

Full Length Research Paper

Technical efficiency in input use by credit and non-credit user emerging farmers in Maruleng Municipality of Limpopo Province, South Africa

M. H. Lefophane^{1*}, A. Belete¹ and I. Jacobs²

¹Department of Agricultural Economics and Animal Production, University of Limpopo, P. Bag X1106 Sovenga 0727, South Africa.

²Water Research Commission, Private Bag X03, Gezina, 0031, South Africa.

Accepted 29 April, 2013

This study examined the relative technical efficiencies in input use by credit and non-credit user farmers in Maruleng Municipality of Limpopo Province, South Africa. The differentials in the technical efficiency levels of maize and green beans farmers were examined. The study used primary data collected from a stratified random sample of 72 emerging farmers of which 32 were credit users and the remaining 40 were noncredit users. Data were analyzed using Cobb-Douglas Production function model. All the variable inputs examined were statistically significant for both credit and non-credit users except pesticides and irrigated land inputs for maize farmers. The results of the study revealed that technical efficiency levels between credit users and non-credit users is too wide being 9.843 for credit users and 2.892 for non-credit users. The implication for this is that, the odds of being efficient is related to credit use and thus credit is a necessary tool to improve farmers' technical efficiency levels. The study, therefore, recommends that the existing farm credit system including other agricultural programmers' should be reviewed, refocused, and be more accessible to emerging farmers in order to improve efficiency in the input use by emerging farmers.

Key words: Technical efficiency, credit use, emerging farmers.

INTRODUCTION

Agriculture is the backbone of South Africa's economy and will continue to be so in the foreseeable future. This includes Limpopo Province and more especially Maruleng Municipality where agriculture is the main source of income and employment for the majority of residents (Roth and Haase, 1998). In addition, agriculture, in general, has an important role to play in the economy through the development of emerging farmers and alleviation of poverty. In order for emerging farmers to exit the poverty cycle and experience sustainable

economic growth through increased employment and productivity, support services such as access to credit, training and capacity building need to be created for the emerging farm sector (Fairlamb and Nieudwoudt, 1990).

According to Makhura et al. (1996) and Niewoudt (2000) the concept of emerging farmer is understood to refer to farmers who have desire to increasingly commercialize their production. Emerging farmers, in South Africa, are seen as representing evolutionary step on a linear development trajectory from subsistence

*Corresponding author. E-mail: Hildah.Lefophane@ul.ac.za. Tel: +27152682731, +2773817973.

farmer to emerging farmer and finally to commercial farmer. Therefore, access to credit is a key determining factor of emerging farmer success in South Africa. Formal financial institutions provide agricultural credit for the purposes of production and development. Agricultural credit is offered specifically for the purchase of agricultural inputs including seed, fertilizer, plant protection chemicals, poultry/animal feeds and medicines, water charges, labour etc. while on the other hand, development loans are supplied for the purchase of agricultural equipment such as tractors, cutter binders, threshers, trolley, and installation of tube walls, spray machines among others (Hanif et al., 2004).

In South Africa, some of the parastatal credit institutions that were established in the former homelands have collapsed as a result of agricultural transformation in the country, thus leaving emerging farmers without access to credit. The Land Bank, South Africa's primary formal agricultural credit institution was expected to fill the gap and hence a problem was created by the demise of homelands parastatals (Machete, 2004). However, studies by Hedden-Dunkhorst et al. (2001) and Machete (2004) indicated that the Land Bank is not able to reach all the small farmers and emerging farmers with loans since the majority of the small farmers and emerging farmers still do not have access to the credit.

In 2005, the government established Micro Agricultural Financial Institutions of South Africa (MAFISA), after identifying that insufficient progress has been made in improving access to credit by small-scale farmers (DBSA, 2005). The launch of MAFISA pilot project was considered as a great initiative as its objectives went beyond lending and includes: (a) to test delivery systems and channels (b) to identify problem areas for solution prior to full rollout (c) to determine the acceptability of terms in the market, and (d) to obtain information on performance for future business case projections [National Department of Agriculture (NDA), 2006]. The relationship between credit and efficiency had been studied by Hussein and Ohlmer (2006), Omonona et al. (2010), Saima et al. (2010) and others. Nwaru et al. (2006) examined the relative efficiencies of credit using and non-credit using farmers in resource use in Imo state, Nigeria. The results of the study revealed that credit using farmers are more technically efficient than their non-credit using counterparts.

In another study, Nwaru and Onuoha (2010) assessed the impact of credit use on the technical efficiency of smallholder food crop farmers in Imo State of Nigeria. The results of the study indicated that food crop farmers producing without credit perform better than their counterparts producing with credit. The results were contrary to *a priori* expectations but agreed with the result from Okike et al. (2001) who reported that receiving credit contributed to farmers' inefficiency. This could be as a result of disbursement of credit in cash rather than in kind or agricultural loan misuse as a result of resource poverty

The question that this paper seeks to answer is: Is

There any difference in technical efficiency levels of credit and non-credit user emerging maize and green beans farmers in Maruleng Municipality? The study basically examined the relative technical efficiencies in input use by credit and non-credit user emerging maize and green beans farmers in the study area. Technical efficiency is defined as the ability to attain the highest level of output with available resource inputs; while allocative efficiency is the ability to obtain optimal input levels for given resource factor prices (Xu and Jeffrey, 1997). Economic efficiency is the combination of both technical and allocative efficiencies (Mushunje et al., 2003). A study on the measurement of economic efficiency is therefore incomplete without a study of technical efficiency (Elsamma and George, 2002). This study looked at technical efficiency since it is an important subject in developing agriculture where farmers are constrained by socio-economic conditions and use limited resources at their disposal and need external support from government to move from small-scale to commercial production. The study on the technical efficiency of emerging farmers in South Africa is relevant because the government's land reform programme is aimed at increasing efficiency in food production. As argued by Van Zyl et al. (1996), the efficiency of land reform relates to the increased redistribution of agricultural land to small holders and total factor productivity and efficiency in the long run. The rationale for the study derives from the need to determine the extent to which credit access has been able to meet the capital needs of emerging farmers and improve their technical efficiency levels.

Maize was used in the study because it is the main staple food of emerging farmers in the studied area and constitutes a large percentage of the total grain production in South Africa, while green beans was used because it is the main crop that brings additional cash income for emerging farmers in the study area. However, this does not conclusively suggest that emerging farmers are not involved in other crop production activities.

This study specifically estimated the relative technical efficiencies of credit and non-credit user emerging maize and green beans farmers as well as relative elasticity of production. It also determined the returns to scale of the defined maize and green beans farmers and estimated technical efficiency indices of the different resource inputs applied in the maize and green beans farming business.

METHODOLOGY

Study area and data analysis

The study was conducted in the Maruleng Local Municipality (MLM) of Limpopo Province in South Africa. In terms of its location, Maruleng Municipality is situated in the South Eastern quadrant of the Limpopo Province within the Mopani District Municipality. The Municipality borders the Greater Tzaneen and Ba-Phalaborwa

Table 1. Production function estimates of maize production by credit and noncredit user emerging farmers.

Variable	Credit user emerging farmers			Non-credit user emerging farmers		
	Parameter	Standard value	T- error	Parameter	Standard value	T- error
Constant	0.6860	0.48	1.43	0.145	0.14	1.04
Ln of Land (Ha)	0.836	0.35	2.39	0.726	0.49	1.48
Ln of Labor (man-days)	0.425	0.11	3.86	0.435	0.12	3.63
Ln of Capital (Rands)	0.693	0.49	1.42	-0.453	0.24	-1.89
Ln of Fertilizer (Kg)	0.748	0.39	1.92	-0.165	0.17	-0.97
Ln of Pesticides (Rands)	0.465	0.20	2.33	0.023	0.02	1.15
Ln of Seed (Kg)	-0.156	0.17	-0.92	-0.128	0.22	-0.58
Ln of Irrigated land (Ha) as proxy for irrigation water	-0.039	0.02	-1.95	-0.07	0.05	-1.40
Sum b's	3.658			0.513		
Adjusted R ²	0.72			0.452		

Municipalities in the north area and Bushbuckridge on its south area. Maruleng Municipality is described as predominantly rural Municipality with an estimated population of approximately 106,247 residents (MLM, 2010). Agriculture in Maruleng Municipality is characterised by commercial production of mangoes and citrus, and subsistence and small-scale farming of staple food crops (that is, maize), and a variety of other crops such as green beans, potatoes, spinach, sweet potatoes, cabbage, pepper, tomatoes amongst others (MLM, 2008).

The study used primary data which was collected in 2011 through field survey using structured questionnaires. Emerging farmers were identified first with the assistance of Limpopo Department of Agriculture (MLM). Since it is not possible to collect data on all crops grown by emerging farmers, hence it was necessary for the study to target its analysis to two commonly produced crops (that is, maize and green beans) in the study area.

Stratified random sampling technique was used in data collection to classify credit and non-credit users of formal agricultural credit. A total sample size of 72 emerging farmers who grow both maize and green beans was used. Out of this total 32 emerging farmers were credit users and 40 were non-credit users. The data for the study were collected using a structured questionnaire which subsume quantity of maize and green beans produced (in kilogram), inputs used including land, seed, fertilizer, labor, pesticides, capital, and irrigated water.

Data analysis

Cobb-Douglas regression analysis for credit users and non-credit users was carried out for each of the group producing each of the targeted crops. This provided the empirical information on the differential technical efficiency in input use by credit and non-credit users. The operational model for each of the credit and non-credit users relating to the production of Y, to a given set of resources X, and other conditioning factors is given as follows:

$$Y = aX_1^{\beta_1} X_2^{\beta_2} X_3^{\beta_3} X_4^{\beta_4} X_5^{\beta_5} X_6^{\beta_6} X_7^{\beta_7} u \quad (1)$$

In order to be able to use the ordinary least squares (OLS) procedure for estimating, the function is linearized using logarithm and gives the following regression specification:

$$\ln Y = b_0 + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + b_7 \ln X_7 + u \quad (2)$$

Where, output (Y) is the total quantity of maize/green beans

produced per hectare; it is measured in kg per hectare. Land (X_1) is the total area of the farm(s) devoted to the production of maize/green beans, measure in (ha); Labour (X_2) is the total amount of labour used in the production of maize/green beans, measure in (man days); Capital (X_3) to present capital, tractor cost per ha was used; Fertilizer (X_4) includes both basal and top dressing fertilizers and it is measured in kilograms; Pesticides (X_5) is pesticides cost, measured in Rands. Seed (X_6) are considered and measured in kilograms; Irrigation water (X_7) is the amount of water used for irrigation. However, irrigated land, was used as a proxy for the amount of water used for irrigation. The reason for this is due to shortage, unreliable and inconsistent information which resulted in inability to quantify the amount of water (in liters or inch) used for irrigation. Finally, u is the disturbance term; $b_1, b_2, b_3, b_4, b_5, b_6$ and b_7 are elasticities to be estimated.

RESULTS AND DISCUSSION

Estimates of the production functions

The estimated production function by Cobb-Douglas analysis for the credit and non-credit user emerging farmers is summarized and presented in Tables 1 and 2. The adjusted R² for the four production function for credit and non-credit users varies from 0.452 to 0.783 indicating that the explanatory variables included in the model explained about 45 to 78% of the variation in maize and green beans, respectively for credit and non-credit users. The adjusted R² for maize farmers was found to be relatively lower than that of green beans farmers. The reason for this is that, irrigated land variable was found to be insignificant for maize farmers. The insignificance of irrigated land input was due to the fact that most farmers in the study area usually cultivate maize under dry land conditions.

Elasticities of production

According to Truran and Fox (1979), an elasticity of production coefficient for an individual input indicates the percentage increase/decrease in output that will result if

Table 2. Production function estimates of green beans production by credit and non-credit user emerging farmers.

Variable	Credit user emerging farmers			Non-credit user emerging farmers		
	Parameter	Standard value	T- error	Parameter	Standard value	T- error
Constant	0.686	0.36	1.74	0.576	0.20	2.88
Ln of Land (Ha)	0.589	0.32	1.84	0.498	0.19	2.62
Ln of Labor (Man-days)	0.513	0.22	2.33	0.425	0.21	2.01
Ln of Capital (Rands)	0.566	0.29	1.95	-0.499	0.26	-1.92
Ln of Fertilizer (Kg)	0.806	0.50	1.61	-0.098	0.08	-1.23
Ln of Pesticides (Rands)	0.691	0.45	1.54	-0.134	0.03	-4.47
Ln of Seed (Kg)	0.638	0.39	1.64	0.521	0.12	4.34
Ln of Irrigated land (Ha) as proxy for irrigation water	-0.462	0.15	-2.66	-0.366	0.14	-2.61
Sum b's	3.969			0.923		
Adjusted R ²	0.78			0.64		

the particular input is increased/ decreased by one percent, holding all other inputs constant.

Cobb-Douglas regression results on elasticity of production indicated that, land, fertilizer, pesticides, labor, seed, and irrigation water significantly influence output. In addition, only land and labor inputs were positive for both maize and green beans farm credit users and non-farm credit users. These results suggest that an efficient use of this input will result in greater production of maize and green beans.

The elasticities of fertilizer and pesticides were found to be significant but negative for green beans non-credit user farmers. From these results, it could be deduced that non-credit users were unable to purchase these inputs needed to enhance crop output and as a result their output was on the lower side.

Returns to scale

Returns to scale for each credit users and non-credit users was calculated by adding up the coefficient for elasticity of each group. The sum was then used as an indicator of whether or not farmers exhibit constant, decreasing or increasing returns to scale. According to Cornia (1985), as quoted by Mushunje (2001), constant returns to scale are assumed to occur when the sum of the coefficient falls within the interval 0.95 to 1.05 and below 0.95 or above 1.05 for decreasing and increasing returns to scale, respectively.

The results from Tables 1 and 2, indicate that maize and green beans credit users exhibit an increasing returns to scale with value of 3.658 and 3.969, respectively. This indicates efficiency as they are producing more output using fewer inputs. These results are not surprising since credit users would like to maximize profit by producing more at low cost and be able to pay the loan.

It is also noted that the returns to scale of green beans credit users is relatively higher than that of maize credit

users. The reason for this might be due to the fact that green beans farmers in the sample size are more profit oriented than maize farmers, that is; green beans farmers produce for income generation while maize farmers tend to produce for subsistence purpose and sell only a small part of their produce.

Maize non-credit users exhibit decreasing returns to scale (0.513). The results implies that farmers in the study area produce maize for subsistence purpose and only sell surplus maize and non-credit users usually do not apply fertilizer, pesticides and only plant maize under dry land conditions. Non-credit users producing green beans exhibit a decreasing return to scale (0.923). This indicates inefficiency in production since they are producing less output. The implication for this is that, non-credit users might not have enough funds to purchase fertilizer, pesticides, which are crucial in green beans production.

Relative technical efficiency analysis

Since the aim of the study is to examine relative technical efficiencies of credit and non-credit users of agricultural credit, the study employed Saleem's (1988) approach. This method was developed by Lau-Yotopoulos. The method uses Cobb-Douglas production function which is specific to have variables and one fixed input. From the Cobb-Douglas function $Y = AL^{\alpha}K^{\beta}$, A (intercept) indicates the technology of the group that generated the observation upon which the parameters of the function were to be estimated. The higher value of the intercept, the more positively it affects the yield. As a result, the farm with higher intercept value is more technically efficient. The Cobb-Douglas production function is specified to have a set of variable inputs and a set of fixed inputs. Since, in this study two credit status groups were considered (that is, credit and non-credit users); credit users are denoted by superscript 1 and non-credit users are denoted by superscript 2.

Table 3. Relative technical efficiencies of credit and non-credit users.

Credit status group	Maize production	Green beans production
Credit users	6.776	9.843
Non-credit users	2.892	3.567

The following production functions are developed: $Y^1 = A^1 F(X^1, Z^1)$ and $Y^2 = A^2 F(X^2, Z^2)$ Where: Y^1, Y^2 is the output of maize and green beans, respectively. A is a constant, the technical efficiency parameter which incorporates other factors such as managerial capacity and environmental factors. F is the functional relationship between inputs and outputs. X is the set of variable inputs. Z is the set of fixed inputs. The numbers 1, 2 are superscripts denoting the credit and non-credit users. As a result relative technical efficiency measure for the study is thus shown by the intercept in the model.

The relative technical efficiency estimates of borrowers and non-borrowers were derived, summarized and presented in Table 3. Table 3 reveals that the level of technical efficiencies varies widely; being 9.843 for green beans farmers who use credit and 2.892 for maize non-credit users.

The results also revealed that technical efficiency levels of credit and non-credit users is too wide and that technical efficiency level of green beans and maize credit users is significantly higher than those of their non-credit users counterparts. From the results, it may be stated that the technical efficiency level of credit users is significantly higher than those of non-credit users. This indicates that credit users are more technically efficient than their non-credit users' counterparts. The implication for this is that, the chance of emerging farmers being efficient increases with their credit access. The results of the study is consistent with those of Nwaru et al. (2006) who found out that the mean technical efficiency of 10 best performing credit using farmers was significantly higher than those of 10 best performing non-credit using farmers.

These results should however not be overstated due to the fact that there are other factors that explain technical efficiency but were not considered due to the scope of the study. All unexplained factors which were not considered in the study might also contribute to measured inefficiency. It should also be noted that there are a number of crops that emerging farmers in the study area produce, but only maize and green beans were looked at. If the value of all crops had been pooled together for estimation, different values of technical efficiency may have been observed. Despite these, the results of the study is further supported by Desai and Mellor (1993), and Nwagbo (1989) who stated that, farm level credit when used properly encourages agricultural diversification which stabilises and increases resource productivity, agricultural production, value adding, net farm income and therefore facilitate adoption of

innovation in farming, encourage capital formation and market efficiency.

It is interesting to observe higher technical efficiency in green beans production. The implication for this is that green beans producers are relatively more technically efficient than maize producers. This is due to the fact that emerging farmers in the study area generally produce green beans for income generation and produce maize for home consumption and only sell surplus maize.

CONCLUSION AND RECOMMENDATIONS

The general conclusion that have emerged from this study is that credit, although is not a direct factor of production, can help farmers to purchase inputs needed in the production process and thus a necessary tool for improving farmers' technical efficiency level. Therefore, the study recommends that existing agricultural credit programmes and other programmes that impact on the efficient disbursement of agricultural credit be reviewed refocused and be more accessible to emerging farmers in order to improve efficiency in the input use by emerging farmers.

ACKNOWLEDGEMENT

The authors would like to thank the South African Council for Scientific and Industrial Research/Water Research commission (CSIR/WRC) for the role they have played in soliciting and funding a research project upon which this paper is based. Specifically, the paper is based on research conducted on the project, An Investigation of Water conservation in food Value Chains by Beneficiaries of Water allocation Reform and Land Reform Programmes in south Africa" (K5/1958/4). More information on these and similar projects can be found at the WRC's website: <http://www.wrc.org.za>.

REFERENCES

- Desai BM, Mellor JW (1993). Institutional Finance for Agricultural Development: An Analytical Survey of Critical Issues, Food Policy Review 1, Washington: Int. Food Policy Res. Inst.
- DBSA (2005). "Road To Recovery" Conference Wellness Strategies Breakout Session III Supplemental Information.
- Elsamma J, George MV (2002). Technical efficiency in rice production: A frontier production function approach. *Agric. Econ. Res. Rev.* 15:50-55.
- Fairlamb CD, Nieuwdoudt WL (1990). Economic factors affecting human fertility in South Africa: A Policy perspective. *Agrekon* 29:284-289.

- Hanif M, Khan S, Nauman F (2004). *Agricultural perspective and policy*. ISBN 969-8581-06-5. Ministry of Food, Agriculture and Livestock (MINFAL), Islamabad.
- Hedden-Dunkhorst B, Mathonzi T, Mphahlele R (2001). Institutional Transformation of small-scale irrigation farming in South Africa. *Agrekon* 40:60-75.
- Hussein HK, Ohlmer BO (2006). Influence of Credit Constraint on Production efficiency of Farm Households in Southerneastern Ethiopia. *Ethiop. J. Econ.* 15:1-34.
- Machete CL (2004). Agriculture and poverty in South Africa: can agriculture reduce poverty? Paper presented at the Overcoming Underdevelopment Conference, Pretoria, South Africa.
- Makhura MT, Coetzee GK, Goode MF (1996). Commercialization as a strategy for reconstruction in agriculture. *Agrekon* 35:1-72.
- Maruleng Local Municipality (MLM) (2008). *Integrated Development Plan*.
- Maruleng Local Municipality (MLM) (2010). *Integrated Development Plan*.
- Mushunje A, Belete A, Fraser G (2003). Technical efficiency of resettlement farmers of Zimbabwe. Contributed Paper Presented at the 41st Annual Conference of the Agricultural Economic Association of South Africa (AESAs), October 2-3, 2003, Pretoria, South Africa.
- Mushunje MT (2001). Women's Land Rights in Zimbabwe.
- Machete CL (2004). Agriculture and poverty in South Africa: CAN agriculture reduce poverty?1
- National Department of Agriculture (2006). www.nda.agric.za/docs/definition%comm%20%20subsistence. Accessed on June, 2010.
- Niewoudt WL (2000). An economic evaluation of a crop insurance programme for small-scale commercial farmers in South Africa. *Agrekon* 29:269-291.
- Nwaru JC, Onyenweaku CE, Nwosu AC (2006). Relative technical efficiency of credit and non-credit user crop farmers. *Afr. Crop Sci. J.* 14:241-251.
- Nwaru JC, Onuoha RE (2010). Credit Use and Technical Change in Smallholder Food Crop Production in Imo State of Nigeria. *NY. Sci. J.* 3:144-151.
- Nwagbo EC (1989). Impact of Institutional Credit on Agriculture in Funtua Local Government Area of Katsina State; Nigeria. *Samaru. J. Agric. Res.* 6:75-86.
- Okike I, Jabbor MA, Manyong V, Smith JW, Akinwumi JA, Ehui SK (2001). Agricultural Intensification and Efficiency in the West African Savannahs: Evidence from Northern Nigeria. *Socio economics and Policy Research Working International Livestock Research Institute (ILRI)*, Nairobi, Kenya. P. 33.
- Omonona BT, Lawal JO, Oyinlana AO (2010). Determinants of Credit Constraints Conditions and Production Efficiency Among Farming Households in Southwestern Nigeria. *Soc. Sci.* 5:326-331.
- Roth M, Haase D (1998). Land tenure security and agricultural performances in Southern Africa. *Land Tenure Centre, University of Wisconsin, Madison, United States*.
- Truran JA, Fox RW (1979). Resource Productivity of Landowners and Sharecroppers in the Cariri Region of Ceara Brazil. *Land Econ.* 55:93-107.
- Saima A, Zakir H, Maqbool HS (2010). Role of Credit on Production Efficiency of Farming Sector in Pakistan: A Data Envelopment Analysis. *World Academy of Science. Eng. Technol.* 66:1042-104.
- Van Zyl J, Kirsten J, Binswanger H (1996). Introduction. In: Van Zyl j, Kirsten J, Binswanger H. *Agricultural Land Reform in South Africa: Policies, markets and mechanisms*. Oxford University Press, Cape Town, South Africa.