Entrepreneurship and Efficiency of Smallholder Maize farmers: The Case of Eastern Cape Province of South Africa

Douglas Kibirige

Department of Agricultural Economics and Management, University of Eswatini, Eswatini (Swaziland), P.O. M205, Luyengo, Eswatini

Corresponding author: Dr. Douglas Kibirige (PhD)

Abstract

The South African government has invested substantial amounts of funds to improve the entrepreneurial environment for economic growth and rural development through development programmes. Among the beneficiaries of this support include the smallholder agricultural sector through government's provision of input subsidies, farm implements, land retribution programmes and revitalization of smallholder irrigation schemes. Despite the interventions, less impact has been realized and this partly explains the fact that South Africa is still ranked among countries with the lowest successful entrepreneurial activity. Therefore, this study identified a need to establish the level of entrepreneurial spirit, determinants of entrepreneurial spirit and its impact on production efficiency among smallholders. The study was conducted at Qamata and Tyefu irrigation scheme. Primary data was collected using a well-designed structured questionnaire. The total sample size of smallholder farmers interviewed was 108, and descriptive statistics, factor analysis, and stochastic frontier analysis were among the methods used to achieve the set objectives.

This study established that there is low entrepreneurial spirit among smallholder farmers, and most of them being risk averse. The factor analysis method yielded three principal components related to farmers' entrepreneurial spirit and these included risk taking, innovativeness and recognition of farm business opportunities. Farmer/farm characteristics related to farmers' entrepreneurial spirit included farmer's age, education level, major occupation, farming experience, farm incomes, remittances, social grants and pension, source of irrigation water, and location of the irrigation scheme. The results of this study indicated that smallholders are technically inefficient at 44% in maize production. Farmer/farm characteristics responsible for this inefficiency included crop incomes, farming experience and location of the irrigation scheme. Considering the entrepreneurial spirit, smallholder farmers exposed to high risks with less recognition of opportunities are more likely to be technically inefficient. The key policy recommendations for improved entrepreneurial activity and technical efficiency include improved human capital through farmer trainings in

efficient farm production and business management, expansion of the irrigated farm land, and more investments in forward and backward linkages in the agribusiness sector.

Keywords: *Entrepreneurship; technical efficiency; smallholders; smallholder irrigators; stochastic frontier analysis.*

1. Introduction

Entrepreneurship is believed to plays a critical role in catalysing jobs creation, innovation, and enhances productivity and economic growth (McElwee, 2005; LEISA Magazine, 2009; Modiba, 2009; Sudharani, 2010; Masaviru, 2011; and Ndou, 2012). In developed countries like United States of America endowed with high entrepreneurial spirit, there are over 3.5 million businesses established annually and hence providing employment to millions of people (Modiba, 2009). In agriculture, entrepreneurial spirit has a potential of increasing productivity both in forward linkages and backward linkages and avail employment opportunities along the value chain. The concept of entrepreneurship was introduced by economist like Schumpeter (1942) and Hayek (1937). Schumpeter (1942) viewed an entrepreneur as an agent of change who innovate new product or production processes or new sources or goods ("gets new things done.") while Hayek (1937) urged that an entrepreneur is an agent who adjust his/her production based on the new information or knowledge of facts, or newly-perceived changes in the plans of other market participants. Although attempts have been made to define entrepreneurship, it has no definite definition (McElwee, 2005; Modiba, 2009; Sudharani, 2010).

Einstein College of Engineering (2011) defined entrepreneurship based on the entrepreneurs' activities or as a person endowed with knowledge, skills, initiative and spirit of innovating to achieve his/her set goals. Some of these activities may include initiation, risk calculation, resource mobilisation and setting up new businesses through innovations to meet a defined market demands. The Schumpeterian school of thought may define an entrepreneur as an economic agent who combines resources by all means of production to maximize profit. Entrepreneurship can also be defined as a continuous process which aids the entrepreneur to cause changes and innovation in production, mobilize and create new production methods, and new markets among others Sudharani (2010). Based on the definitions, entrepreneurial spirit can therefore be measured by estimating the individual's ability to take risks, innovativeness and pro-activeness (Optimistic) (Modiba, 2009). Further, entrepreneurship

success is dependent on optimal utilisation of a combination physical and financial capital (Sudharani, 2010).

According to GEM (2011), entrepreneurial activity can be enhanced through improved infrastructure development, quality of the population in terms of skill building, research and development, and technology advancement. Further, availability of flexible labour markets, relatively efficient inputs/output markets, and financial market flexibilities within the location of operations are essential for a better entrepreneurship environment. Successful entrepreneurs are considered to be more efficient in utilising available resources and they ensure product quality enough to fetch more profits. According to Modiba (2009), agribusiness entrepreneurs are faced with increasing challenges in input/output prices, changes in trade policies and stiff environmental regulatory policies. In order to respond to these challenges, entrepreneurs' need to be innovative, risk taking, recognise opportunities, and strive to ensure a balance between people, policies and natural environment for a sustainable agribusiness sector (Modiba, 2009).

Although the Global Entrepreneurship Monitor (GEM) used the World Economic Forum's (WEF) classifications to categories South Africa among the efficient-driven economies, the rural resourced-poor households in this country can be classified among the factor-driven economies (GEM, 2011). The factor-driven economy is characterised by mainly subsistence agriculture and extraction businesses with a heavy reliance on unskilled labour and natural resources (GEM, 2011). As a way of boosting entrepreneurial activity in the factor-driven economy, the South African government allocated vast financial resources to catalyse the establishment of self-owned or joint ventures businesses (Modiba, 2009; GEM, 2011). Among beneficiaries included smallholder farmers who were provided with small-scale irrigation schemes, farm input subsidies, farm implements, credit facilities and cash grants to purchase land under the land reform programmes (Ramaila, 2011).

Despite the support, South Africa's level of entrepreneurial activity is reported to be the lowest and lagging behind many countries globally (Modiba, 2009; GEM, 2011). In South Africa, only 1.7% of businesses started do survive after a period beyond three years and six months, and the Total early-stage Entrepreneurial Activity (TEA) rate was reported at 9.1% (GEM, 2011). The prevalence rates for established self-employed business in South Africa were reported at 2.3% (GEM, 2011). Moreover, the country's agribusiness sector is the most underdeveloped yet considered as one of the most important sectors that can promote rural

economic growth (Modiba, 2009; First National Bank (FNB) and Endeavor SA, 2010, GEM, 2011). Low entrepreneurial spirit indicates a worrying situation for smallholder's agribusiness sector especially in its efforts to contribute towards meaningful job creation, poverty eradication and rural economic development (Modiba, 2009).

Few entrepreneurship researches have concentrated on establishing the entrepreneurial performance of smallholder agriculture and understanding the famers' values attached to farm business (McElwee, 2005, Modiba, 2009). Therefore this study was aimed at establishing farmers' level of entrepreneurial spirit and perception towards the three core entrepreneurial spirit measurements (risk taking, innovativeness and recognition of opportunities). Further the study sought to establish the impact of entrepreneurship on technical efficiency in the production of maize among smallholders at Qamata and Tyefu areas.

2. Methodology

Field Methods

This study was purposively carried out at Qamata and Tyefu irrigation schemes located in the Eastern Cape Province of South Africa because farmers utilizing the schemes are still battling with high poverty level despite the availability of these economically viable facilities. Further, maize crop was chosen because it is regarded as a staple food, animal feed and source of incomes among households in Qamata and Tyefu area. The study used primary survey data which was collected through administering structured questions and physical observations. Farm/farmer characteristics, farm production and market related data was collected. Using a 4 point Likert scale, respondents were asked to indicate their level of agreement in response to the 15 entrepreneurial spirit attitudinal statements, where "1" being strongly disagreed and "4" being strongly agree. Some of the attitudinal statements used in this study were adapted from WIDCORP (2008) and redesigned to suit the research. Sixty four and 44 smallholder farmers were interviewed in Qamata and Tyefu communities, respectively, making a total sample of 108 respondents.

Analytical Methods

Factor analysis method was employed to generate the principal component of perceived farmers' entrepreneurial spirit. The purpose of using the factor analysis was to reduce the large number of variables (i.e. entrepreneurship spirit attitudinal statements) to a smaller set of new composite factors. This process also ensures limited loss of information contained in the large number of attitudinal statements. The eigenvalues greater than one, the Kaiser-Meyer-Oklin KMO score greater than 0.6 and the Bartlett's test of sphericity were used to verify the suitability of data for Principal Component Analysis (PCA) (WIDCORP, 2008; Kisaka-Lwayo and Obi, 2012).

Following Kisaka-Lwayo and Obi (2012), the principal component (PC) of a given dataset of P numeric variables can be presented mathematically as:

$$PC_n = f\,(a_{ni}X_i, \ldots\ldots\ldots\ldots\ldots\ldots a_{1j}X_j) \quad \ldots\ldots\ldots\ldots (1)$$

Where, PC is the principal component, n represents a number greater than one. The PC can take different forms of measurement and these include continuous variables, quantity of related products of values that makeup a component, and weighted values or generated values from the component loading. The a_{1j} is the regression coefficient for the j^{th} variable and it is known as the eigenvector of the covariance matrix between variables. X_j is the value of the j^{th} variable. Explicitly the equation can be written as:

$$PC_1 = a_{11}X_1 + a_{12}X_2 + \ldots\ldots a_{1j}X_j \quad \ldots\ldots\ldots\ldots (2)$$

Where PC_1 = the first principal component. X_1 and X_2 are the first and second independent variables of PC_1 in the linear additive model needed to derive the principal component, and the a_{11} and a_{12} are coefficient (component loadings) associated with the X_1 and X_2 variables.

Relationship between Entrepreneurship and Farmer/Farm Characteristics

The impact of socioeconomic characteristics on farmer's entrepreneurial spirit was estimated using factor analysis and multivariate regression analysis. The multivariate regression analysis used standard factor scores generated after the factor analysis was performed, and these scores were regressed on farm and farmers' socioeconomic characteristics. Thus:

$$FS_{ij} = \beta_0 + \beta_3 HHSZE + \beta_1 AGE + \beta_2 EDUC + \beta_4 MJOCUP + \beta_5 EXPE + \beta_6 LANDSIZE + \beta_7 CRPINCOM + \beta_8 LVTINCOM + \beta_9 RMGP + \beta_{10} SOURCWAT + \beta_{11} IRSLOC + e \quad \ldots(3)$$

Where FSij (dependent variable) = generated regression factor analysis scores, β = coefficient parameters to be measured, e = error term, explanatory variable include *HHSZE* = household size, *AGE* = Age of the farmer (years), *EDUC* = education level of the farmer (years), *MJOCUP* = major occupation of the farmer, *EXPE* = farming experience (years) of the farmer, *LANDSIZE* = size of land owned (ha), *CRPINCOM* =crop incomes (Rand), *LVTINCOM* =livestock incomes (Rand) , *RMGP* = remittances, social grants and pension amount received by the farm household (Rand), *SOURWAT* = Source of water for crop production (Rain, tap, dam, river, or spring) and *IRSLOC* = Location of the irrigation scheme (1 = Qamata and 2 =Tyefu irrigation scheme)

Stochastic Frontier Analysis

The stochastic frontier analysis assumes the presence of technical inefficiency of maize production. A Cobb-Douglas production function of maize was employed to construct the stochastic frontier. The Typical Cobb-Douglas production can be presented as follows:

$$Y = AX_1^{\alpha_1} X_2^{\alpha_2} \ldots\ldots X_n^{\alpha_n} \gamma \ldots \quad (4)$$

Where Y = Amount of crop produced per farm, and X_n is a vector of farm inputs/resources employed to produce a given output and these include X_1= Land allocated to crop production, X_2= Amount of fertilizers used, X_3= Amount of seed planted, X_4= Amount of pesticide, X_5= Amount of herbicides, X_6 = Total number of times a farmer irrigates his/her plot per season, X_7 = Total cost for inputs used, $X_8 – X_{10}$ = Principal components of entrepreneurial spirit, A = Constant and α = Random error term.

The Cobb-Douglas production in equation 4 is log-linearized and fitted in the stochastic frontier analysis. Following Rahman (2003), technical efficiency of maize production is estimated using a stochastic frontier model, and is specified as:

$$Ln(Y_i)=\beta_0+\Sigma_i\beta_i LnX_{ij} + [V_i - U_i] \quad \ldots(5)$$

Where LnY_i is the natural logarithm of output of farmer i, LnX_i is the logarithm of input variables, β_i are production coefficients, the V_i is a random error, which is associated with

random factors not under control of the farmers (like weather, natural disasters, and luck), measurement errors, and other statistical noise, while U_i is the technical efficiency measure. Sometimes the error term [V_i - U_i] is considered "composite" (Bravo-Ureta and Pinheiro 1997; Rahman, 2003; Chavas *et al.*, 2005). Where V_i is a two-sided $(-\infty < V_i < \infty)$ normally distributed random error [$V_i \approx N(0,\sigma v^2)$]. The term U_i is a one-sided ($Ui \geq 0$) efficiency that measures the shortfall in output Y_i from its maximum value given by the stochastic frontier $f(X_i; \beta_i) + v$. We assume U_i has a half or exponential distribution [$Ui \approx N(0,\sigma u^2)$]. The two components V_i and U_i are also assumed to be independent of each other.

The impact of entrepreneurship on technical efficiency was estimated using a robust Ordinary Least Squares (OLS) because of its characteristics of being unbiased and consistent estimator. Following Bravo-Ureta and Rieger (1990), and Bravo-Ureta, and Pinheiro (1997) the second step estimation adapted from the relationship between technical efficiency, and farm/farmer characteristics and entrepreneurial spirit is determined. The OLS model is estimated as shown in equation 6 for each farmer.

$$T.E = \beta_i X_i + e_i \quad (6)$$

Where $T.E$ = technical efficiency scores; X_i is a vector of explanatory variables which include household size, age of household head, sex of respondent, crop incomes, remittances, social grants and pension, education level (years in school), farming experience (years), location of the irrigation scheme (Qamata or Tyefu), Risk taking (PC1), Innovativeness (PC2), and farmers ability to recognise farm business opportunity (PC3), β_i = Coefficients and e is the error term.

3. Empirical Results

Table 1 indicates that overall 66% of farmers were men with an average age of 61 years, and mean household size of 6 persons with the household head having at least obtained some primary school education (6 years in School). Interviewed farmers had farming experience of about 12 years. Homestead food gardeners' major source of water for crop production was mainly rainfall (48%) whereas 55% of smallholder irrigators indicated that rivers were the major source of irrigation water. Results presented in Table 1 further indicated that remittance, social grants (child, disability, and elderly) and pension (R3865) were the major

source of income for smallholder farmers. Crop incomes earned by smallholders was about R2079 per cropping season and few incomes were earned from livestock (R920).

Table 1: Demographic characteristics of smallholder farmers

Characteristics	Description	Smallholder Irrigator (n =75) (%)	Homestead Gardener (n = 33) (%)	Overall Sample (n=108) (%)
	Non-continuous Variables			
Sex of respondent	Male	57	85	66
	Female	43	15	34
Source of water for crop production	Rainfall	8	48	20
	Tape water	0	12	4
	Dam	37	30	35
	River	55	9	41
Major occupation	Farmer	92	88	89
	Self-employed	5	6	6
	Civil servant	3	7	5
	Continuous Variables			
		Mean-value	**Mean-value**	**Average Mean**
Household size	numbers	4.75	4.55	4.65
Age of farmer	years	58.51	63.91	61.21
Education level	years	5.47	6.79	6.13
Faming Experience	years	9.61	14.42	12.02
Crop incomes	Rand	2658.67	1500.00	2079.33
Livestock incomes	Rand	845.33	993.94	919.64
Remittances, social grants and pension	Rand	3717.60	4012.12	3864.86

Source: Field survey, 2012.

Estimating the Entrepreneurial Spirit

Farmers with higher entrepreneurial spirit are assumed to be more productive and have the ability to produce more marketable surplus and hence more household incomes. For a better understanding of the entrepreneurial spirit among smallholder farmers in Qamata and Tyefu irrigation schemes, the research used entrepreneurial attitudinal statements as presented in the structured questionnaire. The statements were designed to measure the farmers' risking taking ability, innovativeness and the ability to respond to available farm business opportunities all aimed at maximizing profits. According to the smallholder irrigators average mean score results presented in Table 2, they have the ability to adopt new technologies,

organize available resources to achieve a goal, seize opportunities perceived to be profitable and prefer group marketing. This suggests that smallholder irrigators are innovative and have the potential to embrace new technology and scale up operations to take advantage of available opportunities. They also considered group marketing important in farm business.

Table 2: Average Item Scores of Entrepreneurial Spirit for Smallholder Farmers

	Smallholder irrigators (n=75)		**Homestead Food Gardener (n=33)**		**Overall Sample (n=108)**		**T-Test**
Entrepreneurship spirit/drive	Mean	S. D	Mean	SD	Mean	S. D	
Not Afraid to try a new technique	3.09	0.89	2.85	0.97	2.97	0.93	1.28
Irrespective of any challenges I continue trying till the solution is got	2.35	0.89	2.46	1.06	2.41	0.98	-0.55
You have the ability to organize available resources to achieve a goal	2.60	0.92	2.76	0.90	2.68	0.91	-0.83
If there is a change in supply and demand, you take action faster before government response	2.40	0.99	2.12	0.93	2.26	0.96	1.41
Take action always on the basis of what you perceive profitable	3.00	0.79	2.76	0.83	2.88	0.81	1.45
Do not wait for subsidies before applying new technology	2.21	1.04	2.24	1.03	2.23	1.04	-0.13
You take your own judgment about the new technology before consulting friends	2.15	0.98	2.46	1.20	2.31	1.09	-0.40
Not afraid to be different when adopting new technologies on your farm	2.27	1.01	2.88	1.02	2.58	1.02	-2.90***
Spend more time on new technologies where you anticipate profits	2.47	0.95	2.70	0.68	2.59	0.82	-1.42
You are not afraid of investing more money in new technologies	2.29	0.98	2.24	0.97	2.27	0.98	0.25
Risks of new technologies isn't your first priority to take a decision	2.04	0.86	2.15	0.87	2.10	0.87	-0.62
I prefer group marketing	2.77	1.07	2.64	0.99	2.70	1.03	0.63
Can supply produce on credit	2.21	1.03	3.21	1.02	2.71	1.03	-4.65***
Will to pay for any farm related trainings	2.15	1.11	2.42	1.09	2.29	1.10	-1.21
Will to source for information wherever possible at a cost	2.09	1.00	2.42	1.03	2.26	1.02	-1.57
Total Average Score	2.41	0.95	2.55	0.99	2.48	0.97	

*Source: Field Survey, 2012. Where ***,represents significance at 1% level: SD = Standard Deviation: Data was elicited using* a *4-point Likert scale* (*1 = Strongly Disagree to 4 = Strongly Agree).*

In addition to adoption of new technologies, organizing resources to achieve a goal, seizing business opportunities and group marketing, the homestead food gardeners can supply produce on credit, committed to spend more time on new technologies and are not afraid to be different when adopting new technologies. Based on the homestead food gardeners' entrepreneurial spirit attributes, there is a suggestion that they are more enterprising than smallholder irrigators. The homestead gardeners are obviously working under difficult circumstances and without the benefit of collective action to help them access information and markets with ease. There is probably a fair amount of resilience and doggedness that is necessary to sustain enterprise in such circumstances. The implication might be that a good basis exists to design effective post-settlement support that builds on the resilience and determination of these individuals and link them to networks that will complement the skills they already possess. The ability to supply produce on credit however needs to be strengthened by formal contracts to avert opportunism behaviours between the buyer and the seller where buyers use limited market information (information asymmetry) as an opportunity to cheat the uninformed farmers.

Overall, farmers lacked confidence especially on statements regarding individual decision making and investing in new innovations and this explains the low total average entrepreneurial spirit scores. Farmers were not willing to invest more money in new technologies, and lacked the spirit of searching for information. Fear of risks to invest in new technologies and information search may result to low productivity and low farm incomes among smallholder famers. This may necessitate provision of trainings on risk management and establishment of forward contracts for assured market for produce as a policy response, and improved business environment that aid farmers' entrepreneurial skills.

The low entrepreneurial spirit among smallholder irrigators may be attributed to reduced government support for small-scale irrigation schemes. Government stopped providing farmers with input subsidies, free tractor services, and reduced on the number of technical staff managing and operating the small irrigation schemes (Kodua-Agyekum, 2009). This has made farming on small irrigation schemes more expensive in the face of the resource poor smallholder irrigators. They can hardly meet input costs and tractor hire, and lack technical skills to efficiently utilization these schemes. Due to unfavourable entrepreneurial environment, most smallholder irrigators have resorted to intensifying cultivation of homestead food gardens that require less purchased inputs, less labour, and less technical skills. For example, farmers use manure and compost to improve soil fertility, horse pipes or

buckets to irrigate their gardens, and family labour to plough for increased productivity (Fay, 2011).

The Principal Components for the Farmers' Perceived Entrepreneurial Spirit

Factor loadings method was employed to elicit factors that explain statistically the variances within the statements, and the principal components were generated. Three factors or principal components were extracted that explained 61.48% variance in the responses. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (0.615) was above the recommended minimum value of 0.60 as shown in Table 3. The Bartlett's test of sphericity test also approved the worthiness of proceeding to the factor loading stage.

Based on the factor correlation with entrepreneurial spirit attitudinal statements, the extracted three principal components can be best described as risking taking, innovativeness, and ability to recognise opportunities. The most correlated entrepreneurial spirit statements that best described the first principal component were mainly related to risk taking. This principal component was explained by 30.55% of the variance in the explanatory variables with six estimated coefficients above 0.3 being positive. Risk taking related variables included the ability to organize available resources to achieve a goal, spend more time on new technologies where you anticipate profits, not afraid of investing more money in new technologies, not considering risks as a first priority in adopting new technologies, willingness to pay for any farm related trainings, and willingness to source for information wherever possible at a cost. The attitudinal statements that form this principal component suggest that, it is mainly upheld by homestead food gardeners more than smallholder irrigators.

The second extracted principal component was explained by 17.64% of the explanatory variables with five estimated coefficients above 0.3. Of the five coefficients, one statement is negatively associated with innovativeness and four are positively associated with innovativeness. Farmers had a more positive attitude towards adopting new techniques, ability to organize available resources to achieve a goal, take action always on what is perceived to be profitable and willingness to investing more money in new technologies. However, farmers did not consider spending more time on new technologies anticipated to be profitable as an import aspect in farm business. Thus, farmers were willing to spend lesser time on any risky ventures and this call for time saving technologies with fewer risks involved. The second principal component is mainly ascribed by smallholder irrigators more

than homestead food gardeners based on the entrepreneurial spirit statements average scores in Table 2.

Table 3: Estimated Principal Components for the Perceived Entrepreneurial Spirit

	Risk Taking	**Innovative**	**Recognize Opportunities**
Proportion of Variation (%)	*30.55*	*17.64*	*13.29*
Eigen Values	*2.444*	*1.411*	*1.063*
	Factor Loadings		
Entrepreneurial Spirit/drive	PC1	PC2	PC3
Not Afraid to try a new technique	-0.005	**0.714**	-0.106
You have the ability to organize available resources to achieve a goal	**0.393**	**0.395**	**-0.638**
Take action always on the basis of what you perceive profitable	-0.103	**0.608**	**0.597**
Spend more time on new technologies where you anticipate profits	**0.324**	**-0.527**	-0.085
You are not afraid of investing more money in new technologies	**0.505**	**0.309**	-0.178
Risks of new technologies isn't your first priority to take a decision	**0.742**	-0.012	-0.164
Will to pay for any farm related trainings	**0.828**	-0.044	**0.338**
Will to source for information wherever possible at a cost	**0.825**	-0.035	**0.329**
Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy = 0.607 Bartlett's Test of Sphericity: Approx. Chi-Square = 172.894, df = 28, Model significance level = 1%			

Source: Field survey, 2012. Where df = degree of freedoms; Note: The bold and underlined factors > (0.3) qualify to constitute a given component: Extraction method; Rotation Method: Varimax with Kaiser Normalization. (n=108)

The third principal component (PC3) describing farmer's entrepreneurial spirit accounted for 13.29% of the variation and indicated that farmers had a strong attitude towards recognising farm business opportunities available, and were willing to source for more opportunities through farmer trainings and information access (optimists). With exception of organizing available resources to achieve a goal, farmers viewed taking action always on the basis of what is perceive to be profitable, access to training, and willingness to source for information as vital tools for improved farm business. When compare average scores displayed in Table 2 both smallholder irrigators and homestead food gardeners considered the third principal component important for profits maximization.

Relationship between Entrepreneurial Spirit and Farm /Farmer's Characteristics

Results in Table 4 indicate that the regression models for principle components one and three are statistically significant (1% alpha level) and the corresponding Durbin-Watson statistics for the regression model ranges from 1.5 to 1.8, indicating a no autocorrelation problems among the variables. Farmers' ability to take-up risks had a positive and significant (1% alpha level) relationship with major occupation of the household head and livestock incomes. The age of a farmer and education level (year spent in school) also had a positive and significant impact on the same at 10% levels, respectively.

More experienced farmers who use dams as their major source of water for irrigation were likely to be risk averse because farming experience and source of water for crop production had a negative and significant influence on risk taking at 10%, respectively. Based on these results it can be concluded that an increase in farmers' age, education, farming as a major occupation and livestock incomes boosts farmers' hope to take up calculated farming risks while farming experience and irrigation water from the dam results into less and less farmer's interest in taking up risky farm business activities. The negative impact of sources of water for crop irrigation (mainly dams) on the PC1 may be attributed to less or lack of control/power over the use of dam water and hence impeding individual's initiated and experimental techniques practice. Some of the set regulations regarding irrigation water use include the number of times a farmer is allowed to irrigate, amounts of water used and dictate the type of crops grown on the scheme. These rules and regulations on irrigation schemes suppress farmer's entrepreneurial spirit.

Only two socioeconomic factors had a significant impact on farmers' innovativeness both at 10% level and they include major occupation and farming experience. Farming as major occupation of most smallholders was found to have a positive and significant impact on farmers' innovativeness whereas farming experience was found to have a negative and significant impact on the same. This is an indication that farming as a major occupation improves farmers' confidence to innovate new ways of maximizing farm profits given that he/she spends more time in farming activities. The negative impact of farming experience on farmers' innovativeness may be attributed to limiting adoption of new technologies based on the past bad experiences or risk failures.

Table 4: Estimating the Relationship between Entrepreneurial Spirit and Farm/Farmer's Characteristics

	Dependent Variables (Extracted from Factor Analysis -PCA)					
	Risk Taking (Hope)		Innovative (Confidence)		Recognizing Opportunities (Optimism)	
Independent Variables	β	p-value	β	p-value	β	p-value
Household size	0.000	0.978	-0.014	0.726	0.011	0.765
Age	0.018	0.074*	-0.003	0.816	-0.023	0.049*
Education level (years)	0.047	0.066*	0.042	0.172	-0.036	0.203
Major type of occupation	0.203	0.004***	0.143	0.088*	0.072	0.357
Farming experience	-0.015	0.091*	-0.018	0.085*	0.011	0.268
Amount of land owned	0.064	0.530	-0.021	0.861	-0.043	0.707
Crop Incomes	0.000	0.143	-0.000	0.330	0.000	0.010***
Livestock incomes	0.000	0.000***	0.000	0.256	0.000	0.339
Remittances, social grants & pension	0.000	0.270	0.000	0.955	0.000	0.030**
source of water for crop production	-0.148	0.060*	0.034	0.717	-0.128	0.145
Location of irrigation scheme	0.074	0.799	-0.326	0.350	0.894	0.007***
Constant	-1.529	0.102*	0.364	0.744	0.098	0.925
R2 adjusted	0.320		0.019		0.143	
p-value	0.006***		0.307		0.006***	
Durbin-Watson statistics	1.817		1.748		1.465	

*Source: Field Survey, 2012. Where ****, **, * = significant at 1%, 5% and 10% level, respectively: β = coefficients and p-value = probability value.*

Age of the household head has a negative and significant impact on farmer's ability to recognise business opportunities (optimism) at 10% level while crop incomes, remittances, social grants and pension, and location of the irrigation scheme have a positive and significant influence on farmers' ability to recognize business opportunities at 1%, 5% and 1% levels, respectively. Most smallholder irrigators are old and they tend to be less optimistic in future farm business investment. The old age demotivates them to undertake new technologies perceived to be profitable and they are not willing to pay for trainings and information important for profit maximisation. This may result into the old aged farmers' tendency to adhere to the old farming styles which are less productive. Crop incomes and remittance, grants and pensions may be a source of capital needed to undertake business opportunities. Results presented in Table 4 further suggest that smallholder farmers at Qamata irrigation scheme take faster action to benefit from available farm business opportunities (optimists) more than Tyefu smallholder farmers. This is so because most respondents interviewed were located in Qamata irrigation scheme area.

Estimating Smallholders' Technical Efficiency of Maize production

Technical efficiency scores of maize enterprise among smallholder farmers were generated from this estimation and are presented in Table 5. Keeping other factors constant, the estimated production function indicated that amount of land, amount of seed planted, number of irrigations/ha/season and the total cost spent on input purchase had a positive and significant influence on maize output at 1% level, respectively. Thus, a unit increase in land allocated to maize production, amount of seed planted, number of irrigations/ha/season and cost for purchased farm inputs increases maize output by 1.982, 0.391, 1.013 and 0.326 units, respectively. Whereas someone would expect a positive relationship between output and amount of pesticide applied, the findings of this study indicated a negative and significant relationship at 5% level. Indicating that an increase in amount of pesticide applied results into a 0.234 units decrease in the amount of maize produced. The negative relationship between maize output, and pesticide application may be due to farmers' lack of skills in utilizing this input.

Table 5: Stochastic Frontier Analysis Results for Maize Enterprise

	Maize Output (Y) = Dependent Variable			
Independent Variables (in natural logarithm)	**Coefficient**	**S.E**	**Z Value**	**P-value**
Land under maize farming (ha)	1.982	0.244	8.13	0.000***
Quantity of seed planted (Kg/ha)	0.391	0.099	3.93	0.000***
Quantity of fertilizer applied (Kg/ha)	-0.053	0.070	-0.75	0.450
Quantity of herbicide applied (L/ha)	0.095	0.153	0.62	0.536
Quantity of pesticide applied (L/ha)	-0.234	0.115	2.04	0.041**
Number irrigations per ha/season	1.013	0.134	7.57	0.000***
Total costs on maize inputs (Rand)	0.326	0.082	3.97	0.000***
Constant	1.078	0.484	2.23	0.026**
sigma_v	0.253	0.167		
sigma_u	1.310	0.196		
Sigma2	1.780	0.447		
lambda	5.171	0.347		
Log likelihood = -120.805 Prob > chi2 = 0.000*** Wald chi2(6) = 426.62 Number of Observations (n =105)				

*Source: Field survey, 2012. ***, ** represents significance at 1% and 5%, ha = hectares, Kg = Kilograms; L = litres; S.E = Standard Error.*

Technical efficiency was obtained by employing the log-linear Cobb-Douglas production using a stochastic frontier analysis. The minimum estimated efficiency score of smallholder

farmers is about 2%, the maximum being 88% and the overall mean was found to be approximately 44%. As expected, smallholder irrigators are more and significantly (1% alpha level) technically efficient than homestead food gardeners (see Table 6). This proves the efficacy of the use of improved technology for increased farmers' technical efficiency. Smallholder irrigators on average were 48% technically efficient while homestead food gardeners on average were 34% technically efficient in maize production. These results suggest that homestead food gardeners should shift from the type of irrigation systems they use in maize production to that of smallholder irrigators in order to improve on their technical efficiency.

Table 6: T-test of T.E for Smallholder irrigators and Homestead Food Gardeners

Type of farmer	Sample Size	Mean Efficiency	Standard Error	Standard Deviation
Smallholder irrigators (y)	74	0.4835	0.028	0.242
Homestead food gardeners(x)	31	0.3432	0.037	0.207
Combined	105	0.4421	0.023	0.240
Mean difference		0.1403	0.050	

Source: Field survey, 2012

Satterthwaite's degrees of freedom = 103 **t** = 2.8198

Ho: mean(y) - mean(x) = 0

Ho: diff = 0

Ha: diff < 0 Ha: diff != 0 Ha: diff > 0

Pr(T < t) = 0.9971 Pr(T > t) = 0.0058 Pr(T > t) = 0.0029

The Impact of Entrepreneurship on Technical Efficiency of Maize Production

Based on the OLS model linear regression results presented in Table 7, the Durbin-Watson statistic was 1.889 signifying absence of autocorrelation problems. The F-value indicates that the explanatory variables combined, significantly influence changes in the dependent variable at 1% level. Crop incomes have a positive and significant impact on technical efficiency at 10% level while incomes earned from remittance, social grants and pension has a negative and significant impact on the technical efficiency of maize production at 10% level. These results suggest that an increase in crop incomes results into an increase in technical efficiency. This may be attributed to re-investing the incomes in crop production through purchase of farm inputs and implements which in turn result into improved technical efficiency. Technical efficiency has a positive and significant relationship with farmer's farming experience at 10% level, and thus, an increase in farming experience results into increased efficient use of input for output maximisation. Qamata smallholder farmers are

likely to be more technically efficient than their counterparts at Tyefu irrigation scheme since location of irrigation scheme has a positive and significant impact on efficiency at 1% level. This is probably because farmers at Qamata irrigation scheme are well organised in cooperatives, have more access to input credit, access to government extension officers and are closer to the urban centre (Queenstown) providing a more flexible input/output markets compared to the rural Tyefu irrigation scheme with less access to these services.

Table 7: The Impact of Entrepreneurship on Technical Efficiency of Maize Production

Explanatory Variables	Dependent Variable = Technical Efficiency Scores			
	Coefficients	**Std. Error**	**T-values**	**P-values**
Household size	0.005	0.008	0.654	0.515
Age	-0.002	0.003	-0.933	0.353
Gender	0.036	0.049	0.736	0.463
crop incomes	0.000	0.000	1.846	0.068*
Remittances, social grants & pension	-0.000	0.000	-1.909	0.059*
Education level (years)	-0.005	0.007	-0.698	0.487
Farming Experience (years)	0.004	0.002	1.723	0.088*
Location of the irrigation scheme	0.145	0.057	2.534	0.013***
Risk taking	-0.197	0.068	-2.913	0.004***
Innovativeness	-0.096	0.069	-1.400	0.165
Recognizing opportunities (optimism)	0.228	0.064	3.579	0.001***
(Constant)	0.455	0.262	1.740	0.085*
Adjusted R^2 = 0.257 F-Value = 4.278*** Durbin-Watson statistics = 1.889 Number of observation (n=105)				

*Data Source: Own survey data 2012. Where *** and ** denotes significant at 1%, 5% level respectively; Std. Error = Standard Error.*

The technically efficient smallholder maize farmers are less risk takers (risk averse) since the variable is negatively and significantly related to technical efficiency at 1% level. According to the principal component analysis, farmers who are less risk takers recognize opportunities and act quickly on existing opportunities (optimists). The quick action may call for less concentration on the use resources more efficiently and much focus put on the end-product. Also risk taking farmers lacked the ability to adopt new technologies yet use of new technology is reported to be a crucial ingredient for improved technical efficiency (Kibirige, 2008). Recognition of farm business opportunities (optimistic) has a positive and significant influence on technical efficiency at 1% level. Thus, an increase in farmers' ability to take on

opportunities, ability to organize available resources, willingness to pay for farm trainings and information results into increased technical efficiency.

Conclusions

Smallholder irrigators utilizing small-scale irrigation schemes and homestead food gardeners in the study area exhibited some entrepreneurial spirit although it was reported to be low, and thus, need to be strengthened. The entrepreneurial spirit statements that scored highly included farmers' ability to adopt new, ability to organize available resources to achieve a goal, take action always on the basis of what is perceive to be profitable, and supply of produce on credit. Farmers underscored attitudinal statements that had some aspects of individual decision making and sourcing for information at a given cost. Three principal components were extracted using factor and principal component analysis through factor loading statistical method. The three components included risk taking, innovativeness and recognizing opportunities. Comparing the mean scores from Table 2 and Table 3 for entrepreneurial spirit principal component, smallholder irrigators are endowed with innovative spirit while homestead food gardeners are more risk takers. Both smallholder irrigators and homestead food gardeners had a potential of taking on farm business opportunities. The results of this study indicate that farm/farmer characteristics are key factors that greatly influence farmers' entrepreneurial spirit.

Farmers' risk taking was positively and significantly influenced by farmers' age, education level, major occupation and livestock incomes while farming experience and source of irrigation water had a negative impact on risk taking. Determinants of the second principal component (farmers' innovativeness) included farming as the major occupation which had a positive and significant influence while farming experience had a negative and significant influence on same. Farmers' recognition of opportunities (optimism) was positively and significantly related to crop incomes, remittances, grants and pension, and location of the irrigation scheme while age had a negative and significant influence on farmers' ability to recognize opportunities. Therefore, policies that target to improve on the socioeconomic factors which are positively and significantly related to entrepreneurial spirit may catalyse the shift from subsistence to more business oriented commercial farming. This is thought to improve on productivity, household incomes, food security and poverty alleviation in rural communities. However, precautions should be taken in regards to the socioeconomic factors that negatively and significantly impact on farmers' entrepreneurial spirit.

Smallholder farmers' entrepreneurship has a significant impact on technical efficiency in maize production. The findings indicate that risk taking has a negative and significant impact on technical efficiency while recognition of opportunities (optimism) has a positive and significant influence on technical efficiency in maize production.

4. Recommendation

Since smallholder farmers at Qamata and Tyefu irrigation schemes exhibit some entrepreneurial spirit and such has a significant impact on production efficiency the follow key policies should be considered:

Policies geared towards attracting youth in farming should be developed or catalysed for a sustainable smallholder agricultural sector, food security and poverty reduction in these rural communities. These policies should include promotion of establishment of farmer youth clubs/ associations, avail farm business trainings and financial support. The policies are thought to be suitable for these communities because age was found to have a significant impact on entrepreneurship spirit yet most farmers in the study area were aged and lack the energy, vitality and dynamism required for increased farm efficiency and farm production.

Further, formal adult education should be promoted among smallholder farmers to attain skills and knowledge enough to keep farm records and read instruction as presented on purchased input packages. In this case extension officers with special skills in business management are crucial to transfer the knowledge to farmers. Since farm incomes and remittances, social grants and pension had an impact on entrepreneurship spirit and technical efficiency, policies on farmers' access to input credit should also be promoted.

Due to its proximity to urban areas, smallholder farmers at Qamata have more access to markets, information and services compared to Tyefu irrigation scheme. This can be explained by the positive and significant impact of location of the irrigation scheme on entrepreneurship spirit and technical efficiency. Market accessibility, access to information and other services promote value addition and attract better product prices to farmers. Therefore, the government should set policies that promote investment incentives especially in establishing agro-based small scale industries that avail market for farmer produce and also provide farmers with agro-inputs. Thus, this should strengthen the forward and backward linkages in the agribusiness sector. Further, investment in infrastructure development should

be emphasised especially for improved rural feeder roads, ease access to water, improved rural electrification and housing, and storage facilities in order to attract service providers' investments in these communities.

References:

Bravo-ureta, B. E. and A.E Pinheiro, 1997, "Technical, Economic, and Allocative Efficiency in Peasant Farming: Evidence from the Dominican Republic", *The Developing Economies,* XXXV (1):48–67.

Bravo-Ureta, B.E., and L Rieger 1990, "Alternative Production Frontier Methodologies and Dairy Farm Efficiency", *Journal of Agricultural Economics* 41(2): 215–26.

Chavas, J. P., R. Petrie and M. Roth, 2005, "Farm Household Production Efficiency: Evidence from The Gambia", *American Journal of Agricultural Economics* 87(1): 160-179.

Einstein College of Engineering, 2011, "Entrepreneurship development". Available in:http://www.einsteincollege.ac.in/Assets/Department/Lecturer%20notes/mba/entrepreneurship%20development.pdf.

Fay Derick, 2011, "Cultivators in action, Siyazondla inaction? Trends and potential in homestead cultivation in rural Mbhashe Municipality", Department of Anthropology, University of California, Riverside.

First National Bank (FNB) and Endeavor SA, 2010, "The State of Entrepreneurship in South Africa", *The second State of Entrepreneurship White Paper*, 17th November 2010 at Mount Nelson Hotel.

Global Entrepreneurship Monitor (GEM), 2011, "Global Entrepreneurship Monitor 2011 South Africa", The UCT Centre for Innovation and Entrepreneurship.

Hayek, F.A. 1937, "Economics and Knowledge," *Economica*, Vol. 4 (February 1937); reprinted in *Individualism and Economic Order*, (London: Routledge and Kegan Paul, 1949, pp. 33-56; and "The Use of Knowledge in Society," American Economic Review, XXXV, No. 4 (September, 1945), pp. 519-30.

Kibirige, D, 2008, "Analysis of the impact of the agricultural productivity enhancement program on the technical and allocative efficiency of maize farmers in Masindi District". Master's thesis, Department of Agricultural Economics and Agribusiness, Makerere University Kampala, Uganda.

Kisaka-Lwayo M., and A. Obi, 2012, "Risk Perception and Management Strategies by Small Holder Farmers in Kwazulu-Natal Provice, South Africa", International Management Association and institute of Agricultural Management, ISSN 2047-3710, *International Journal of Agricultural Management,* Volume 1 Issue 3.

Kodua-Agyekum C., 2009, "The transfer of technology to the rural poor: The case of Qamata Irrigation Scheme in the Eastern Cape Province of South Africa". PhD Thesis, Faculty of Humanities, Development and Social Sciences, University of Kwazulu-Natal, South Africa.

Magazine on Low External Input and Sustainable Agriculture (LEISA), 2009, "Farmers as entrepreneurs", June 2009 Volume 25 No. 2, Pp 5 - 8.

Masaviru W., 2011, "Econometric Analysis of the Impact of Entrepreneurship on Economic Growth-Case of the Kenyan Economy", *Journal of Economics and Sustainable,* Vol.2, No.7, 2011, ISSN 2222-1700 (Paper); ISSN 2222-2855

McElwee G. 2005, "Developing entrepreneurial skills of farmers, A literature review of entrepreneurship in agriculture", SSPE-CT-2005-006500, University of Lincoln.

Modiba M. D., 2009, "An Entrepreneurial framework to enhance the agricultural sector in a district of the Limpopo Province", Master's Thesis, Potchefstroom Business School, Potchefstroom campus of the North-West University, South Africa.

Ndou P. 2012, "The competitiveness of the South African citrus industry in the face of the changing global health and environmental standards". PhD thesis, Department of Agricultural Economics and Extension Faculty of Science and Agriculture University of Fort Hare, Alice, South Africa.

Rahman, S., 2003. "Profit efficiency among Bangladeshi rice farmers", *Food Policy* 28:487-503.

Ramaila R., S. Mahlangu and Toit, 2011, *Agricultural productivity report in south Africa literature review*. Department of Agriculture, Forestry and fisheries, Directory Economic Service, Production Economics Unit.

Schumpeter J. A., 1942, *Capitalism, Socialism and Democracy*, Harrap, p 84.

Sudharani V., 2010, "Entrepreneurship Development", Study Material, Department of Agricultural Extension, College of Agriculture, Acharya N.G.Ranga Agricultural University.

Water in Dry-land Collaborative Research Program (WIDCORP), 2008, *Identifying farmer typologies, attitudes and aspirations of the Wimmera Mallee Pipeline – Supply System 6*. A report prepared for the Department of Primary Industries, Horsham, December 2008, *Report* no. 3/08.