

countries to protect plant breeders' rights has been accompanied by the patenting of specific plant varieties. Commercial companies, particularly multinational chemical companies, have greatly reduced the number of small seed breeding firms which have traditionally ensured the retention of a wide genetic base in field crops.

Furthermore, disquiet has arisen over the performance of such officially-designated gene banks as those of the International Board for Plant Genetic Resources. Finally, the pattern emerging from the breeding programmes of such international research institutes as IPRI, despite their progression into a phase of breeding for 'difficult environments', is towards increased reliance on a small number of genes in the varieties they release. The dangers for developing countries in relying too heavily on a few high-yielding genotypes have been illustrated by major outbreaks of pest and disease in Indonesia in the mid-1970s (Conway, 1987) and in the more recent plant hopper outbreak in Haryana referred to above.

In the light of these fears, the approach discussed here should commend itself to adoption by other breeding institutes in difficult environments, and to the support - financial and otherwise - of those international organizations pledged to combat the current erosion of genetic diversity.

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TECHNOLOGY DEVELOPMENT AND FARMER GROUPS: EXPERIENCES FROM BOTSWANA

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SUMMARY

The Agricultural Technology Improvement Project (ATIP) has been conducting on-farm research in Botswana with the goal of identifying improved arable production technologies. In an effort to increase the role of farmers in technology design and assessment, ATIP set up farmer groups that meet on a regular basis to discuss farming problems and on-farm trials. This article reviews and evaluates ATIP's experiences with farmer groups. A typology of technology development groups is proposed and group management issues are discussed.

D. Norman, D. Baker, G. Heinrich y F. Worman: *Desarrollo de la tecnología y grupos de agricultores: Experiencias de Botswana.*

RESUMEN

El Proyecto de Mejoramiento de la Tecnología Agrícola (ATIP) ha estado realizando investigaciones en la granja en Botswana con el fin de identificar tecnologías mejoradas de producción arable. En un intento de aumentar la participación del agricultor en el diseño y evaluación de tecnologías, ATIP ha establecido grupos de agricultores que se reúnen con regularidad para tratar problemas agrícolas y ensayos en la granja. Este artículo repasa y evalúa las experiencias de ATIP con los grupos de agricultores. Se propone una tipología de grupos de desarrollo de la tecnología, y se tratan temas referentes a la administración de grupos.

INTRODUCTION

Since 1982, the Agricultural Technology Improvement Project (ATIP) has been conducting on-farm research in Botswana in conjunction with limited resource farmers. The goals of ATIP's on-farm research have been to identify and test relevant, improved arable production technologies, and develop appropriate, low-cost methods for on-farm research and extension.

ATIP took as a point of departure the farming systems (FS) approach to research, an important feature of which is the 'bottom-up' perspective of the research and development process (Norman, 1980). Because of its bottom-up perspective, the FS approach shares much in common with farmer participatory research (FPR) as recently described by Farrington and Martin (1987), including the 'farmer-back-to-farmer' model (Rhoades and Booth, 1982) and the 'farmer-first-and-last' model (Chambers and Ghildyal, 1985; Chambers and Jiggins, 1986). Recent criticisms that many FS teams have tended to give farmers too small a role in the technology development and assessment process are valid (e.g. Chambers and Jiggins, 1986), but conceptually FS work is consistent with putting the farmer first.

Given the declining level of financial support for on-farm research in favour of on-station commodity research and macro policy analysis, it would be a pragmatic error to abandon support of the FS approach in favour of specialized FPR models, as called for in some of the FPR literature. Rather what is needed at this time is attention to alternative methods for ensuring effective farmer participation in the FS research process.

In an effort to address the farmer participation issue, and other issues, ATIP has set up farmer groups that meet on a regular basis to discuss farming problems, implementation procedures for on-farm trials, and alternatives for farming systems improvement. No efforts have been made to promote collective production activities. Consequently, the ATIP farmer groups are analogous to the concept of farmer 'panels' as described by Chambers and Jiggins (1986). This article reviews and evaluates ATIP's experiences with farmer groups. After characterizing the circumstances which stimulated interest in groups, the group formation and management procedures are described and a typology of groups is proposed in relation to the technology development process. This is followed by discussion about the advantages of groups in a technology development context and problems in group management. Finally there is a brief discussion of issues that need to be resolved.

GROUP DEVELOPMENT SETTING

Despite rapid economic growth, largely due to diamond and beef exports, Botswana is plagued by low and erratic levels of crop production. Throughout the arable parts of the country, annual rainfall averages only 450-500 mm. However, 1987 was the sixth successive year of drought in the country during which Botswana farmers have produced less than 10% of the national requirements for food grains.

Agricultural production in Botswana largely takes place in small mixed livestock-crop farm systems. Cattle are the backbone of the agricultural economy. Sorghum is the main crop, generally grown in mixtures with cowpeas and melons. More than 90% of the cultivated area is planted to sorghum-dominated crop mixtures. Seed is broadcast and ploughed in with a mouldboard plough. The average area cultivated is around five hectares. Oxen, tractor and donkey traction are used, with an emphasis on the first two. Only half the households control their own traction but most households have access to traction through hiring or cooperative arrangements. Fertilizers, herbicides and pesticides are used by very few farmers. Average yields of sorghum are approximately 250 kg ha⁻¹ and the returns to cropping labour have been under \$0.10 an hour during the recent drought.

During the first two seasons of research, ATIP attempted to address poor arable farming productivity primarily through investigations of modified tillage-planting practices. After an initial emphasis on different planting methods, attention was increasingly concentrated on double ploughing (a spring plough-

ing followed by a combined plough-planting operation after at least one rainfall). Some promising results were obtained but there tended to be a bias toward richer and male-headed households because the changes in tillage practices required control of traction resources. Also, because of the importance of technical questions, most research had been carried out in a researcher managed and implemented (RMRI) or researcher managed and farmer implemented (RMFI) mode. Even with farmer implementation, a lot of researcher time was required per trial site. In the face of limited research resources, only a small number of trials, involving relatively few farmers, could be examined in any season.

By the third season, it became obvious that some steps would be needed to redress the imbalance and broaden the base of farmers involved in FS activities. Aside from equity considerations, there were a number of 'non-leverage' interventions building on traditional practices which merited investigation. (Non-leverage interventions do not necessarily address the most critical constraint or enterprise but can improve farm system productivity.) Equally important, the complexity of household-farm interactions in Botswana required increased farmer involvement in the selection of technologies for testing and the design of trials, as well as the assessment of trial outcomes.

ATIP GROUP FORMATION AND ADMINISTRATION

On the basis of these observations and circumstances, farmer group activities were initiated by the Mahalapye and Francistown on-farm research teams during the 1985-86 seasons. The objectives and procedures for group formation and administration were somewhat different in the two locations.

In the Mahalapye area, groups were formed in three villages in direct response to special circumstances and access problems for women and poorer households. In addition to facilitating trial management, the groups were developed in order to create an opportunity for continuing dialogue about problems and opportunities, and the advantages and disadvantages of different interventions. Group formation in the Mahalapye area was viewed as an 'institutional experiment' with the objective of assessing relationships between group composition and the dynamics of farmer interaction in technology development.

All three groups - and all group members - continued to meet during the 1986-87 season. Over time, somewhat less emphasis was given to discussion of general problems and more to discussing options for farming systems improvement. The groups continued to focus on interventions which were of particular relevance for women and for poorer households.

In the Francistown area, one farmer group was formed during the 1985-86 season in order to test double ploughing under farmer managed and implemented (FMFI) conditions, and to get farmer evaluations of the system through the season. The wider potential of group testing activities became obvious during the season.

As a development of the double ploughing farmer group, three groups were formed during the 1986-87 season, partly to expand and supplement the research programme which had been based on RM work tightly focussed on a few research topics. The specific group objectives were to test a broad range of innovations under farmer management conditions, to involve farmers and extension agents directly in the technology development process, and to determine what types of innovations were most appealing to different types of farmers.

Although the reasons for forming groups were somewhat different in the two locations, in both cases group formation was motivated by an interest in increasing farmer participation in the technology development, assessment and extension process. The remainder of this section reviews the formation and administration procedures of the two groups.

Groups in the Mahalapye area

In each of three villages, 10-20 farmers were recruited to participate in monthly meetings and to implement farmer managed trials. As part of the 'institutional experiment', different types of groups were formed in each of the three villages. Recruitment was done on a quota basis taking into account the desired household circumstances. In Makwate village, two groups were at first formed, one comprising females from poor households while the other was based on representatives from households involved in several past ATIP experiments. For logistical reasons, the groups were later combined to give one large heterogeneous group. In Shoshong village, the group was based on representatives from small conjugal units and both spouses were encouraged to attend meetings. In Makoro, the groups involved just females and most were from female-headed households. Most of the individuals attending the meetings in all three villages were female.

Each group elected a chairperson and set its own meeting date. A topical agenda was prepared for each meeting, comparable to a simple checklist used for an exploratory survey. At the beginning of each meeting the farmers reported individually on their problems and trials. Each farmer had one or more trials, which served as a focal point for group participation. This was particularly important for farmers who otherwise did not feel like talking about their farming problems.

Starting mid-season, a series of field visits were made in order to stimulate discussion. At the end of the season, a formal assessment was made of both the trials and the group process.

Groups in the Francistown area

To form groups in the 1986-87 season, village meetings were held in each of three villages in early spring. At the meetings, previous trial results were discussed and the activities planned for the following season were introduced. Interested farmers were asked to attend a special meeting at which the full range of

technology options available for testing were described. The options discussed included both 'proven' technologies - put forward for final stage farmer testing and adaptation - and unproven technologies which were included in order to get farmers involved at an early stage of technology evaluation. In addition, farmers were encouraged to suggest additional options to be tested by group members. Participating farmers were provided with the equipment (if needed), seeds, and fertilizer required for the experiments. Essentially all the experiments involved a simple comparison of the modified practice (or crop/variety) with the traditional one.

Monthly meetings were held with the farmers and extension agent in each village in order to discuss progress, problems and farmers' observations. A baseline survey and a mid-season assessment survey were used to quantify farmers' reactions and problems. For each trial, the dates of all field operations were recorded and grain yields were weighed by ATIP staff. Field days were held in which selected farmers presented their trials and results.

TYPOLOGY OF GROUPS

After two seasons of formal group activities, ATIP is firmly committed to the use of groups in order to facilitate FPR in the context of FS research. While the implementation procedures and evaluation of group formats are still evolving, we have started the process of synthesizing our thinking about groups, farmer participation and their merit in the Botswana setting.

In order to organize our thinking, we have developed a tentative typology of groups which distinguishes between design groups, focused-testing groups and options-testing groups (Table 1). Although not originally intended as such, the groups in a sense constitute a continuum in farming systems terms and with reference to farmer participation.

Following efforts initiated at Mahalapye, the distinguishing characteristics of the design and focused-testing groups are the relative homogeneity of circumstances among group members and their concentration on a relatively small range of interventions. The main distinction between the design and focused-testing groups is the greater role of researchers relative to farmers in determining the agenda of the design groups, and in assessing outcomes. Farmers are participants in the process, but primarily in the role of advisers and assistants. Researchers are the primary client of the design groups in the sense that the main objective is to develop knowledge about the contributions of components to modified production systems. Because farmer assessment plays a somewhat smaller role, it is not necessary for the design groups to meet on a regular basis.

The focused-testing groups primarily serve as a vehicle for organizing and assessing farmer implemented trials. An important feature is the opportunity for farmers facing similar circumstances to discuss and assess the relevance of a limited number of options for improving their farm productivity. While

Table 1. *Typology of farmer groups*

	Design groups	Focused-testing groups	Options testing groups
Objectives	Farmer involvement in technology design	Discuss farmers' own problems. Measure economic benefits. Farmer assessment	Increased farmer and extension involvement. Large scale assessment
Number of trial types	1 to 3	4 to 6	10 to 12
Trial			
proposal	Researcher	Researcher	Researcher
selection	Researcher	Researcher/farmer	Farmer
management	Researcher	Farmer	Farmer
implementation	Researcher/farmer	Farmer	Farmer
Quantitative measurement †	Most	Intermediate	Least
Assessment			
researcher	Most	Intermediate	Least
farmer	Least	Intermediate	Most
Group			
size	2-3 farmers	10-15 farmers	25-40 farmers
nature	Homogeneous	Homogeneous	Heterogeneous
selection	Technical situation appropriate for design work	Socio-economic situation for targeted technology	Volunteers from village meeting
Frequency of meeting	2-3 times a season	Monthly in season	Monthly in season

† Relative to other types of groups.

researchers make *a priori* assessments of the relevance of proposed technologies with respect to technical feasibility and consistency with resource constraints, the farmer implemented trials and associated discussions are needed to assess the economic viability (under farmers' management) and social acceptability of options. The focused-testing format is particularly appropriate for screening technologies which are outside farmers' normal frames of reference. The discussions in the focused-testing groups also provide an opportunity for farmers to identify additional options not considered by the researchers.

A major strength of the focused-testing groups is also a weakness; the researchers try to target technologies to a relatively homogeneous group of farmers. This can create problems in that farmers other than those identified by the researchers might be interested in a technological option. Also, the small groups do create pressure on farmers to implement trials, resulting in a distorted picture of farmers' independent responses to an option.

The options-testing groups therefore represent an important step in the technology assessment process in which a wide range of options are presented to a large number of volunteer farmers. This enables an assessment of farmers' reactions to a proposal to try an option, as well as to the option itself. With less pressure to implement, a better assessment can be made of the social acceptability of an innovation. With larger numbers of participants, greater emphasis can be given to farmer assessment. The inclusion of local extension agents enables them to become familiar with new technologies before promotion through the extension service.

In a conceptual continuum of groups, yet another type of group has been identified, namely dissemination and monitoring groups. These are not included in the proposed typology because they are most accurately viewed as extension groups, not technology development groups. Dissemination groups differ from the options-testing groups in three respects: only a limited range of the most promising options can realistically be promoted; the groups are organized and managed by the extension service - village extension agents with the support of subject matter specialists and the local farming systems team; and the emphasis is on facilitating exposure to new technologies rather than assessment of potential options.

ADVANTAGES OF FARMER GROUPS

Farmer groups have a number of advantages. The main ones as far as ATIP is concerned are highlighted in the following discussion.

Improvement of dialogue

The group format provides a forum for improving dialogue with, and among, farmers. Unlike the more common approach where two or three researchers talk to one farmer at a time, the ratio in group meetings is reversed with a larger number of farmers in relation to researchers. This can completely change the dynamics of the interaction. Regular group meetings help provide solidarity for the group, create familiarity between the group members and researchers, and provide unique insights into farmers' priorities and perceptions.

The group format also provides an efficient way of ascertaining consensus opinions about the relevance of technologies being tested. For example, a major constraint in Botswana is erratic seedling emergence due to poor soil moisture and the lack of control over seed depth. Several solutions have been examined, including double ploughing and the introduction of various hand and traction-drawn planters. In one village in the Francistown area, where most farmers plough with their own animals, a consensus quickly developed in favour of double ploughing. In another village, however, many farmers said they could not easily double plough because they had to hire traction. In that village, most group members expressed interest in a hand rotary injection planter. The farmers said they could hand plant when there were good soil moisture conditions, regardless of when their ploughing was done. In this example, the patterns of reactions in the two groups helped the researcher to identify more quickly why and where different solutions were required to what seemingly was the same problem.

Improved efficiency of research resources

A continuing issue for farming systems practitioners is the need to economize on resources in terms of time and logistical costs. The group format provides a way to economize on the use of time since trial designs can be proposed and discussed in group meetings. Moreover, group meetings allow farmers to consult

with each other about trial objectives and implementation procedures, thereby increasing implementation rates and reducing errors. After trials are implemented, the time required for farmer feedback is reduced by relying on group discussions.

With reference to logistical issues, inputs can be distributed to the farmers at group meetings. Later in the season, schedules for data collection can be more effectively coordinated through joint discussions with researchers, farmers and enumerators. This is particularly helpful when different trial sites are planted over a period of several weeks or even two to three months - as in Botswana.

Facilitating farmer field days

The farmer groups and associated trials provide an admirable format for farmer field days when group members are encouraged to explain what they did in the trials and why, and what results they observed. The field days seem to engender a competitive spirit and to create momentum for the interventions which look favourable to some farmers. Although it is not necessary to have farmer groups in order to hold field days, ATIP researchers have observed that in the field days dominated by representatives from groups, there is more discussion and greater momentum is achieved.

Potential for improving linkages

To bring about agricultural development there need to be good linkages among farmers, researchers and extension agents. Unfortunately, in Botswana, as in so many countries, these linkages are not as strong as would be desirable. The group format provides an excellent opportunity for bringing together on-station researchers, FS workers, extension staff and farmers.

One of the main advantages of a group format is that researchers and extension officers outside the farming systems group, who are faced with limited amounts of time and resources, can address a number of farmers simultaneously. For example, groundnut researchers from the main research station were invited to discuss the value of fungicide seed treatment. As a result, a number of farmers tried a simple seed treatment trial and were quite impressed with the results. On the other side, the on-station researchers developed a greater appreciation for the farmers' current practice of planting groundnuts at very low populations.

The progress made in building linkages with extension agents has been one of the most obvious benefits of the farmer groups. By participating in farmer groups, extension agents collaborate in the development and assessment of technologies. Therefore, when technologies are ready for dissemination, the extension agents already understand any advantages and disadvantages and are in a better position to present recommendations to new sets of farmers.

PROBLEMS IN GROUP MANAGEMENT

While there are clear advantages to groups which function well, not all groups run smoothly. In fact, the vast majority of groups in Botswana villages have

severe problems which limit their effectiveness. This section reviews the major problems ATIP has encountered in managing technology development and assessment oriented groups.

In any group situation, not everyone will speak up. Since dialogue is extremely important, this can become a key group management problem. The larger and more heterogeneous the group, the less likely is it that all members will regularly participate in group discussions. One approach ATIP has used to facilitate participation is to have a portion of each meeting during which each farmer is asked to report on her or his own farming circumstances (such as any ploughing done). Even with such steps, however, there tend to be a few more articulate and aggressive group members who tend to dominate most discussions.

Another problem is a tendency to visit some farm sites more frequently than others. This can cause jealousy. There is no easy solution for this where research resources are limited and not all trial sites are of comparable value in evaluating a proposed change in production practices. One potential solution, at least in the focused-testing format, is to make sure the hosting of trials is fairly distributed among group members.

Farmers subjectively evaluate the benefits from the time spent in group meetings relative to other activities. During busy parts of the year, the competing demands for farmers' time can lead to poor attendance. The ATIP on-farm research teams have tried several complementary approaches to maintaining farmer interest including reducing the frequency of meetings during particularly busy periods and during the winter (non-cropping season), providing transport for farmers living far from the meeting site, bringing in outside speakers, having refreshments at some meetings, arranging field visits or other outings of interest to the group members, and scheduling meetings on days when drought relief food is distributed or when farmers traditionally do not work.

In ATIP's experience, nearly all farmers have wanted to continue participating in the groups. This has created an unexpected dilemma, particularly in the focused-testing format, raising the question of whether old group members should be forced to drop out in favour of new farmers after two or three seasons. The main reasons for replacement are that the views and attitudes of old group members might become atypical as a result of continual interaction with researchers, and that it is desirable to include as many farmers as possible in the technology development process. On the other hand, it is difficult to exclude active and interested group participants. One of the main advantages of the options-testing format is that there is a less formal group structure, facilitating replacement on an annual basis. However, there can be a tendency for a gradually expanding membership which, in itself, can pose a problem in terms of the required research resources.

Even simple trials have implementation requirements that force researchers to give some guidelines to farmers. If meetings are dominated by researchers' presentations, farmers may adopt a passive role, and not shift easily back to a collegiate mode of interaction.

OUTSTANDING GROUP MANAGEMENT ISSUES

When attempting to synthesize our thinking about group formats and management procedures, it became apparent that some issues concerning farmer participation remained unresolved. The experiences of the two ATIP on-farm teams have often differed with respect to the following issues. Nevertheless, we agree that each issue affects the nature of farmer participation and needs to be addressed by FS teams contemplating the use of farmer groups.

It is important to ascertain whether larger groups result in a lower quality of dialogue than smaller groups. If the quality of farmer dialogue is somewhat reduced in larger groups, is this a reasonable trade-off in order to enable more farmers to participate in FS activities? As reflected in the focused-testing versus the options-testing formats, the appropriate size of the group depends largely on the group objectives.

Some degree of researcher initiative is inevitable in FS work since researchers often have information about options that fall outside the scope of farmers' experience. However, the more the researchers take the initiative in group activities, the less collegiate researcher-farmer relationships become. Two issues need to be considered with reference to the degree of researcher versus farmer initiative. Should researchers try to target options to particular farmer circumstances, as is implicit in the FSR recommendation domain concept? Do farmers have enough information about the potential options to assess *a priori* which should be tried?

The options-testing group format represents an attempt to shift the initiative from the researchers to the farmers by offering many options to interested farmers. In contrast, the focused-testing format is based on the assumption that greater targeting and researcher initiative is required when introducing (at least some types of) new options. Which format is most appropriate depends on the diversity of farmer circumstances, the type of options to be considered, and the objectives of group work.

Meetings can take up much time but, over time, fewer and fewer new insights are gained from discussions of general farming problems and there is less that needs to be discussed after an initial trial implementation period. The issues are whether it is necessary to meet regularly and how often to meet. The frequency of meetings obviously depends on farmer interest, but also on the success of researchers in arranging supplementary activities like field visits or presentations on specific topics of interest to farmers - such as a demonstration of how to spray sorghum for aphid control.

CONCLUSIONS

ATIP experiences with farmer groups indicate quite clearly that groups can be effective in increasing and improving the pattern of farmer participation in the technology development process. Groups keep farmers in the foreground,

provide a means of using social dynamics constructively, and create a multiplier effect which assists the spread of relevant improved technologies. There are many other benefits from farmer groups, including the increased efficiency in use of research resources and improved linkages between researchers, extension agents and farmers.

There is no doubt that the idea of farmer groups has struck a chord within the farming community. Farmers have almost universally expressed an interest in continuing the groups. Although some problems and issues remain, ATIP's experiences suggest that farmer groups provide a pragmatic tool for undertaking farming systems work which is complementary to informal and formal surveys, and researcher managed trials.

The formation of farmer groups should be seriously considered by other FS teams concerned with the issue of farmer participation. Several group formats have been discussed on the basis of experiences in Botswana. While these group formats have worked well in Botswana, the structuring and management of groups obviously need to be adapted to different social and agricultural settings.

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