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SOCIO-ECONOMIC INDICATORS INFLUENCING THE ADOPTION OF HYBRID SORGHUM: THE SEKHUKHUNE DISTRICT PERSPECTIVE.

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ABSTRACT

The study observed the poor use of hybrid sorghum cultivars by subsistence farmers. The project sought to establish which, if any, socio-economic factors influence the adoption of hybrid sorghum cultivars by this sector of the farming community. The focus was on Makhuduthamaga Municipality in Sekhukhune District of Limpopo Province in South Africa, and was confined to the sorghum belt situated around Lepellane catchments in Schoonoord area. The population of the study consisted of farmers that planted sorghum using either hybrid or non-hybrid sorghum cultivars. Non-probability quota sampling method was used with field interviews through structured questionnaire, to collect quantitative sets of data. The study found that there were socio-economic differences between the hybrid user and non-hybrid users. These factors included farmers' gender, level of literacy, access to extension service, membership to agricultural co-operatives, access to credit and inputs, sorghum output, farm income, access to farm land, and cultural influences.

1. INTRODUCTION

Sustainable development and poverty eradication form the core objectives of the United Nations Millennium development goals and New Partnership for Africa's Development (NEPAD) strategies (NEPAD, 2004). To achieve these goals, NEPAD established the Comprehensive African Agricultural Development Program (CAADP), the fourth pillar of which encompasses among others, land and water management; increasing food supply to reducing hunger; and strengthening agricultural research and technology development, dissemination and adoption, as well as improving access to affordable farm inputs, particularly fertilizers and seeds (NEPAD, 2005). For the enhancement of agricultural development in Southern African countries, Southern African Development Community (SADC)'s Seed Security Network secretariat had been tasked to *inter alia* ensure that farmers gain increased access to different types and varieties of seeds (SADC Seed Security Network, 2005:3). Hybrid seed technology is an integral part of this strategy.

Seed production strongly emerged in Africa during 1900 to 1960. From 1960 to 1985 most of the African countries embarked on vigorous seed production programs. Zimbabwe for example, produced the World's first single-cross hybrid crop cultivar in

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1960 (Rusike & Eicher, 1997:181). Hybrid crop cultivar was introduced in Nigeria in 1984 when the Nigerian Government, in collaboration with the International Institute of Tropical Agriculture (IITA), produced their first hybrid crop cultivar (Smith, Weber, Manyong & Fakodere, 1997:112). The first South African hybrid maize called Potchefstroom Pearl was produced when South Africa embarked on an experiment process to select and test foreign and local cultivars in the period, 1960-1980. By 1964 the country had already registered 16 hybrid cultivars on the national list of official varieties, and by 1993 South Africa had registered 284 hybrid crop cultivars (Rusike & Eicher, 1997:178).

Sorghum and maize are amongst the major field crops mostly used to some extent in food manufacturing processes in the industrialised countries (Connett & Barfoot, 1992:51). These crops are major traditional basic food in Southern Africa (Smith *et al,* 1997:113). The Limpopo Department of Agriculture (2004:21) has also identified dry land grain production as one of the key priorities on its strategic objectives towards poverty eradication.

In a number of countries, the use of hybrid cultivars in sorghum and maize production has been increasing. However, this varies from one country to the other, as well as from region to region within the countries. In some African countries, the adoption of hybrid crop cultivars has been a success. In Nigeria, for example, hybrid cultivars were largely used in sorghum and maize production (Smith *et al*. 1997:114). The use of hybrid cultivars also varies between farming sectors. In Kenya, for instance, there was a great gap between commercial and small-scale farmers. The commercial farmers widely used hybrid crop cultivars more than small-scale farmers (Morris, 1998:17). The use of this technology is considerably higher in South African commercial farming sector than in smallholder sector (Rusike & Eicher, 1997:181). In contrast, hybrid cultivars dominated agricultural food production systems of small-scale farming sectors in Zambia and Zimbabwe (Rubey, Ward & Tschirley, 1997:149). The adoption of these hybrid crop cultivars was not only encouraged through extension strategies, but also through government policies. In Zimbabwe for example, following independence in 1980, the new government removed racial barriers to institutional credit and embarked on campaigns on promoting hybrid cultivars among smallholder farming sector (Rusike, 1998:306).

Mazuze (2004:57-65) examined the factors that affected the adoption of orange-fleshed sweet potatoes in Gaza Province, in Mozambique and found that the adoption was mostly dependent on the farmers' socio-economic conditions and factors such as age, gender, extension services, cropping systems, productivity and availability of the new technology, and size of farm land. Heisey, Morris, Byerlee and Lopez-Pereira (1998:157) noted that hybrid technology is likely to be adopted more extensively by farmers that have large farms. Farmers who have access to farming support services tend to swiftly adopt new technology. In Kenya, for example, farmers' access to credit, input supply and extension service enhanced the adoption of their new hybrid maize (Hassan & Karanja, 1997:85). They also intensified extension services during the 1960's and 1970's to popularising the benefits of hybrid maize technology and this resulted in an increased adoption of the hybrid cultivars (Byerlee & Jewell, 1997:137). According to Rohrbach and Makhwaje (1999), Botswana released three open pollinated sorghum varieties and one hybrid sorghum variety in 1994. These varieties were widely disseminated to small-scale farmers, 90% of which became

aware of the varieties within two years of their release, and almost 50% of them planted the varieties.

Despite such a long period of hybrid cultivars' existence and their proven advantages, there are farmers in some sections of the African farming community who still did not take advantage of such a technology. In some parts of Zambia, for instance, hybrid cultivars were rejected by some farmers, who argued that this method of farming had been introduced by United States of America and other European countries to contaminate their local grain crops (Mafata, 2002:5). However, these new technological systems are sometimes not available to subsistence farming sector in rural areas (Carruthers, 1992:2). Hassan and Karanja (1997:84) found that farmers' major reason for not using hybrid cultivars in some parts of Kenya, was the high costs of the technology. Such conditions may negatively impact on the adoption of new agricultural technology particularly in rural areas.

2. PROBLEM STATEMENT

Hybrid crop cultivars such as sorghum have been in existence in Africa and in South Africa, in particular, since 1960 (Rusike & Eicher, 1997:178). These cultivars have higher yield potential, which can contribute to the improvement of the farmers' income, agricultural development, and economic growth of rural communities (Smale and Heisey, 1997:75). The adoption of this technology might contribute to the improvement of their income and standard of living. Extension service has a role to play in bringing change in adoption of new technology. However, due to shortage of extension workers for facilitation of dissemination of agricultural information, extension worker/farmer ratio sometimes makes it difficult to reach out to all the farmers as it is a typical case in many developing countries (Williams & Düvel, 2006). Nevertheless, it is not the case in some regions.

According to Limpopo Department of Agriculture (2005), nineteen extension officers have been deployed to serve the Makhuduthamaga area which has approximately 400 subsistence sorghum farmers. This therefore suggests that the extension worker/farmer ratio is 1: 21 which is sufficient for effective and efficient extension service. However, the economic condition of the farmers remains unchanged. It is therefore assumed that the farmers' socio-economic conditions other than access to extension services, may presumably impact on their decisions on the adoption of new agricultural technology (Mazuze, 2004:57).

3. AIMS AND OBJECTIVES OF THE STUDY

The aim of the study was to explore the socio-economic factors determining adoption of hybrid cultivars by subsistence farmers in sorghum production. The objectives of the study were:

3.1. To investigate the extent to which subsistence farmers use hybrid cultivars in sorghum production, with assumption that the use of the technology reflects the level of the farmer adoption in the use of the hybrid sorghum cultivars.

3.2. To determine how farmers' socio-economic conditions such as age, gender, level of literacy, access to extension service, membership to farmers cooperatives, access to credit and inputs, farm output and income, access to

farming land, and the cultural norms and values affect adoption of the technology.

3.3. To carry out quantitative analysis to determining which socio-economic factors are to a greater extent associated with the adoption of hybrid sorghum cultivars, as well as testing the significance of their influence.

3.4. To make recommendations on how adoption of the technology could be improved.

4. RESEARCH METHODOLOGY

The study sought to establish which, if any, socio-economic factors influence the adoption of hybrid sorghum cultivars by subsistence farmers. The study was conducted in Makhuduthamaga Municipality in Sekhukhune district of Limpopo Province in South Africa. The survey was confined to sorghum belt situated around Lepellane catchments in Schoonoord area. The study population consisted of farmers that planted sorghum using either hybrid or non-hybrid sorghum cultivars for at least the previous two consecutive years. As the majority of subsistence farmers did not actively participate in the local economic mainstream, they were not registered with the local marketing agencies. As a result, it became difficult to secure a farmers' database from the local authorities. As Krathwohl (1998:164) noted that in the absence of a sample frame, non-probability quota sampling method may be used, a quota sample consisting of forty farmers was drawn. Qualitative data was collected using a structured questionnaire in individual interviews. Open ended questions were coded and included in a categorical data coding sheet as Neuman (2003:146) recommends.

The categorically coded data was then analysed using the Statistical Package for Social Science (SPSS). Frequency tables and related summary statistics such as the average, mode and variance of variables were computed. Cross-tabulations between the variables, technology adoption and other variables were also computed on a computer spreadsheet.

De Vos, Strydom, Fouché and Delport (2005:242) argue that chi-square and t-test help to ascertain statistical significance of the results. Neuman (2003:358) agrees that chi-square test is the precise way to ascertain relationship amongst variables. Chi-square and T-tests were then run to determine if there are significant differences between hybrid user and non-hybrid users, in relation to socio-economic factors such as farmer's age, gender, education level, access to extension services, membership to co-operatives, access to credit, access to inputs, input availability and costs, access to farm land, farm output and income, access to farming land, cultural background, etc.

5. RESULTS AND DISCUSSIONS

The study looked into farmers' socio-economic conditions such as age, gender, level of literacy, access to extension service, membership to farmers' cooperatives, access to credit and inputs, farm output and income, access to farming land, and effects of new technology on cultural norms and values. The chi-square and t-tests showed that there were some differences in the hybrid user and non-hybrid users. From the analysis, the following variables showed a relationship with the farmers' adoption patterns: gender, level of literacy, access to extension service, membership to farmers' cooperatives, access to credit, access to inputs, farm output and income, access to

farming land, and cultural norms and values. The study found that the majority (65%) of the respondents used non-hybrid sorghum cultivars, and only 35% used hybrid cultivars.

5.1. Farmers' social conditions

Women constitute 80% of subsistence farmers in rural communities of Limpopo Province (Limpopo Department of Agriculture, 2004:8). They also made up the vast majority of subsistence sorghum farmers in the area of study. And the majority of the non-hybrid users consisted of women. On the other hand, men constituted the majority of the hybrid users. The distribution of gender in adoption variants is illustrated in figure 1.

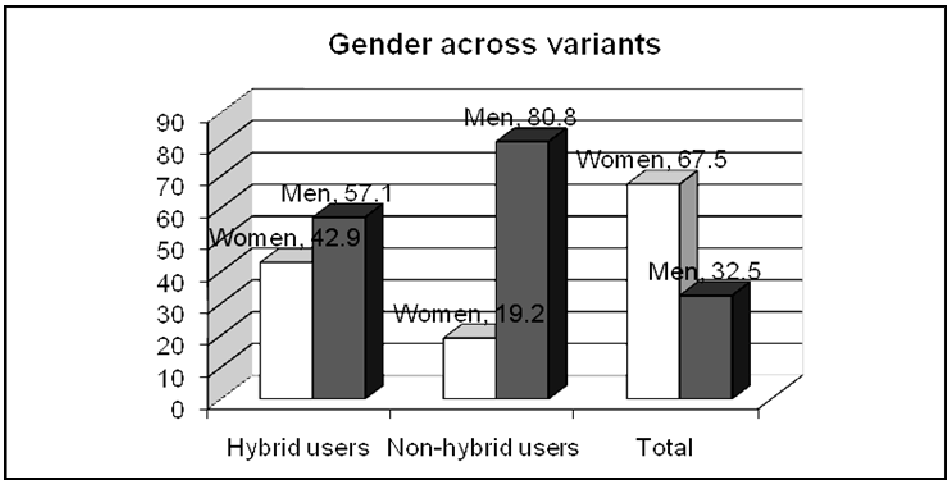

Figure 1: Gender of farmers

To find out whether the farmers' level of literacy had any impact on their technology adoption, their number of years of schooling was tested. 32.5% of the sampled farmers never had formal schooling, and only 5% had more than 10 years of schooling. Farmers with higher number of years of schooling recorded high use of hybrid technology. Figure 2 depicts the distribution of years of schooling across technology adoption categories.

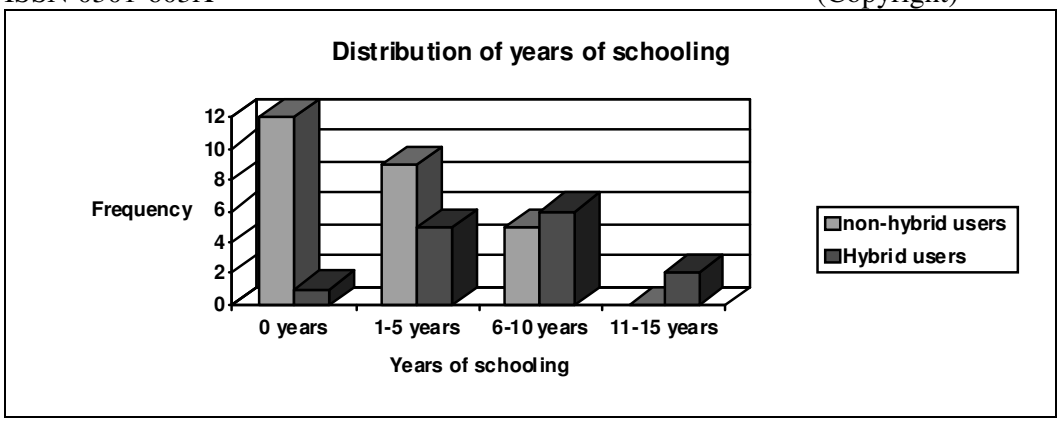

Figure 2: Frequency distribution of years of schooling of the farmers across technology adoption categories

The relationship realised in the findings suggest that gender and level of literacy have impact on the adoption of the seed technology. Though women constitute the majority of the subsistence farming community, men fall within the category of farmers who tend to adopt hybrid sorghum. Farmers' level of literacy plays a role in their change process as more farmers with some level of education adopt the hybrid cultivars than those without years of schooling.

5.2. Farmer support services

Farmers who have access to support in extension service, and credit tend to swiftly adopt new technology (Hassan & Karanja, 1997). This set of variables was tested to establish the extent to which farmers accessed extension service. The farmers were asked whether they had some contacts with an extension worker within the last 12 months. Hybrid users had more contacts than the non-users. In average, extension worker contacted each farmer almost once a year. The difference on extension service contacts is tabulated in table 1. It was noted during the interviews that most of the contacts the farmers had with extension workers, were during farmers' mass meetings rather than through individual farmer contacts. The level of exposure to extension service was low. However, the hybrid users seemed to have slightly more access to the service than the non-hybrid users. Extension service might have influenced the farmers' decisions in choice of input varieties. This therefore suggests that extension service has an impact on the adoption of the technology.

Membership to farmers' organisations may enhance farmers' access to extension services in that these organisations provide their members, on a regular basis, with farming information, and represent the interests of their members in agricultural matters and co-ordinate services to their benefit (Jeche, 1999:53). The farmers were also asked about their membership to agricultural organisations to find out whether they affiliated to such organisations for extension service. The majority of the total sampled farmers recorded membership to farmers' cooperatives. The vast majority of the hybrid users affiliated to farmers' cooperatives. The membership affiliation across the variables is illustrated in table 1. As majority of farmers with membership to cooperatives use hybrid sorghum, one may conclude that it is due to their access to

such information, that they adopt the technology. Access to agricultural organisations may therefore have an impact on the farmer adoption of farming technology.

The participants were also asked about their access to credit facilities in order to find out whether financing might have any relationship with their adoption. The hybrid users recorded to have had more access to credit for their operations than the non-hybrid users.
The access to agricultural credit support and improved seed technology appears to be one of the major challenges in the subsistence farming sector. The vast majority of the farmers do not use credit in their farming operations except a few of those who use hybrid seed. The distribution of access to credit is illustrated in table 1. The indication here is that access to credit support may contribute to the adoption of hybrid seed.

Table 1: Farmers-extension contact and membership to cooperatives

Variable	Non-hybrid users n=26	Hybrid users n=14	Total sample n=40
Farmers without contacts	46.2%	28.6%	40.0%
Farmers with contacts	53.8%	71.4%	60.0%
Average contacts/year	0.6	0.7	0.9
Non- members to coops	30.8%	14.3%	25.0%
Members to coops	69.2%	85.7%	75.0%
Farmers with credit	3.8%	21.4%	10.0%
Farmers without credit	96.2%	78.6%	90.0%

5.3. Access to inputs

The availability of new farming technological changes becomes a challenge to subsistence farmers for they are sometimes not readily available in rural areas (Carruthers, 1992). The participants were asked about their sources of seed material. The majority of the non-hybrid users recycled their seed. Others got their non-hybrid seed from the local shops. All hybrid users got their seeds from commercial suppliers.

The costs of inputs may also impede adoption of a new technology (Hassan & Karanja, 1997). To find out the influence of input cost on the adoption of hybrid technology, the seed cost was looked into. The hybrid users recorded higher costs in seed procurement and transportation. Table 2 depicts the various sources and cost of seeds. The findings show that hybrid seeds are expensive in respect of prices and transport costs. This might be attributed to the unavailability of the hybrid seed from local shops. This level of expenses might deter farmers to adopt the technology. Only the farmers with higher farm income can afford to acquire the hybrid seeds. The cost on hybrid seed and their transportation appear to be impediment on the adoption of the technology.

Table 2: Seed sources and cost

Variable	Non-hybrid users n=26	Hybrid users n=14	Total sample n=40
Recycled seed	57.7%	.0%	37.5.0%
Seed from local shops	23.1%	.0%	15.0%
Seed from both sources	19.2%	.0%	12.5%
Seed from seed suppliers	0.%	100	35.0%
Seed cost(10kg)	R55.36	R154.29	R88.60
Seed transport cost	R0.00	R75.36	R26.38

5.4. Effects of adoption/non-adoption

The productivity of a new technology may influence its own adoption (Mazuze, 2004). The farmers were requested to provide information about their sorghum output, yield, income and profit generated from sorghum operations. The majority of the total sampled farmers recorded "no profit" from their sorghum output. However, the majority of the hybrid users recorded above average outcome, yield, income and profit more than non-hybrid users. Table 3 illustrates the variations. These high amounts of outputs from hybrid sorghum cultivars might have encouraged the farmers to adopting the technology.

Table 3: Sorghum output, yield, income and profit

Variable	Non-hybrid users n=26	Hybrid users n=14	Total sample n=40
Output (kg)	1556	3783	2396
Yield (kg/ha)	707.2	1401.1	998.3
Farm Income	R1 336.80	R7 756.07	R3 768.88
Average Farm Income	R12 513.60	R25 233.36	R16 706.68
"No" profit	69.2%	42.9%	60.0%
"Yes" profit	30.8%	57.1%	40.0%

5.5. Access to farming land

Hybrid technology is likely to be adopted more extensively by farmers that have large farms (Heisey, et al. 1998). The farmers' access to farming land was tested to establish its relationship with hybrid sorghum adoption. The land was categorised into total farm land and the land available for sorghum production. The participants were asked whether their available land was sufficient for their operations. The majority of the hybrid users were satisfied with the average land available to them. On the other hand, the majority of the non-hybrid users were not satisfied with the land they had at their disposal. Table 4 illustrates the differences among the variables.

The size of farming land appears to have effect on the adoption of the hybrid cultivar. The farmers with small farm land tend not to adopt the hybrid technology. The farmers with sufficient farming land are more likely to adopt the technology. This might be attributed to land being used as security for financial support for improved inputs.

Table 4: Land sizes and its sufficiency

Variable	Non-hybrid users n=26	Hybrid users n=14	Total sample n=40
Average farm size (ha)	2.2	7.5	4.5
Average sorghum area	2.2	2.7	2.5
"No" sufficient land	57.7%	42.9%	52.5%
"Yes" sufficient land	42.3%	57.1%	47.5%

5.6. Effects of new technology on cultural norms and values

In some cultures, some new technologies are rejected as foreign material accompanied by negative effects onto the local traditional resources (Mafata, 2002). To find out whether hybrid cultivars had any relationship with the adoption of hybrid sorghum cultivars, the participants were asked about any negative effects they had on their culture. The following factors were recorded: (1) traditional beer brewed from hybrid sorghum had a different taste and quality; (2) hybrid sorghum produced porridge with unpleasant texture and aroma; (3) hybrid sorghum crop matured and had to be harvested earlier than non-hybrid varieties. As a result, it conflicted with the community's traditional designated harvesting time. Though there is no great statistical significant difference between the variables, this cultural conflict may negatively impact on the adoption of the technology for they may discourage farmers to adopting the technology.

6. CONCLUSIONS AND RECOMMENDATIONS

The findings show that the extent to which extension workers interact with farmers is low for they interact with farmers almost once a year. Most of the interactions are not on individual basis but rather in meetings. The findings therefore highlight a fact that subsistence farmers are less considered when extension contacts are done in the communities. The extension worker/farmer ratio has been found to be very normal. However, their rate of interaction with the farmers remains low. The question remained unanswered is "despite the balanced extension worker/farmer ration, what is it that makes the interaction unbalanced? Extension services need to look into this problem for effective and efficient extension service.

The results of the study may have several implications on policy formulations in various organisations involved in extension service and agricultural development. Most of the organisations that can learn from the results of this study include extension service institutions, farmers' cooperatives such as agricultural co-operatives, financial institutions, farming input supply organisations, and policy makers. These organisations may learn the following lessons:

(1) The need to intensify awareness campaigns and membership drive in rural areas to encourage subsistence farming community to forming or affiliating to agricultural cooperatives so that they enhance their access to farming information as well as to have joint bargaining power for farming services and inputs.

(2) The need to establish credit agencies in rural areas to enhancing the farmers awareness of the credit services and the access thereof.

(3) The need for input suppliers to establishing seed distribution points closer to farming farmers in rural areas. And the need to making small seed packages affordable to subsistence farmers.

(4) The need for policy makers, particularly in Government, to formulating policies that prioritise free access to credit support by rural subsistence farming communities. This strategy worked for Zimbabwe after independence from colonial rule (Rusike, 1998).

(5) The need to advise traditional leaders about hybrid cultivars' growing behaviour relative to their traditional farming practices so that they do not apply such norms and practices to negatively impacting on farming and broader agricultural development in the rural communities.

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