PN-ABA-050
ISN 56663

AGRICULTURAL TECHNOLOGY IMPROVEMENT PROJECT (ATIP)

Agricultural Technology Improvement Project
Department of Agricultural Research
Ministry of Agriculture
P/Bag 0033
Gaborone
Botswana

Telephone 031/52381

A MIAC/USAID Project

Funded through USAID Grant No. 339-0221

AGRICULTURAL TECHNOLOGY IMPROVEMENT PROJECT

(ATIP)

WORKING PAPER

ATIP MAHALAPYE TRIAL PARTICIPATION: PARTICIPANT CHARACTERISTICS, IMPLEMENTATION PATTERNS AND DIRECT FARMER BENEFITS, 1982-87

BY

D. BAKER

NUMBER: ATIP WP-12

DEPARTMENT OF AGRIC. RESEARCH
MINISTRY OF AGRICULTURE
BOTSWANA

MID-AMERICA INTERNATIONAL
AGRICULTURAL CONSORTIUM
(MIAC)

MAY 1988

PRINTED: 31/05/88

ADDRESSES:

P/BAG 0033 GABORONE	P. O. BOX 10 MAHALAPYE	P.O. BOX 10275 TATITOWN (FRANCISTOWN)

ATIP WORKING PAPERS CONSIST OF METHODOLOGICAL AND EMPIRICAL MATERIAL WHICH HAS BEEN REVIEWED INTERNALLY BY ATIP BUT DOES NOT NECESSARILY REFLECT THE VIEWS OF THE DEPARTMENT OF AGRICULTURAL RESEARCH, MINISTRY OF AGRICULTURE, BOTSWANA

PREFACE

ATIP working papers consist of methodological and empirical material which has been reviewed internally by ATIP. Working papers are prepared and circulated to make ATIP research findings easily available to GOB personnel and researchers interested in Botswana farming systems. The viewpoints expressed do not necessarily reflect the views of the Department of Agricultural Research, USAID or Kansas State University.

This paper describes patterns of trials participation, implementation rates and participant benefits for the Mahalapye farming systems team. The paper covers the 1982-83 season through the 1986-87 season. In addition to documenting trends, the paper explains and critically assesses past patterns. Guidelines for other on-farm research programmes are implicit in the judgements presented on programme trends.

ACKNOWLEDGMENTS

The Mahalapye farming systems programme has been a cooperative effort involving representatives from the Department of Agricultural Research, Division of Planning and Statistics, and Kansas State University. In addition to the author, the following individuals were instrumental in designing and implementing the research programme during the seasons covered by this paper:

(a).J. Siebert (agronomist, DAR and Kansas State University)
(b).E. Modiakgotla (agronomist, DAR)
(c).J. Luzani (agronomist, DAR)
(d).M. Tjirongo (agricultural economist, DPS and DAR)
(d).C. Tibone (agricultural economist, DPS and DAR)
(e).A. Caplan (agricultural economist, DAR)
(f).J. Lesotlho (rural sociologist, DPS and DAR)
(g).C. Jonas (rural sociologist, DPS and DAR)

The three agronomists have provided leadership for the trials programme. Special acknowledgment is due to Dr. J. Siebert who has been responsible for conceptualizing and designing most of the on-farm trials. Many of the observations presented in this paper were developed in conversations with Dr. Siebert.

In addition to the research officers, the following field staff have played an important role in the on-farm trials programme:

(a).D. Dira (supervisor, DAFS and DAR)
(b).R. Mosojane (supervisor, DAFS and DAR)
(c).N. Keipeile (supervisor, DAFS and DAR)
(d).C. Mahilo (technical assistant, DAR)
(e).K. Okaile (technical assistant, DAR)
(f).L. Mapena (technical assistant, DAFS and DAR)
(g).R. Serumola (enumerator, DAR)
(h).I. Bane (enumerator, DAR)

Finally, the author would like to thank Dr. F. Worman, DAR Francistown and Kansas State University, for helpful comments on an earlier draft of the paper.

ATIP MAHALAPYE TRIAL PARTICIPATION: PARTICIPANT CHARACTERISTICS, IMPLEMENTATION PATTERNS AND DIRECT FARMER BENEFITS, 1982-87

INTRODUCTION

One of the main objectives of farming systems work is to ensure farmer participation in the testing and evaluation of production technologies. Ideally, trial participants should represent a wide range of farmer circumstances so the relevance of interventions for different farmers can be assessed. To ensure that ATIP Mahalapye trial participants were indeed representative, participants were initially chosen using stratified random sampling procedures. The procedures are described in detail in ATIP Research Report Number One.

During the first two seasons of research, it became apparent that not all interventions could be implemented by all farmers. Therefore, beginning the third season, trials were increasingly targeted to particular farmer circumstances. In addition, farmer contacts were directed to particular individuals within households.

As the emphasis shifted from representativeness to household and individual targeting, new farmers were selected according to the targeting strategy identified for each intervention. The incorporation of new farmers was motivated by a desire to avoid participant fatigue and to increase the number of farmers exposed to farming systems work. Also, an active trials programme was initiated in Makoro village, necessitating the selection of several new farmers. As a result, the pattern of trial participation has changed overtime.

This paper gives a year-by-year summary of the pattern of trial participation, trial implementation rates, and the direct benefits to trial participants. In the first part, trial participants are distinguished according to gender of household head, cattle assets and draught access. The second part describes and attempts to explain implementation patterns. The final part identifies the direct benefits (besides new knowledge) from trial participation.

CHARACTERISTICS OF TRIAL PARTICIPANTS

Table 1 lists the number of trial participants from the 1982-83 season through the 1986-87 season. All farmer implemented (FI) trials are included. Researcher implemented (RI) trials which involved superimposition of a treatment on a farmer's own plot are also included. Other RI trials have not been included since farmer involvement and assessment were not major priorities.

The numbers in Table 1 refer to those farmers who agreed to implement the trials, and received seed and/or had their plots marked. As mentioned above, not all participants were able to implement. However, with a few exceptions discussed below, there were not systematic differences between trial participants and implementors with reference to gender of household head or cattle assets. In several trials, draught-dependent households have had a lower implementation rate (or implemented late in the season).

Three sub-divisions have been made for each trial:

(a).Male versus female-headed household. Gender of household head

has been monitored in order to avoid a male head bias. This is important in Botswana since female-headed households tend to be among the poorest and least productive households.

(b). **Poor (0-15 head of cattle) versus rich (more than 15 head).** Fifteen head is approximately the median for cattle holdings. Households with more than 15 head but less than 40 head are considered by the Government of Botswana to be resource poor farmers, and are included in the ATIP research mandate. However, 15 head is a more critical level for distinguishing relatively poor and rich households.

(c). **Draught control versus dependent.** Draught control refers to households which did some or all of their ploughing with owned animals. Households which borrowed draught animals for the entire season and, therefore, had control over the amount and timing of ploughing during the season were also classified as draught-controlling households. Draught-dependent households include those which hired traction or which obtained draught through cooperative agreements. There have been few of the latter during the recent drought.

For each trial, the primary contacts among household members have been specified according to gender: females, males, or both. Identification of the primary contact has been based on the gender division of labour in the Central Region.

The following notes hopefully will facilitate interpretation of the participation patterns presented in Table 1.

1. According to the 1983 Crop Management Survey, the distribution of the three identified characteristics in Shoshong East and Makwate (based on 116 households) were as follows:

   (a). 60 percent male and 40 percent female
   (b). 52 percent poor and 48 percent rich
   (c). 62 percent control and 38 percent dependent

   It further can be noted that 73 percent of female-headed households were poor and only 50 percent of female-headed households controlled draught resources. Of draught-controlling households, only 21 percent were female headed in 1983. This proportion has fallen to as low as 10-15 percent since 1983 due to the drought. Similarly, a majority of draught-controlling households were rich in 1983. Given the above patterns in the population, it has not been feasible to target for one characteristic (eg., draught control or poor) without this targeting affecting sample composition with respect to other characteristics.

2. During the first two seasons, the tillage-planting trials were not targeted. It was hoped that even draught-dependent households might be able to take advantage of modified tillage practices. However, draught-dependent households and female-headed households lacking male labour often were unable to implement multiple tillage and planting operations. Thus, during years three to five, tillage-planting trials were directed at draught-controlling households and those with sufficient labour resources.

   Because few female-headed households have both the labour and traction needed to implement the proposed tillage-planting interventions, few have been included when testing these interventions. Therefore, the composition of participation in the tillage planting trials was a

TABLE 1: ATTP MAHALAPYE TRIAL PARTICIPATION, 1982-1987

			—GENDER—		—WEALTH—		—DRAUGHT—		
	TYPE	TOTAL	MALE	FEMALE	RICH	POOR	CONT.	DEP.	CONTACT
1982-83									
Eval. of Planting Methods	RMFI	22	13	9	12	10	11	11	Both
Double Ploughing	RMFI	2	2	0	2	0	2	0	Male
1983-84									
Effects of Early Tillage	RMRI	2	2	0	1	1	0	2	Male
Bird Scaring	RMRI	4	2	2	1	3	2	2	Female
N and P Benefits	RMRI	10	8	2	7	3	7	3	Both
Sole Plough & Plant. Methods	RMFI	16	12	4	8	8	10	6	Male
Draught Team Management	RMFI	5	5	0	3	2	5	0	Male
Lands Area Veg. Plot	RMFI	1	1	0	1	0	1	0	Female
Post. Emerg. Harrowing	RMFI	1	1	0	0	1	1	0	Male
Cowpea Cropping Comparison	FMFI	31	22	9	12	19	19	12	Female
Plough-Planter	FMFI	3	2	1	3	0	2	1	Both
Seed Treatment	FMFI	15	9	6	12	3	9	6	Female
1984-85									
Cowpea Planting-Varieties	RMRI	8	4	4	1	7	6	2	Both
Intensive Production One	RMFI	15	9	6	8	7	8	7	Female
Intensive Production Two	RMFI	5	4	1	3	2	4	1	Both
Undersowing	RMFI	13	5	8	4	9	3	10	Female
Tillage-Planting Scheme	RMFI	16	14	2	10	4	13	3	Male
Cropping Comparisons	FMFI	25	18	7	10	15	14	11	Female
1985-86									
Hand Planting	RMRI	13	7	6	6	7	7	6	Female
Thinning	RMRI	5	2	3	3	2	4	1	Female
Double Ploughing	RMFI	43	35	8	—/a	—	37	6	Male
Row Planting	RMFI	14	14	0	—	—	14	0	Male

Continued next page

Table 1 (continued)

	TYPE	TOTAL	MALE	FEMALE	RICH	POOR	CONT.	DEP.	CONTACT
1985-86 (cont.)									
Specialised Cultivation	NMFI	12	7	5	—	—	7	5	Female
Transplanting	NMFI	2	0	2	1	1	1	1	Female
Sole Planting	NMFI	40	21	19	17	23	20	20	Female
1986-87									
Intensification at HPS	NMFI	8	6	2	4	4	6	2	Male
Double Ploughing	NMFI	14/b	10	4	—	—	13	1	Male
Seed Treatment	NMFI	24	13	11	6	18	14	10	Female
Sorghum Varieties	NMFI	23	12	11	6	17	12	11	Female
Hand Furrow Planting	NMFI	11	6	5	3	8	6	5	Female
SUB-TOTALS									
Trial Focus									
Tillage-Planting System		155	117	38	39	31	115	40	
Crop-Variety		127	77	50	46	81	71	56	
Post-Establishment Prac.		34	15	19	14	20	16	18	
Other		87	57	30	45	42	56	31	
Trial Format									
NMRI		42	25	17	19	23	26	16	
NMFI		175	128	47	60	46	123	52	
MMFI		186	113	73	69	103	109	77	
Year									
1982-83		24	15	9	14	10	13	11	
1983-84		88	64	24	48	40	56	32	
1984-85		82	54	28	38	44	48	34	
1985-86		129	86	43	29	31	90	39	
1986-87		80	47	33	19	47	51	29	

a.Data not collected.

b.This is is based on trial implementors. Trial recruitment was done in a group format and records were not kept of participants who received seed but did not implement.

follows:

(a).75 percent male-headed households
(b).56 percent had more than 15 cattle
(c).74 percent controlled draught resources

3.Aside from the tillage-planting trials, the composition of trial participants was as follows:

(a).60 percent of the households were male-headed
(b).42 percent had more than 15 cattle
(c).58 percent controlled draught resources

Thus, for trials applicable to all types of households, trial participation has closely reflected population characteristics. It might be noted, however, that population characteristics have changed during the drought. More households are now draught dependent than in 1983. This was reflected in the patterns of trial participation during the fourth and fifth seasons.

4.The pattern of trial participation has been affected by the drought, regardless of ATIP staff preferences. In general, it has been difficult to identify the desired number of participants from poor, draught-dependent and female-headed households. These households are more at risk during drought and understandably have been less willing to participate in trials.

5.Participation in some trials has been biased by the requirements for trial implementation (aside from draught control). For example, participation in the 1983-84 Seed Treatment Trial was biased toward draught-controlling and richer households since the trial required farmers to have at least ten kgs of sorghum seed retained from the prior harvest (a drought season). Few poor households had that much retained seed. Participation in the 1985-86 Row Planting Trial was similarly biased since participants were required to own a row planter.

6.During the fourth and fifth seasons, the various crop-variety and post-establishment practices trials were specifically targeted toward female-headed and poor households -- even though the trials were relevant for all households. This targeting strategy was used to compensate for a potential male and rich farmer bias stemming from the emphasis on tillage-planting systems trials.

Whether compensatory farmer selection should have been done is not a simple issue. On the one hand, all farmers could and perhaps should have been included in the crop-variety and post-establishment practices trials -- since the interventions were relevant for all households. On the other hand, if all households had been included farmer feedback probably would not have been substantially different but the overall programme would have continued to have had a rich and male farmer bias. Since ATIP has a mandate to focus on limited resource farmers, it was important to avoid such a bias. Compensatory farmer selection was a useful approach for minimizing bias. The research programme clearly has gained because of increased access to the views of females and poor farmers, not only on the trials they have implemented but on a wide range of farmer priorities and problems.

7.For some trials, targeting was based on variables not included in Table 1. For example, the Draught Management Trial took into consideration the type of draught owned. The Intensive Production Trials involved site

selection criteria appropriate for intensive production (soil, topography, access to manure, etc.). The 1985-86 and 1986-87 Double Ploughing Trials necessitated selection based on soil type, ploughing history and weed development. In such cases, socio-economic criteria received minor attention when selecting participants.

8. There has been a balance between continuity and replacement in trial participation. Most of the participants from the first year also participated in the second season's trials. Some ATIP survey cooperators also implemented trials in the second season. Beginning in year three, non-ATIP cooperators were recruited to participate in trials and some of the original trial participants dropped out. Most participants, however, were still from among the original cooperators. By the start of the fourth season, a majority of trial participants were no longer original ATIP cooperators (trial or survey). This resulted from four main factors:

   (a). Research in Makoro has played an increasing role in the trials programme. The level of activity actually has exceeded that in the original villages during the past two seasons (due to the pattern of rainfall).

   (b). A great diversity of field circumstances was needed in years four and five in order to evaluate double ploughing and water harvesting systems.

   (c). Farmers with little interest in new practices were phased out in favour of farmers expressing greater interest in trial participation. In principle, bias could have been introduced when phasing out farmers with little interest. This could have happened if there had been systematic relationships between specific interventions and the characteristics of farmers expressing no interest. This was not a problem for the Mahalapye team, however, since the lack of interest was not related to any specific intervention or farmer characteristic. Rather certain farmers from all resource categories simply had less interest in continuing with on-farm experiments. Perhaps one could argue those farmers were less progressive, but that would be somewhat tautological.

   (d). FI trial participation increasingly has been organized through farmer groups, and ATIP has had limited control over the exact composition of the groups.

9. The seeding and crop-variety, sole planting, cowpea planting, and post-establishment practices trials have been directed toward the female decision makers in households, regardless of who was the head of a household. In most cases, women have been the ones who implemented these trials. Females were the primary contact in female-headed households even for those activities for which males would otherwise have been the primary contact.

   Although other factors may have been partially responsible, implementation rates and the proportions of trials correctly implemented have been higher since the gender contact strategy was adopted (mainly in seasons three through five). The improvements in implementation seem to have resulted from the logical step of talking directly with implementors, rather than through other family members.

TRIAL IMPLEMENTATION PATTERNS

This section turns to an overview of how many farmers actually implemented the trials. A summary of the number of implementors and the percent of potential participants who actually implemented is given in Table 2.

In Table 2, the reasons why the implementation rates might have been low for certain trials have been indicated. Poor implementation has been attributed to one or a combination of five causes:

(a). **Resource requirements.** This refers to a failure to obtain standard resources such as traction animals, labour for fieldwork, or ploughs. ATIP provided specially required resources.

(b). **Rainfall/soil moisture conditions.** During the drought there have been relatively few days with adequate soil moisture for implementing tillage and planting operations.

(c). **Perceived value or feasibility of proposed intervention.** Some farmers felt that some proposed interventions would have little value or would be difficult to implement.

(d). **Trial design.** Some trial designs called for sequences of activities which were too difficult for some farmers to implement.

(e). **Farmer-researcher communication.** Some farmers did not understand the objectives and hypotheses of a trial and, as a result, did not appreciate the requirements for correct implementation.

The following comments give additional observations on implementation patterns, and factors affecting trials implementation.

1. In many cases, trials were not implemented at a desirable time -- even though implemented. For example, many of the cropping comparison trials were planted into drying soils and several were not planted until mid-January. This affected the trial outcomes and the direct benefits to trial participants. There were three main reasons for untimely implementation:

   (a). The sizes of some plots were so large that certain trials had a large and perhaps undesired impact on the farmers' normal cropping patterns.

   (b). Some farmers were uncertain about the value of particular trials and therefore reduced the opportunity cost of trial participation by planting late.

   (c). Some farmers delayed because they were not aware of the implementation requirements for some new practices or varieties.

2. There has seemed to be a direct relationship between the farmers' "sense of ownership" and success in implementation. The "sense of ownership" is intangible but involves a combination of initial farmer interest in the intervention, relevance to the farmer's circumstances, and constraints on complete farmer management. This became evident during the fourth and fifth seasons when several FI trials were proposed which did not specify plot size or shape, seeding rates, or timing. Most trials, in fact, proposed minor changes or addressed new crop-varieties. Since the farmers were essentially free to do what they wanted, and when, all farmers who planted at all planted the trials.

TABLE 2: ATIP MAHALAPYE TRIAL IMPLEMENTATION, 1982-1987

	TYPE	TOTAL	PERCENT	PROBLEMS/a
1982-83				
Eval. of Planting Methods	RMFI	18	82	A
Double Ploughing	RMFI	2	100	
1983-84				
Post. Emerg. Harrowing	RMRI	0	0	C,
Effects of Early Tillage	RMRI	0/b	0	A,E
Bird Scaring	RMRI	4	100	
N and P Benefits	RMRI	6/c	60	B,E
Sole Plough & Plant. Methods	RMFI	6	35	A,B,C
Draught Team Management	RMFI	5	100	
Large Area Veg. Plot	RMFI	0	0	C
Cowpea Cropping Comparison	FMFI	16	52	A,B,C
Plough-Planter	FMFI	3	100	
Seed Treatment	FMFI	12	80	B
1984-85				
Cowpea Tillage-Varieties	RMRI	8	100	
Intensive Production One	RMFI	7	47	B,E
Intensive Production Two	RMFI	5	100	
Undersowing	RMFI	9	69	B,C,E
Tillage-Planting Scheme	RMFI	8	50	B,C,D,E
Cropping Comparisons	FMFI	17	68	B,D
1985-86				
Hand Planting	RMRI	13	100	
Thinning	RMRI	5	100	
Double Ploughing	RMFI	20	47	B,D
Row Planting	RMFI	8	57	A,B,D
Specialized Cultivation	RMFI	5	42	A,C,E
Transplanting	RMFI	2	100	
Sole Planting	FMFI	40	100	
1986-87				
Intensification at HPS	RMFI	8	100	
Double Ploughing	FMFI	14	100	
Seed Treatment	FMFI	17	71	B
Sorghum Varieties	FMFI	19	83	B
Hand Furrow Planting	FMFI	8	73	B,C

Continued next page

Table 2 (continued)

TYPE	TOTAL	PERCENT	PROBLEMS/a
SUB-TOTALS			
Trial Focus			
Tillage-Planting System	92	59	
Seeding, Crop-Variety	100	79	
Post-Establishment Prac.	29	85	
Other	64	74	
Trial Format			
RMRI	36	86	
RMFI	103	59	
FMFI	146	78	
Year			
1982-83	20	83	
1983-84	52	59	
1984-85	54	66	
1985-86	85	66	
1986-87	66	83	

a. Problems are coded as follows: A = insufficient resources, particularly draught; B = poor rainfall and/or soil moisture; C = perceived value of feasibility of the proposed intervention; D = trial design; E = farmer-researcher communication.

b. These involved combined researcher and farmer implementation. Researcher implementation was correct, farmer implementation was not.

3. Many farmers may have implemented primarily in order to gain access to resources, particularly seed. Ordinarily small quantities of seed, such as provided by ATIP, would not provide a major inducement to participate. However, seed has been quite scarce during the drought, particularly the seed for high valued secondary crops. Thus, high implementation rates cannot necessarily be interpreted as enthusiasm for a new practice or variety.

4. Implementation rates, and the correctness of implementation, have been directly related to the quality of communication between farmers and ATIP staff. Understanding of trial objectives has clearly impacted on implementation.

5. Implementation rates have tended to be higher on smaller trials involving few comparisons. Trials calling for implementation on two or more separate dates have had the lowest implementation rates. The reasons for better implementation are that smaller and simpler trials require fewer resources and less management skills. Another explanation is that many farmers carry out trials because they want to determine whether a particular change might be good for them. Trials with many comparisons often do not relate to a clear choice to the farmers (ie. Is this new practice or variety better for me?), and therefore are of less interest to many farmers.

6. Lack of control of draught resource has perhaps been the single greatest factor affecting trials implementation. This problem surfaced because there have been relatively limited opportunities for implementation during the drought. Implementation rates, therefore, could be expected

to be higher during years with good rainfall.

7. Potential participants have refused to implement certain activities or treatments, after initially agreeing, because of perceived management problems rather than an assessment that the intervention will be of little benefit. This sometimes prevented the team from obtaining sufficient implementations of certain interventions. This was a problem, for example, in a draught animal feeding trial where farmers encountered problems in kraaling and watering the sub-set of animals to be fed. It was also a problem in a trial calling for farmers to plough without planting when the soil was too dry to ensure good seed germination.

8. The best implementation -- both in terms of implementation rates and quality of implementation -- has been obtained in RMRI trials. ATIP has had the resources and overtime has developed the knowledge required to ensure good implementation. Therefore, strictly on the basis of implementation, the RMRI format would appear to be the best for trials which are not directed toward farmer assessment or an evaluation of managerial feasibility.

DIRECT BENEFITS FROM TRIAL PARTICIPATION

In this part, the direct benefits trial participants received are summarized. This part includes all researcher managed and implemented (RMRI) trials since the host farmers have kept any resulting production.

In nearly all trials, participants have received the seed required, have had access to ATIP equipment when new equipment was required, and have kept all resulting production. Most ATIP trials have ranged from .1 to .3 hectares. The seeding rates have varied but, as a rule, large seed crops have been provided at a rate of around ten kgs/ha, sorghum at six to eight kgs/ha, and millet at four to five kgs/ha. ATIP Mahalapye adopted the approach of providing seed for three reasons:

(a). Seed has been scarce during the drought, particularly for cowpeas, jugo beans, and groundnuts.
(b). Uniform seed lots help with trial analysis.
(c). The incentive effect has been needed in light of the drought and other government programmes which have provided free inputs to farmers.

In addition to direct benefits from trial participation, the trial participants have benefited from:

(a). Information and advise on new practices and government programmes.
(b). Access to ATIP equipment when it was not otherwise required for trial implementation.
(c). Participation in annual field-days where farmers review and discuss trial outcomes, and receive free meals.

The direct benefits are now summarized by year and by trial. (Details on yields (and consequently the amount of production retained) are reported in the ATIP Annual Reports and will not be repeated here.

1982-83 SEASON

1. **Evaluation of planting methods.** Eighteen farmers received seed and were loaned equipment for trial implementation -- including a

plough-planter, single row planter and a harrow. There was no significant increase in yield as a result of the extra investment in row planting, plough-planting, or harrowing.

2. **Double ploughing.** Large plots were early ploughed for two farmers using ATIP hired tractors. The farmers later planted the plots, one using an ATIP provided plough-planter. Seed was given to the farmers. There was a subtantial increase in yield due to the double ploughing.

3. **Sorghum intercropping (RMRI *).** A large plot was ploughed and planted by ATIP on one field. ATIP hired labourers to undersow several crop-varieties of legumes. Yields were low.

1983-84 SEASON

1. **Effects of early tillage.** Three early tillage strips were ploughed all the way across two farmers' fields. The farmers cross plough-planted using their own traction and seed. The increases in yield due to the early tillage were quite small.

2. **Bird scaring.** ATIP installed bird scaring tape at four separate sites. The increased production due to reduced bird damage was again quite small.

3. **N and P benefits.** ATIP superimposed P on the planting methods trial of ten farmers. ATIP provided the P and ATIP staff broadcasted it. Four farmers planted their own crops where the phosphate had been placed rather than the proposed trial. There was little yield benefit from the phosphate.

4. **Sole ploughing and planting methods.** Six farmers received seed and were loaned row planters, cultivators and harrows for trial implementation. Some of the six, and several additional farmers, used the row planters and harrows on their own plots. Small but significant increases in yields were obtained in the trial relative to traditional plots.

5. **Draught team management.** Five farmers received enough wheat straw and minerals for their draught teams to be fed for the first two months of the ploughing season. Any benefit from earlier ploughing due to stronger animals was left to the farmers. The benefit was small due to the drought and an unwillingness of most of the draught animals to eat the provided feed.

6. **Lands area vegetable plot.** A small vegetable plot was prepared by ATIP staff, including the addition of sand and manure. The farmer did not plant the plot so there was no benefit.

7. **Post-emergence harrowing.** There was no benefit since the one farmer who agreed to the trial did not implement it. The farmer was offered use of an ATIP harrow.

8. **Cowpea cropping comparisons.** Enough cowpea and sorghum seed to plant

---

* Trials labelled "RMRI" in this section were not included in Table 1.

1600 sq metres was given to 31 farmers. Only 16 farmers planted the seed. A large proportion of the trial implementors' entire cowpea production came from the trial.

9. **Plough-planter.** ATIP loaned plough-planters to three farmers and helped with required adjustments to get the implement working. Farmers were provided with seed. There were problems with the implement and, therefore, little direct benefit.

10. **Seed treatment.** ATIP treated five kgs of sorghum for each of 15 farmers. (Five additional kgs were needed for a control plot.) Twelve farmers planted the seed. Due to drought yields were low and no significant increase in yield was obtained.

1984-85 SEASON

1. **Cowpea planting-varieties.** Eight farmers ploughed 800 sq metres. ATIP did the hand planting and provided the seed. Farmers weeded and kept all production. Yields were good for drought conditions.

2. **Intensive production one.** Small vegetable plots were prepared (sand and manure) for seven farmers. Participating farmers also received seed and production advice. No production was obtained.

3. **Intensive production two.** Five farmers were advised on site selection. ATIP helped with the addition of manure to the high potential sites (HPS). Seed was provided as was advise on post-establishment practices. Initial stands were not good enough to warrant a continued intensive approach and there was not a significant response to the manuring. Direct benefits were small.

4. **Undersowing.** Nine farmers received seed and advice on undersowing methods. ATIP assisted several farmers with the undersowing operation. Undersowing generally was done too late and there was little production benefit from the extra time investment.

5. **Tillage-planting scheme.** Eight farmers received seed and access to row planters. Small but significant increases in yields were retained by the farmers.

6. **Cropping comparisons.** Twenty-five farmers received seed but only 17 planted it. The seed provided included cowpeas, groundnuts, mung bean, tepary and sorghum. Reasonable yields were obtained given the drought, particularly for cowpeas.

7. **Mineral supplementation for goats.** For nearly two years beginning in 1984, six farmers received minerals for their goats. This was an informal activity initiated by the Francistown animal scientist (not include in Table 1).

8. **Sorghum factorial trial (RMRI).** ATIP implemented this large trial at five sites. Trial implementation involved seed, several tillage and planting operations, phosphate, and weed control. Farmers harvested the trial and retained a large production.

1985-86 SEASON

1. **Hand planting.** ATIP planted plots ranging from 400 to 800 sq metres

on 13 fields. ATIP also did an initial weeding at planting time. Plots were planted in February on plots where earlier plantings by farmers had failed. The plantings were the only productive February plantings on those farmers' fields.

2. **Thinning.** Small plots were thinned by ATIP staff on the fields of five farmers. There was a small production benefit.

3. **Double ploughing.** Twenty farmers received seed and implemented at least one replication of the trial. At most sites, the value of extra sorghum produced provided an attractive return to the labour invested in double ploughing.

4. **Row planting.** Eight farmers received seed but used their own planters. Farmers were helped with repairs of their planters and were given advise on row planting. Little production was obtained due to drought.

5. **Specialized cultivation.** Five farmers received seed but did their own planting. There was little production and no significant benefit relative to broadcast planting.

6. **Transplanting.** ATIP staff transplanted sorghum and millet plants on the field of two farmers. The plots were quite small but some production was obtained from nearly all the transplanted plants.

7. **Sole planting.** Forty farmers received seed for two to six high-valued crop-varieties. The amount of seed ranged from one-third to two-thirds of a kg, depending on the variety. Farmers did all field operations. The value of production per unit area and time was higher than on the farmers' own sorghum plots.

8. **Sorghum factorial trial (RMRI).** ATIP did all the tillage-planting operations at five sites, and provided seed and phosphate. The farmers harvested and kept a substantial production.

9. **Water conservation systems (RMRI).** ATIP did all the tillage-planting operations for six treatments, and provided seed, at three sites. Results were poor.

1986-87 SEASON

1. **Production intensification at HPS.** High potential sites (HPS) were identified for eight farmers. Plots of around one hectare were winter ploughed by ATIP. Phosphate was applied and stover was incorporated during the winter ploughing. Farmers were responsible for their own plough-planting during spring. Grain yields in the selected and winter ploughed plots were nearly four times as high as on the other plots of the same eight farmers. Stover slightly increased yields and the phosphate significantly increased yields. The trial production for several farmers exceeded half a ton.

2. **Double ploughing.** Fourteen farmers were given advice on site selection and received seed. There was a 50-60 percent yield increase on the double ploughed plots, which provided an attractive return to the time spent on the second ploughing.

3. **Seed treatment.** Twenty-two farmers were given seed lots (667 gms each) of fungicide treated versus untreated groundnut seeds. Farmers were responsible for their own plough-planting. Seventeen farmer

correctly planted the comparison. There was a significant increase in the percent of seeds which emerged due to the seed treatment. As a service activity, ATIP treated the sorghum and/or jugo bean seeds of eight farmers.

4. **Sorghum varieties.** Twenty-three farmers were given 333 gms of each of four sorghum varieties. Nineteen farmers planted the seed and 11 farmers harvested the trial. Yields were comparable to the farmers' own plots.

5. **Hand furrow planting.** Eleven farmers were given maize or cowpeas seed for a hand furrow plot and a control (broadcast) plot. Nine farmers received both types of seed. One to one and a half kgs of seed were received for each comparison. Eight farmers implemented the trial, planting a total of 13 comparisons. Six comparisons were for maize and the rest were for cowpeas. There was no benefit from the hand furrow planting relative to broadcasting. Yields for both were low.

6. **Sorghum factorial trial (RMRI).** ATIP implemented six tillage-planting systems and applied phosphate in a factorial design at five sites. Seed was provided. The farmers harvested and kept a substantial production.

7. **Water conservation systems (RMRI).** ATIP implemented six tillage-planting treatments at three sites. ATIP also was responsible for weeding. Plantings were late and there were technical problems with each system. Farmers kept the small resulting production.

8. **Water harvesting (RMRI).** Water harvesting networks were designed and installed at two fields. ATIP winter ploughed the water harvest sites and added phosphate. Yields were substantially higher on the water harvest sites than on the rest of the farmers' fields.

9. **Hand replanting (RMRI).** ATIP hand planted six crop-varieties at each of nine fields where previous farmer plantings had failed. The trial covered more than .2 ha and reasonably good yields were obtained for all crops except KEP maize. ATIP harvested two of the crop-varieties, while farmers harvested four.

CONCLUDING COMMENTS AND RECOMMENDATIONS

Selecting farmers and determining farmer benefits can significantly impact on the success of farming systems work. Farmer selection involves a delicate balance between obtaining representativeness and ensuring that interventions are tested by farmers with appropriate circumstances. This may not be a problem if all interventions being tested are relevant to all farming households, but has been important in the Central Region.

When selecting farmers, ATIP Mahalapye initially emphasised representativeness and then shifted to a stress on targeting -- as our knowledge of Central Region farming households increased. The evolution from an initial emphasis on representativeness to a subsequent emphasis on targeting would appear to be a desirable progression for other on-farm research programmes as well. Narrow targeting at an early stage may unnecessarily exclude some farmer categories from potentially valuable trials. Also, it is important to have a representative range of farmer circumstances in order to ensure the trials programme has something to offer to the poor as well as the rich, and females as well as males. Later in the programme, however, it would be inefficient to include all farmers in testing all interventions when (and if) it is clear that certain interventions are inappropriate for certain farmer categories.

In selecting trial participants, there was a difficult challenge which was further aggravated by the drought. Based on the potential to impact on overall arable productivity, much time and energy has been devoted to tillage-planting systems investigations. This focus resulted in a potential bias in favour of richer, male-headed, and draught-controlling households. However, this danger was minimized by:

(a). Conducting baseline surveys so population characteristics could be determined and used as a guide to participant selection.

(b). Monitoring implementation requirements and success rates in order to assess biases associated with particular interventions.

(c). Identifying and addressing a wide range of interventions which are relevant to poor -- as well as rich households.

(d). Intentionally targeting some trials to poor and female-headed households in order to ensure broad exposure to farming systems work.

(e). Making sure there was a gradual roll-over among trial participants.

While the above steps have not completely counteracted the potential problems of participant bias, the steps taken by the Mahalapye team have been reasonably effective. The above comparison of population and participant characteristics supports this view.

The first three steps taken by the Mahalapye team should be considered by other on-farm research teams in order to minimize participant bias problems. The fourth step may not always be necessary but should be considered as a remedial measure if biased participation patterns are observed. The fifth step likely will be necessary in programmes lasting longer than two or three seasons. No matter how representative farmers are when they are selected, researcher-farmer interactions over several seasons almost certainly will influence the farmers' (and researchers') attitudes. If researchers want to continue working with certain good cooperators, the potential for atypical response should be acknowledged and any observations from long term cooperators should be verified with new sets of farmers.

The issue of direct participant benefits also is a potential pit-fall in farming systems work. If there are no benefits, then farmers have little incentive to participate. Even if farmers agree to implement, implementation rates can be low. On the other hand, substantial and unwarranted benefits can bias farmer assessment. Also, if large benefits are guaranteed, many farmers might see the trials as a government "give-away" programme and could be distracted from the objective of evaluating the benefits from alternative production technologies. Therefore, as with the selection of participants, the provision of direct benefits must be determined by balancing multiple objectives.

ATIP Mahalapye settled on the provision of seed and the retention of production as basic direct benefits. Other benefits, such as equipment loans, were necessary in some cases -- but were of minimal direct benefit to participants. There were not greater benefits because of the drought conditions, and the less than desired yields from most of the trials.

On balance, the principle of providing seed and allowing farmers to retain the production has been a successful approach and should be considered by other on-farm research teams. Implementation rates for FMFI trials generally exceeded 70 percent and often were higher. In most cases, farmers

who did any planting, planted their FMFI trials. Implementation rates were lower for most RMFI trials, but this most likely resulted from the greater complexity of those trials and the loss of farmer control, rather than from differences in farmer direct benefits. Implementation rates were nearly 100 percent for RMRI Trials, but this format has its own cost in terms of reduced farmer participation.

As a general rule, on-farm teams should accept somewhat lower implementation rates, perhaps 70 to 80 percent (not lower), if farmer participation can be increased. By appropriately targeting contact within households, however, it should be possible to obtain high implementation rates even in FMFI trials. In any event, it nearly always is possible to obtain sufficient oobservations for statistical analyses by merely adding a safety margin of extra farmers at the beginning of the season.