

Predicting Access to Credit By Smallholder Irrigation Farmers: A Logistic Regression Approach

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ABSTRACT This paper assesses socio-economic variables that impact on smallholder irrigation farmers in Vhembe District, South Africa. Although irrigation farmers were selected as units of study, the focus was on all smallholder farmers. Inferential statistical analysis detected a negative impact of educational achievement, investment in production costs, access to market information and membership of cooperative on access to credit.

INTRODUCTION

Failure of large-scale farming to address the plight of the rural poor and thus to bring about anticipated development shifted the policy agendas of many developing countries to supporting the smallholder farming sector, particularly in the 1980s to 1990s. One of the first African countries that adopted this policy was Ghana, in response to observations that rather than encompassing rural masses, large scale farming ended up accruing benefits to fewer rich commercial farmers and bureaucrats (Torah 1994).

At independence in 1994, the government of South Africa (SA) was faced with massive challenges of redressing inequalities within the country's rural landscape that was characterised by large-scale White commercial farming and small-scale Black subsistence farming operating side-by-side. Redressing inequalities entailed concerted efforts at the formulation of policies that would transfer effective support to the latter, including those that are the focus of this study (that is, creating a conducive environment for credit availability, access to markets, promotion of cooperative enterprises, provision of extension services, access to inputs and farmer education). This paper is therefore premised on the economic theory of capital enhancement that supports intervention strategies leading to efficient allocation of resources, increased production and higher welfare (Schallock et al. 1994). Priority is accorded to the contribution of credit provision to smallholder farmers, particularly the extent to which it was impacted by the other support strategies identified above. Lack of credit facilities for smallholder farming in South Africa

was sought to be one major contributing factor towards the collapse of many smaller enterprises and a major cause for higher transaction costs in both input and output markets (Randela et al. 2008; Drimie et al. 2009).

The first major task that was performed by the new SA government within the context of the agricultural sector was to amalgamate the various apartheid created agencies into a single unit (Department of Justice 2011). This paper seeks to evaluate small-scale irrigators within one of the country's rural areas, that is, Vhembe District Municipality (VDM) in Limpopo Province. The central problem to be unravelled centres on the exposition of these support strategies and how they impact on access to credit. In the end both the targeted beneficiaries and government agencies will benefit from subsequent report back sessions to be cascaded within the district. To do justice to such an assessment however, it is imperative to provide an exposé of previous support services as attested by literature. The following section therefore provides a general review of the above mentioned support strategies, prior to articulation of the methodology, results, discussions, conclusions and recommendations based on an empirical study in the VDM.

Some positive spinoffs that emanated from credit provision to smallholder farmers included participation in income generating activities, contribution to total family income and general improvement in the quality of life of rural people (Torah 1994; Ferdoushi et al. 2011). As shown by the study conducted by Torah (1994) credit provision that is attached to funder's pre-conceived outcomes such as shifting crop produc-

tion away from traditional uses could prove detrimental. In response to the failure of large scale commercial farming, the Bangladeshi government [under the auspices of Agricultural Extension Services (AES)] provided credit in kind to smallholders (seeds, equipment, etc.) with the proviso for replacement of traditional staple food crops with high value market oriented commodities. In turn government undertook to procure all high value produce from smallholders at acceptable prices. However factors beyond farmers' control (bad weather, diseases etc.) resulted in low and poor quality crop yields that were unsuitable for the market. As government agencies were reluctant to purchase the crop, higher repayment defaults ensued. Measures instituted by AES to improve repayment rates (group loans, loan delivery via traditional leaders, holding extension staff accountable for loans advanced to smallholders under their supervision) only succeeded in perpetuating the predicament as traditional leaders were also defaulters, whereas extension officers were reluctant to be associated with poor performing smallholders.

Lack of support related to market access is a critical challenge that confronts smallholder farmers in South Africa (Mbatha et al. 2010). These farmers are faced with adverse produce marketing choices that are characterized by many producers and fewer buyers, confining them to be price takers with little opportunity for flexibility as market players. The challenge is further exacerbated by lack of access to market information, a critical factor in the reduction of high transaction costs that are usually associated with agricultural markets (Randela et al. 2008). In response to this challenge some smallholders in South Africa negotiate with bigger supermarkets for preferential procurement of their produce under reasonable price arrangements. Such an arrangement allows smallholders to participate in regional trade as most South African supermarkets have invested extensively in neighbouring countries such as Botswana, Zambia and Namibia (Emongor and Kirsten 2009).

Cooperatives have been recognized in most developing countries as important vehicles for facilitation of both vertical coordination and horizontal integration of smallholder farmers and thus providing them with opportunities for venturing into the mainstream supply chain (Ortman and King 2010; Lyne and Collins 2008). In South Africa, several programmes such as those

inclined towards the provision of direct cash grants, training, business advisory services, access to loans and technical support have been established (DTI 2010 and DWCPD 2011). As advanced by Holloway et al. (1999) and Kherallah and Kirsten (2001) cooperatives assure members uninterrupted supplies of the right inputs at the right time, leading to a reduction in the transaction costs for both input and product markets. Cooperatives are also critical for improving the negotiation power of smaller farmers in comparison to large buyers or sellers. Bulking and bargaining services also enable cooperatives to increase access to market outlets and to avoid the hazards associated with perishability of crops and low rural produce demand. Cooperation also addresses the challenge that usually confronts smallholder farmers particularly in supplying produce that meet the required grades, quality standards and safety regulations (Kherallah and Minot 2001; Mangisoni 2006; Barnard et al. 2002).

Any support strategy that enhances access to educational opportunities will indirectly impact on agricultural productivity. It can therefore be safely concluded that the level of education attained by smallholder farmers will contribute significantly to farm efficiency. Research work has attested to a positive relationship between income generation and the level of education held by smallholder farmers (Hellin et al. 2011; Evenson and Mwabu 2001). This observation has also been confirmed in a South African study on modernizing agriculture, which has shown that the application of technological inputs called for certain skills such as reading instructions on packaging material (Kidane et al. 2005). In addition, as noted by Talimi and Masuku (2010), poorly educated and illiterate farmers were more likely to engage in illegal activities, such as employment of children in their farm production activities. In their study, Talimi and Masuku (2010) found that almost a third of households that engaged child labour were illiterate as compared to a lower proportion of their literate counterparts. Illiteracy amongst smallholder farmers in South Africa is a long-term creation of the pre-1994 apartheid education policy that discriminated against blacks (Jogo and Hassan 2010).

One major concern that impacts on support to smallholder farmers is the dominance of the elderly, especially women, in farming activities

(Blake 2011). In Nebraska for example, the average age of female farmers (59) years) was eight years higher than that of their male counterparts. This is a disturbing observation as individual job performance has been observed to decrease from around the age of 50 years, particularly for tasks that require problem-solving, learning and speed (Verhaegen and Salthouse 1997). Elderly farmers are however desirable in jobs requiring experience and verbal abilities, particularly in maintaining a high level of productivity. Arguments in support of the former observation centre around the slow pace at which elderly people grasp new technological concepts that differ from what they have already mastered as against in those that they had acquired many years of experience (Colonia-Willner 1999). Minois and Boug (1997) also observed age related reductions in memory and learning capabilities among non-human species, ranging from fruit flies to primates. Some recent studies have however negated the hypothesis of an inverse relationship between age and productivity (Nakana and Mkhabela 2011; Barbierie and Mshenga 2008). This paper however subscribes to the former views.

Support to farmers in the form of inputs is also critical for improved farmer participation in farming activities. James et al. (2009) have conveniently grouped agricultural inputs into four categories, namely, land, labour, capital and material inputs. The land input is further sub-divided into pastureland, non-irrigated crop lands and irrigated cropland while labour is usually sub-categorised into family and hired components. James et al. (2009) noted substantial growth in output against declining but high quality inputs. The study also found that labour productivity was positively influenced by higher levels of educational achievements. The positive role of input application to increased agricultural production has also been observed in a Malawian study that sought to improve the distribution of agricultural inputs to rural smallholder farmers (Farrow et al. 2011).

METHODOLOGY

The study was conducted in the Vhembe District Municipality (VDM), which is situated in the northern side of Limpopo Province, South Africa. The district shares international borders with Zimbabwe in the north, Mozambique in the

east and Botswana on the north western side. It is composed of four local municipalities, namely; Makhado, Musina, Thulamela and Mutale. The VDM covers an area of 21 407 km² with a population of over 1.1 million inhabitants. It is predominantly rural with critical basic services backlogs, characterised by semi-arid conditions with rainfall ranging from 300 to 1000 mm per year. Farming under smallholder system is characterized by low levels of production and small farm sizes of approximately 1.5 hectares with production being primarily for subsistence and little marketable surplus. Maize is the dominant cereal grain despite the dry and drought prone agro-ecology of much of the district (Statistics South Africa 2001).

A pilot study that was conducted in April 2011 in Thulamela, one of the Vhembe District Municipality's four local municipalities, on smallholder irrigators (storage dam and borehole dependent) detected challenges regarding the keeping of operational records. Failure to keep proper operational records prevents an assessment of productivity and income generating trends. Following the above pilot study, a cross-sectional survey of smallholder farmers was conducted in the VDM in May 2011. The district had 30 irrigation schemes that were located within the three local municipalities, that is, Thulamela (14), Makhado (9) and Mutale (7). Water sources were mainly storage dams and boreholes. These schemes accommodated 2100 farmers (900 in Thulamela, 700 in Makhado and 500 in Mutale respectively). A multistage clustered random sample of 370 farmers was carried out in the three local municipalities, that is, 162 from Thulamela, 126 from Makhado and 90 from Mutale respectively. In the first stage only smallholder irrigation farmers from the VDM were considered. Secondly smallholder irrigation farmers were selected on the basis of the local municipality in which they were located. The final stage involved selecting approximate proportional samples from three local municipalities since one had no small-scale irrigation farming.

The SPSS Version 19 computer program was used to capture and analyse data. Collected data were subjected to analytical technique that focused on important variables that were identified for the study. A logistic regression model, which considered credit availability as a dependent variable versus age, level of education attained, access to market information, member-

ship to cooperatives and input cost as predictor variables was also run on the basis of the probability equation as derived from the logistic regression model (Field 2005) below:

$$P(Y_i) = 1 / (1 + e^{-b_0 - b_1 AGE + b_2 EDU + b_3 PRDC + b_4 INFO + b_5 MCOP + e}) \quad (\text{Field 2005})$$

Where:

$P(Y_i)$ = Probability of credit being accessed by the i^{th} irrigation scheme leader (1 = accessed credit, 0 = otherwise);

AGE = Age of irrigation scheme leader in years (categorical);

EDU = Level of education attained by irrigation scheme leader (categorical);

PRDC = Production inputs cost (Rand);

INFO = Access to market information (1 = access, 0 = otherwise);

MCOP= Membership to agricultural cooperatives. (1= member; 0 = otherwise);

b_2 to b_6 = Coefficients of the predictor variables;

b_0 = constant; and

e = base of natural logarithm.

Diagnosis of the data was achieved through the log-likelihood and Wald statistics. The log-likelihood ratio is a measure of how well a particular model fits the data by comparing the observed and predicted values of the outcome. For example, for a given irrigation scheme leader, Y could either be 1 (credit has been provided) or 0 (credit was not provided). As noted by Field (2005), the log-likelihood is analogous to the residual sum of squares in multiple regression (an indicator of the extent of unexplained information after fitting the model, that is, larger values of the log-likelihood reflect poorly fitting statistical models). Log-likelihoods of different models are calculated and compared by looking at their differences, that is, comparing the state of a logistic regression model against a baseline, usually the logistic model when only the constant is included. The improvement of the model as additional predictors are added is computed using the following equation (Field 2005):

$$\chi^2 = 2[LL(\text{New}) - LL(\text{Baseline})]$$

$$(\text{df} = k_{\text{new}} - k_{\text{baseline}})$$

Table 1: Logistic regression model results

Variables	\hat{a}	Std error	Wald	Significance	Exp (\hat{a})
Age	0.11	0.014	0.635	0.425	1.012
Level of education	-2.992	1.049	0.635	0.004	0.050
Production cost	-0.510	0.024	4.645	0.031	0.950
Access to info	-3.667	1.136	10.427	0.001	0.026
Co-op member	-0.223	0.830	0.073	0.788	0.800
Constant	5.174	1.310	15.608	0.000	176.698

Nagelkerke $R^2 = 0.234$; Cox and Snell $R^2 = 0.076$; Hosmer and Lemeshow Test: $\chi^2 = 2.81$; $\text{df}=8$; $p=0.946$; $n=370$; Dependent variable= access to credit.

(multiplication of the value by 2 produces a χ^2 distribution, and k = degrees of freedom).

Whereas in linear regression the estimated regression coefficients (b 's) and their standard errors are used to compute the t-statistic, an analogous statistic for logistic regression is the Wald statistic, with its special distribution (the chi-square distribution). The Wald statistic reflects whether the b-coefficient of the predictor variables are significantly different from zero, that is, if significantly different, then the predictor is assumed to be making a significant contribution to predicting the outcome (Field 2005).

RESULTS

The output of the logistic regression model is presented in Table 1. The model was run to assess the relationship between access to credit (dependent variable) and five predictor variables that is, age, level of education, membership to agricultural cooperatives, access to market information and production costs, following the elimination of some highly insignificant variables.

As can be observed from Table 2, the model correctly predicted 95.40 % of the cases. The Hosmer and Lemeshow test produced a Chi squared value of 2.81 with a p-value of 0.95, in-

Table 2: Observed versus predicted probabilities for access to credit

Observed	Predicted			% Correct
	Access to credit			
	Yes	No		
Access to credit	Yes	1	17	5.6%
	No	0	352	100%
Overall percentage				95.4%

Source: Study Results 2011

dicating that the model's predicted estimates did not differ significantly from the observed data and thus an indication of an acceptable goodness of fit (Field 2005). The high Wald statistics for production cost and access to market information variables depict that their b-values are significantly different from zero, thus making a significant contribution to credit access.

The categorical variable EDU had two sub-categories (having secondary education) and (having tertiary education) being compared to a base category of no education/primary education only. From the results in Table 1, it can be seen that production cost and having both secondary and tertiary education, negatively affected access to credit. The more educated a farmer was the less likely for him or her to have accessed credit since having secondary or tertiary education both affected credit access negatively relative to no education at all. Being a member of an agricultural cooperative also had a negative impact on farmers' access to credit although this variable was not significant. Age, although not significant had a positive impact on the likelihood of accessing credit.

A priori expectations were that access to credit would be positively influenced by all the variables. The negative impact of both higher educational attainment and membership to cooperatives was unexpected. Farmers that have been exposed to higher educational opportunities and membership to agricultural cooperatives were expected to be conversant with the associated beneficial effects. However, in this study, most irrigation scheme leaders were not only poorly educated but were also elderly, factors that impact negatively on access to new information and promotion of active economic participation in farming.

DISCUSSION

The observation that the leadership of most irrigation schemes had acquired primary education, with a large proportion that was illiterate, translates into a number of bottlenecks for future sustainability of the agricultural sector. In the first instance such leaders will be denied access to published information particularly related to produce market activities and price trends. National Fresh Produce markets and parastatals such as the National Marketing Council in South Africa publish vital market related data

that farmers could take advantage of on a daily basis. Such data can only be accessed by farmers who are not only literate but also exposed to secondary and tertiary educational opportunities. Low educational achievement as attested through descriptive statistical analyses for this study could be associated with reliance on other farmers and dependence on the already glutted local market for disposal of produce. Consequently, due to large numbers of sellers and a relatively low customer base, farming enterprises that target such a market are bound to be price takers with high attrition rates.

Poor access to credit as noted for this study has negative consequences for the sustainability of smallholder farmers in the VDM. Almost all (save for about 5%) relied on own funding for their farming activities. Although lack of collateral (a characteristic of most smallholders farming) could be attributed to this observation, the dominance of the elderly and a high combination of leaders with lower educational qualifications or illiteracy cannot be excluded. A study conducted in Pakistan noted that increasing access to credit was not only associated with increasing technical efficiency, but also that farmers who had access to the resource were more efficient (technical efficiency score of 0.8 and above) than their counterparts (technical efficiency score of 2.0) (Ayaz et al. 2010). Through the application of the Tobit model to collected data, that study identified farming experience (5% level of significance) and number of schooling years (5% level of significance) as additional contributors to technical efficiency of farmers.

Agricultural cooperatives have been considered as important vehicles for the provision of affordable inputs, market access and technical production skills to farmers. Inappropriate access to formal produce markets by small-scale irrigators in the VDM could be linked to the high level of non-membership to agricultural cooperatives. Effective membership is based on the extent to which potential benefactors are exposed to the principles and perceived advantages of cooperation. The revelation from literature regarding access to government funding as a precursor to the formation of cooperatives, needs urgent attention and complete reversal. For effective participation, members should not only be educated but also exposed to productivity-enhancing mechanisms such as extension

services. As this study has clearly articulated, these are limiting factors in the Vhembe District. One critical principle of cooperation relates to internal rather than external drive in the establishment of cooperatives. The observations for this study regarding the few members that had affiliated to local primary cooperatives and the derivation of minimal benefits from such affiliation attest to external influence in the formation of most cooperatives in the VDM. As reflected in the literature review above, most cooperatives in South Africa were initiated in order to source government funding. As soon as such funds dry-up, the affected cooperative enterprises cease to exist.

CONCLUSION

The main objective of this paper was to assess the support provided to smallholder irrigation farmers especially in the Vhembe District Municipality, South Africa. Some support strategies that the study assessed included credit provision, extension services, access to markets and membership to agricultural cooperatives. A multistage random selection process yielded a sample of 370 small scale irrigation schemes scattered in three of the four local municipalities of the district. A pre-piloted questionnaire was administered to the leadership (either chairperson or his/her representative) of the irrigation schemes. The gender, education level and age of the respondents were also considered as important variables for assessing demographical impact on service provision. The collected data were captured and analysed through the SPSS version 19 computer programme. A logistic regression model that considered credit availability as a dependent variable and seven other variables (age, level of education attained, gender, extension services, market information, membership to cooperatives, production costs.) as predictor variables was fitted into the data. Through an elimination process, a number of variables were omitted from further analyses due to their insignificant predictive powers to the model.

Reducing the dominance of the elderly (65 years and above) will be a daunting task as many retirees look upon farming as an alternative to active participation in the formal job market. Exit strategies from the formal job market should therefore include workshops that would discourage new retirees from investing their life-long sav-

ings into new farming ventures as these will require physical strength and high level decision making skills. Retirees should instead be encouraged not only to look upon retirement as a period of rest but also as an opportunity to hand over existing farming ventures to their siblings. The benefactors (young farmers) should be exposed to training programmes and support mechanisms such as cheap finance, government grants and gradual exposure to private funding institutions.

In the earlier years of their retirement, elderly farmers could be critical in monitoring and transmission of skills to younger farmers. As income from farming only accrues in the medium to long term, one strategy that could be used to attract youth into farming could be the provision of allowances - consistent with that prevailing in the formal job market. Perhaps the most critical challenge that prevents elderly farmers from abandoning their farming ventures could be linked to asset ownership and associated loss of esteem. To counteract the challenge, elderly farmers could be encouraged to hire out their farms to unemployed university and college graduates that are widespread in the VDM and other regions of South Africa. Targeted graduates should undergo relevant training in entrepreneurship, financial management and market development. Finance should initially be provided to cover both rental and living expenses for a predetermined period aligned to produce market readiness.

RECOMMENDATIONS

The high proportion of irrigation schemes lacking membership to agricultural cooperatives could be associated with lack of knowledge regarding benefits that can be derived from these business entities. Rather than encouraging farmers to form cooperatives in lieu of grant funding, public agencies should utilize their extension officials to expose farmers to the principles of cooperation as espoused by the International Cooperative Alliance (ICA) and the SA Cooperatives Act of 2005. In particular cooperatives should be established on the basis of perceived internal benefits rather than extrinsic rewards.

Reliance on other farmers for market information should be mitigated through exposure to formal produce channels, especially fresh produce and export markets. The role of public agen-

cies, particularly in exposing farmers to new technologies such as market based computer websites and cell phones, could be vital in opening up new markets for smallholder irrigation schemes in the Vhembe District.

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