in seed on the bands after an intervening rain.
(6).Ripping, alone (rip soil in Autumn and plant on rip line in Spring).
(7).Sanitas package — rip in Autumn, with land shaping, and Spring plant.

In one location the farmer's own tractor tillage system was added. It was

Treatment Number 8, and included Autumn plowing, Spring plowing and then row planting on a 2 meter row spacing.

Treatment 9 was a new variation of the Sanitas package, using a three tyne ripper. All land preparation was implemented by a consultant from Sanitas.

Plot size was 10m by 40m, with two replications per location, laid out in a randomised complete block design. Autumn treatments were implemented in September. To prevent confounding, all systems received 20 kg P/ha during the first tillage operation. The crop was sorghum (v. Segaolane) planted at the rate of 4kg/ha.

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

Results: Complete results of this trial may be found in ATIP Progress Report PR F87-8. Mean plant stands and grain yields are given by treatment in Table 7.3

Across repetitions and locations, double plowed (DP) treatments performed better than single plowed (SP) treatments or deep ripping treatments.

TABLE 7.3: AVERAGE PLANT STANDS AND GRAIN YIELDS OBTAINED IN THE TILLAGE SYSTEMS TRIALS, FRANCISTOWN AREA, 1986-87

TREATMENT	PLANTS/HA/a/b	KG/HA GRAIN/a/b
1. Traditional Check	16,781 w	108 yz
2. Double Plough	24,688 w	289 wx
3. Single Plough,Row Plant	16,875 w	12 z
4. Double Plough,Row Plant	26,281 w	342 w
5. Contour Band Plough	24,016 w	163 xy
6. Deep Ripping alone	3,406 x	15 z
7. Deep Ripping + Land Shape	3,313 x	3 z

a. Values have been rounded to the nearest whole numbers
b. Numbers followed by the same letter, within a column, are not different at the 0.05 level
c. Comparisons based on a LSD 0.05
Note: Mean plant stands and grain yields respectively were 7,938 and 203 for treatment 8 and 4,501 and 8kg/ha for treatment 9.

There was a severe problem with grassy weeds on the deep ripping treatments, but other factors (eg soil bulk densities) may also have inhibited crop growth in these treatments.

Primary agronomic conclusions from these trials were that:

(a).Deep ripping systems must include a practical and effective weed control component before they can be adopted by farmers. This was supported by findings in Mahalapye. Hence the system should not be implemented on a large scale at this time.

(b).Double plowing was the most productive tillage system.

(c).It is likely that a secondary tillage at planting time is required for farmers to capitalize on the yield benefits of row planting.

7.3.2 FORAGE CULTIVAR EVALUATION

Due to the drought, this trial was not implemented. Arrangements have been made to give the seeds to APRU for use by the pasture agronomist.

7.3.3 DOUBLE PLOWING TRIAL

This trial was basically the same as the "Draught Animal Management and Early Plowing Trial" performed in 1985-86 (see Section 8.1.3.1). The term "early plowing" was changed to "double plowing" since it appeared that the observed per hectare yield increases were due to the fact that plots were plowed twice, rather than their being plowed "early".

Objectives: The objectives of this RMFI work were to determine whether:

(a).Plowing one hectare twice was more profitable than plowing two hectares once.
(b).Whether there was any advantage in allowing an interval of two rains between first and second plowing versus allowing a single rain, and
(c).Whether it was necessary to start plowing on the first rains to realize the yield advantage of double plowing.

Justification: Botswana agricultural researchers have established the positive effects of early plowing, without planting, on moisture conservation and yield. However, farmers who do not have access to a tractor usually cannot do early plowing because of the poor condition of their draught animals. These trials were initiated in an effort to modify the recommendation and develop an appropriate, economic double plowing system for farmers.

Approach: The study was researcher managed and farmer implemented (RMFI). Most of the same cooperators from 1985-86 also collaborated in 1986-87. Some of these cooperators collected stover off one hectare for feeding during 1986-87.

(a).Farmers were asked to start feeding their stored crop residues beginning 1st September 1986. Rumevite blocks were made available to

the oxen ad libitum and mineral-mix (50% salt:50% dicalcium phosphate or bonemeal) feeding was continued.

(b).Agronomy team members arranged double plowing procedures with the farmers.

(c).Agronomy team members also arranged later planting procedures and collaborated with economists to carry out necessary monitoring to determine economic returns from double plowing.

The agronomy work continued to examine ideas for improving the productivity of the double plowing system. These improvements were based on observations of the experiments in 1984-85. The changes are discussed below. Five farmers participated. The trials were conducted on light and medium textured soils. Two blocks of five plots were marked out on the fields of participating farmers. The plots were 10m by 40m, making each block 50m by 40m in size. The plowing and planting sequence for the first block was as follows:

Rain 1 Plant plot 1 (traditional check 1)
Plough plot 2
Plough plot 4

Rain 2 Plant plot 2 (double plowed plot)
Plant plot 3 (traditional check 2)

Rain 3 Plant plot 4 (double plowed plot)
Plant plot 5 (traditional check 3)

Note:
Plough = single plowing without planting
Planting = broadcast seed/plough under

The sequence was the same for the second block, but started on Rain 4.

An attempt was made to have all plowing done on soil that was dryer than optimal for planting. All planting for the double plowed plots was done on good moisture, within two to three days after a planting rain. The question of fertilizer effects was left out because there was a need to keep the trials as simple as possible.

The economic focus for these trials was to collect sufficient labor use, input cost, and harvested output information on the individual trials to allow the formulation of budgets for each treatment. The budgets were used in comparing double plowing with the traditional technology in order to determine which interventions might be economically superior.

Results: Detailed results of this trial are reported in ATIP PR F87-5.

The cropping season was characterized by below normal rainfall at all locations, and poor rainfall distribution. the result was generally sub-normal grain yields. Over all plots, mean grain yield for one hectare single plowed (SP1) was 54 kg/ha. Mean yield for double plowed (DP) plots

was 109 kg/ha.

Primary conclusions from these trials were that:

(a).On average, double plowing did increase per hectare grain yields significantly;

(b).There did not appear to be any major differences in the DP effect when using an interval of one versus two rains between the first and second plowings;

(c).There was evidence to support other data indicating that the effects of double plowing can be obtained even when the first plowing is not done "early", as long as there is sufficient post-planting rainfall to produce a grain yield.

A more complete picture of the relative benefits of double plowing versus SP1 or two hectares single plowed (SP2), was obtained through economic analysis. This analysis indicated that, given 1986-87 rainfall conditions, the shift from single plowing two hectares to double plowing one hectare would be profitable. The shift from single plowing one hectare to double plowing one hectare is marginally profitable, but could cause a loss if grain prices decreased.

7.3.4 WINTER STALL FEEDING OF CATTLE TRIAL

Sufficient crop residues were unavailable in the Francistown area due to the drought conditions and this trial was not implemented.

7.3.5 GOAT PRODUCTION

Objectives: The objectives of this RMF1 study were to:

(a).Determine the amount of milk taken by farmers from their goat herd for household use or sale using traditional management.
(b).Determine the genetic potential of the indigenous goat for milk production.
(c).Evaluate the economic feasibility of an improved management system for goat milk production.
(d).Collaborate with the DAFS small stock extension personnel.

Justification: Results of the Tutume Agricultural District Agricultural Baseline Survey indicated that more than 90 percent of the farmers take milk from their herd. More than 40 percent said milk was the first reason they kept goats and another 33 percent gave milk as the second reason they kept goats. Thus, goat milk appears to be of great importance in the daily diet of the household. Work to date indicates that farmers take an average of over 1.2 liters of milk from their herd per day and average daily production per goat exceeds 200ml.

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. All goats were weighed at the end of the rainy season in May and at the end of the dry season in November. Newborn kids were weighed and tagged at birth. Bi-monthly weights were taken thereafter on the kids. Milk records were taken daily. Milk was measured in a 1 liter aluminum cup, graduated into 100 ml units and was measured to the nearest 100 ml.

Results: Detailed results of this study can be found in ATIP Progress Report PR F87-3.

The indigenous Tswana breed of goats was evaluated for productivity under farm conditions with 20 ATIP farmers in Tutume Agricultural District. The data indicates that the genetic potential exists for improvement of both milk and meat production. Although no information on heritability of traits is available on Tswana goats, the heterozygous nature of the population indicates that a high response to selection would be expected for traits such as growth rate, carcass desirability and milk production. A kidding rate of 137 percent was observed with a death loss of 11.4 percent. Mean weights of kids adjusted to 150 days of age were 16.2, 17.8, 14.9 and 15.4 kg for single born females, single born males, twin born females and twin born males, respectively. Mean total milk production for all farmers was 1.8 liters/day with a mean daily production per goat of 284 ml. One farmer took a total of 1,387.7 liters of milk from his herd during 1986 in 274 recorded milkings, averaging 5 liters per day. At the end of the rainy season in May, mature females weighed 38.8 ± 5.0 kg and mature males weighed 44.0 ± 10.4 kg. Weight losses during the dry season were approximately 10 percent. At the end of the dry season (October-November) the herds were composed of 66 percent females, 25.7 percent males and 8.3 percent castrated males. Only two farmers sold milk in the form of madila during peak milk production. Sales and slaughter of goats were low.

7.3.6 CROPPING SYSTEMS STUDIES

Objectives: These were to examine whether:

(a).A sorghum-cowpea intercropping system can reduce the risk of crop failure relative to sole crop sorghum production.
(b).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 1983-84). 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. Further, the between-row spacing was increased from the usual 75cm to 100cm, reducing the between row and between species competition still further.

It was hoped that the added legume crop in this cropping system would:

(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 (Tswana variety -- selected because of stand establishment characteristics). Rows were on one meter spacing, and planted with the Sanitas 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 on the same row spacings.

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

Results: Complete details on this study are available in ATIP PR F87-7. Although the yields from the intercropping studies in the 1986-87 season were generally poor, there were some indications that growing more than one crop on a given area using the intercrop system would help reduce the risk of total crop failure. It is too early to make any conclusions from one years' data. The study will be repeated again next cropping season.

7.3.7 FMFI OPTIONS TESTING WITH FARMER GROUPS

This was an expansion of the FMFI testing of the double plowing system conducted in 1985-86.

Objectives: These 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 were most appealing to different types of farmers.

Justification: Numerous technological innovations have been developed in Botswana (and elsewhere) which may be relevant to subsistence farmers in Tutume Agricultural District. However, it has been difficult to evaluate a very wide range of these innovations under researcher managed conditions in

on-farm tests (due to time constraints). Further, it was 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 cropping options (especially relating to specific contingencies at different times of year). Farmers were then asked to select innovations that seem 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 seemed most appropriate to them, and researchers were able to observe the effectiveness of those innovations and work with farmers towards development of improved crop production systems. By including ADs in the group monthly meetings, the ADs also became part of the systems development process.

Approach: In approximately mid-September, kgotla meetings were held to invite participating ATIP farmers, members of village Farmers' Committees, the general public and the local ADs to an introductory group meeting. At this meeting ATIP staff presented:

(a).The results from last years research
(b).A description of various technical innovations and the appropriate situations for their use.

Farmers were then asked to select any innovation or package of innovations they wished to test in the coming season. Those farmers electing to perform a test (or tests) then formed the Farmer's Technology Options Testing Group that would meet monthly. The ADs were also invited to attend these latter meetings, where progress and problems were discussed.

The types of innovations introduced included:

(a).Tillage/water conservation techniques
(b).Planting method options
(c).Crop varieties, combinations, and rotations
(d).Manure and fertilizer possibilities

Depending on the degree of interest, 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. A record was kept by ATIP staff regarding the dates of all operations, and grain yield. Baseline and end-of-season Farmer Assessment Surveys were administered.

Results: ATIP PR F87-6 contains details of this activity. A large amount of data was collected in these trials, and it is only briefly summarized here.

Ninety seven farmers participated in these activities, over three villages, attempting a total of 142 trials. The sheer numbers of participating farmers and trials implemented makes this approach a very powerful tool for getting both technical and farmer assessments of technologies under FMFI conditions.

Though a wide range of technological options were offered, farmers'

selections tended to concentrate mainly on a few options that were apparently judged to meet felt needs, or otherwise be most attractive and practical. This was not unexpected and it gives some indication of where farmers interests lie. Of the 142 comparisons planned by farmers; 101 were double plowing (DP) trials and 8 more were DP plus either fertilizer or row planting; 20 comparisons were tests with hand row planters; 5 were trials with P-fertilizer; 3 were maize variety trials; 2 were sorghum variety trials; 2 were trials with long and short season crop species: and one was a test of the two furrow plough. In addition, three tractor owners tested a tractor mounted plough/planter unit from Sebele.

Researchers believe that the heavy bias on selections towards DP trials occurred because farmers in Marapong and Matobo had previously seen the effectiveness of DP in other trials, had developed an interest in it, and felt they had the resources and skills to implement it.

DP was not selected heavily in Mathangwane because most people in the group did not control their own draught, and therefore felt that they could not effectively implement a DP system. These people concentrated heavily on the hand row planters, because it allowed them to separate the planting operation for the tillage operation. This was thought to be of benefit because they could not reliably obtain draught power at optimum planting times.

The 1986-87 cropping season was a season of below-average and poorly distributed rainfall. This was reflected in extremely poor grain yields, and the high percentage of plots destroyed by drought. The number of failed trials and mean yields for all trials are given in Table 7.4

With regard to DP, these data showed that work to date had stimulated considerable interest in the technology. They also served to verify that while DP does give a consistent per hectare yield benefit, the technology is not sufficient to produce reasonable yields under severe lack of rainfall conditions, and is probably not profitable under the same. While it is still a useful technology for moderate to good rainfall in Botswana, further work is required on technologies (such as water-harvesting systems) that can provide more security against drought.

All of the Hand Row Planter (HRP) trials were conducted in Mathangwane. The results were therefore biased because of the extremely poor rainfall distribution in that village. Results showed no particular advantage in using the HRP versus the traditional system. None the less, the idea remains popular among farmers, and will no doubt be tested further in the coming season.

P-Fertilizer (20 kg/ha of P) showed a significant yield benefit, where crops survived to maturity. The economics of it, in a drought year such as this, are questionable. However, the use of P-fertilizer is not a "new" technology, and farmers tests were encouraged only for their own information and reaction. Observations by farmers on the carry-over effects of P-fertilizer, where the previous crop had failed, may be of even greater interest to farmers. Knowing that even if the crops fail in the first year of application the effects may be obtained the following year, may encourage them to risk fertilizer more often.

TABLE 7.4: NUMBER OF FAILED TRIALS, AND MEAN GRAIN YIELDS (ACROSS CROPS AND VILLAGES), TECHNOLOGY OPTIONS TESTING WITH FARMER GROUPS, TUTUME DISTRICT 1986-87.

TRIAL	TOTAL COMPARISONS	HARVESTED COMPARISONS	TREATMENT YIELD (KG/HA)	TRADITIONAL CHECK YIELD (KG/HA)
Double Plowing	101	30		
Including Failed Plots			53	31
Excluding Failed Plots			177	105
Hand Row Planter	20	6		
Including Failed Plots			27	26
Excluding Failed Plots			86	81
P-Fertilizer	5	3		
Including Failed Plots			-124	63
Excluding Failed Plots			-207	105

No other comparisons harvested
TRAD=Traditional

Several other types of trials were implemented, as mentioned earlier, but none of them survived to produce a grain yield.

One of the primary objectives of this approach was to obtain farmer feed back on the technologies they tested. Notes were kept on farmer comments at all group meetings. These provide considerable insight into farmer problems and perceptions. These notes are available in the appendices of ATIP FR F87-6. A general overview is presented here.

Farmers are aware that very few technologies are productive under extreme drought conditions, and were apparently not discouraged from further testing by the poor results obtained this year. Further, quite a number of farmers noted that the potential benefit of certain technologies was observable prior to the destruction of the crop by drought.

Some farmers observed that DP did appear to improve crop growth under marginal conditions, and stated it might be better to intensively manage 5 hectares and get some yield, rather than try to extensively manage 10 hectares, since this size of field could not be effectively weeded by hand, and was likely to give no yield at all under droughty conditions.

Farmer selection of different technologies in different villages clearly pinpointed critical differences in technological requirements (e.g., DP was heavily favored in Matobo and Marapong where farmers have better access to animal draught. The HRP's were much more popular (than DP) in Mathangwane, where farmers have a severe problem with timely access to draught power).

Though the HRP's gave no demonstrated yield benefit this year, farmers saw their potential, and continued to express an interest in them.

The fertilizer trials were instrumental in changing some farmer opinions on fertilizer use.

In general farmers' appeared enthusiastic about having the opportunity to work with government personnel (research and extension) in testing various technical options. They felt that monthly intervals between meetings was an appropriate time span and did not suggest any changes in format when asked to do so. As usual they wanted to increase trial plot size. It is expected that the number of people wishing to participate in the coming year will increase. If it occurs, this will be taken as a positive response to the approach.

As the work with this approach develops, it may well be necessary to have input from sociologists and/or anthropologists in developing methodology. Specifically such input would be useful in providing information on:

(a).Group dynamics: how could farmer-extension-research interaction be improved, and what are the implications for groups size and makeup.

(b).Farmer participation: why do farmers invest the time to participate in these activities? Are they actually intent on improving their farm productivity; are there social reasons; to get free seed; etc. This question is important for group management and incentives.

(c).Are farmers honest in expressing themselves in group discussions, or do they just say what they think officials want to hear? This knowledge is important for knowing how much weight to put on farmers expressed opinions. (At present they are accepted at face value).

(d).Do farmers intend to apply what they learn? If not, how can they be encouraged to do so. This question is of primary importance for extension personnel.

7.4 DISSEMINATION STAGE

Dissemination stage activities were undertaken to promote the wider use of tested technologies within the villages where ATIP works.

7.4.1 CROP RESIDUE AND FORAGE CROP PROGRAM

Objectives: The objectives of this FMFI type work, collaboratively undertaken with ALDEP, were to:

(a).Encourage farmers to produce and conserve forage and fodder crops for dry season feeding to selected animals.

(b).Make more efficient use of crop residues.

(c).Plant selected annual and perennial grasses and legumes to be harvested and used exclusively for animal feeding during the dry season.

Justification: Much valuable livestock feed can be produced by farmers

from their crop residues and from cultivated forage/fodder crops. Preserved crop residues have been shown to contain ample Total Digestible Nutrients (TDN) to meet maintenance requirements of mature oxen and donkeys. Several cultivated species have proven successful, even in drier than average years.

Approach: Farmers were asked to plant two annual forages, Babala millet and Dolichos lab lab in a replicated split-plot design. Single superphosphate was applied to half of each plot at the rate of 200 kg/ha.

Results: The forage crop trials were hindered by the extreme drought in the Tutume Agricultural District. Only three farmers were able to plant and only one farmer harvested plots. The successful plot was planted on 24th November 1986 and harvested on 17th March 1987. Results of this trial are summarized in Table 7.5. The Babala millet out yielded Dolichos lab lab by an average of 768 kg DM/ha and single superphosphate applied at the rate of 200 kg/ha increased DM yield by 608 kg/ha and crude protein yield by 43 kg/ha. Thus, an investment in fertilizer of P50 produced 0.6 tons DM/ha, even in a very dry year.

TABLE 7.5 FORAGE TRIAL, MARAPONG, FRANCISTOWN 1986-87/a

SPECIES	DRY MATTER YIELD/HA (KG)	CRUDE PROTEIN (%)	CRUDE PROTEIN YIELD/HA (KG)
Lablab (+P)/b	1,041	13.69x	140.9
Lablab (-P)	651	17.19x	99.9
Babala millet (+P)	2,027	7.59y	140.9
Babala millet (-P)	1,200	8.32y	109.0

a.Means in the same column followed by different letters (x,y) differ significantly (P < 0.05).
b.200 kg single superphosphate/ha.

7.4.2 SUPPLEMENTAL MINERAL-MIX PROGRAM

Objective: The objective of this FMFI type work was to determine if farmers would feed mineral-mix, providing it were more easily available.

Justification: Supplemental mineral feeding should be economically and socially acceptable to every farmer producing animals. Research has shown that farm animals respond dramatically to supplemental phosphorus and salt. Feeding the supplemental mineral-mix requires a very small monetary outlay. It does not require a large change in management or husbandry. It has been recommended to farmers for several years. Government has been subsidizing the cost of salt, bonemeal and dicalcium phosphate to encourage the practice of feeding mineral-mix. Yet, according to government figures, less than 10 per cent of the farmers in the Central Agricultural Region and less than 5 percent of those in the Francistown Agricultural Region feed bonemeal and salt (mineral-mix) to their animals.

Approach: ATIP had been providing mineral-mix to participating farmers without charge for the prior three years. During this year, an effort was made to get farmers to purchase salt and bonemeal (or dicalcium phosphate) from the Livestock Advisory Center (LAC). ATIP provided transportation from the LAC to the farmers compound, since unavailability of transportation appears to be a major constraint.

Results: Only two of the 47 farmers who had been participating in the free mineral feeding program ordered mineral through ATIP from the LAC during the year. Both of these cattle farmers had been feeding supplemental mineral to cattle prior to the ATIP project. It was therefore concluded that farmers do not perceive sufficient benefits from mineral feeding to justify the expenditure required. Other work (see Section 7.1.2) has shown that mineral-mix feeding to goats does not improve their performance, while working donkeys probably benefit from mineral-mix feeding. Past work by APRU has shown clearly that cattle benefit from mineral-mix feeding. The problem remains to convince farmers that it is economically feasible. Clearly, availability and transportation were not constraints that prevented farmers from using mineral-mix.

7.5 OTHER PROFESSIONAL ACTIVITIES

7.5.1 LINKAGES WITH EXTENSION AND RESEARCH OFFICERS

In order to promote the institutionalization of farming systems work, it was important to increase contacts between the team and other agencies, both in terms of conducting joint research and in the inclusion of extension staff through field days and joint visits to fields. Linkages and collaboration were strengthened during 1986-87 through the following activities:

(a).DAFS staff was involved in the design and testing of systems' options through involvement of local ADs in Farmer's Technology Options Testing Groups monthly meetings. Field days held in Marapong, Matobo and Mathangwane were well attended by district and regional DAFS officers.

(b).ATIP collaborated with ALDEP on forage trials.

(c).Increased cooperation with the Regional Agricultural Office was achieved by actively seeking their suggestions concerning the identification of research problems and the formulation of the Francistown ATIP Workplan. Two formal meetings were held with the RAO and his staff to discuss the ATIP Workplan. In addition, regular meetings were held between ATIP staff and DAFS staff to discuss ATIP program plans and to keep them fully informed of ATIP's activities. DAFS staff participated in numerous informal social events held in conjunction with visits by various MIAC, Kansas State and other researchers and administrators.

(d).ATIP staff actively collaborated with the Regional Livestock Officer, Francistown, on Land Rehabilitation Trials and Improved Herd and Range

Management in Communal Areas Pilot Project. ATIP staff has helped in the design of this project. In addition, ATIP staff organized and conducted a baseline study of the project were, and are currently analyzing the results.

(e). ATIP staff cooperated with the Regional Veterinary Office and continued collaborative research efforts which led to the publication of two working papers.

(f). Collaborated with DAR on tillage systems research, fine tuning of the double plowing-broadcast planting system, and other activities.

(g). The Francistown team prepared articles on ATIP activities, with pictures, for inclusion in extension publications. A major article on farmers groups appeared in Agrinews as well as smaller articles on the hand row planters, field days, donkey harness and goats. Two articles on donkey harness also appeared in the Northern Advertiser, and an article on field days and soils consultants was published in the MIAC Update.

(h). ATIP Francistown was heavily involved with seminars/workshops at Sebele on double plowing, weeds, and goats as well as the annual meetings to discuss progress and plans for crop and livestock research.

7.5.2 METHODOLOGY DEVELOPMENT

The Francistown ATIP team worked with other members of ATIP in the preparation and dissemination of methodological materials. The Francistown team worked on the development of a sequential decision system framework for examining the applicability of technological innovations under various environmental conditions by groups of farmers with different resource constraints. This system has been discussed in several different forms by the entire ATIP team. The Francistown team also cooperated in the preparation of publications on the methodology of farmer's group work.

7.5.3 EMPIRICAL ANALYSIS

While much analysis of the Multiple Visit Data collected during the first two years of the Francistown work has been done, additional analysis was carried out during the year. Some of this work was incorporated in the 1985-86 Cooperators' Cropping Practices Survey, ATIP PR F87-1, which included time series data for a number of cropping practices.

CHAPTER 8: VISITORS

The following is a partial list of visitors to ATIP during the reporting year. Most of them came to Botswana for purposes other than visiting ATIP. This is by no means a complete list of visitors since for many a record was not kept.

8.1 NAMES RECORDED

D. Acker, Head S and T Bureau, Washington, D.C.
D. Andrews, Sorghum Breeder, University of Nebraska
P. Barnes, McConnell, Bean/Cowpea CRSP
H.D. Blackburn, Animal Science Department, Texas A and M
T.C. Cartwright, Animal Science Department, Texas A and M
D. Dietel, Rockefellor Foundation
K. Feltner, Director Kansas State Experiment Station, Kansas State University
H. Fitzhugh, Head Africa Program, Winrock International
L. Gourley, Plant Breeder, Mississippi State University
R. Havener, President, Winrock International
T. Hall, Bean/Cowpea CRSP
E.B. Hogan, USAID/W, CRSP Review
A. Low, CIMMYT, Harare, Zimbabwe
K. Peters, Director of Research, ILCA, Ethiopia
B. Rock, Science Officer, American Embassy, Tel Aviv, Israel
J.S. Robbins, USAID/W, CRSP Review
R. Vanderlip, Agronomist, Kansas State University
L.V. Withee, INTSORMIL Coordinator, Kansas State University
J. Yoke, Associate Director INTSORMIL, Univeristy of Nebraska

8.2 NAMES NOT RECORDED

Two Members of GOB/ODA Team -- reviewing FSSR, ODA, UK
Two Ethiopian Agricultura Engineers, IAR, Ethiopia
Two Members of World Bank Mission -- looking at Pandamatenga, IBRD, Washington, D.C.
Two Members of External Review Team of ALDEP, FAO, Rome, Italy

PART III

WORK PLAN, 1987-88

CHAPTER 9: PERSONNEL AND EQUIPMENT

9.1 PROFESSIONAL STAFF

A search is commencing for replacing the animal scientist (Gray). The position is being slightly redefined as an extension animal scientist. The plan is that Gray's replacement would continue in Francistown doing some of the same work that Gray is currently undertaking but will also have specific expertise and experience in extension.

With reference to the vacant soil management specialist position to be filled by INTSORMIL, Persaud has been identified and negotiations are currently underway for him to arrive in Botswana within the near future. ATIP will be responsible for providing some local support costs and money for equipment needed in carrying out his work.

9.2 SUPPORT STAFF

In the Second Mid-Term Evaluation and the contract extension there was a recommendation given that a second Administrative Assistant should be hired to help facilitate administration of the project. If this is approved then the recruitment of this person will start in the near future. Because of limited office capacity at DAR it is likely that this person will have to be officed at some other location in Gaborone.

9.3 CONSULTANTS

Currently plans are to employ the services of a number of consultants during the coming year. The list that appears below is in order of priority but this may change in the light of developments over the coming year. In any case it is unlikely that funds can be made available to employ all the consultants listed. This list should be considered to be illustrative in nature and subject to change. The proposed consultants are as follows:

(a). Rural Sociology. Because it is no longer possible for the Rural Sociology Unit (RSU) in DPS to provide a staff member to ATIP on a full time basis, some collaboration is being investigated — with the help of the Rural Sociology Unit — with a staff member at the University of Botswana. The person the negotiations are currently underway with is Dr. P. Molutsi. Because of teaching responsibilities it will not be easy for him to spend a great deal of time in the field. Currently a number of topics are being considered. It is expected that a decision will be made by ATIP, Dr. Molutsi and the RSU as to which one should be investigated during the coming year.

(b). Communications Specialist. It is proposed that Dr. D. Esslinger, of the University of Missouri, will return as a repeat consultant to continue short courses in technical writing for staff in DAR and DAFS. If approved he will also look at communication issues.

(c).Anthropology/Rural Sociology. Dr. A. Hansen will be returning on the repeat consultancy. It is anticipated that he will work closely with Dr. P. Molutsi, University of Botswana, will be one of the resource people in the proposed workshop on Farmer Participatory Methods to be hosted, if approved, by the Rural Sociology Unit, will continue some short course training along the lines of last year, may investigate a topic to be chosen in conjunction with ATIP, and will help the Rural Sociology Unit in giving advice on analysis of data.

(d).Librarian. It is anticipated that Mrs. C. Carter will continue to help to some extent in the library at DAR. This work involves helping in reorganizing cataloging, etc.

(e).Modelling and Risk Assessment. It is proposed that Dr. Bryan Schurle of Kansas State University, will be asked on a repeat consultancy to look at how to assess the impact of technologies in the whole farm situation and to work with existing data to develop ways of analysing risk in a way which can be incorporated in the proposed methodological manual.

(f).Range Management Specialist. If the extension animal scientist position is filled and it is felt desirable to pursue the matter further, a Range Management Specialist will be brought here as a short term consultant to help give advice on the work in the Matsitama Communal Grazing Area.

(g).Agricultural Editor. It is proposed that, if funds permit, an agricultural journalist or editor will assist the Agricultural Information Section in training reporters and editors to produce publications, and in helping to provide training on the use of table top publishing equipment. If possible, such a visit would preferably be for two weeks two times a year.

(h).Farm and Non-Farm Employment Linkages. It is proposed that, if funds permit, Dr. F. Hagreblade of Syracuse University will be approached for a short-term consultancy to sythesise information on employment and income linkages between on-farm agricultural, on-farm non-agricultural and off-farm within village income activities. Particular attention will be given to identifying rural manufacturing and services which complement agricultural production investments. Although this is a little bit beyond ATIP's mandate it is compatible with ATIP's belief that crops, livestock and off-farm employment are all equally important components of the farming system and together provide the means for providing income for purchasing food and other necessities.

It is anticipated that the Memorandum of Understanding between Kansas State University and Alabama A and M Univeristy can help in facilitating one or two of the consultancies. For example, approaches will be made to Kansas State University to see if a second person can be brought out with Dr. Esslinger to help in the short-term training courses. Also with reference to Dr. Schurle one of the possibilities being explored is for him to visit Botswana under the Memorandum of Understanding auspices and then return to Kansas State and be provided with money from ATIP, saved from the consultancy, which would enable him to undertake the analyses required, while in Kansas State University.

No proposed length of time has been given with reference to the duration of the different consultancies although average length is likely to be about three weeks. This will be negotiated as terms of reference on them become more finalised. As indicated above, at the moment this list should be considered illustrative rather than definitive in nature.

9.4 EQUIPMENT

Major items of equipment likely to be purchased over the coming year are:

(a).Equipment to support the work of the soil management specialist.
(b).Up to three Sperry microcomputers plus printers.
(c).Possibly two more project vehicles -- one double cab four wheel drive and one minibus.

CHAPTER 10: TRAINING

10.1: LONG-TERM TRAINING

Long-term training of those people listed in Table 4.1, who will not return until after the next reporting year, will continue to be an obligation on the part of ATIP and GOB. In addition GOB will, as part of their commitment, be sending off four more people for long-term training. These are listed in Table 10.1.

TABLE 10.1: NEW LONG-TERM TRAINING TO BE SPONSORED BY GOB, 1987-88

NAME	LOCAL AFFILITATION	CURRENT QUALIFICATIONS	TRAINING
Modise, N.	DAFS	BSc	MS (Agronomy)
Kgotlele, R.	DAFS	BSc	MS (Ag. Econ.)
Tabone, R.	DAFS	BA	BS (Agron.)
Senyatso, E.	APRU, DAR	BSc	MS (Animal Sc.)

In addition the contract extension specifies that a further 12 person years of long-term training will be financed by ATIP. These people will have to complete their training by August 1989. If this is not possible any costs incurred after then will have to be met by GOB. Therefore it is anticipated that these people will depart by August 1988 and will study for MS degrees. Currently it is planned to provisionally allocate two training slots each to DAFS, DAFS and DAR. If one of the departments or divisions are not able to find suitable candidates then this slot will be transferred to another department or division.

10.2 SHORT-TERM TRAINING

In terms of short-term training outside the country there are three general areas that will be supported during the next year. These are as follows:

(a). CIMMYT Workshop. It is anticipated that two people will attend the two farming systems workshops to be held by CIMMYT during the next year. The short course that they offer is divided into parts so both people will attend each workshop. It is planned this year to initially approach FSSR to see if they have people they wish to send. ATIP will propose to help finance the attendance, if other sources of funds are not forthcoming.

(b). Farming Systems Visit by Senior Ministry of Agriculture Personnel. In conjunction with CIMMYT it is proposed that ATIP will help in organising a field trip around eastern and southern Africa for middle- to senior level personnel in the Ministry of Agriculture. The object of the visit to three or four countries will be to provide an opportunity for the participants to interact with individuals engaged

in farming systems type activities in other countries. Up to seven people will be financed for the trip. It is likely that the group will be accompanied by ATIP and CIMMYT representatives. The bulk of the cost of this trip will in fact be met by CIMMYT.

(c). Short Courses for Crop Division, DAFS, Personnel. The Head of the Crop Division has requested ATIP's assistance to send a number of staff on short courses organised by USDA. Since a number of courses were listed he has been requested to make a priority list. It is hoped that ATIP will be able to contribute towards tuition and per diem for attendance at one or two of the courses.

10.3 ON-THE-JOB TRAINING

During the coming year in-service training that will likely receive some funding from ATIP will be in the following areas:

(a). Technical Writing. The technical writing workshops offered last year for DAFS and DAR staff will be repeated during the coming year. Dr. D. Esslinger will be the major resource person for these workshops.

(b). Enumerator Workshop. Consideration is being given to repeating courses for enumerators in the Ministry of Agriculture. The material to be covered will be a little different from that given this last year. The major resource person for this will be Dr. A. Hansen.

(c). Software Package Courses. ATIP is proposing, if approved by DAR, to help finance in-service training of DAR staff in the use of Word Perfect, Lotus 1,2,3 and dBase 3 for the IBM compatible machines that are currently being purchased in DAR.

(d). Farmer Participatory Workshop. It is likely that ATIP, along with some support from the Ford Foundation, will help the Rural Sociology Unit in organising a workshop on Farmer Participatory Methods. Participants at this workshop will be people from within Botswana plus one or two resource persons from outside. It is anticipated that Dr. A. Hansen will be one of those resource persons.

(e). Farmer Field Days. As in previous years, farmer field days will continue this coming year. Depending on the success of the agricultural season up to 10 farmer field days are being proposed in the ATIP villages.

In addition to the above items which involve allocation of funds, it is anticipated that ATIP's staff will be involved, when requested, to deliver talks and papers to MOA staff, lectures to BAC and University of Botswana students, and help to train the trainers for the in-service training programme within DAFS.

CHAPTER II SEBELE/GABORONE WORK PLANS, SEPT. 1987 - AUG. 1988

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 the ATIP Project. Special efforts will be made to ensure that is undertaken in a way that is compatible with operations of the Ministry of Agriculture. Continuing efforts will be made to liaise with other staff in the Ministry of Agriculture, other institutions in GOB, USAID/B, MIAC and KSU. Efforts will also continue in timely production and dissemination of papers produced by ATIP. The Monthly Activity Newsletter recently started will continue.

11.1.2 PROFESSIONAL SUPPORT TO ATIP TEAM MEMBERS

Efforts will continue to emphasise visiting team members in the field and organising 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

Supervision of the SMU data entry on the ATIP microcomputers will continue. Also, when requested, the entry of data from ATIP field stations that need to be entered on microcomputers at Sebele, will be supervised by the Team Leader. Ordering of further Sperry IBM compatible machines will be implemented during the coming year. Also considerable time is expected to be taken up in collaborating with other DAR staff to ensure a smooth change over from the Apple microcomputers to the IBM compatible machines. Also it is anticipated that 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 and dBase3 plus MSTAT and possible SPSS or SASS adapted to microcomputers will be the main packages for the new systems.

11.1.4 METHODOLOGICAL MANUAL

It is anticipated a considerable amount of time, in conjunction with other ATIP staff members, will be spent in completing a first draft of a methodological manual to 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 BAC and the University of Botswana, and talks will be given at MOA sponsored meetings, workshops,

conferences, etc.

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 writing up information on ATIP's work and thinking, and arranging to have it 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 LIAISON OFFICER

RELO: R. Hill

11.2.1 ATIP ADMINISTRATION AND OPERATIONS

As Deputy Team Leader for ATIP, the RELO devotes approximately 40 percent of his time to administrative activities of ATIP. Administrative activities of the Deputy Team Leader for next year will be the following:

(a). Serve as acting Team Leader in the absence of the Team Leader.

(b). Administer the KSU Revolving Account and the Research and Operations Account.

(c). Manage the long-term and short-term ATIP participant training programme.

(d). Assist the Team Leader in the preparation of Annual Reports and Work Plans.

(e). Process requests for consultants and arrange itineraries.

(f). Organize and conduct training for ATIP local staff on farming systems work and communications.

(g). Assist in organizing field days at regional ATIP locations.

(h). Prepare educational material for use in explaining ATIP to its various publics.

(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). Assist with other administrative and organizational duties as requested by the Team Leader.

Some of the above activities may be delegated to Baker and Siebert when they move to Gaborone in December.

11.2.2. RESEARCH EXTENSION LIAISON

The key to the success of any agricultural development project is a close tie between agricultural research and extension.

In order for progress to be made there must be an adequate:

(a). Supply of tested agricultural technology applicable to farms in the various sections of the country,
(b). Diffusion system whereby technology can be disseminated and adopted by the majority of farmers.

The focus for the Research Extension Liaison Unit (RELU) during the coming year will be on helping regional and headquarter Crop Production Officers acquire the necessary training and experience necessary for carrying out their two main functions — serve as a link between the extension field staff and DAR, and serve as trainers of the field staff. If the extension specialists can be taught and are willing to assume these roles, the need for a RELU will deminish. Along with the major focus, the RELO will concentrate efforts on the following areas:

11.2.2.1 VISITS WITH EXTENSION AND RESEARCH STAFF

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

Approach: The RELO 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 discussions designed to clear extension publications for printing.

11.2.2.2 MEETINGS AND CONFERENCES

Objective: An important value of meetings and conferences is the interchange of ideas among participants. To foster this exchange among and between researchers and extension staff is the major objective,

Approach: The RELO will continue to attend and participate in district AD monthly management meetings, CPO conferences, regional agricultural officers' planning meetings, department and division meetings in research and extension services, farming systems team meetings, Arable Research and Priorities Committee meetings, ARAP and ALDEP annual meetings, ATIP meetings and research conferences. He will encourage participation by both research and extension personnel.

The RELO 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.

11.2.2.3 AGRINEWS

Objective: Agrinews is the only agricultural informational publication which reaches all MOA personnel on a regular basis. The objectives are to increase the number of contributions to this publication by extension specialists and farming systems teams and decrease the amount of time and effort required to prepare each issue for publication.

Approach: A second workshop on agricultural writing will be conducted for extension and research staff in July 1988. It will be a continuation of the workshop held in July 1987, and arrangements will be made through the ATIP project, for a communications consultant on a continuing basis.

The RELO will work with the Agricultural Information Division in setting up the new computer operated typesetting - graphics - word processing unit and assist in training staff in its use.

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

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

11.2.2.4. AGRIFACTS

Objective: Agrifacts are the primary source of agricultural research information for the agricultural field staff. The objectives are to update all obsolete crop 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 developing and implementing a production plan.

The new computer operated typesetting - graphics - word processor system will be used to prepare Agrifacts copy for transmission to the Government Printer.

11.2.2.5 EXTENSION PUBLICATIONS

Objective: The objective is to initiate the production of a research oriented newsletter and a series of extension leaflets, pamphlets and bulletins on agricultural and extension methods topics for use by Agricultural Demonstrators.

Approach: Efforts will continue in the training of extension specialists in publication writing. As indicated above a second writing workshop will be held in July 1988. Each headquarter Crop Production Officer will prepare at least one leaflet, circular or bulletin for publication during the coming year.

The RELO will work with the extension specialists in the development and

writing of the publications.

A schedule will be prepared for the publication of the Crop Production Divisions' Newsletter. An editor will be selected and publication will begin.

11.2.2.6 TRAINING

Objective: 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 programme for all field services staff to keep them abreast of new developments in agriculture and extension methods.

Approach: The RELO will continue to promote and assist in arranging for in-service, long-term degree and short-term training for extension subject matter specialists.

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

The RELO will assist in organizing and conducting in-service training for ATIP field staff and arrange for short-term and long-term training activities for ATIP counterparts.

11.2.2.7 TOURS AND FIELD DAYS

Objective: 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 extension staff and improve the quality and effectiveness of tours and field days.

Approach: The RELO will keep Crop Production Officers, 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 has prepared an extension leaflet on planning and conducting demonstration tours. It will be distributed to extension and research staff members.

An effort will be made to persuade researchers and extension specialists to collaborate and jointly plan major tours and field days. As a part of the long-term AD in-service training programme, training on planning tours and field days will be given to LAOs who, in turn, will train ADs.

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

11.2.2.8 FARMING SYSTEMS WORK LIAISON

Objective: The objective is to develop closer ties among the various farming systems 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 continue to assist in planning and conducting the semi-annual conferences/workshops for active farming systems personnel.

The RELO will work closely with the farming systems teams and the editor of Agrinews on articles for publication.

11.3 FARMING SYSTEMS RESEARCH LIAISON AGRONOMIST, SEBELE

Agronomist, J.D. Siebert

The farming systems research liaison agronomist's (FSRLA) position, which is to begin December 1987, will have responsibility for strengthening professional technical support for farming systems work (FSW) in the field. The FSRLA position will be located at Sebele in DAR.

Activities of the FSRLA will include:

(a). Contributing to the strengthening of linkages between FSW and other Ministry of Agriculture (MOA) programs,
(b). Providing technical support and liaison for farming systems agronomists,
(c). Contributing to dissemination of information on FSW,
(d). Increasing the capacity of DAR to conduct on-farm research appropriate for the development and screening of technologies.

Linkage between FSW and station-based research programs has been generally satisfactory though generally on an ad hoc basis. The FSRLA should work under the CARO and the ATIP team leader to improve this linkage. Linkage between FSW and extension staff at both the village and specialist level has not been as satisfactory. The FSRLA should work through RELU to improve this linkage.

Even though farming systems agronomists are part of DAR, because of the location of FSW, they tend not to be part of the mainstream in terms of career paths and decision making. Farming systems scientists are also not in as favorable a position to receive profcssional support and interaction as are station-based scientists. It will be a task of the FSRLA to explore ways to integrate FSW scientists more into the professional mainstream of DAR.

To date, farming systems work has been limited in part by a lack of important "technologies on the shelf" that could quickly make a large impact on the arable farming system. There is also a concern expressed within DAR that resource allocation to FSW is too great and that station-based technology screening and development must be strengthened to bring about an appropriate balance between the two areas. The FSRLA will have the task of

working under the CARO and with other researchers (station-based and FSW) in coordinating certain collaborative technology design or screening activities that can be best done on-farm (e.g., on-farm evaluation of the Sanitas rip-line/water harvesting tillage system). A relatively small research program as found in DAF can certainly benefit from increased long term capacity to conduct on-farm research that is commodity or disciplinary oriented. In this effort, the inter-disciplinary farming systems teams can not only provide logistical support but can make a major contribution, in terms of farming systems perspective, at the planning stage.

In accordance with specific duties listed for the FSRLA, work planned can be divided into four broad categories:

(a).Technology development research.
(b).Liaison with extension specialists and regional extension staff.
(c).Station/farming systems agronomy linkage development and support.
(d).Farming systems dissemination.

11.3.1 TECHNOLOGY DEVELOPMENT RESEARCH

11.3.1.1 COMPONENT PRACTICES TRIAL

Objectives: This trial in the design stage (RMRI level) includes the following objectives to evaluate:

(a).Seeding rates in broadcast sorghum production.

(b).Tillage-planting system interactions with traction and soil type. Inclusion of objective (b) will hinge on the outcome of discussions with other ATIP and INTSORMIL researchers.

Justification: Over the past three seasons, this trial has provided useful information on technologies and interactions with environment for directing testing at the farmer implemented level and for project assessment of long term research priorities. New issues related to component practices in sorghum production have surfaced. These issues include appropriate seeding rate under broadcasting and traction type by tillage-planting system interaction.

Approach: This trial is a collaborative effort based on research resources at Mahalapye and in the INTSORMIL program. The trial will be implemented on at least two contrasting soil types in each region.

Treatment comparisons should include traction type, time of first tillage, single and double plowing, high and low seeding rate under broadcasting, row planting versus broadcasting and applied fertilizer levels.

11.3.1.2 RAINFALL RUN-OFF MEASUREMENT STUDY (DESCRIPTIVE/DIAGNOSTIC)

Objective: This trial at the descriptive/diagnostic level (RMRI level) involves collaborating in the DAR/LWRM study to define relationships between rainfall, soil type, slope, land-use and run-off.

Justification: Data on expected run-off in the traditional lands area are

not available for Botswana. Such data are useful in designing or evaluating the potential of run-off management structures or systems for agricultural purposes.

Approach: Three bunded plots of between 100 and 200 meters in length will be implemented on each of three or four sites in the Shoshong area. Land use patterns in the three plots will be (a) uncleared bush land, (b) cleared but fallow land, and (c) cultivated land. Run-off and soil moisture will be monitored with automatic flow recorders and neutron probe readings, respectively.

The hydrologist for the SACCAR Land and Water Resource Management Resource Project (LWRM) team will have primary responsibility for this study. LWRM will provide funding for equipment and staff to record data. The FSLRA will participate in selecting sites and installing the plots.

11.3.1.3 RAINFALL RUN-OFF MANAGEMENT (DESIGN)

Objectives: The objective of this design stage (RMRI level) study is to collaborate in DAR/LWRM program investigating the design of systems that can most effectively manage rainfall run-off.

Justification: Observations on rainfall run-off/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 effective water control structures. Permanent structures also have an important advantage over tillage systems that improve water retention in that they do not need to be re-implemented every season by farmers. 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 tillage-planting periods in the Mahalapye area. A benefit/cost analysis is needed to evaluate permanent structures against tillage based systems that conserve moisture or promote water harvesting.

Approach: Five plots comparing (a) off-field water harvesting into bunded plot, (b) bunded plot to conserve in situ rainfall only, (c) double plowing, (d) single plowing, and (e) cultivation bands will be placed on four fields in the Shoshong area. Similar comparisons will be implemented by the INTSORMIL project on farms in the Sebele area. Soil type and slope differ between the fields though important run-off occurs on all four. Soil moisture will be monitored with neutron probe readings. Crop production data will also be collected. The FSLRA will have primary responsibility for this study in the Shoshong area. LWRM project will provide funding for equipment and staff to record data. The FSLRA will select sites and install treatments.

11.3.2 LIAISON WITH EXTENSION

Objective: The purpose of this activity is to integrate extension specialists into the technology development and testing process. There is also a need to better understand the prevailing attitudes of extension specialists towards rainfall arable production in the traditional sector.

Approach: Two sub-activities are proposed:

(a).To explore possibilities for more direct involvement of Ministry Extension Specialists in the identification of arable production constraints at the ATIP research level. Working through the RELO, research/extension work trips will be organized to interact with farming systems researchers. To the extent practical, each work trip should have a problem solving focus. A minimum of three such trips will be made to Mahalapye and Francistown during the coming season.

(b).Through the Mahalapye backstopping role, promote integration of District CPOs, DAOs and local ADs into farming systems work. CPOs will be recruited to extend FSW at the dissemination and farmer testing level to non-ATIP village areas in Central Agricultural Region. Discussions are under way to see if this should be managed through the Regional ALDEP program and the CPOs assigned to work with ALDEP.

ALDEP is exploring the possibility of expanding its extension related role and has expressed interest in coordinating with FSW in the region. It will be proposed that expansion of FSW in Central Region b co-coordinated by the FSRLA and the regional ALDEP manager. This activity will focus on promising technologies already tested and proven in the ATIP research areas.

11.3.3 ON-STATION/FARMING SYSTEMS AGRONOMY LINKAGE

Objective: The objective is to improve the linkage between FSW and station-based work, particularly in the agronomy area.

Approach: Proposed activities include:

(a).Coordinate station level logistical support for farming systems agronomists as needed.
(b).Activate literature search options for ATIP/DAR and promote use of this service by farming systems agronomists.
(c).Explore mechanisms to have farming systems agronomists be more integrated into DAR activities (Mahalapye backstopping role).
(d).Provide professional backstopping at Mahalapye and at other farming systems research sites. In addition to trips to Mahalapye and Francistown research programs, at least one trip will be made to each of the other FSW program sites in Botswana during the course of the cropping season.
(e).Prepare outlines on three to four technical topics that will be included in ATIP methodology handbook.

11.3.4 FARMING SYSTEMS DISSEMINATION

Objective: The objective is to analyse and write up some of the major studies that have been undertaken in the Mahalapye area over the last five years.

Approach: The FSRLA will take a lead in preparing the following:

(a).Component practices paper: This paper will be a synthesis of all ATIP research results comparing component sorghum production practices.

(b).Soil moisture estimation: This will involve verification of a soil moisture model developed by the Evapo-Transpiration Lab of the Department of Agronomy, Kansas State University.

(c).Farming systems plowing pattern and outcomes analyses: This will involve completion of analyses on three seasons' plot monitoring data.

11.4 AGRICULTURAL SYSTEMS ECONOMIST, SEBELE

Ag. Economist: D. Baker

This position will commence - December 1987.

Agricultural programs and support systems affect the ability of farmers to adopt new technologies, and their incentives to change the way they farm. Therefore, the potential for ATIP to contribute to improved production and productivity in Botswana is dependent on the degree of compatibility between technologies, programs and support systems. Unfortunately, the capability of DAR to carry out economic and institutional analyses of technology development policy, agricultural programs and support systems remains underdeveloped.

Despite the limited capability of the DAR, ATIP took a passive approach to technology development policy, agricultural programs and support systems during the first five years of the project. Some issues were identified but the farming systems economists generally emphasized farm management research and the economic analysis of on-farm trials. However, after five years of research, ATIP technicians feel that increased emphasis should be given to a broader agricultural systems perspective -- encompassing technology development policy, agricultural programs and support systems.

Therefore, in support of the ATIP mandate to strengthen the capacity of the DAR, the MIAC Mahalapye farming systems economist position will be phased out in December, 1987, in favor of a Sebele-based agricultural systems economist. As identified in the Technical Proposal, the agricultural systems economist will have the following duties:

(a).Assess the impacts of modified production technologies, support systems and Ministry programs on food output, employment and agricultural opportunities.

(b).Assist DAR by:

--providing an input into commodity-oriented economic analyses;

--providing support for project planning, preparation, development and evaluation;

--bringing relevant agricultural policy issues to the attention of the Director of Agricultural Research for submission, if appropriate, to the Ministry of Agriculture Policy Committee; and

--assisting with the training of a departmental (commodity)

agricultural economist.

(c).Participate with other ATIP staff in:

--analyzing economic data collected between 1982 and 1987;

--developing a handbook on farming systems methodology appropriate for Botswana;

--developing training courses in on-farm research methods for farming systems workers, BAC students, RSU and FMS enumerators, and DAFS staff;

--backstopping the farm management research and extension activities of the Mahalapye farming systems team and others as instructed; and

--disseminating information on ATIP activities and farming systems work in general.

(d).Provide additional services as determined necessary by the ATIP Team Leader and the cognisant MOA administrative representative.

The duties of the agricultural systems economist conceptually can be divided into: (a) agricultural systems analysis and (b) farming systems work support. Agricultural systems analysis refers to data collection, data analysis, report preparation and dissemination activities relating to agricultural development policy, agricultural programs and support systems. FSW support encompasses training, backstopping and other activities designed to improve the capacity of the DAR to carry out FSW. The work plan will be discussed according to these two areas of responsibility.

11.4.1 AGRICULTURAL SYSTEMS ANALYSIS

11.4.1.1 EX POST PROGRAM ANALYSIS: ARAP, DR and ALDEP

Objectives : These are to:

(a).Analyze patterns of participation in ARAP, Drought Relief and ALDEP with reference to regional location, gender of household head and wealth.
(b).Assess patterns of household dependency on other households and on the Ministry of Agriculture.

Justification : A large share of the Ministry's budget is devoted to farmer assistance programs. A survey of the three main programs was carried out in each major agricultural region during 1987. The survey was collaboratively designed by the economists from each of the farming systems teams. Until now, however, no multi-regional analysis has been done on the data. Moreover, the analysis which has been done to-date has not distinguished between different types of households.

In order to ensure that the major farmer assistance programs are having an equitable impact, it is necessary to analyze the available survey data by location, gender of household head and relative wealth.

Approach : Data from the Francistown, Central, Gaborone and Southern Regions will be merged -- to the extent possible. Priorities for data analysis will be determined collaboratively with economists from ATIP Francistown, FSSR, and Sebele. After the analysis has been carried out, a joint report will be produced.

11.4.1.2 EX ANTE PROGRAM ANALYSIS: TRACTOR PROMOTION

Objectives : These are to:

(a).Analyze the financial and economic profitability of tractor use.
(b).Assess the viability of alternative tractor promotion programs.

Justification : There is a rapid trend toward tractor plowing in Botswana. Farmers with the resources to buy a tractor need advice as to whether such an investment is profitable or not. The Ministry needs advice as to whether tractor use should be promoted or discouraged. Tractor promotion is a crucial macro economic issue because of: (a) a history of failure in tractor promotion schemes, (b) the potential income and employment effects of a shift to custom tractor hire from use of own animal traction, and (c) the foreign exchange costs of importing and maintaining tractors.

Approach : ATIP Mahalapye tractor record keeping data from 1986 will be analyzed. The data will be supplemented (if possible) by data collected at Sebele and the former EFSATP project. A bibliographic essay will be prepared on experiences with tractor promotion in Africa.

11.4.1.3 NEEDS ASSESSMENT STUDY: SUPPORT SYSTEMS IMPROVEMENT

Objectives : These are to:

(a).Provide DAR researchers with information on agricultural policies, programs and support systems.
(b).Identify opportunities to improve the support systems affecting the adoption of improved technologies.

Justification : DAR researchers -- and farming systems workers in particular -- need information about the larger agricultural system in order to ensure that their research is compatible with the institutional environment and with planning and policy priorities. It would be inefficient for each researcher to individually develop this information.

Agricultural support systems can have a major impact on farmers' incentives to try technologies. Therefore, it is important to identify opportunities to improve the performance of support systems, particularly input and output distribution markets.

Approach : Secondary information will be collected and synthesized on the structure and performance of organizations responsible for: (a) agricultural credit; (b) input production, importation and distribution; and (c) agricultural processing and marketing. Possible opportunities for improving support systems performance will be identified.

11.4.1.4 FEASIBILITY EVALUATION STUDY: THE ECONOMICS OF UNIMODAL DEVELOPMENT

Objectives : These are to:

(a).Identify an appropriate analytical framework for evaluating the economics of unimodal agricultural development.
(b).Determine whether the data are available to eventually carry out the analysis.

Justification : ATIP has an implicit unimodal agricultural development strategy derived from the project mandate. (The term "unimodal" generally refers to a single dominant pattern of development for the agricultural sector, rather than separate patterns for different subsectors of the agricultural economy.) The ATIP strategy has been to improve arable farming productivity of the mass of limited resource traditional farmers, primarily through labor- and capital-using production technologies. Other strategies, however, may be better or may be complementary to the existing strategy.

Three questions should be asked about the "unimodal" focus on limited resource traditional farmers: Should relatively more attention be given to the livestock sector? Should relatively more attention be given to intermediate and non-traditional producers? Should relatively more attention be given to non-farm enterprises which have forward and backward linkages with agriculture? Within the context of the current unimodal strategy, an important issue is whether development should proceed via labor and capital investments versus an increase in the area cultivated.

There has been little economic analysis of these issues in Botswana. If the required data are available, such analysis needs to be carried out.

Approach : A bibliographic essay on will be prepared on appropriate analytical frameworks. A rapid appraisal survey will be carried out with Ministry decision makers to identify priority issues (with reference to development strategy) and data availability. A proposal for implementing the analysis will be prepared and circulated for review.

11.4.1.5 DISSEMINATE MAHALAPYE AGRICULTURAL SYSTEMS FINDINGS

Objectives : The objective is to finalize and distribute reports based on previous research carried out in the Mahalapye area.

Justification : Over the past five years in Mahalapye, much data on agricultural systems performance have been collected and analyzed. Selected results have been reported in various annual reports but many additional findings have yet to be presented in report formats which can be easily read by Ministry officials. At this point, the marginal cost of finishing and distributing a series of subject matter reports is small relative to the value of the information which can be provided.

Approach : Working papers (WP) or progress reports (PR) will be prepared on the following subjects: (a) cart acquisition and use (PR), (b) tractor acquisition and use (PR), (c) prices and the trading network in the Central Region (WP), (d) farmer activity patterns (WP), (e) draft arrangements in

Shoshong and Makwate (WP), and (f) village groups and voluntary organizations (PR). One or two seminars will be prepared and presented on the basis of the reports.

11.4.2 FARMING SYSTEMS WORK SUPPORT

11.4.2.1 RESOURCE AND PRODUCT VALUATION STUDY

Objectives : The objective is 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 FS 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 Mahalapye and Francistown farming system teams have agreed to provide logistical support for price monitoring in the Central and Francistown Regions. Hopefully, logistical support will also be provided by the FSSR team — so national coverage can be more nearly obtained.

In each region where collaboration can be established, four to six representative villages will be identified. The villages would include the primary research villages (e.g., Shoshong, Makwate and Makoro) plus two to three randomly selected villages. Twice during the season, trading establishments in each village will be enumerated to determine their levels of seed and crop commodity sales, levels of crop commodity purchases from farmers, and prices for both sales and purchases. Five to ten randomly encountered farmers per village will be asked about agricultural wage rates and about prices for seed and grain observed in inter-household trade.

11.4.2.2 METHODOLOGY HANDBOOK CHAPTERS

Objectives : The objectives are to:

(a).Identify three to five research methodology topics.
(b).Prepare outlines on those topics for chapters to be included in the planned ATIP methodology handbook.

Justification : ATIP technicians have made substantial progress in developing on-farm research methods. In order to improve the capacity of the DAR to conduct FSW, ATIP technicians have agreed to synthesize insights as to appropriate research methods in a research methodology handbook.

Approach : The proposed handbook should deal with conceptual issues, as well as specific field techniques, or it will merely duplicate available methodology manuals. The following topics will initially be assessed for possible inclusion:

(a).Targeting for agricultural research, extension and planning;
(b).Inclusion of support systems in FSW -- the use of subject surveys; and,
(c).Where is the best boundary for farming systems analysis? Outlines will be prepared and circulated. Drafting of the chapters will be done in accordance with the time schedule established by the ATIP Team Leader for the overall ATIP handbook.

11.4.2.3 DATABASE DOCUMENTATION

Objectives : The objectives are to:

(a).Document some of the Mahalapye (MA, MB and MD) databases.
(b).Make sure the documentation is readily available to researchers who might be interested in further analysis of the data.

Justification : During five years of on-farm research, data have been collected on a number of topics which might be of interest to other Ministry researchers. Since most of the data have been entered into computer databases, the marginal cost of additional analysis should be quite small. Not only might additional analysis contribute new insights, but data analysis can also be used as a training tool. Therefore, documentation should be made available to facilitate additional analyses.

Approach : Data collection procedures will be described for each survey and trial. All the variables on each component database will be defined and, where relevant, codes presented. Modifications made in all retained statistical files will be described. The information will be synthesized into a progress report and distributed through established channels.

11.4.2.4 DISSEMINATE MAHALAPYE FARMING SYSTEMS FINDINGS

Objectives : The objective is to finalize and distribute reports based on previous research carried out in the Mahalapye area.

Justification : Over the past five years in Mahalapye, much farm management data have been collected and analyzed. Selected results have been reported in various annual reports but many additional findings have yet to be presented in report formats which can be easily read by Ministry officials. At this point, the marginal cost of finishing and distributing a series of subject matter reports is small relative to the value of the information which can be provided.

Approach : Working papers (WP) or progress reports (PR) will be prepared on

the following subjects: (a) arable farming decision making (WP), (b) livestock practices (WP), (c) resource control patterns (PR), (d) Crop Management Survey Part Two -- household characteristics (PR), and (e) hand planting for gap filling (WP). One or two seminars will be prepared and presented on the basis of the reports.

CHAPTER 12: ATIP MAHALAPYE WORK PLAN, SEPT. 1987 - AUG. 1988

GOB: E. Modiakgotla (Arable Crops Division, DAR)
M. Tjirongo (Agricultural Economist)
On return from overseas study leave

USPCV: A. Caplan (Agricultural Economist)

12.1 OVERVIEW

The 1987-88 season will be a transition year for the Mahalapye team. On December 1st, the two USAID technician positions will be phased out and a localized team established. Despite the change in personnel, the activities planned for the 1987-88 season build on prior investigations. However, there will be four notable modifications in the team's research approach.

First, the use of groups will increase and there will be a slight change in group management procedures. Two types of groups will be formed: small special purpose groups and larger general purpose groups. Each special purpose group will focus on one of two particular themes -- implementation of row planting or the development of high potential sites. The objective will be to facilitate joint researcher and farmer assessments of multiple interventions which, together, result in modified arable farming systems.

The general purpose groups will be used to manage four FMFI trials: Dual Purpose Cowpea Variety Trial, Cowpea-Forage Variety Trial, Rotary Injection Planter Trial, and Groundnut Hilling-Undersowing Trial. To increase the number of farmers involved in the FMFI trials, kgotla meetings will be held in each village prior to the start of the season. The FMFI trials proposed for the 1987-88 season will be introduced. Trial participation will be solicited on a voluntary basis, but a minimum number of desired participants will be established for each trial -- to ensure adequate numbers for trial assessment. Only a limited range of options will be offered so sufficient data can be collected to evaluate the proposed interventions rather than rely strictly on farmers' assessments. Members of the current farmer groups in Shoshong, Makwate and Makoro will be encouraged to participate in the enlarged general purpose farmer groups.

Second, part of the team's resources will be allocated to the support of multi-regional research activities initiated by Sebele-based researchers. This represents an attempt to better integrate farming sytems work into the mainstream of DAR research, and to logically distinguish between investigations which are location-specific and those which have national relevance.

During the 1986-87 season, the Mahalapye team will provide logistical support for a rainfall run-off management trial and a sorghum production practices trial. Leadership will be provided by the FSRLA. Support will also be provided for price and fieldwork monitoring activities initiated by the Agricultural Systems Economist. In addition to providing support for the above activities, collaborative trials have been set up with the Sebele

oilseed and cowpea programs.

Third, research planning and implementation will be carried out with reference to conceptually distinct investigation themes, rather designing and justifying trials on an ad hoc basis. The two main themes for the 1987-88 season will be: (a) land and water management and, (b) the assessment of row planting systems. Multiple activities are planned in relation to each theme. In addition, the team will classify research not relating to these themes into commodity or component technology research. The use of these categories hopefully will help clarify the function of different investigations and will facilitate communication with other on-station and on-farm researchers.

Fourth, dissemination stage activities will be carried out on a village promotion basis and not be limited to group participants. Group activities are therefore distinguished as part of the technology research program. Village promotions are conducted through the joint efforts of village research and extension personnel. Farmer assessment is the only important evaluation criterion for these recommendations.

In keeping with the interest in research themes, activities presented in the workplan are identified according to the following categories: land and water management, row planting systems, component practices, and commodity investigations. Listing of activities in the workplan and in Table 1.4 is, as in previous years, according to the stage of research.

12.2 DIAGNOSTIC STAGE

12.2.1 SITE CHARACTERIZATION STUDY (LAND AND WATER MANAGEMENT)

This is an on-going investigation which will be continued and, hopefully completed during the 1987-88 season. For an explanation of the study objectives and past findings, see Section 6.1.1.

12.2.2 WEED PROBLEM STUDY (LAND AND WATER MANAGEMENT)

This is an on-going investigation which will be continued and, hopefully completed during the 1987-88 season. For an explanation of the study objectives and past findings (see Section 7.1.1.2(2) of Annual Report Number 3).

12.2.3 ROW PLANTER CONDITION SURVEY (ROW PLANTING SYSTEMS)

Objective: The objective is to assess condition of planter units currently owned by farmers or available to farmers in the Mahalapye research area.

Justification: Exploratory findings suggest that the general condition of row planters owned by farmers in the Mahalapye area is very poor. It is useful for the purposes of a row planting systems assessment to evaluate condition of the units and causes of poor condition as well as determine how poor planter condition is affecting the quality of the seeding operation.

Approach: A row planter acquisition and use survey will be administered

along with a "shop test" assessment of row planter units currently owned by farmers in the ATIP research area including Mahalapye. This study will attempt to relate planter use patterns with seeding quality parameters.

12.3 DESIGN STAGE

12.3.1 DEVELOPMENT OF HIGH POTENTIAL SITES (LAND AND WATER MANAGEMENT)

Objectives: The main objectives are to:

(a).Implement an intensified production package at high potential sites (HPS) in order to determine yield potentials at these sites.
(b).Assess the benefits of a range of inputs including soil building with kraal manure, phosphate and water conservation as part of the HPS package.
(c).Assess, through interaction with a special interest group of farmers participating in this research, farmer acceptance and ability to implement the intensified production.

Justification: Observations over the past five seasons indicate that areas of many fields remain relatively productive even in drought. Results from previous ATIP studies indicate that sites with greater natural water storage combined with water run-on capacity are most likely to give economic return to inputs such as double plowing and phosphate. It is logical that if a farmer is considering intensification in his arable operation, he/she should first work at high potential sites (HPS).

Even though soil building should be promoted for reasons of long term production stability over all areas, practices such as organic matter build-up, legume-cereal rotations, etc., have often failed to yield economic benefits because of limiting soil moisture in on-farm investigations. It is felt that these practices would more likely succeed at HPS even under traditional tillage-planting and post-establishment management.

Approach: Six farmers with appropriate sites in both Shoshong and Makoro villages will be selected. These six farmers in a village will meet periodically to deal with implementation issues and later for assessment purposes. Interaction with these farmers will probably involve a mixture of group meetings and individual contacts. Development of comparisons at the HPS will require a series of implementations. Envisioned are comparisons on kraal manure, phosphate, double plowing, thinning/gap-filling, priority weeding versus normal weeding. Implementation will need to be handled on a cooperative basis with the farmer. As an example, kraal manure must be arranged by the farmer but the project may help with transportation. ATIP may also provide the first plowing for the double plowing. It is felt that the primary issues are still technical and economic though the group interaction with the farmers should provide a good sample of interest and capability to organize the development.

12.3.2 ROW PLANT CUSTOM HIRE SCHEME (ROW PLANTING SYSTEMS)

Objectives: The objectives are to:

(a).Increase the row planting/cultivation resource available in a village area through development of a custom hire scheme.
(b).Promote early plowing followed by row planting on good soil moisture and relatively early inter-row cultivation.

Justification Many farmers indicate an interest in row planting but do not have access to planting resources. Interest in inter-row cultivation is less well developed but this maybe due to little experience with row planting and to the unavailability of cultivation resources. Because only a few farmers own row planters in each of these villages, additional row planting and cultivating resources made available on a custom hire basis could be well received.

Approach: Farmers not owning planters but interested in row planting will have row planting and inter-row cultivation done by a special unit organized by ATIP. Scheduling planting and cultivating operations will be handled by the AD/ATIP village staff in much the same way that ARAP plowing is currently handled. Most farmers in this part of the group should be draft dependent but maintain a strong interest in arable farming.

Research on the custom hire unit could have implications for increasing the area row planted on a village basis and for increasing the quality of row planting. Two two-row planter units with cultivators are being provided by the Farm Machinery Development Unit in DAR for this purpose. An additional S-90 two-row planter is available in Mahalapye. Although considered too expensive for most individual animal draft operations, the two-row units on a wheeled carriage are considered more stable on poor seedbeds and generally provide better seed placement. One planter unit is on a tool carrier that can also be converted to a cart. The cart could provide additional income for the operators of the scheme.

Custom hire operators in a pilot study of this scheme are being selected on the basis of active interest, available labor and draft and sufficient resources to maintain their own arable operation at the current level. Some of the operators will have their fields plowed under the ARAP scheme. Operators can also be host participants for the row planting scheme.

Operators will claim government subsidy money for row planting and inter-row cultivation. ATIP will "top-up" the inter-row cultivation payment by P5.00/ha. "Top-up" payments will be contingent on passing an inspection of the work by ATIP staff and the village AD. Bonuses will be given to operators successfully implementing row planting and cultivating on 10 farms and again at completing implementation on 15 farms. The "top-up" helps correct an unrealistically low payment for this operation and also places a premium on management of the operation.

12.4 TESTING STAGE

12.4.1 ROTARY INJECTION PLANTER TRIAL (ROW PLANTING SYSTEMS)

Objectives: The objective is to compare stand establishment and yields when using the rotary injection planter to those obtained with the traditional broadcast-plough 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 potential value of the hand rotary injection planter will be explained at village kgotla meetings. In each village three or four farmers will be selected to control the use of a planter. The selected participants will be asked to not plant approximately one hectare out of the area plowed during the early part of the season. Farmers will then be asked to plant approximately one-third of the hectare on each of the following three rains using the rotary injection planter. Each farmer will be asked to share their planter with one or two other farmers (who also must agree to follow the same trial format).

Measurements will be made on weed burden at planting, labor requirements for planting, seed used, stand establishment, weed burden four to six weeks after planting, and yields. Results will be compared to the average outcomes for the traditional system, as determined through monitoring of adjacent farmer plots.

12.4.2 SORGHUM VARIETY TRIAL (COMMODITY INVESTIGATIONS)

Objectives: The objectives are to:

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

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

Justification: Because performance data from previous on-station testing have not yet been received, it is difficult to assess the potential role of these new sorghum varieties. Palatability, grain yield and maturity were among the criteria used in selecting these varieties. Area farmers express an interest in new varieties and it is anticipated that interest in these comparisons will be good. Because several of the test lines are still in a segregating generation, the plant breeder has suggested that it should be possible for individual farmers to make their own selections to improve local adaptation of those particular lines.

Approach: Comparisons will be implemented under a RMRI format. This will be the safest way to produce the largest number of successful plantings with the limited quantity of seed available. In contrast to other interventions wher farmer assessment hinges on "hands-on" implementation, the local community of farmers would still be able to evaluate most aspects of the character of these sorghum varieties. For local palatability assessment, harvested grain could be handed out to a set of farmer judges.

Plantings will be on plots of 5 meter by 20 meter with two replications at each of three sites. Treatments will be broadcast plowed, however, replication blocks maybe split with one-half of each plot double plowed. Double plowing would provide some security against drought for the comparison. In the Mahalapye area, the early plowing could be easily implemented by tractor at the same time the early HPS activity is done.

12.4.3 DUAL PURPOSE COWPEA VARIETY TRIAL (COMMODITY INVESTIGATIONS)

Objectives: The objective is to compare plant establishment and yields for Blackeye versus TVX3236016.

Justification: The Sebele cowpea program has identified TVX3236016 as a promising dual purpose cowpea variety. The new variety must be compared to the standard Blackeye variety when planted on-farm using existing practices before it can be recommended to farmers.

Approach: Trial participation will be solicited at village kgotla meetings. Selected participants will be given equal amounts of Blackeye and TVX3236016 seed and instructed to plant the seed in adjacent plots (on the same acre and on the same day). Measurements will be made on emergence stand counts and yields (both grain and leaf). A simple disease monitoring system will be set up and implemented in conjunction with the Sebele-based cowpea researchers.

12.4.4 FORAGE-COWPEA VARIETY TRIAL (COMMODITY INVESTIGATIONS)

Objectives: The objectives are:

(a).To compare grain and dry matter yields for B005C cowpea, Dolichos lab lab, and mixed Tswana cowpeas,
(b).To assess the impact of phosphate on grain and dry matter yields in these fodder crops.

Justification: The Sebele cowpea program has identified B005C as a potential triple-purpose cowpea (grain, leaf, forage). It is necessary to compare the new cowpea variety with Dolichos lab lab, since this is the most promising special purpose annual forage crop. Mixed Tswana beans will be included to facilitate a comparison between double and triple purpose Tswana cowpeas.

Phosphate fertilizer is currently recommended for grain and fodder crops in eastern Botswana yet few farmers are prepared to invest in this amendment. Previous work in ATIP indicates that phosphate applications can significantly increase fodder production. Farmer and economic assessment of this increase are important.

Approach: Trial participation will be solicited at village kgotla meetings. Selected participants will be given equal amounts of B005C, mixed Tswana and Dolichos lab lab seed, and instructed to plant the seed in adjacent plots (on the same acre and on the same day). Plots at several of these sites will be split with dry matter production responses compared at recommended levels of phosphate against no phosphate. Measurements will be made on emergence stand counts, grain yields, and dry matter yield.

A demonstration of forage harvesting and the building of drying (and storage) racks will be carried out in each research village.

12.4.5 GROUNDNUT HILLING-UNDERSOWING TRIAL (COMMODITY INVESTIGATIONS)

Objectives: The objective is to determine whether farmers should hill

their groundnuts, or if they should undersow groundnuts with a quick growing crop-variety such as ER-7.

Justification: Most farmers currently hill their groundnuts to facilitate pegging. Hilling is a labor consuming activity but there is no firm agronomic evidence that hilling increases yields. Therefore, the returns to labor invested in groundnuts might be increased if farmers were to eliminate the hilling operation.

Farmers traditionally plant groundnuts at a low population density. This practice seemingly represents an underutilization of an expensive resource — plowed land. It may be possible to increase the returns to plowed land, without reducing groundnut production, by undersowing ER-7 cowpeas in the gaps between groundnut plants.

Approach: Trial participation will be solicited through village kgotla meetings. Selected participants will be given enough groundnut seed to plant an acre. At the time of emergence stand counts, the acre will be sub-divided into three equal sub-plots. Farmers will be asked to hill one sub-plot according to their normal timing of hilling. Gap filling will be carried out on the second sub-plot using ER-7 cowpeas. The amount of seed used will be left to the farmers. Data will be collected on gap-filling labor, seed for gap filling, hilling labor, and yields.

12.5 DISSEMINATION STAGE

12.5.1 ROW PLANTING FARMER GROUPS (ROW PLANTING SYSTEMS)

Objectives: The main objectives are to:

(a).Research extension of the row planting option through the special interest group format.
(b).Link row planting with early preparation plowing and early inter-row cultivation.

Justification: Early plowing plus row planting can be effective in increasing grain yield over broadcasting in plot level comparisons though this system can be weed prone. In the context of a whole field where much of the area is plowed on less than optimum moisture conditions, plant establishment could be greatly improved over large areas by rapid row planting on days with good soil moisture. This requires earlier plowing preparation. As is indicated by other researchers in DAR, row planting can only be superior if planting is of a quality to permit inter-row cultivation. The depth of seed placement and seeding rate are also important issues.

Approach: Special interest farmer groups organized in Makwate and Makoro villages. These groups will only meet as required/requested to discuss problems with implementation of row planting. The AD in Makwate who has selected row planting issues for demonstration work will be asked to play an important role in this activity in Makwate. Characteristics of the activity include:

(a).Requesting each participant to row plant and inter-row cultivate at least one hectare. Monitoring areas not row planted (if any) will provide controls for comparison.
(b).Offering advice on correct setting of the row planter and correct row planting to the entire group before the beginning of the season.
(c).Demonstrating planter modifications such as blocking holes in the seed metering plate and fitting a row marker.
(d).Discussing and recording farmer evaluations of row planting options (i.e., wide row spacings).

12.5.2 DOUBLE PLOWING (COMPONENT PRACTICES)

Objectives: The objective is to assess implementation rates and farmers' assessments of double plowing (DP) when DP is implemented outside of a formal trial context.

Justification: DP has been examined in a wide range of trial formats. DP is of some benefit when averaged across all sites and appears to be particularly beneficial when implemented on sites with high water holding capacity soils.

Despite a substantial investment in research on DP, little is known about how farmers might implement DP in the context of their existing cropping system or about farmers' interest in the practice when the practice is not subsidized. Therefore, before DP is presented to the extension service as a proven recommendation, it is necessary to assess DP outside of a formal trial context (involving free seed and control plots).

Approach: Past trial results on DP will be presented at village kgotla meetings. Farmers interested in DP will be asked to attend a follow-up meeting at which time guidelines for site selection will be explained. Volunteer farmers will be asked to not plant approximately one hectare out of the area they plough during the early part of the season, and then to plough-plant that area on the following rain(s).

An assessment will be made of the sites farmers select for DP relative to the guidelines on site selection. A record will be kept on the proportion of farmers who actually implement DP, and the area double plowed. Farmers will be asked to report their observations on the benefits of DP.

If the season's rainfall pattern is substantially different from the recent drought seasons, measurements will be made on weed burdens four to six weeks after planting and yields. Net benefits will be calculated relative to the outcomes for traditional broadcast-plough plots as determined through monitoring adjacent farmer plots.

12.5.3 HAND PLANTING FOR GAP FILLING (COMPONENT PRACTICES)

Objectives: The major objective is to encourage farmers to try hand gap filling. The idea is to:

(a).Monitor farmer interest in the proposal.
(b).Assess the profitability of hand planting when farmer implemented.

Justification: Data from three seasons of RI trials show that hand planting for gap filling is a profitable field operation. It is necessary

for farmers to try gap filling in order to (a) generate interest in this intervention and (b) confirm that the intervention is profitable when implemented by farmers.

Approach: Farmers willing to gap fill will be identified by the village staff from among those farmers participating in the general purpose farmer groups. Village staff will be instructed to promote interest in hand gap filling. If a farmer agrees to try hand gap filling, the staff will visit his/her field and, in conjunction with the farmer, identify gaps which are large enough to gap fill. The area will be pegged and the farmer asked to hand plant it the next time it rains. If the area is large, ATIP will make available any one of three types of planters -- the rotary injection planter, the Sanitas push planter, or the ATIP hand jab planter.

Measurements will be made on the hand planting labor time, the amount of seed planted, and yields. Returns to the hand planting labor will be calculated.

12.5.4 GROUNDNUT SEED TREATMENT (COMMODITY INVESTIGATIONS)

Objectives: The objective is to promote the use of a fungicide seed treatment (Captan) for groundnuts.

Justification: On-station and on-farm research has shown that seeding rates can be substantially reduce if a fungicide seed treatment is applied before planting. The marginal rate of return on the value of seed saved relative to the cost of the seed treatment is above 400 percent even with farmers' normal practice of planting at very low population densities.

Approach: Past research results will be summarized at village kgotla meetings. ATIP will offer to treat farmers' seed (groundnuts or jugo beans) if the farmers agree to plant a paired comparison of treated versus untreated seed. A post-establishment farmer assessment survey will be conducted.

12.6 SUMMARY OF LINKAGES

12.6.1 LINKAGES WITH FARMERS

Linkages with farmers will be strengthened through the planned revisions in groups management, as discussed in the introduction to the work plan.

12.6.2 LINKAGES WITH EXTENSION

Improved linkages with extension will result from the involvement of the Mahalapye CPO, and possibly Palapye CPO, in the team's trial program. It is planned that the CPOs will play a major role in FMFI trials to be implemented by the general purpose groups. The Mahalapye CPO will also be asked to be involved in other research activities of the Mahalapye team. This collaboration will constitute the main link between farming systems research and the extension phase of DAFS in the Central Region.

Working through the CPO, the AD of Makwate village will play an important

role in the development of the special farmer group for row planting in that village. Row planting is already a special interest of the Makwate AD. As in previous seasons, efforts will also be made to encourage:

(a).ADs in the ATIP research villages to participate in other farmer groups and trial activities, and
(b).The ATIP extension staff to attend some district monthly management meetings.

Given the mid-season shift in team personnel, it would not appear to be reasonable to attempt to expect much team involvement into new extension areas during the 1987-88 season. (The FSRLA working with the Mahalapye team will be primarily responsible for any efforts on this). However, the team will provide advice on demonstration priorities and formats to the three Central Region CPOs. The Mahalapye team will continue to participate in the ALDEP in-service training of ADs. At least one field-day will be held specifically for the purpose of familisrizing ADs with ATIP activities and trial outcomes.

12.6.3 LINKAGES WITH ON-STATION RESEARCH

The Mahalapye team will assume responsibility for at least one seminar to be presented at Sebele, if the Sebele research seminar series is revived.

The team will maintain relationships with station based researchers established during previous seasons. A close working relationship with the Sebele-based FSRLA is expected. As part of this relationship cooperative trials management is planned for the rainfall run-off management research and the RMRI sorghum component practices trial.

The team also will provide logistical support for price monitoring (see Section 11.4.2.1).

12.6.4 LINKAGES WITH POLICY/PLANNING

If requested, the team will collaborate on at least one policy-oriented survey under the context of the proposed "problem identification studies," following the format established for the 1986 ARAP and Drought Relief Assessment Survey.

CHAPTER 13: ATIP FRANCISTOWN WORK PLAN, SEPT. 1987-AUG. 1988

USAID: R. Gray (Animal Scientist)
Successor being recruited
G. Heinrich (Agronomist)
F. Worman (Agricultural Economist)

GOB: B. Mabongo (Agricultural Economist, DPS)
S. Masikara (Agronomist, DAR)
W. Mababile (Animal Scientist, DAR)
On return from overseas study leave

PCV: S. Bock (Ms) (Agricultural Economist)

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 1987-88 year. More emphasis will be placed on preparation of materials covering technologies which are provisionally ready for dissemination. 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 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 1987-88 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's 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).Testing of a new rainfall conservation and concentration system designed to improve the reliability of crop production (and possibly increase per hectare crop yields). It requires the same amount of plowing time, and less weeding time than the traditional system;

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

(c).Increase work with an effective, easy to use, hand row planter to assist non-draught power owners and others with timely row planting;

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

(e).Expanded collaboration with extension in the area of technology testing, adaptation and dissemination through new work with a farmer's group in the Communal First Development Area, NE District. (Extension takes the lead role in this work).

(1).Animal Production/Traction: Work will continue in collaboration with the socio-economists and agronomists at ATIP Francistown and Mahalapye and the livestock extension personnel with the objectives of improving animal traction efficiency and livestock production.

Descriptive work will continue on identification of production parameters of goats in the smallholder sector. Design activities will focus on development of a pilot communal grazing project in collaboration with the extension service. The focus of the testing stage will center on management systems for goats, purpose grown fodder/agro-forestry crops, and improved donkey harnesses and ox yokes. In the dissemination stage, emphasis will continue on introduction of fodder crops into the farming system and harvesting and storing crop residues for feeding during the latter part of the dry season.

(2).Farm Management: Activities will be in five major areas. First, there will continue to be the analysis 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. The publication of data already obtained continues to be an important part of this work.

A second major priority for 1987-88 will be continued collaboration in the agronomy and animal production trials to collect data for and to provide an economic analysis of the design and testing trials. The proposed interventions will be analyzed in terms of their economic feasibility when compared with traditional technology checks.

A third related area is to participate in farmer's 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 interested in forming

similar groups in non-ATIP villages.

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

Finally, in order to promote the acceptance of the FSR, 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 DESCRIPTIVE AND DIAGNOSTIC STAGE

Analysis of existing descriptive data in conjunction with collection and analysis of new descriptive data is an on-going process. As was the case last year descriptive/diagnostic studies will concentrate on periodic monitoring of technical and economic factors to identify trends in the farming system. Specific one time surveys will be conducted in response to distinct needs that may arise during the course of the year.

13.2.1 ECONOMIC AND TECHNICAL MONITORING SURVEYS AND STUDIES

Objective: 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).Small stock and grain prices.
(e).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 will provide information on the fluctuations in the system over time and will allow the identification of trends, such a 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, 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 multiple visit study undertaken in earlier years of the project. Small stock and grain prices will continue to be collected from the same sources on a monthly basis. Timings for plowing activities under

farmer's field conditions will be collected for animal and tractor traction.

13.3 DESIGN STAGE

13.3.1 MATSITAMA/MOKUBILO PILOT COMMUNAL GRAZING PROJECT

This work is being done in collaboration with the Animal Production and Range Extension Officers of the Francistown Regional Agricultural Office.

Objective: The long-term objective of this project is 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 are 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), almost to the exclusion of the range resource. 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 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 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. km. located in the vicinity of Matsitama and Mokubilo in 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 at which 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 is currently underway.

Cattle owners who reside in the project area are currently consulting with absentee cattle owners. After due deliberation, a meeting will be called of all cattle owners, at which time they will be asked to form a management committee to assist in formulating a proposal for submission to the Animal Production Division (APD), DAFS, for funding. A range management consultant may be provided by ATIP to give guidance in preparation of this proposal, with a goal of April 1st, 1988 for submission to APD.

13.4 TESTING STAGE

13.4.1 WATER HARVESTING TRIAL

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

(a). A simple system can be used to concentrate rainfall and runoff water in specific cropped areas of the field.

(b). This system improves per hectare crop yields and reduces the risk of crop failures over the traditional cropping system.

(c). This system improves on the yield and stability benefits of double plowing on the contour.

(d). Implementing this system in the field can 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 is 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 is referred to as contour band plowing (CBP). Soil contours are first laid out using a string level. Then bands two meters wide are plowed along the contour. Between these bands, two meter strips are left unplowed to enhance runoff into the plowed areas. Thus half the field is plowed, and half is 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 10 mm) seed and fertilizer are broadcast on plowed areas (beds) and plowed down. (So the beds are plowed a total of two times.) Beds are weeded by hand, while the inter-bed areas can be weeded mechanically. (An implement for this purpose is being designed by the Farm Management Unit at Sebele.) Theoretically this system should:

(a). Increase moisture available in the beds through both double plowing and collection of runoff from the adjacent unplowed areas;
(b). Not increase plowing labor requirements per hectare (because only half the field is double plowed); and
(c). Reduce weeding time requirements because half the field can be mechanically weeded.

Double plowing has been shown to produce approximately twice the per hectare grain yield of single plowing. 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 1986-87 and was seen to conserve water. It will be tested both in Tutume Agricultural District and at Sebele in 1987-88.

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

The economic focus for these trials will be to collect sufficient labor use, input cost, and harvested output information for 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.

13.4.2 AGRO-FORESTRY/ALLEY CROPPING

Objectives: The objectives of this RMRI work are 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, such agro-forestry/alley crops can supply valuable feed for livestock as well as firewood and building materials.

Approach: Arrangements have been made with the Impala Forestry Nursery to start approximately 1,000 leucaena and 1,000 pigeon pea plants in pots which will be transplanted to test sites on farmer's fields early in the 1987-88 crop season. Problems associated with establishment of such plants will be identified with 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.

13.4.3 DOUBLE PLOWING

Objectives: The objectives of this RMFI 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 a benefit in 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 given 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.

(1).For Farmers Who Own Their Own Draught Power (Largely Cattle):

On the first rains when the animals are ready to plough, the farmer will plough/plant an area of 50 meters by 50 meters. This should require one day. When the soil dries slightly below a reasonable moisture level for planting, an area of 50 meters by 50 meters will be plowed in preparation for DP on the next rain.

On the next rain, 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 50 meters strip will be prepared. This system will continue on 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 allow a determination 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.

(2).For Farmers Who Share Animal Draught:

Assume a subsidy on tractor tillage, as is the case this year, and tractor availability. 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 one hectare strip, 50 meters by 200 meters. On the first planting rain that animals are available, the farmer will plant half of this area (50 m by 100 m), plus an adjacent (unplowed) area of 50 meters by 100 meters. All of this land (1 hectare total) will be either row planted or broadcast planted in the traditional manner at the farmer's discretion. On 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 draught to double plough without increasing their direct costs. The double plowing should allow them to increase their production and profit from a limited plowed area.

(3).For Farmers Without Access to Animal Draught:

Again assume a subsidy on tractor plowing. Before the rains, or on the first rains, a tractor will be hired to plough an area of 50 meters by 200 meters. On the next subsequent rain, half of the area will be re-plowed by tractor (50 m by 100 m), plus an adjacent area of 50 meters by 100 meters will be plowed. This should be immediately planted using a hand pulled rotary injection planter. This same procedure will be repeated on the second half of the plowed area, plus an equal adjacent area, on the next rain.

As well as allowing assessment of the double plowing system using tractors on a large scale, this system will shed some light on the relative merit of DP versus single plowing with hand row planting 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 allow comparisons between labor requirements for large areas versus labor requirements for small plots.

13.4.4 EVALUATION OF TRIPLE PURPOSE COWPEAS AND DOLICHOS LAB LAB

Objective: The objective of this RMFI work is to evaluate the acceptability of purpose grown 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 dolicos lab lab .

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

13.4.5 GOAT PRODUCTION

Objectives: The objectives of this RMFI study are to:

(a).Monitor goat production on smallholder farms to identify production parameters in the natural situation over their life-time.
(b).Evaluate the benefits to be obtained by supplementary feeding (creep feeding of cowpea and dolichos lab lab leaves) young goats.
(c).Collaborate with the DAFS smallstock extension personnel in establishing smallstock management groups in villages.

If time permits the following additional objectives will also be pursued:

(d).Evaluate the benefits of housing for protection of young stock from the elements.
(e).Evaluate the economic benefits of dipping, deworming and vaccination for enterotoxemia.

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 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) are participating in this study. All goats in each farmer's herd were ear tagged and weighed when the herd entered the program. Detailed records are being kept on herd dynamics and production parameters. All goats are weighed at the end of the rainy season in May and at the end of the dry season in November. New born kids are weighed and tagged at birth and periodically thereafter.

Six herds at Mathangwane have been divided into two sub-groups to study the economic benefits of deworming and vaccination for enterotoxemia. Housing facilities have been constructed on three farms to study the effects on survival and performance of kids. Additional types of housing will be designed in collaboration with DAFS smallstock personnel and will be tested on selected farms in the four villages. The feasibility of purpose grown fodders (triple purpose cowpeas and dolichos lab lab) will be evaluated as a source of creep feed for kids (see Section 13.4.4).

In collaboration with the Regional DAFS Smallstock Officers, goat management groups will be organized in Matobo and Mathangwane. Goat handling-dipping facilities will be constructed in Marapong with ATIP funds, if SLOCA funds are not forthcoming by November 1987.

13.4.6 CROPPING SYSTEMS STUDIES

This study was initiated in 1986-87 and will be continued in 1987-88 to collect a second year of observations. The only change will be that the cowpea variety used last season (Tswana), will be changed to ER7. This is because unpublished data from the Cowpea CRSP work at Sebele found that this variety was the most effective for a sorghum/cowpea intercropping system.

Objectives: The objectives of this RMFI 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 1983-84). 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 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.

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 three 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.

13.4.7 EVALUATION OF IMPROVED DONKEY HARNESSES AND OX YOKES

Objectives: The objectives of this FMFI work are 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 draught power for plowing, cultivating and planting. Little improvement has been made in the traditional harnesses and yokes which have been used for centuries. Improved harnesses and yokes have been shown to increase the efficiency of draught animal utilization by as much as 30 percent. This

study will test two such improved designs with the aim of introducing them nationwide through ALDEP, if they prove acceptable.

Approach: Fifty Kenya donkey harnesses and 50 improved Sebele ox yokes will be manufactured in collaboration with the Rural Industries Innovation Center, Kanye. Farmers will be selected from among ATIP cooperators in the Francistown and Mahalapye areas to test the harnesses and yokes during the 1987-88 crop season.

13.4.8 EVALUATION OF ROTARY INJECTION HAND ROW PLANTER

Objectives: The objective of this FMFI trial is to compare stand establishment and yields using the rotary injection planter to those obtained with the traditional broadcast-plough 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 will be assessed through the farmer assessment groups as a tool for row planting in terms of its practicability and performance vis-a-vis the traditional broadcast-plough system.

13.4.9 FMFI OPTIONS TESTING WITH FARMER'S ASSESSMENT GROUPS

The work with farmer groups in 1986-87 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 are 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 1986-87 farmer trials in Matobo.

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 (especially relating to specific contingencies at different times of the year). Farmers are then asked to select innovations that seem most relevant to their situation, and to 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 AD's 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, 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 Farmers 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 DP with fertilizer versus DP/row planted (as happened last year) will be encouraged to separate his trials into DP with and without fertilizer, DP with and without row planting, and to

TABLE 13.1: SEQUENTIAL TECHNOLOGY DECISION OPTIONS

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[5/D] b] on dryer periods between rains NB: Not to be done after mid Jan.	Non restricted access to draught power. Will increase plowing labor and draught use where animal draught 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 SCE [SCE]
C] Contour land plowing	Concentrate water Reduce runoff & erosion, increase soil porosity.	Field contours marked before onset of rains	Extra weeding between strips.
D] Fallow	Conserve water between years.	Field not planted, weed control	Chemical or mechanical weed control.
SUBJECT: CROP MIXTURES			
A] Long season crops & varieties.	Traditional system uses rains over season.	Seed saved from prior year. Plant from Oct - Feb.	Harvesting usually after weeding completed.
B] Short season crops & varieties: Cowpeas ERT [60-70 day] Millet Serere 6A [75-80] Sorghum SC [85-9C] Sorghum SSD [70-80]	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 March onwards. Purchase seed? Bird scaring may be necessary earlier than usual.
C] Annual forage crops	Provide supplemental dry season feed of good quality for	Livestock needs [eg early feeding of draught animals, fattening for sale, milk production].	Planting labor in Feb., weeding in March. Seeds [free from ALDEP]. Harvesting May-June
SUBJECT: PLANTING METHODS			
A] Broadcast [traditional]	Buffered planting system for non-optimal soil moisture condition	Anytime especially for farmers without planting equipment or planting on non-optimal soil water	None extra [plough, animals labor]
B] Broadcast [Cyclone Seeder]	Same as above. More even seed dist. Decrease within field plant stand variation.	Farmer interest	Cyclone seeder, no extra labor.
C] Hand row planter	Plough on poor soil water, plant on good moisture [for farmers without drought - 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 Master planter. Extra labor at planting. [Master Planter to be emphasized]

TABLE 13.1: [CONTINUED]

TECHNOLOGY	USES	CONDITIONS FOR APPLICATIONS (AND TIMING)	RESOURCES AND INPUTS REQUIRED (LABOR, CASH)
D] Sabele row 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 draught power.	Sabele row planter. Planting labor. Well trained draught power
E] Improved harnesses, yokes, and animal care. Proper plough adjustment.	Improve efficiency of plowing operations, improved animal well being.	Throughout plowing operations	Improved equipment. Knowledge of animal husbandry [rudimentary]. Cost of equipment
SUBJECT: WEEDING			
A] Hand weeding.	Traditional.	Use on broadcast fields.	Family or hired labor.
B] Inter-row weeder [modified Indian design]	Reduce weeding time. Increase timeliness of weeding	Row planting situation	Donkeys, weeder NB. Depending on availability from Sabele.
SUBJECT: FORAGES			
A] Annual forages Sabele millet and Lablab	Provide supplemental dry season feed of good quality for early feeding of	Anytime but only on good moisture or completely dry soils. Good soil preparation required.	Well tilled seed bed. Broadcast and plough down or use Sabele row planter. March weeding? May-June harvesting.
B] Perennial forages Buffel grass and Stratro	draught 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]. Draught power, weeding labor [late season], harvest labor.
SUBJECT: STALL FEEDING			
A] Fattening market animals for sale in Oct.-Dec.	Marketing crop residues through livestock.	Animals available for feeding. Feed for approx. 100 days from July-Aug. to Oct.-Dec. Access to good market.	Stall for feeding built with local materials. Purchased maize bran, salt and boreswel. Use spare labor during dry season.
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 = Tuture Agricultural District

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 agreed with the CPOs and the Regional Agricultural Officer (Tutume Agricultural District), that group research and extension activities will be expanded in the Region. Any new groups will be supervised by CPOs (or DAOs) and run by ADs. ATIP will probably provide field assistants to the ADs, attend all meetings, probably assist with training of ADs and field-assistants, and provide some material inputs (i.e., seed, fertilizer and new machinery). DAFS staff will probably organize and lead meetings, provide equipment available in the ALDEP package and present current recommended practices.

The exact format, conduct and locations of the new groups will be decided in a meeting of ATIP and DAFS staff in October. The formats and objectives of these groups will differ slightly from those groups being led by ATIP. This is because groups led by DAFS will have more of an extension perspective than those led by research. The DAFS-led groups will focus more on tested technologies coming out of the research-led groups. However, by participating in DAFS-led groups, research can:

(a).Observe the effectiveness of tested technologies in more and different 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 arise. If extension personnel participate in research groups, and research participates in extension groups, this will provide a true continuum for technology development and dissemination.

13.4.10 TESTING OF LOW LIFT HAND WATER PUMPS

Objectives: The objective of this trial is 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, have been obtained which will be tested at lands areas

and/or cattle post areas. Farmer assessments will be obtained. If the tests are successful, Zimplow at Bulawayo -- which has the casting facilities -- will be approached to determine if the pumps can be made locally at a reasonable cost.

13.5 OTHER PROFESSIONAL ACTIVITIES

In order to promote the acceptance of FSW, 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.

13.5.1 LINKAGES WITH FARMERS

This will be accomplished in the following ways:

(a).Continue to expand activities with Farmer's Assessment Groups.
(b).Continue active involvement of farmers in RMFI trials implementation.
(c).Make annual report on ATIP activities at kgotla meeting in each ATIP village.

13.5.2 LINKAGES WITH EXTENSION

This will involve:

(a).Continuing to involve DAFS in the FMFI design and testing of systems' options through involvement of local ADs in monthly meetings, and field days with district and regional DAFS officers.

(b).If there is sufficient interest, assist in the formation of two to four additional Farmer's Assessment Groups by CPOs and ADs. Groups will probably be located in the CFDA in Northeast District, in the proposed communal grazing study area (Matsitama), or in areas adjacent to ATIP villages.

(c).Collaborating with ALDEP on forage trials.

(d).Cooperating 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.

(e).Collaborating with the Regional Animal Production and Range Officers, Francistown, on the Matsitama/Mokubilo Pilot Communal Grazing Project.

(f).Preparing articles on ATIP activities, with pictures, for inclusion in extension publications.

(g).ATIP Senior Technical Officers will regularly attend DAFS Monthly Management Meetings and discuss ATIP activities.

13.5.3 LINKAGES WITH ON-STATION RESEARCH

This will involve collaborating with DAR on water harvesting research, fine tuning of the double plowing-broadcast planting system, crop variety testing, and other activities.

13.5.4 LINKAGES WITH POLICY/PLANNING

Data sets on the Multiple Visit Data and other surveys will be reviewed and documented. These data sets will be made available to other potential users in GOB.

13.5.5 METHODOLOGY DEVELOPMENT

The Francistown ATIP team will continue to work with other members of ATIP in the preparation and dissemination of methodological materials. The Francistown Agricultural Economist will continue to coordinate team efforts to further develop and utilize the Sequential Decision System Framework.

PART IV

FINANCIAL PLAN, 1987-88

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 seperately. 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 seperate 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 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 RELATED ACTIVITIES, SEPT. 1987-AUG. 1988/a

UNIT	PLACE	NUMBER OF OFFICES	NUMBER OF HOUSES
ATIP Related	Gaborone	1	1
	Sebele	2	1
	Mahalapye	4	3
	Francistown	4	3
INTSORMIL Related	Sebele	3	2
SMU Related	Sebele	1	1

a. 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.

TABLE 14.2: COSTS OF RUNNING GOB VEHICLES

TOYOTA TYPE	NUMBER	COST PER VEHICLE PER YEAR (PULA) HIRE COST	MONTHLY COST/a
Landcruiser Station Wagon	1	2,691	4,026
Landcruiser	5/b	2,691	4,026

a. Assumes vehicle travels 30,000 kms per year and at rate of five kilometers per liter. Cost of petrol per liter is P0.67.
b. This also includes one vehicle for SMC and one for the FIELD.

TABLE 14.3: MEDIAN SALARIES AND ALLOWANCES OF GOB STAFF, SEPT. 1987-AUG. 1988

RATE	NUMBER IN ACTIVITY ATIP	NUMBER IN ACTIVITY INTSORMIL/a	COST PER PERSON PER YEAR (PULA) SALARY	COST PER PERSON PER YEAR (PULA) ALLOWANCE S/b
P83	4/c		13,344	1,780
P82	1		9,984	1,298
T3	1	2	8,688	1,129
T4	1		6,552	852
T5	1	1	4,464	580
S4	1	2	3,396	441
GA5/6	1		2,874	374
Industrial Class 1			2,408	313

a. SMC positions have not been given.
b. These have been estimated to be 13% of the salary.
c. This assumes promotion of three individuals who will be returning from long term training during the coming year.

TABL. 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 - GOB	FOR ATIP - PROJECT	FOR ATIP RELATED/b GOB	FOR ATIP RELATED/b PROJECT
Salaries and Allowances:				
Other than Industrial Class	141,441		32,352	
Industrial Class	10,784			
Casual Labour	12,700		3,000	1,000
Vehicles	46,465			6,578/b
Miscellaneous/c		100,000		30,000

a. 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.
b. Unless indicated otherwise "ATIP Related" refers to support for INTSORMIL and SMC.
c. Includes purchase of equipment such as microcomputers and implements, consumable stories, etc.

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
Housing: Gaborone	1			
Sebele	3		2	
Mahalapye	1/a			
Francistown	1/a			
Allowances ATIP Technicians/b	7	11,145	2	3,470
PCV Support/c	2	2,648		
Short Term Training/d		30,000		
Long Term Training/e	3.2	64,000		

a. Includes a PCV.
b. Assumed to be at a rate equivalent to P83 (1171 in Table 14.3).
c. 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.
d. 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.
e. Expressed in person years and estimated at a cost of P30,000 per year.

TABL. 14.6: COMMITMENTS TO BE MADE WITH DONOR FUNDS THAT WILL NOT NEED TO BE ASSUMED 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/a	1
Training:			
Long Term	Person years	7.8	
Short Term/b	Person months	5	

a. Includes 3 months of the agricultural extension consultant who is currently with the project.
b. It does not include those who will receive in-service training (up to 100)

(a). GOB (i.e., BX) Vehicles. The Central Transport Organization (CTO) are now planning to rent vehicles to governmental departments. 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.

(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.

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

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.

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.

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 1987 to August 1988 will be in the region of P365,105 (see Tables 14.4 and 14.5), of which P117,263 (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 P137,579 (see Table 14.4) for the period September 1987 to August 1988, 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 A

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 systematise 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

Baker, D., E. Modiakgotla, D. Norman, J. Siebert and M. Tjirongo. 1983. "Helping the Limited Resource Farmer Through the Farming Systems Approach to Research." Culture and Agriculture 19: 1-8. ATIP EP 83-1.

1984

Norman, D., D. Baker and J. Siebert. 1984. "The Challenge of Developing Agriculture in the 400-600mm Rainfall Zone within the SADCC Countries." Zimbabwe Agricultural Journal 81(6):205-214. ATIP EP 84-1.

1985

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 85-1.

Norman, D.W. "The Limited Resource Farmer and Africa's Food Production Crisis". In IFDC (Ed.), Fertiliser Efficiency Research and Technology Transfer Workshop for Africa South of the Sahara. Muscle Shoals: International Fertilizer Center, 1985. pp. 23-67. ATIP EP 85-2.

1986

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 86-1.

Baker, D.C. and D.W. Norman. "Farming Systems Research and Extension in Harsh Environments: Development of a Farmer Cooperator Approach in Botswana." In C. Flora and M. Tomecek (Eds.), Selected Proceedings of KSU's 1985 Farming Systems Research Symposium. Farming Systems Research and Extension: Management and Methodology. Farming Systems Research Paper No. 11. Manhattan: Kansas State University, 1986. pp.

535-555. ATIP EP 86-7.

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 86-2.

Koch B., Masikara, S., G. Heinrich, and W. Matlho. "Draught Animal Management and Early Ploughing." In C. Flora and M. Tomecek (Eds.), Selected Proceedings of KSU's 1985 Farming Systems Research Symposium. Farming Systems Research and Extension: Management and Methodology. Farming Systems Research Paper No. 11. Manhattan: Kansas State University, 1986. pp. 467-474. ATIP EP 86-8.

Merafe, Y., D. Baker, and D. Norman. "Socio-Economic Constraints to Farm Equipment Innovations in Botswana". In ILO (Eds.), Initiatives for Farm Equipment Programmes in Botswana: Improving Coordination. Geneva, Switzerland: ILO, 1986. pp. 41-49. ATIP EP 86-6.

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 86-4.

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 86-3.

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. ATIP EP 86-5.

1987.

ATIP Francistown. "Link Among Farmers, Extension and Research for Agricultural Development." Agrinews 18 (April 1987): 8-9. ATIP EP 87-2.

Gray, R. C. July/August, 1987. "Donkeys." Northern Advertiser. 107:11 and 110:11. ATIP EP 87-3.

Gray, R. C. and D. Horspool. 1987. "Using Donkeys for Draught Power." Four Parts. Agrifacts. F/28/1-4. Gaborone: Department of Agricultural Field Services, Ministry of Agriculture. ATIP EP 87-1.

A.2.2 RESEARCH PAPERS

1986

ATIP. "Farming System Research Activities at Mahalapye: Summary of Activities, 1982-85". 1986. ATIP RP 1.

ATIP. "Farming System Research Activities at Francistown: Summary of Activities, 1983-85". 1986. ATIP RP 2.

A.2.3 WORKING PAPERS

1983

Hobbs, A. (Ed.). "Report on Farming Systems Workshop, Denman Rural Training Centre, 28th - 29th June, 1983." ATIP WP 2.

1985

Ramolemana, G. and A. Hobbs. "Relative Importance of Factors that Influence Extension Efficiency and Crop Production Improvement." July 1985. ATIP WP 1.

Miller, W. and T. Seleka. "Agricultural Baseline Survey of Tutume District." October 1985. ATIP WP 3.

1986

Gray, R. (Ed.) "Cattle Post-Lands Interaction Study." Two Parts: Text and Appendices. September 1986. ATIP WP 7.

Miller, S. "Agricultural Markets for Crops, Small Stock and Animal Products in Tutume District." (Forthcoming). ATIP WP 4.

Heinrich, G. and S. Masikara. "Performance of the Extension Package for Cereal Production, and its Components, in Tutume District, 1983-85". May 1986. ATIP WP 5.

Trent, C., D. Styles, and G. Ramolemana. "An Assessment of Subject Matter Competencies of Agricultural Demonstrators in Botswana." June 1986. ATIP WP 6.

1987

Gray, R., C. Berg, B. Koch, R. Windsor, W. Mahabile and A. Holmes. "Blood Parameters of Donkeys, Mathangwane Village, Tutume Agricultural District, Botswana." July 1987. ATIP WP 8.

Gray, R., C. Berg, B. Koch, R. Windsor, W. Mahabile and A. Holmes. "Blood Parameters of Goats, Mathangwane Village, Tutume Agricultural District, Botswana." July 1987. ATIP WP 9.

A.2.4 MISCELLANEOUS PAPERS

1983

Baker, D., E. Modiakgotla, J. Siebert, and M. Tjirongo. "Agricultural Technology Improvement Project." Paper presented to the Farming System Workshop, Denman Rural Training Centre, Sebele, 28th - 29th June, 1983. ATIP MP 83-3.

Baker, D., and D. Norman. "Relevance of the Farming Systems Approach to Agricultural Demonstrators." Paper presented at ALDEP In-Service Training Course, Mahalapye RTC, August, 1983. ATIP MP 83-5.

Norman, D.W. "Some Problems in the Implementation of Agricultural Research Projects with a Farming Systems Perspective." Paper presented at a seminar on Introduction of On-Farm Research with a Farming Systems Perspective, CIMMYT, Nairobi, Kenya, 18th - 20th April, 1983. ATIP MP 83-1. Now published, see ATIP EP 85-1.

Norman, D.W. "Helping Resource Poor Farmers: the Agricultural Technology Improvement Project, Botswana." Paper given at Workshop for US Technicians Preparing for Overseas Assignments, Manhattan, Kansas, 10th - 14th May, 1983. ATIP MP 83-7.

Norman, D.W. "The Farming Systems Approach." Paper presented to the Farming System Workshop, Denman Rural Training Centre, Sebele, 28th -29th June, 1983. ATIP MP 83-4.

Norman, D.W., D.C. Baker, and J. D. Siebert. "The Challenge of Developing Agriculture in the 400-600 mm. Rainfall Zone Within the SADCC Countries." Paper presented to the SADCC seminar on Agronomic Adjustment to the Environment of 400 to 600 mm. Rainfall Zone, 14th-16th Sept. 1983, Harare, Zimbabwe. ATIP MP 83-6. Now published, see ATIP EP 84-1.

1984

Baker, D.C. "FSR Credibility: Experiences in Botswana." Paper presented at Michigan State University, March 1984. ATIP MP 84-10

Baker, D.C. and J. A. Bobbs. "Farming Systems Research and Extension in Botswana: Current Programmes and Issues Facing the Ministry of Agriculture." Paper presented at the KSU Farming Systems Research Symposium on Farming Systems Research and Extension: Implementation and Monitoring, 7th - 10th Oct. 1984, Manhattan, Kansas, USA. ATIP MP 84-5. Now published, see ATIP EP 86-1.

Baker, D.C. and J. Lesotlho. "A Methodology for Farm Management Research in Botswana". Invited paper presented at ARPT/CIMMYT Networkshop on The Role of the Rural Sociologist in FSR and Technology Generation and Adoption, Lusaka, 26th - 28th November 1984. ATIP MP 84-9

Bobbs, J.A. "Report on a Visit to the Farming Systems Research Project, Department of Agricultural Research, Maseru, Lesotho," May 1984. ATIP MP 84-4.

Koch, B.A. and W. Matlho. "Farming Systems Research on Animal Husbandry Problems in Tutume Agricultural District of Botswana." Abstract of paper accepted at the KSU Farming Systems Research Symposium on Farming Systems Research and Extension: Implementation and Monitoring, 7th - 10th Oct. 1984, Manhattan, Kansas, USA. ATIP MP 84-6. Now published, see ATIP EP 86-2.

Koch, B.A. "Animal Science Input in ATIP: Poster Presentation." Paper accompanying poster presented at the KSU Farming Systems Research Symposium on Farming Systems Research and Extension: Implementation and Monitoring, 7th - 10th Oct. 1984, Manhattan, Kansas, USA. ATIP MP 84-7.

Miller, W. and S. Miller. "Agricultural Pricing Policy and its Effect on Production and Equity with Special Emphasis on Botswana Farming Systems." Invited paper presented at Botswana Agricultural Society Meeting, 12th December, 1984. ATIP MP 84-8.

Norman, D.W. "Consultancy to Tunisia." March 1984. ATIP MP 84-3.

Norman, D.W. "Institutionalising the Farming Systems Approach to Research." Seminar given at INAT, Tunis, Tunisia, 12th March, 1984. ATIP MP 84-2.

Norman, D.W. and D.C. Baker. "Components of Farming Systems Research: FSR Credibility and Experiences in Botswana." Paper presented at ADC sponsored conference on Intra-Household Processes and Farming

Systems Analysis, Bellagio, Italy, 5th-9th March, 1984. ATIP MP 84-1. Now published, see ATIP EP 86-4.

1985

Baker, D.C. "Population Council/FSSP Case Studies Project: Training Workshop Trip Report." Arising out POPCO/FSSP Case Studies Project Workshop, Boston, USA, 9th-12th June, 1985. ATIP MP 85-3.

Baker, D.C. "Farming Systems Development Project - Eastern Visayas Philippine Trip Report and Implications for ATIP." Report on USAID consultancy trip to Philippines, May 1985. ATIP MP 85-4.

Baker, D.C. "Labour Productivity in Traditional Agriculture." Invited paper given at The National Seminar on Labour Productivity in Botswana, Gaberone, 8th-11th July, 1985. ATIP MP 85-9.

Baker, D.C. and D.W. Norman. "Farming Systems Research and Extension in Harsh Environments: Development of a Farmer Cooperator Approach in Botswana." Paper presented at the KSU Farming Systems Research Symposium on Farming Systems Research and Extension: Management and Methodology, 13th - 16th Oct. 1985, Manhattan, Kansas, USA. ATIP MP 85-13. Now published, see ATIP EP 86-7.

Baker, D.C. and J. Lesotlho. "The Place of Sociology/ Anthropology in FSR and E in Botswana." [In Press]. ATIP MP 85-6.

Baker, D.C., M. Flint and N. Hunter. "Contributions of Farm Management Economists to FSR and E in Botswana." Paper presented at CIMMYT/GOB sponsored Regional Workshop on Socio-Economics and Microcomputers in Farming Systems Research, Gaborone, Botswana, 2nd-4th July, 1985. ATIP MP 85-7.

Bobbs, J.A. "Research/Farming Systems Teams/Extension Relationships and Agricultural Development in Botswana." Prepared for Agricultural Staff Relations Seminar, Pelotsetlha, 6th-8th March, 1985. ATIP MP 85-10.

Masikara, S., G. Heinrich, W. Matlho, and B. Koch. "Draught Animal Management for Early Ploughing." Paper presented at the KSU Farming Systems Research Symposium on Farming Systems Research and Extension: Management and Methodology, 13th - 16th Oct. 1985, Manhattan, Kansas, USA. ATIP MP 85-12. Now published, see ATIP EP 86-8.

Merafe, Y., D. Baker, and D. Norman. "Socio-Economic Constraints to Farm Equipment Innovations in Botswana". Paper invited for ILO sponsored Workshop on Farm Tools and Equipment Technology: Basic Needs and Employment", Gaborone, Botswana, 3rd-5th December, 1985. ATIP MP 85-15. Now published, see ATIP EP 86-6.

Miller, S., T. Farrington and D. Norman. "Selecting a Microcomputer System for Farming Systems Research: A Framework for Decision-Making." Paper presented at CIMMYT/GOB sponsored Regional Workshop on Socio-Economics and Microcomputers in Farming Systems Research, Gaborone, Botswana, 2nd-4th July, 1985. ATIP MP 85-5.

Norman, D.W. "The Limited Resource Farmer and Africa's Food Production Crisis". Invited paper presented at IFDC/IRA workshop on Fertiliser Efficiency Research and Technology Transfer, Douala, Cameroon, 21st - 25th January, 1985. ATIP MP 85-1. Now published, see ATIP EP 85-2.

Norman, D.W. "Farming Systems Research in Africa -- An Overview." Invited

paper given at The Farming Systems and Extension Seminar, Nhlangano, Swaziland, 22nd-23rd April, 1985. ATIP MP 85-11.

Norman, D. and M. Collinson. "The Concept of FSR in Theory and Practice." Invited paper presented at Australian Centre for International Agricultural Research sponsored Workshop on Farming Systems Research (FSR), Hawkesbury Agricultural College, Sydney, Australia, 12th - 15th May, 1985. ATIP MP 85-2. Now published, see ATIP EP 85-3.

Nygaard, D. and D. Norman. "The Potential Use of Farming Systems Research in Madagascar". Report submitted to FOFIFA, Madagascar, as a result of a consultancy trip to Madagascar, 8th-15th November, 1985. [Also in French] ATIP MP 85-16.

Siebert, J.D. "Use of a Spreadsheet in FSR and E." Paper presented at CIMMYT/COB sponsored Regional Workshop on Socio-Economics and Microcomputers in Farming Systems Research, 2nd-4th July, 1985. ATIP MP 85-8

Trent, C., Monyatsi, T., and E. Modiakgotla. "Progress and Needs in On-Farm Research in Botswana." Paper presented at CIMMYT sponsored Networkshop of Senior Agricultural Research, Extension, and Teaching Personnel of Eastern and Southern Africa", Maseru, Lesotho, 25th-28th November, 1985. ATIP MP 85-14. Now published, see ATIP EP 86-5.

1986

Baker, D. "Botswana: Agricultural Technology Improvement Project. Mahalapye Farming Systems Team." Produced for POPCO/FSSP Case Studies Project, Boston, July 1986. ATIP MP 86-4.

Baker, D. and D. Norman. "A Framework for Assessing Farming System Activities in National Settings in West Africa: With Special Reference to Mali, Nigeria and Senegal". Invited paper given at West African Farming Systems Networkshop, Dakar, Senegal, 10th-14th March, 1986. ATIP MP 86-1.

Baker, D. and E. Modiakgotla. "Training of Non-Professionals in FS Work". Invited paper given CIMMYT Regional Review of OFR, 1986, Mbabane, Swaziland, 12th-16th May, 1986. ATIP MP 86-2.

Gray, R. "Goat Production in Botswana". Paper given at the SR-CRSP Fifth Annual Scientist Workshop, Nairobi, Kenya, 4th-6th November, 1986. ATIP MP 86-5.

Gray, R. "Farming Systems Work". Invited paper given at the Animal Production Division 1986 Senior Staff Meeting, Denham Rural Training Centre, 9th October 1986. ATIP MP 86-6

Heinrich, G.M., Modiakgotla, E. and D.W. Norman. "Enhancing the Productivity of National Agricultural Research Programmes Through Farming Systems Research: the Case of the Semi-Arid Areas of Sub-Saharan Africa". Invited paper given at International Drought Symposium sponsored by SAFGRAD, OAU, Nairobi, Kenya, 19th-23rd May 1986. ATIP MP 86-3.

Makwaje, E. "Goat Management, Milk and Meat Production, Tutume District, Botswana." Project Paper for Seale Hayne College, U.K., December 1986. MP 86-9.

Norman, D. "Farming Systems Work and Extension". Paper given at the Extension Crop Officers Meeting, Denham Rural Training Centre, 18th-19th December, 1986. ATIP MP 86-7.

Siebert, J. "On-Farm Trials and Demonstrations". Paper given at the Extension Crop Officers Meeting, Denham Rural Training Centre, 18th-19th December, 1986. ATIP MP 86-8.

Trent, C. "Research/Extension Linkages." Paper presented at SADCC Extension Study Visit, Gaborone, Botswana, 1st-5th December, 1986. ATIP MP 86-10.

1987

Baker, D. "Trip Report: UZ/MSU Food Security Research Methodology Workshop." Harare, Zimbabwe, 23-25 March, 1987. ATIP MP 87-8.

Baker, D.C. and D.W. Norman. "The Farming Systems Research and Extension Approach to Small Farmer Development." Draft only. October, 1987. ATIP MP 87-11.

Gray, R., and D. Horspool. "Using Donkeys for Draught Power." Four Parts. Prepared for publication as Agrifacts. Now published, see ATIP EP 87-1. ATIP MP 87-1.

Heinrich, G., S. Masikara, F. Worman, and D.C. Carter. "Effects of Tillage Systems on Weed Growth and Weeding Labour Requirements." Presented at Department of Agricultural Research Weeds Workshop, Botswana Agricultural College. Sebele, Botswana, June 19th, 1987. ATIP MP 87-7.

Norman, D.W. "Communication and Information Systems in Farming Systems Work: An Overview of the Past and Present." Plenary address given at the 7th Annual Farming Systems Symposium at the University of Arkansas. Fayetteville, Arkansas, USA, October 18th-22nd, 1987. ATIP MP 87-5.

Norman, D., and D. Baker. "Incentives for the development of the Arable (Cereal) Sub-Sector: The Small-Scale Farmer." Prepared for Panel Discussion hosted by BOSAD on Crop Incentives for the Development of the Arable Sub-Sector (Cereals) in Botswana, Gaborone, 18th March, 1987. ATIP MP 87-2.

Norman, D., D. Baker, G. Heinrich, and F. Worman. "Technology Development Farmer Groups: Experiences from Botswana." Submitted for publication in the Experimental Agriculture, October, 1987. ATIP MP 87-10.

Norman, D., D. Baker, G. Heinrich, C. Masikara, and F. Worman. "Farmer Groups for Technology Development: Experiences from Botswana." Prepared for Workshop on Farmers and Agricultural Research: Complementary Methods, IDS, University of Sussex, England, 27th-31st July, 1987. ATIP MP 87-4.

Norman, D.W., H. Sigwele and D. Baker. "Reflections on Two Decades of Research on Sorghum-Based Farming Systems in Northern Nigeria and Botswana." Presented at the 3rd Annual Conference on Food Security Research in Southern Africa. Harare, Zimbabwe, October 29th, 1987. ATIP MP 87-12.

Siebert, J.D., and E. Modiakgotla. "Tillage-Planting Method Effects on Weed Development." Presented at Department of Agricultural Research Weeds Workshop, Botswana Agricultural College. Sebele, Botswana, June 19th, 1987. ATIP MP 87-9.

Siebert, J.D., and E. Modiakgotla. "Water Harvesting and Soil Moisture Conservation in Dryland Farming." Presented at National Training Course on Reclamation and Management of Deteriorated Soils, Gaborone, 10th March 1987. ATIP MP 87-3.

Worman, F. "Economic Analysis of the ATIP Double Ploughing Trials, 1983-87." Presented at Department of Agricultural Research Seminar on Double Ploughing. Sebele, Botswana, September 7th, 1987. ATIP MP 87-6.

A.2.5 PROGRESS REPORTS

GABORONE

1983

Hobbs, A. "Report on Visits to Agricultural Extension and Research Officers by the RELO", May 1983. ATIP PR G83-1.

Hobbs, A. and G. Moremedi. "Report on Problems Raised by Southern Region ADs and DAOs and Solutions Proposed by Research Officers." June 1983. ATIP PR G83-2.

MAHALAPYE

1983

Baker, D.C. "Early Season Cropping Plans of ATIP Mahalapye Farmers." December 1983. ATIP PR M83-2.

Baker, D., Tjirongo, M., and T. Monyatsi. "Household Characteristics in Shoshong East and Makwate: November 1982 Sample Frame Census Summary Results." October 1983. ATIP PR M83-1.

1984

Baker, D.C. "ATIP Makwate Farmer Workshop, 18th April,1984." June 1984. ATIP PR M84-1.

Baker, D.C. "1983 Agricultural Demonstrator Survey: Tables and Summary Findings. Part One: Extension Area Characteristics in the Central Agricultural Region." September 1984. ATIP PR M84-2.

Baker, D.C. "1983 Agricultural Demonstrator Survey: Tables and Summary Findings. Part Two: AD Activities and Constraints on Effectiveness in the Central Agricultural Region." September 1984. ATIP PR M84-3.

Baker, D.C. "1983 Crop Management Survey: Tables and Summary Findings. Part One: Household Characteristics and Practices of Farmers Cooperating with ATIP Mahalapye." September 1984. ATIP PR M84-4.

Baker, D.C. "1983 Cowpea Baseline Survey: Tables and Summary Findings from ATIP Mahalapye Farmers." September 1984. ATIP PR M84-5.

1985

Lesotlho, J. and D. Baker. "Decision Unit-Management Information Study: Exploratory Study". December 1985. ATIP PR M85-2.

Siebert, J.P. "A Portable Quadrat Sampling Method for Measuring Plant Stand Establishment and Harvest Outcomes." ATIP PR M85-1

1986

ATIP, Mahalapye. "Progress on Work Planned for 1985-1986". May 1986. ATIP PR M86-1.

FRANCISTOWN

1983

Miller, W. "ATIP Selection of Villages and Participating Households in Tutume Agricultural District." November 1983. ATIP PR F83-1.

1984

Miller, W. and T. Seleka. "Cowpea Baseline Survey: Implementation and Findings in Tutume District". September 1984. ATIP PR F84-1.

Koch, B. and W. Matlho. "Livestock Practices Survey." November 1984. ATIP PR F84-2.

Koch, B. and W. Matlho. "Draught Management for Early Ploughing." November 1984. ATIP PR F84-3.

Koch, B. and W. Matlho. "Plough Condition Survey and Observations Concerning Harnesses and Yokes." November 1984. ATIP PR F84-4.

Koch, B. and W. Matlho. "Supplemental Mineral-Mix for Animals." November 1984. ATIP PR F84-5.

1985

Miller, W. "Analysis of Census Frame Survey in Matobo, Mathangwane and Marapong Villages in the Tutume Agricultural District of Botswana, October 1983." March 1985. ATIP PR F85-1.

Koch, B.A. and W. Matlho. "Livestock Inventory Changes on ATIP Farms in 1984." ATIP PR F85-2.

Koch, B.A. and W. Matlho. "Dry-Season Supplemental Feed for Draught Animals." May 1985. ATIP PR F85-3.

Seleka, T. "Tonota Smallstock Market Study". ATIP PR F85-4.

Worman, F.D. "Government Subsidized Ploughing Programme Participation and Demand for Tractor Ploughing, November 1985." ATIP PR F85-5.

1986

ATIP, Francistown. "Progress on Work Planned for 1985-1986". May 1986. ATIP PR F86-1.

Heinrich, G., S. Masikara, and F. Worman. "Tillage Systems Trial (Researcher Managed/Researcher Implemented)." ATIP PR F86-5.

Heinrich, G., F. Worman, S. Masikara, and B. Mabongo. "1986 Double Ploughing/Broadcast Planting System Trial (Farmer Managed and Implemented)". November 1986. ATIP PR F86-2.

Heinrich, G., F. Worman, S. Masikara and R. Gray. "1986 Draught Management and Early Ploughing Trial (Researcher Managed and Farmer Implemented)." ATIP PR F86-3.

Heinrich, G., F. Worman, and S. Masikara. "1986 Hand Planter Trial (Farmer Managed/Farmer Implemented). PR F86-4.

1987.

Bock, S., F. Worman, and B. Mabongo. "1985-86 Cooperators' Cropping Practices Survey." January, 1987. ATIP PR F87-1.

Bock, S., F. Worman, and B. Mabongo. "1985-86 Cooperators' Cropping Practices Survey" Contains survey form only. January 1987. ATIP PR F87-1. (Supplement)

Bock, S., F. Worman, and B. Mabongo. "Ploughing Labour Study." May, 1987. ATIP PR F87-4.

Gray, R. C. "Goat Production by ATIP Farmers during 1986 in Tutume District, Botswana." February, 1987. ATIP PR F87-2.

Gray, R. C. "Livestock Inventory Changes on ATIP Farms, Tutume District, Botswana, 1984-86." May, 1987. ATIP PR F87-3.

Heinrich, G., F. Worman, S. Masikara, and R. Gray. "1987 Double Ploughing Trial (Researcher Managed/Farmer Implemented)." September 1987. ATIP PR F87-5.

Masikara, S., and B. Mabongo. "1987 Cropping Systems Trials (Researcher Managed/Farmer Implemented)." September 1987. ATIP PR F87-7.

Worman, F., G. Heinrich, S. Masikara, B. Mabongo, and S. Bock. "1986 Farmer's Groups Technology Options Testing Trial." October 1987. ATIP PR F87-6.

A.2.6 REPORTING DOCUMENTS

These are documents produced to fulfill requirements of USAID and written by the ATIP team as a whole.

ATIP, ATIP Annual Work Plan Number 1, December 1982. ATIP RD 82-1.

ATIP, ATIP Annual Work Report Number 1, December 1983. ATIP RD 83-1.

ATIP, ATIP Annual Work Plan Number 2, December 1983. ATIP RD 83-2.

ATIP, ATIP Annual Work Report Number 2, October 1984. ATIP RD 84-1.

ATIP, ATIP Annual Work Plan Number 3, December 1984. ATIP RD 84-2.

ATIP, ATIP Annual Report Number 3, September 1985. ATIP RD 85-1.

ATIP, ATIP Annual Report Number 4, October 1986. ATIP RD 86-1.

ATIP, ATIP Annual Report Number 4, November 1987. ATIP RD 87-1.