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EVALUATION OF THE APPROPRIATENESS OF CERTAIN GRAIN PRODUCTION TECHNOLOGIES FOR SMALL-SCALE FARMERS

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ABSTRACT

The paper suggests a combination of both modern, high-input technologies and low-input technologies in a context based technology development approach. These technologies are: improved maize varieties; row planting; legumes in the cropping system; reduced tillage practices and weed control. Although some adaptations are needed, none of the innovations in the program failed the test of appropriateness completely. According to the findings Open Pollinated Varieties (OPV's), although intensively promoted, were only preferred by 35% of the farmers while hybrid seed was preferred by 59% of the farmers. The majority of farmers (63%) indicated that they do plant maize in rows with a mechanised planter; despite high labour costs 59% of farmers still control weeds by hand and 61% of the respondents do realise the economic advantage of reduced tillage practices but still does not implement the practices. The strong linkages between all role players and active farmer participation are probably the most important reasons for the fact that farmers are still enthusiastic and eager to continue with the program.

1. INTRODUCTION

Two divergent schools of thought can be identified within the context of technology development for small-scale farming systems. Firstly, those who propagate a high external input approach. In their view the central principle is that agricultural development cannot be achieved unless

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farmers have greater access to the products of science-based agriculture (Pretty, 1995:50). On the contrary, the second group strongly promotes the low external input approach. Proponents of this approach also consider technologies appropriate only when it is rooted in the indigenous knowledge of the people (Cáceres & Woodhouse, 1998:21).

Many development programs in South Africa, both public and private sector, supported by a vibrant media tend to support the modernization paradigm. In some cases capital intensive or high-tech innovations such as Genetic Modified Organisms (GMO's) sophisticated mechanization or irrigation systems are presented as the dawn towards a "Green revolution" in Africa. This paper argues that neither the modernization nor the low external input approach should be seen as the high road to technological change and progress. The unique farming conditions and the realities of the broader agricultural environment that exists in the developing sector in South Africa call for a balanced and context based strategy. A combination of both paradigms should be adopted. Indigenous knowledge should be considered in new technological designs together with scientific knowledge. At the same time researchers and development agents should be allowed to be less cautious to introduce external technologies of which farmers have no previous experience (Cáceres & Woodhouse, 1998:27).

2. IN PURSUIT OF APPROPRIATE TECHNOLOGIES

In a multi-institutional program implemented in the Limpopo and Mpumalanga Provinces, 14 farming communities form the basis of a comprehensive program of technology development for the improvement of grain production systems. The majority of participating farmers are confined to communal land areas. The type and scale of individual cropping systems are relatively homogeneous where the majority of farmers have access to between one and six ha of arable land (Agricultural Research Council, 2007:20).

Although the program is supported by various private enterprises, the major role players are researchers mainly from the Agricultural Research Council (ARC), extension officers of the Departments of Agriculture of both Provinces and farmers. The main objective of the program is to, in close collaboration with farmers, develop appropriate technologies that will ensure more sustainable and viable farming units.

Technology options investigated in different combinations at different localities are:

- Improved maize varieties particularly Open Pollinated Varieties or OPV's;
- Row planting in maize production;
- Legumes in cropping systems;
- Reduced tillage systems and;
- Chemical weed control.

Although individual options, these technologies are all seen as equally important components of an integrated production system.

3. METHODOLOGY

Technology development is a dynamic process and development projects or programs of this nature need to be evaluated at regular intervals as part of a continuous monitoring and evaluation process. As the project is running in its fifth consecutive year an assessment at this point of time was deemed necessary to enable the stakeholders to "take stock" of the program. The objective was twofold: First, to create an opportunity for farmers to help assess the appropriateness of the technology and secondly, to determine the stage of adoption to which the technology development process has progressed.

The program serves 14 farming communities, 10 in Limpopo and four in Mpumalanga. However, only six of these communities, representing 110 participating farmers, have been exposed to the specific technologies listed above. Based on the period of exposure to the technology four of the six communities, two in Limpopo and two in Mpumalanga, were targeted to participate in the assessment. The assessment was conducted by means of two instruments: a scorecard and a questionnaire. In the process 46 farmers were individually interviewed using both the scorecard and the questionnaire. The scorecard was designed to help assess the appropriateness of the individual technologies based on selected criteria as indicators of appropriateness (Bunch, 1985:125). The purpose of the questionnaire was to determine farmer's perceptions and attitudes towards the technology.

4. FINDINGS

4.1 The scorecard method

Seven of the attributes of technologies, cited by Bunch (1985:99) and also Slabbert and Thompson (1985:80) have been selected to serve as criteria for the assessment of the technologies on the scorecard. The criteria are:

i) Felt need – Do the farmers really need the technology and to what extent are they convinced that it will improve their circumstances?

ii) Financial advantage also seen as relative advantage in terms of increased profitability (Rogers, 1983:213).

iii) Labour intensiveness. Labour in rural South Africa is not anymore as abundant as in the past, making this a relevant criteria.

iv) Capital intensiveness. Will farmers be able to afford the particular technology?

v) Complexity and sophistication. Is it easy to understand, to operate and maintain?

vi) Access to markets. Are the input products readily available and what market opportunities exist for specific farm commodities?

vii) Risk. Will the technology increase the risk of production or not?

The results obtained by the scorecard, measuring the technologies against each criterion, are somewhat surprising as it was expected that the technologies would be clearly categorised as either appropriate or less appropriate. Instead, farmers rated them relatively equally appropriate with almost insignificant differences between technologies. However, the two technologies that rated the lowest, namely reduced tillage and chemical weed control are also the more recently introduced technologies that farmers were less exposed to and probably seen as more "foreign".

In view of this result two questions can be asked: First, is the scorecard an appropriate and accurate method to achieve the objectives and secondly, to what extent could the farmers misinterpret the criteria? Despite the shortcomings it can be concluded that farmers are generally enthusiastic about the technical interventions, and that none of the technologies, even those that are relatively new and technically challenging, needs to be rejected at this stage. It is important at this point to note that the good support and visible trust in the program, displayed by the farmers, can largely be attributed to the good relationship existing among the role players i.e. farmers, extension workers and researchers. The success of joint ventures in technology development depends highly on the relationships and effective communication between role players (Cáceres & Woodhouse, 1998:27).

4.2 The questionnaire

The purpose of the questionnaire, as previously indicated, was to determine the perceptions and attitudes of farmers with regards to the technologies. The following section highlights the farmers' responses in terms of the respective technologies.

4.2.1 Improved maize varieties

One of the major focus areas of the program is the evaluation of maize varieties. At each locality a number of seven or, in some cases, nine varieties were planted in on-farm trials managed by a partnership consisting of local extension officers, research staff of the ARC and participating farmers. One of the objectives was also to promote Open Pollinated Varieties (OPV's) mainly for two reasons: One, the affordability of the seed compared to hybrid seed and two, to improve access to seed in response to an initiative by the Limpopo Province to establish a local seed provision system. Despite this attempt to promote OPV's based on the reasons mentioned, the majority of farmers in the program (58.6%) indicated that they are in favour of hybrids (Figure 1).

The same trend is strongly supported by the findings of an assessment done by the ARC to evaluate the status of a sub-project in the program known as the LIMPAST (Limpopo Agricultural Strategic Team) Grain Production Advancement Project. Contrary to the expectations of the project the use of hybrids increased by 21% since the start of the project in 2003 at the expense of OPV's (Agricultural Research Council, 2007).

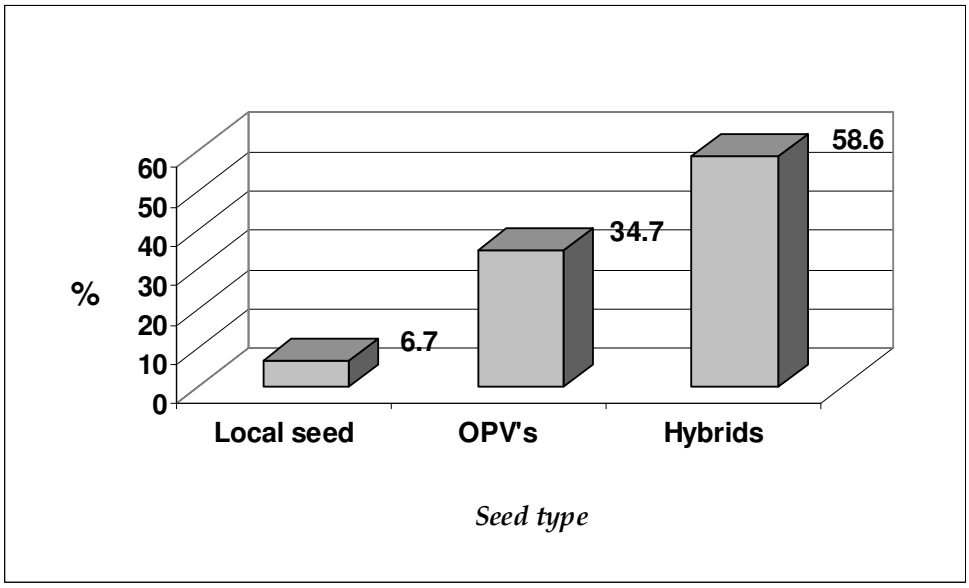

Figure 1: Farmer preferences for different seed types

The increased use of hybrid maize seed can mainly be attributed to the following:

- The project also included a partnership between a local milling company, Progress Milling, providing supply depots for a seed company called PANNAR actively marketing hybrid seed. The easy access to hybrid seed created by the project clearly resulted in the shift towards hybrids.

- The superior performance of hybrid maize when compared to OPV's in the on-farm trials has probably greatly influenced farmers deciding to opt for hybrids.

The potential of hybrids to do as well as or better than OPV's under low input conditions has also been reported by Byerlee and Jewell (1997:134) in their study of advances in maize production in various African countries.

The prominent shift towards hybrid seed not only suggests that the emphasis on OPV's should be revisited but also to address the important aspect of access to seed. In the case of OPV's very little progress to establish an effective seed provision system has yet been made.

4.2.2 Row planting

In the past, maize planting methods in the communal land areas, such as seed broadcasting and planting in the plough furrow, was a common practice. In most cases these practices result in poor and scattered maize stands creating a backlog position from the start. Figure 2 however, clearly indicates that the majority of farmers (63%) in the program now have switched to mechanical planters, mainly provided by contractors, instead of traditional methods.

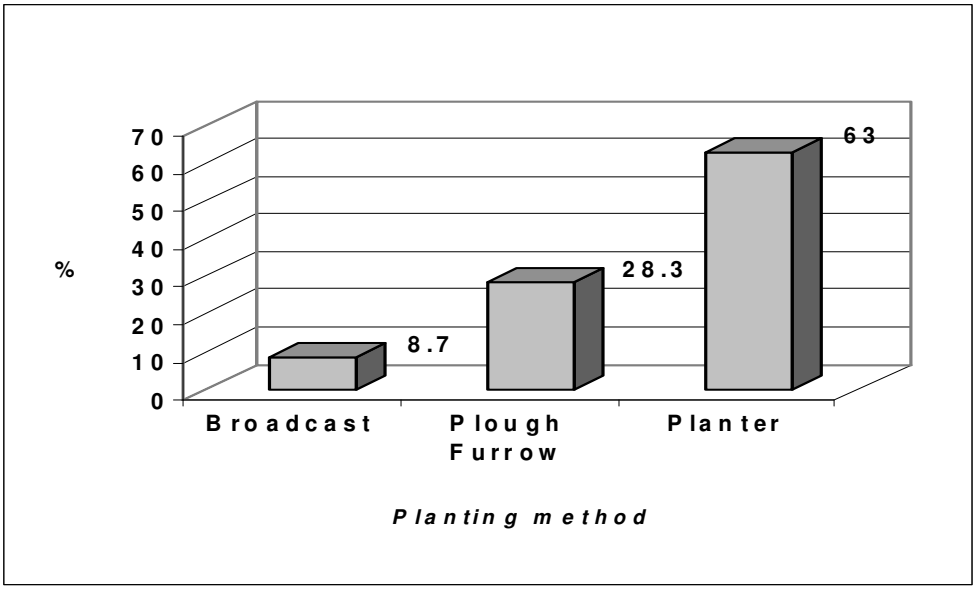

Figure 2: Proportion of farmers using different planting methods

The concept of row planting has also been strongly advocated by the LIMPAST Grain Production Advancement project. As a result a 32% increase in the practice of row planting occurred, since the start of the project (Agricultural Research Council, 2007:25).

The apparent increase in the use of mechanical planters evident in Figure 2 has very important implications, not only for the application of planting practices e.g. seed spacing, but also for technologies such as fertilization. Since the majority of farmers make use of hired mechanization (Agricultural Research Council, 2007:25), the correct implementation of planting practices is therefore not in the hands of farmers but in the hands of the contractors. This implies that tractor contractors should now also be included in the program as an

additional target group in order to ensure the implementation of sound planting and fertilization practices.

4.2.3 Legumes in the cropping system

Most farmers in the target areas are familiar with legume crops such as cowpea, sugar beans, groundnut and bambara. Cowpea is the most common legume while in many cases, crops like groundnut and sugar beans have to be re-introduced as the production of these commodities rapidly declined in the target areas mainly due to the absence of a sustainable seed provision system. According to the results of the assessment 67% of farmers indicated that legume crops are already part of their cropping systems. The fraction that does not currently produce legumes (33%) indicated clearly that they would all like to engage in legume production. Two major problems prevent farmers to produce legumes namely, lack of seed as major input as well as limited and unreliable market opportunities. Thus, most farmers see these crops only as a food source for household food consumption and that they are yet not able to exploit the economic value of these crops.

Farmers were requested in an open question to give reasons for growing legumes. Table 1 gives an indication of the reasons cited and their relative importance.

Table 1: Reasons for growing legumes

Reason	Percentage of cases in which a specific reason was sited (n=55)	
	(n)	%
Household food consumption	33	60
Economic	16	29
Agronomic	6	11
Total	**55**	**100**

Note: *In some cases respondents provided more than one reason, hence n = 55*

The majority of respondents (60%) perceived these crops only as a food source for household food consumption and that they are yet not able to exploit the economic value of these crops. Unless an effective seed provision system can be developed and market opportunities created, these problems will remain major stumbling blocks preventing farmers to expand the production of legumes.

4.2.4 Reduced tillage

Reduced tillage technology implies a package of practices as well as the use of specific adapted tools or implements. The technology is relatively complex since it is very situation specific and many components need to be carefully integrated. To introduce the technology to farmers in the program the ripper planter, a tractor drawn tine implement with mounted planting units, served as a prototype model to demonstrate basic principles of reduced tillage. Although 78% of the farmers interviewed indicated that they have been exposed to the technology, the level of exposure might be superficial at this stage. However, the on-farm demonstration trials planted with the ripper planter to compare conventional systems to a reduced tillage system created excellent opportunities for farmers to learn more about the technology. Table 2 provides more insight into farmer perceptions in terms of certain advantages of reduced tillage.

Table 2: Advantages of reduced tillage perceived by farmers

Advantage perceived by farmers	Number of farmers citing advantage (n = 46)	
	n	%
No advantages perceived	4	9
Environmental advantages	3	6
Agronomic advantages	11	24
Economic advantages	28	61
Total	**46**	**100**

The demonstration plots and field discussions between researchers, extension officers and farmers revealed various advantages and disadvantages of the technology. It is however encouraging to observe (Table 2) that farmers are specifically aware of the economic advantages, mostly reduced soil preparation costs, and also, in some cases, the agronomic advantages such as improved soil moisture conservation. Despite the increased awareness about cost savings farmers however, do not view the ripper planter as appropriate to their conditions. Farmers now are requiring a less costly, smaller and easy to operate implement to replace the ripper planter.

4.2.5 Chemical weed control

Figure 3 clearly reveals that hand hoeing is still the most common weed control method applied by farmers in the program. Although a significant group of farmers use chemical weed control methods, either as a single method (17%) or in combination with hand hoeing (22%), it can probably be concluded that, in most cases, this is only at an experimental stage.

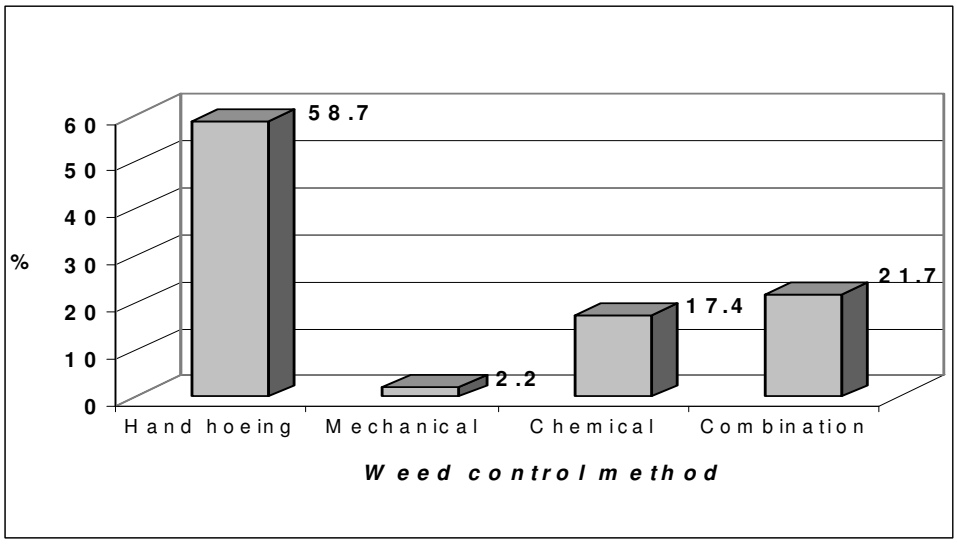

Figure 3: Proportion of farmers using different weed control methods

An important finding is that most of the hand hoeing in these cropping systems is supplied by hired labour services. Sixty seven percent of farmers in the program employ hired labour services. This has important implications to farmers in view of increasing labour wages in South Africa. According to the information provided by farmers in the interviews farmers pay an average amount of R734/ha. This was also confirmed by a number of case studies across the target area. Despite these high expenses, effective weed control remains a major constraint on most farms. At current herbicide prices a basic chemical weed control program, including application costs, can be implemented at a cost of R200-R300 ha. In view of this important input cost implication to small-scale farmers, alternative technologies such as chemical weed control, although seen as modern technology, will remain to be high on the priority list. However, a proper training program will be key in any attempt to transfer this technology successfully to farmers.

5. CONCLUSION

In terms of technological progress, the assessment of the program revealed a number of distinct shortcomings as well as significant advances. Technologies such as OPV's, the integration of legumes and reduced tillage practices should be revisited or adapted. External factors such as market access and price trends strongly reflect the relation between the economic environment and the appropriateness of the technologies. Despite the limitations identified none of these innovations, not even those seen as modern, at this stage has failed the test of appropriateness. The strong linkages between role players established over an extended period and good rapport with farmers made an important contribution to ensure that the technologies are in line with the farming circumstances and objectives of the farmers. At the end it is the farmers who will decide what is "good" or "bad" technology.

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