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Making Technologies Work for Resource-Poor Farmers in Botswana

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Abstract

The need for productivity increases in the agricultural sector in Botswana in order to help improve farm incomes, especially incomes of resource-poor farmers, has been an important concern in the poverty alleviation effort in the country. Appropriate technology generation and dissemination in both the crop and livestock production sub-sectors hold the promise of improving agricultural productivity. This paper discusses how the farming systems approach (FSA) can contribute to the successful generation and dissemination of appropriate agricultural technologies. The paper concludes that prerequisites for success in the technology generation and dissemination process include the political will to do so, adequate funding, the provision of relevant technical personnel and the willing participation of farmers in the technology generation process.

1. Introduction

The contribution of the agricultural sector to Botswana's gross domestic product (GDP) has dwindled from about 40 per cent at independence in 1966 to 2.6 per cent in 2000 due to the dominance of the economy by the mineral sector, especially diamonds (MFDP, 2003:176). The decline of agriculture in the economy has been attributed to the relative unattractiveness of traditional agriculture as an economic activity compared to other forms of activities in the national economy due to the "low average level, and high annual variability of agricultural incomes" (MFDP, 1997:56). The variability in agricultural incomes leading to this source of income being classified as unreliable has been attributed to the highly variable rainfall, yields and production levels (MFDP, 1997:56). The weakness of agriculture as a provider of reasonable incomes to the rural population has also led to an exodus of able-bodied persons from the rural to the urban areas in search of jobs since agriculture is only able to provide employment to less than 20 per cent of the national labour force (MFDP, 1997:59).

Productivity increases in the agricultural sector have also been slow and very low. Despite the enormous resources devoted to the agricultural sector during the period 1979-1996, for example, productivity in the sector is estimated to have increased by only 1.6 per cent (Republic of Botswana, 2001:18). The concern with the continued decline in agricultural productivity has again been echoed in the National Development Plan 9 document (MFDP, 2003:187). The low productivity of the agricultural sector has been attributed, in part, to the harsh physical and climatic conditions prevailing in most parts of the country. These harsh conditions have been identified as the poor soils, low and erratic rainfall and lack of permanent water sources in most parts of the country (MOA, 1991:12-15).

Since the agricultural sector is an important source of livelihood for some rural residents, it is important that agricultural productivity is increased as much as possible in order to ensure increases in farm incomes. An important determinant of

increases in agricultural productivity is technology. Rapid advances in agricultural technology do impact positively on agricultural productivity and hence on farm incomes. According to the FAO (2001:5):

Productivity can only improve with the introduction of updated technologies, including use of machines, improved plant and animal stock or varieties, better crop and post-harvest care and, importantly, higher investment and access to water.

It may, therefore, be of interest to look at past experiences in the development of agricultural technologies for traditional farmers, especially resource-poor farmers in Botswana, in order to examine constraints faced by researchers, agricultural extension personnel and farmers themselves. This information will afford an opportunity to look at lessons learnt in the technology development and dissemination process, and hopefully improve on techniques and methods of developing and disseminating information on technologies to resource-poor farmers. This approach will help to improve on rates of adoption of new agricultural technologies and hence improve on farm productivity. Increases in farm productivity are then hopefully expected to result in improvements in farm incomes and the livelihoods of resource-poor farmers.

This paper is divided into four sections. The first section deals with the introduction of the paper. The second section examines past experiences in the development of agricultural technologies for farmers, adoption experiences and lessons that can be learnt from the technology development and dissemination process. The third section looks at the farming systems approach and how it can be effectively used in technology development and dissemination to resource-poor farmers in Botswana. The fourth and final section of the paper is a summary and conclusion.

2. Past Experiences in the Development and Dissemination of Agricultural Technologies to Resource-Poor Farmers

2.1 Introduction Agricultural research in Botswana was initiated in 1936 at the Morale Pasture Research Station with emphasis on animal production and range research. Research on crops was introduced in 1945. The headquarters for agricultural research was eventually established in 1969 at Sebele, near Gaborone, where it is still located today (Acquah *et al*, 1998:30). In the 1970s researchers and policy makers (planners) in Botswana observed that despite the impressive results of the agricultural research programme, agricultural production was not increasing. It was realised by researchers and policy makers then that either the various technologies were not reaching farmers or that the technologies were not being accepted by farmers. A concern was also shown on the large gap that existed between on-station research yields and those from farmers' fields even when the same technologies were used (Worman *et al*, 1992:15, quoted in Acquah *et al*, 1998:30). Addressing the problems identified in technology transfer and the high yield gap resulted in a decision to initiate technology testing on farmers' fields. As a result of this decision two projects came into existence in the mid-1970s. These projects were the Evaluation of Farming Systems and Agricultural Implements Project (EFSAIP) and the Integrated Farming Pilot Project (IFPP). The IFPP later on became known as the Farming Systems Southern Region (FSSR) (Acquah *et al*, 1998:30). The rest of this section examines the results of various efforts that were aimed at generating agricultural technologies for resource-poor farmers.

2.2 Experiences in Agricultural Technology Generation and Adoption of Technology by Farmers The main problem facing the effort to generate and disseminate technological innovations to resource-poor farmers in Botswana is low farmer technology adoption. Despite the many technologies released by the Department of Agricultural Research in the Ministry of Agriculture in the past, the adoption of these technologies has been low. Technology adoption studies in Botswana were given serious attention during the 1980s. In 1989 a formal survey was conducted on all farmers who had participated in the researcher-managed Farmer Technology Options Testing Groups (FTOTGs) during the 1985-89 period to determine the extent of spontaneous adoption of new technologies among farmers who had been working with the Agricultural Technology Improvement Project (ATIP) (Worman, *et al*, 1990:1). The results of the survey showed that of the 158 farmers interviewed 26 percent (41) used a technology during the 1988-89 cropping season which they had not used prior to the 1984-85 cropping season.

An adoption study conducted in 1996 on the Sebele standard planter which had then been in circulation for about 10 years showed only 2.8 percent adoption rate and 31 per cent planter ownership, despite the fact that the planter had been shown to save on both seed and labour and improved seed placement, factors which were vital for increased crop production (Makhwaje and Acquah, 1996:8, quoted in Acquah *et al*, 1998:31): Double ploughing, a technology known to double yields, has also been adopted by very few farmers. Other technologies which have potential but which have been adopted by very few farmers include improved varieties of crops, integrated pest control measures and improved crop management practices (Acquah *et al*, 1998:31).

Macala and Acquah (1999) have shown in their discussion of farm management survey results for the period 1989-1996 that access to adequate draft power technology had significant effects on average total farm incomes in Botswana. Resource-poor farmers with adequate draft power generally had higher average total farm incomes compared to those with inadequate draft power. Tractor-powered farms generally received the highest incomes because they could plough the largest number of hectares of land compared to other draft-powered farms. The tractor-powered farms were followed in terms of average total farm income received by donkey-powered farms while oxen-powered farms received the least income. The above information shows that having access to adequate draft power technology increased the average total farm income of a farm household.

Farmers' reasons for not adopting particular technologies were summarised in a survey conducted in the Central Agricultural Region in 1983 (Baker and Siebert, 1986:71). Most of the reasons cited for not adopting some specific types of innovations included lack of implements, too much work, lack of funds, erratic rains, lack of draft power, lack of labour, lack of seeds and no perceived benefits. The majority of the reasons for not adopting some types of innovations were those that could be overcome by working gradually with farmers to enable them to see the potential benefits and subsidising the purchase of some of these innovations, which resource-poor farmers could not afford.

3. The Farming Systems approach Farming Systems approach to Technology Generation and Dissemination

3.1 Overview of the Farming Systems Approach to Technology Development and Dissemination Six steps involved in the farming systems approach to technology develop-

ment and dissemination are: diagnosis, planning/design, testing/experimentation, evaluation/assessment, modification/replanning, and recommendation and wider dissemination (Anandajayasekeram, 1996:17; and Acquah, 2000:17). The various steps are briefly described as follows:

Diagnosis Diagnosis involves a description of the farming system in such a way that the current production system can be understood. It also involves the identification and analysis of key problems of farmers and preliminary ideas on how the identified problems may be solved. The target group (recommendation domain) that will benefit from the technology generation process is also identified. Both biological and social scientists may visit the area of interest to observe farmers' fields, talk to farmers and collect relevant information in order to help them to understand farmers' problems.

Planning/Design This stage involves the analysis of problems identified at the diagnosis stage and listing of potential solutions to the problems. Possible research agenda identified from these problems must be feasible biologically and economically. Factors that are taken into consideration in the planning /design stage include technical feasibility, profitability, risk and compatibility with the current production system.

Experimentation/Testing The actual implementation and management of trials are dealt with at this stage. The trials (on-farm) may be under different combinations of management by researchers or farmers. Promising technologies may be tested on farmers' fields as on-farm trials, or under researchers' conditions.

Assessment and Modification Various statistical, economic and agronomic criteria are used to assess results from the field experiments. These results are also reviewed to ensure conformity with the farming system and also to address various concerns of farmers. Farmers are also allowed to evaluate field results to convince them of the viability of certain technologies. Modifications are done on treatments and other technologies that are not acceptable to farmers as a result of farmers' own evaluations of the results.

Recommendations and Wider Dissemination Viable technologies that are in conformity to the farming systems in the area under consideration are recommended to farmers after assessment and modification. Dissemination of new technologies may involve extension staff, non-governmental organisations (NGOs) and private entities.

The above steps need not follow each other in a chronological order. Some steps may overlap and other stages may be implemented simultaneously.

3.2 The Development of the Farming Systems Approach (FSA) in Botswana The farming systems approach (FSA) to technology development and dissemination is based on the premise that farmers themselves should participate in identifying and reshaping their appropriate development path in terms of participating in the generation and dissemination of technologies appropriate to their own socio-economic circumstances. Thus, the FSA has concentrated on adaptive research where improved technologies have been adapted to the specific environmental conditions facing farmers and where information on future research priorities is fed back to experimental research stations to help in the development of improved technologies. In its evolution and development in Botswana, FSA "has provided a system for understanding the technical, human and

environmental factors farmers face; it has served as a mechanism for relaying relevant research priorities from farmers to experimental stations, and has also served as a device for evaluating technologies within a systems context using criteria relevant to the farmer's environment" (Acquah *et al.*, 1998:29).

The early beginnings of farming systems work were in the form of donor funded projects. Significant efforts in farming systems work were made with the launching of the Agricultural Development for Ngamiland Project (ADNP) in 1979; the Agricultural Technology Improvement Project (ATIP) from 1982 to 1990 and the Molapo Development Project (MDP) in 1983. (Worman *et al.*, 1992:15). In 1991 the Department of Agricultural Research was restructured and all Farming Systems Research projects were combined into one entity known as the Production Systems Programme (PSP).

3.3 The Current Status of the Production Systems Programme (PSP)

3.3.2. The PSP at the National Level The primary mission of the PSP is to foster participation in agricultural development through applied and adaptive technology development which considers circumstances in a holistic manner. The programme is specifically mandated to

- Actively involve the farmer in the process of technology generation and transfer. Since farmers are the ones who decide on which recommended technology to adopt, PSP is expected to ensure that farmers and extension agents participate when such technologies are being verified. In order for agricultural research and development to be successful it is necessary to begin with farmer perception of the problem and end with the farmer evaluation of the solutions. This collaborative method improves dialogue between researchers, extension agents and farmers and improves linkages as groups provide for meetings between on-station researchers, extension agents, policy makers and farmers. Through this approach, farmers are empowered to actively participate in identifying technologies appropriate to their technical and socio-economic circumstances. This approach also makes it easier for extension agents to understand innovations better when these innovations are ready for release.
- Conduct on-farm verification of promising technologies from experiment stations and those derived from on-farm research/observations to ascertain whether they are compatible with farmers' technical and socio-economic environments.
- Study the farmers' environments in order to identify constraints that impede technology diffusion/adoption and relay such information to experiment station-based scientists, extension workers and policy makers. This provision would ensure that technology development, the process of forging adoption and the planning process, are reshaped to meet the demands of the farmers, thus ensuring that technology development is demand driven.

In order to fulfil its mission the PSP has to forge two-way linkages among experimental station-based scientists on one hand, and policy makers, extensionists and farmers on the other.

3.3.2 The Operation of the PSP Programme In order to operate effectively, four PSP teams have been established. These teams are based at Mahalapye in the Central Agricultural Region, Francistown in the Francistown Agricultural Region, Maun in the Ngamiland Agricultural Region and Pelotshetlha in the Southern Agricultural Region. The PSP is headed by a programme leader whose main function is to coordinate the

activities of the various teams. The programme leader also provides a formal link between the PSP and other research programmes, and serves as an informal link with agricultural extension and other related institutions.

3.4 Lessons Learned from the Operations of the PSP in Botswana

The following are some of the lessons learnt in the operations of the farming systems approach through the PSP (Acquah, *et al*, 1998:46-47):

- Adequate human and financial support (both Government and donor sources) were essential in the introduction of FSA to the development of agriculture in Botswana.
- Farmers' contributions to FSA activities were important due to their intimate knowledge of local farming conditions.
- Farmer-based experiments in the PSP resulted in several promising technologies that were assessed. On-farm technology verification conducted through FSA was effective in leading to the release of sorghum varieties which are currently being circulated.
- Farmers' participation in the research process contributed to an improvement in the efficiency of the research system through an increase in the amount of research that was done with regard especially to on-farm research. The participation of farmers in the research process resulted in a better articulation of their needs and the constraints that they face in their efforts to adopt technologies being generated. This has resulted in an improved research agenda aimed at addressing these needs and constraints.
- Experiences from FSA work in Botswana has shown that resource-poor farmers in Botswana are eager and willing to participate in the agricultural research process.

4. Summary and Conclusion

This paper has discussed some of the factors contributing to the weakness of the agricultural sector and its inability to make a significant contribution to income generation in the effort to reduce poverty in Botswana. An avenue for increasing agricultural productivity and hence farm incomes has been indicated by the paper as being an effective technology generation and dissemination process. The Farming Systems Approach (FSA) to agricultural technology generation and dissemination has been mentioned in the paper as holding a lot of promise in the effort to reverse the stagnation in farm crop yields and hence farm incomes in the country. This will make an important contribution to poverty reduction in the agricultural sector.

For an effective utilisation of the farming systems approach (FSA) in the agricultural technology generation and dissemination process, there are some prerequisites that need to be met. The first prerequisite is political will in the form of a commitment by the leadership within the Ministry of Agriculture to make FSA work. The commitment may be seen through the relevant support from the government in the form of adequate funding and the provision of relevant technical personnel to FSA activities within the various agricultural regions in the country. The willingness of farmers to participate in FSA activities together with researchers and extension personnel will be essential in the effort to generate technologies that would be appropriate to farmers' socio-economic circumstances. Although a lot of the discussions in this paper seem to be more applicable to the crop production sub-sector, the ideas expressed in the paper are equally applicable to the livestock production sub-sector.

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