THE IMPACT OF AN AGEING POPULATION ON AGRICULTURAL PRODUCTIVITY IN SMALLHOLDER FARMING: EMPIRICAL EVIDENCE FROM KWAZULU-NATAL IN SOUTH AFRICA

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Abstract. The primary problem in farming has been the ageing rural population, which is significantly influencing agricultural output Factors of production that limit the rural farmers include land, entrepreneurial skills, labour, and capital. This study aimed at examining the effects of old age on the technical efficiency of small-holder farmers in KwaZulu-Natal, South Africa. The research methodology was quantitative, and data were collected using a semi-structured questionnaire among 173 farmers. The variables that contribute to explaining the technical efficiency of smallholder farmers were evaluated through a stochastic frontier model. Moreover, the results of the simulation showed that mean technical efficiency decreases with an increase in education level, whereas an increase in age and land size enhances technical efficiency. Moreover, the results of the simulation showed that the mean technical efficiency decreases with the increase of the education level whereas on the contrary, the increase in age and land size affects the enhancement of technical efficiency. Thus, sufficient evidence is available to indicate that rural population ageing will have a strong influence on agricultural output, and there is no certainty about the implications of the remaining variables
Keywords: *age, Cobb Douglas function, smallholder farmers, food security, sustainability*

Introduction

Farming is a significant rural primary sector and economic factor. Most of the individuals engaged in farming are found in rural South African regions, which contribute to less than 4% of the national GDP (DAFF, 2014). One should also be aware of the place that agriculture occupies among the rural population and the advantages and disadvantages of practising farming in rural areas (Louw, 2013). Demographic factors are simply the changes in the rural population that have a critical role in the rural region of South Africa and other developing countries (Ramaila et al., 2014). The paper covers four causes of rural demographic change such as the involvement of youth in agricultural activities, gender of household head, age of household head, and the agricultural production in rural locations of KwaZulu Natal Province. KwaZulu-Natal Province.

South Africa, as far as it is a developing country, has experienced a swift transformation of demographic make-ups that now dominate the rapid ageing of the rural population (Mofijur et al., 2014). This trend of aging work structure is especially evident in the agricultural labour force, where the demographic shift has been supported by the preference of the youth towards non-agricultural labour in cities. The majority of labour force in the rural regions are the older generation that have retired or those who have never attended school and reside in the rural regions since childhood (Literature on the economics of ageing often indicates that old people might adapt to new technological changes more slowly than the young ones) (Guo et al., 2015). According to Glasgow and Brown (2012), the disadvantages associated with ageing are numerous and include the following; ill-health, low literacy, discrimination in the credit markets, shorter investment horizons, old people can be less market-oriented and basically give birth to what they use in their households, new crops and technologies. A number of research conducted in UK, China and the USA found that rural ageing population has great impacts on agricultural production and revenue of the farmers (Lowe and Speakman, 2007). The economy of an ageing rural population has been observed to be technically and economically inefficient with regards to agricultural production (Glasgow and Brown, 2012). Malnutrition and hunger due to low food production in the rural areas pressure African countries to produce more food (Govender, 2017; Agricultural Statistics, 2020). Peasant farmers or smallholder farmers are those who grow staple foods and little commercial crops that can be marketed to lucrative markets. Maize is the main food staple in the southern continent of Africa and half of all maize produced in the region is produced in South Africa, where maize is about three-quarters of the grain production and two-thirds of the land area crops maize (Akpalu, 2009). In South Africa, old-aged farmers hardly produce commercial crops, as they demand a lot of investments and time to grow. Smallholder farmers typically grow maize, amadumbe (*Colocasia esculente*), green beans, sweet potatoes and vegetables including spinach and cabbage to consume at home and a small portion to sell at the market locally. In view of the above, this study examines the impact of an ageing population on agricultural productivity in smallholder farming from KwaZulu-Natal in South Africa.

Literature review

The impact of ageing population on farming

The world is ageing its rural population (Glasgow and Brown, 2012). The process of ageing a population in South Africa is essentially the same as ageing in any other developed nation including the USA and the UK. Though, the ageing population is simply unbelievable in the majority of developing countries in Africa and Asia, such as China ageing population is approximately 19% of the total population. It represents an inevitable outcome of the so-called demographic transition in which the falling fertility alongside with an increase in life expectancy results in a reversal of the age composition of the population towards the older side of the spectrum. In South Africa, the elderly are quickly growing in number, and the largest proportion of the elderly population resides in the rural regions (Statistics South Africa, 2020). In 2010-2019, Lowe and Speakman (2007) showed that over 15% of the non-metropolitan population was aged 65 years and above versus 21% of the metropolitan population. These sentiments are shared by Lowe and Speakman (2007) when it comes to the ageing population of many other African countries in rural regions and are also supported by Keating and Carberry (2008) who affirm that

the population in Zimbabwe, Lesotho, Zambia and Malawi is rapidly ageing, and they are now living in rural regions. However, the population ageing in South Africa is clearly a unique case, which is influenced by its unique historical, cultural, economic and political factors. The rural majority of South Africa is characterised by an aging population, which competes primarily on old age benefits, remittances, street vending and agriculture. Even though agriculture is not the primary activity of the eldest people, most of them are involved in its subsistence food (Alexander and Larson, 2016). This study has arisen due to the rate at which individuals are ageing within South Africa and the rural regions have a low youth economy. As the percentage of the elderly population is expected to rise during the first half of the twenty-first century as projected by the United Nations, South Africa and most of the African countries are going to have a large population of the aged that is expected to rely on agriculture (Proctor and Lucchesi, 2012). The farming and agriculture in the rural settlements may be devastated when the people continue to migrate to the towns in search of employment opportunities with the old, aged people being left to manage the farms in the rural settlements.

The opportunities and constraints of people in rural settings may be different. In most cases, it is determined by who inherits property (patriarchy) in rural regions that might be either old man in rural regions of South Africa or old women in rural regions of South Africa. In this paper, we have established that local context variables such as inheritance regulations, population health and farming activities influence age disparities and gendered disparities in south Africa (Dalla, 2012). An example is South Africa where the ageing of the rural population may have helped rural development by accelerating land consolidation and by the existing land claims by the black farmers. It is most likely that most of the old-age population will be rural. Thus, the department of agriculture and other parastatals dealing with agriculture would have to provide such people with sufficient support. One should not forget that rural farming is associated with so many challenges like human labour, capital, entrepreneurial skills and application of modern technology. Human labour is questionable in most cases since in most cases, it is human labour as most people living in the rural areas are pensioners or the retired people (Middelberg, 2013). There is no empirical study that has been conducted in KwaZulu Natal concerning the links between ageing and rural development as a form of agricultural development in the rural farms in South Africa. The demographic structure of the KwaZulu Natal rural population and agricultural workforce has become a topical issue because most of the people living in the rural area are pensioners or the retired people. In South Africa and most other Third World nations it is a convention that once a person has retired or has been retrenched or taken a pension they move to the country districts. In this way, agriculture is an alternative food security source. Although the old-aged people live in the countryside they have difficulties with farming. The biggest dilemma affecting the rural population is the problem of input and output market of their produce (KwaZulu-Natal, 2012). The other challenges are availability of finance to improve their agricultural productivity and availability of new technologies to improve their agricultural productivity. Young people on the other hand are more likely to fantasize about life in the cities, and they do not want to engage in agriculture. In certain cases, the rural one's desire to experiment with new methods of crop production, understand the market better, have some interest in the utilization of advanced machinery, application of chemical input, availability of credit and market of output. This leads to inferences about the expected impacts of ageing on agricultural production and rural poverty and hints at policy implications. In the following section, the authors point out the different issues that can

contribute to change in agricultural output in rural KwaZulu Natal and most South Africa provinces.

South Africa has about 3-4 million households and those practice small-scale farming activities primarily as a supplement to their food (Aliber and Hart, 2009; Baiphethi and Peter, 2009). A plethora of measures and policies (numerous other parastatals) have been formulated to develop the smallholder sector and there have been very limited success stories (DAFF, 2012). Frayne et al. (2014) also portrays that in majority of countries in the world, smallholder farming is a significant economic development and food security sector. Despite this sector being observed to be fragmented owing to absence of support services in rural locations and absence of interest of the rural folks in smallholder agriculture (Aliber and Mdoda, 2015), most of the rural folks are victims of the migration of youth labour that can easily embrace technology and the prevailing changes in the agricultural sector. What is happening in the rural places is that, due to the inability to adapt or embrace the new changes in technology that are occurring in the agricultural fraternity, old, aged people practice primitive farming (Frayne et al., 2014). Modern agriculture involves the use of hydroponics, selective agriculture and application of modern technology that, consequently, affects the agricultural production of peasants. To further it, due to technological development in agriculture and the 4th Industrial Revolution (4IR), old people feel under such pressure in order to compete with the commercial sector and, moreover, the reduction of the labour force that works in the agricultural sector leads to the drop in agricultural productivity (Aliber and Mdoda, 2015). Thus, the given research seeks to explore how ageing affects the agricultural productivity. A Cobb Douglas production function is adopted within the study to determine how the ageing population would contribute inefficiency to agricultural production. This paper is an econometric study to examine the relationship between the age of farmers and agricultural production. The hypothesis in this study is that the older the farmer the better the farming experiences. Production, operation, as well as management of agriculture are assumed to improve with age due to agricultural knowledge and skills. The older the farmers are, the more the knowledge and skills they have and thus the more efficient use they put to the agricultural inputs like seeds, pesticides and fertilizers and labour input.

Materials and methods

The information presented in this study is based on the two municipalities located in KwaZulu Natal Province. KwaZulu-Natal consists of ten district municipalities (eThekwini Metropolitan Municipality) with one metropolitan municipality (eThekwini Metropolitan Municipality). The former is uMdoni Local Municipality an administrative area in uGu District of KwaZulu-Natal in South Africa and the latter is uMkhambathini Local Municipality an administrative area in uMgungundlovu District of KwaZulu-Natal in South Africa. Two municipalities were chosen to represent different levels of economic development. This was done by interviewing the smallholder farmers in the two regions who are actively engaged in agriculture. The researcher determined the various enterprises that were involved in the livestock, crop and mixed farming. Questionnaires were used to collect data, and the survey included a total of 173 farmers in 2 municipalities located over 100 km apart. These locations were chosen due to the nature and style of life of the farmers. In the two regions, the farmers practiced crop and livestock agriculture. The farmers have been stratified into two initially due to the municipalities they belong to and subsequently they were chosen randomly out of two lists of different

municipalities using a random table. This study was done by interviewing 97 and 76 smallholder farmers in uMdoni Municipality and uMgungundlovu Municipality respectively. This follows the disqualification of some of the questionnaires of the farmers that were inadequate to be analyzed.

Model specification

The analysis uses a production function to gain insight into the issues surrounding the ageing of the agricultural labour force (Christensen et al., 1973). Human labour in rural areas is in short supply in South Africa and most other African countries due to rural-urban migration and negative mindset by the youth towards farming. The model is constructed based on the Cobb-Douglas production function although its form is changed to make it more flexible because there are many factors that can be taken into consideration when considering this model (Kiani, 2008). The theory of production will help us to determine the dependent and independent variables that can be employed to determine the effects of old age on production. According to the theory, to get production, we must have an input, and therefore we can get nothing out of nothing. This causes the production of a function as indicated by *Equation 1*:

$$Q = \int(x) \text{ where } Q = \text{ output and } x = \text{ input} \tag{Eq.1}$$

To include the regressors in the model, a review of the literature was used to identify appropriate variables that help explain the econometric model utilized in this study. In this case the study used a stochastic frontier production function (Fan, 1991). The stochastic frontier production function model was used because it permits simultaneous estimation of individual technical efficiency of the respondent farmers as well as determining factors of technical efficiency (Solow, 1957; Battese and Coelli,1995).

The idea of using a production function can be illustrated with a farm using a number of inputs (X_1, X_2,......X_n) to produce output Y. Efficient transformation of inputs into output is characterized by the production function f(x), which shows the maximum output obtainable from various inputs used (Heshmati and Kumbhakar, 2011).The stochastic frontier production function assumes the presence of technical inefficiency of production. Hence, the function is defined by *Equation 2*,

$$Y_i = \int(x_i \exists) \exp(v_i - u_i) \text{ where } i = 1,2,....n \tag{Eq.2}$$

where v is a random error that is associated with random factors not under the control of the farmer. The model is such that the possibility production function Yi is bounded above by the stochastic quantity $\int(x_i \exists) \exp(v_i)$ hence the term stochastic frontier. The random error v_i are assumed to be independently and identically distributed as $N(O, \Phi^2)$ random variables independent of the u_i.

Technical efficiency of an individual farmer is defined in terms of the ratio of the observed output to the corresponding frontier output, given the available technology. Technical efficiency is shown by *Equation 3*:

$$\text{Technical efficiency (TE)} = Y_i/Y_{i*} = f(x_i, \exists) \exp(v_i - u_{i)}/f(x_i, \exists) \exp(v_i) = \exp(-u_i) \tag{Eq.3}$$

where Y_i is the observed output and Y_{i*} the frontier output. Technically efficient farms are those that operate on the production frontier and the level by which a farm lies below its production frontier is regarded as the measure of technical inefficiency (Fan and Pardey, 1997; Kumar, 2004).

For this study, the production technology of smallholder crop farmers is assumed to be specified by the Cobb-Douglas production function defined by *Equation 4*:

$$Log\ Y = \exists_0 + \exists_1 \log x_i + \exists_2 log x_2 + \cdots + v_i - u_i \qquad (Eq.4)$$

where:
Log represents the natural logarithm,
Y represents income from crops from the i-th farmer measured in Rands (At the time of collection of the data for this study 1 US $ was exchanged for R15.60),
X_1 represents the total area cultivated in hectares,
X_2 represents family labour in mandays,
X_3 stands for the asset value in Rands,
X_4 represents the amount of fertilizer used (kg),
X_5 stands for value of seed in Rands,
$\exists_{1i}$ are coefficients to be estimated,
V_is are assumed to be independent and identically distributed normal random errors, having zero mean and unknown variance, $\phi^2 v$.

The u_{is} are the technical inefficiency effects, which are assumed to be independent of V_is such that u_i is the non-negative truncation (at zero) of the normal distribution with mean, u_i, and variance, ϕ^2, where u_i is defined by *Equation 5*:

$$u_i = *_i + *_i\ z_{1i} + *_2\ z_{2i} + *_3\ z_{3i} + *_4\ z_{4i} + *_5\ z_{5i} \qquad (Eq.5)$$

where $z_1, z_2, z_3, z_4\ and\ z_5$ are age, education level of the farmer, number of years farming, land size and household size respectively. These variables are assumed to influence technical efficiency of the farmers; $*$s are unknown scalar parameters to be estimated (Kumar and Desai, 1995; Kalirajan, 1996). In this study several variables were included which are: age, education level, gender, agricultural support services, access to credit, technology adoption, years in farming, farm size and household size. They were included in the model as determinants of technical efficiency, to show potential effects of household's head features on technical efficiency. In this regard, the analysis will allow the researcher to come up with recommendations to government and support structures to farmers and come up with policies that will assist or enhance efficiency of the smallholder farmers in South Africa and many developing countries.

Results and discussion

The researcher investigated the demographic characteristics of household heads to determine the household structure. *Table 1* shows that a large proportion of the farm household heads is aged between 31 and 83 years. This implies that most of the farmers are inactive looking at their ages and this means that the labour quality is compromised and the productive energy from the household heads is limited. This is common with most studies in developing countries that there is an ageing rural farm population in South Africa and many other African countries (Du Plessis, 2003). The data also reveals that

most of the households are headed by males than females. This agrees with the tradition in the southern part of Africa where males are heads of the family. It was also observed that spouses and children are an important source labour in rural areas. In rural areas, it is expensive to hire labour and so farmers depend entirely on family labour for agriculture. The average household size for uMdoni municipality was 4 family members and for uMgungundlovu was 3 family members. The household sizes are not that large as the highest in both areas is 4 people and below. This is consistent with national statistics in that household these days have smaller families due to economic and financial challenges (Statistics South Africa, 2020). In terms of education, the majority (44.3%) of the sampled household heads had no formal education while the rest had either secondary or tertiary education. This finding conforms to the results of previous studies in that most rural people had none or limited education due to the financial challenges associated with poverty in rural areas. Limited education of household heads has implications on their farm decision-making as these farmers cannot adapt to new technological changes in the farming fraternity. This may limit their ability to take full advantage of new technology, use of hybrid seeds, modern fertilizers, new machinery and extension services, thus affecting their income generation and poverty.

Table 1. *Estimated statistics on stochastic frontier for smallholder farmers*

Municipality	uMdoni				uMgungundlovu			
Variables	Mean	Std	Min	Max	Mean	Std	Min	Max
Age of household head	36	0.632	31	83	48	0.337	18	77
Occupation	16	1.392	4	35	7	4.231	3	29
Household size	4	3.941	2	5	3	0.673	1	7
Farm experience in years	6	0.467	2	19	3	0.336	4	27
Farm size in Ha	0.3	0.735	0.1	7	0.7	0.566	0.1	23
Education level in years	9	2.631	6	16	3	2.017	7	19
Membership of cooperative in years	2	3.591	2	11	4	1.326	3	17
Access to credit in Rands	12000	2.437	17300	17000	1560	3.015	6000	57200
Distance to the nearest to market	4	1.237	3	13	12	0.327	9	26
Income from production	2100	0.896	6700	14000	33000	0.651	14900	57400

Source: Computed from survey data (2025)

To add on, the majority of the sampled household heads are unemployed and are basically dependent on agriculture as a source of income apart from social grants. South Africa is an agrarian nation that contributes about 4% to the Gross National Product and the role of smallholder farmers has been found to be consistent with good quality because of the scale to size (Galal, 2021). The challenge that smallholder farmers are faced with is that of markets that are located far.

Rural farm households are located distant from urban areas and this shows that a sizeable number of the rural farm households may be landless due to the land distribution inequality and as such, many rural people require some other means of livelihood apart from farming (DAFF, 2012). Most people in rural areas depend on social grants and not so many are employed in the formal sector of the economy. Hence, when people retire, they move to rural areas to start farming for household consumption. This is also supported by Aliber and Hall (2012) that most rural households in South Africa are dependent on agriculture. However, there is no discrimination in crop farming as most

farmers cultivate maize, sweet potatoes, amadumbe, sugar beans and many other vegetables in KwaZulu Natal Province. The next section looks at the model specification and results of the study.

Stochastic frontier results

The estimated statistics on stochastic frontier results indicate that most farmers, because of their age, are affected by their physical strength and the production of crops requires people who still have the energy to farm. Farmers also must be mentally prepared to make rational decisions since farming is a risky enterprise. Being physically fit and mentally prepared in farming is very important to increase agricultural output. It is also anticipated that as physical strength declines with old age, agricultural output is more likely to decline especially for smallholder farmers when we look at the availability of production resources. Hence, old age invites a greater investment of labour for the same production activities in smallholder farming. Meanwhile, the experience of older farmers brings about better efficient combinations of inputs, which is responsible for a unit of labour to be more effective.

For production to take place in rural areas there are other factors involved such as land, labour and capital but also technological development such as precision or mechanized agriculture. An ageing agricultural production needs technology to compensate for the physical deficiency in the rural population (Lin and Deng, 2012). Hence, education becomes an important factor in decision-making by farmers. In this study in both areas, most of the people are not educated with an average of 9 and 17 years at school respectively and this shows that these farmers have basic education.

The nature of farming in rural requires physical labour, this means that a lot of machinery or equipment is needed in rural areas of KwaZulu Natal. Smallholder farmers in KwaZulu Natal are still using outdated farming methods. Recent technology is either unaffordable, or farmers cannot use it (Hu and Zhong, 2013). On the other hand, social grants have become an inhibitor to agriculture as some people in rural areas rely on them and do not see agriculture as a future or an investment. In some instances, smallholder farmers may use their social grants to invest in the use of machinery instead of labour (especially for hiring tractors and people during planting and harvesting time).

Maximum likelihood estimates

This section looks at the inferences of the stochastic frontier model on the maximum likelihood estimates, represented by the elasticity estimates and these are given by the following variance parameters of the model:

$$\sigma s^2 = \sigma u^2 + \sigma v^2 \text{ and}$$
$$Y = \sigma^2/(\sigma u^2 + \Phi^2) \qquad \text{(Eq.6)}$$

The stochastic frontier model parameter is estimated at 63% which is fair enough considering that the data sample was not that large. The magnitude of the variance is relative and shows the inefficiency effects on the significance of the data. This model looks at the proportional change in the i-th input level resulting in a predetermined output level. To ensure that the model gives a proper indication of the impact of age, we keep all other input levels constant. This helps determine the impact of age on the production of crops on these farms. *Table 2* presents the elasticity estimates and the returns-to-scale value.

Table 2. Elasticity and returns-to-scale for smallholder farmers

Municipality	uMdoni	uMgungundlovu
Inputs	Mean Elasticity	
Land	0.37	0.62
Labour	0.34	0.59
Machinery and implements	0.31	0.61
Fertilizer	0.17	0.35
Seeds	0.28	0.47
Returns-to-scale	1.32	1.83

Source: Computed from survey data (2025)

Table 2 shows the mean elasticity values of output with respect to the input estimates used during the production process. The mean elasticities of farm output with respect to land, labour, machinery or implements, fertilizer usage and seeds are 0.37, 0.34, 0.31, 0.17 and 0.28 for uMdoni Municipality and 0.63, 0.59, 0.61, 0.35 and 0.47 for uMgungundlovu Municipality respectively. Given the specification of the Cobb-Douglas frontier models, the results show that the elasticity of mean value of farm output is estimated to be an increasing function of land, an increasing function of labour, machinery and implements used in the production process. It is important to note that the mean value of farm output is estimated to be an increasing function of fertilizer as well as of seeds. The returns-to-scale value, 1.32 and 1.83 respectively of the two municipalities. This indicates an increasing return-to-scale. The implication of increasing-returns-scale in this study means increasing productivity per unit of input which basically means that farmers are not using their resources efficiently. The reason behind such results could be linked to the age, physical energy to produce crops, limited use of sophisticated technology and unreliable weather patterns in the communal areas.

The results would be slightly different if the farmers adopted new technologies looking at their average ages in the two study areas. The results show increasing returns to scale or simply increasing returns when a proportional increase in factor inputs is used and the yields are better than a proportional increase in output under the two areas. An increase in factor inputs in uMdoni municipality where there are a lot of old people farming results in less than a proportional increase in output when compared uMgungundlovu municipality.

Technical efficiency estimates

The Cobb-Douglas stochastic frontier model in *Equation (1)*, dwells much on the predicted technical efficiency variables from the sampled farmers. The minimum and maximum values of 0.08 and 0.93 for uMdoni and 0.09 and 0.91for uMgungundlovu municipality. The mean technical efficiency value of 0.42 and 0.43 respectively for the two municipalities. *Table 3* presents the frequency distribution of technical efficiency of the sample farmers.

The distribution of the technical efficiency in *Table 3* clearly shows that the technical efficiency skewed heavily in the 0.30 and 0.49 range, representing 59% and 43% of the farmers in the two municipalities respectively. This variation in technical efficiency estimates is typical example of why most of the farmers are still underutilizing their resources in the production process. This is an indication that there is room for improving production to achieve technical efficiency.

Table 3. *Frequency distribution of technical efficiency estimates*

Municipality	uMdoni		uMgungundlovu	
Technical efficiency Range	Freq	% of Total	Freq	% of Total
0.1 - 0.29	13	13.40	21	27.63
0.30 - 0.49	57	58.76	33	43.42
0.50 - 0.69	14	14.43	17	22.37
0.70 - 0.89	7	7.21	3	3.95
0.90 - 1.00	6	6.19	2	2.63
Total	97	100	76	100

Source: Computed from survey data (2025)

Table 3 shows various levels of inefficiency in the production function. For example, age of household head, level of education, and year in farming are significant determinants of technical inefficiency. These variables significantly affect the level of technical efficiency of the respondent farmers. Apparently, household size and farm size did not significantly affect technical inefficiency. The negative coefficients of level of education, farm size and farming experience certainly confirm that an increase in any of or in all these variables would lead to reduced agricultural output. Hence, an increase in the value of variables with positive coefficients such as age and household size illustrates that an increase in the value of these variables is certainly likely to increase agricultural output and lead to technical inefficiency. A simulation analysis to understand the magnitude of the different variables was performed to identify those that could have an influence on government policy.

Analysis of policy variables that affect technical inefficiency

Table 4 presents the simulation outcomes, assuming a change in policy that interferes with the determinants of technical inefficiency. The simulation is done with a rise in the values of the variables by 5% and 10% and the observed changes in the level of technical efficiency are as presented in *Table 4*.

Table 4. *Simulation results of variation in policy variables on mean technical efficiency*

Municipality	uMdoni		uMgungundlovu	
Variable	+5%	+10%	+5%	+10%
Age of farmer	0.47	0.44	0.43	0.41
Level of education	0.46	0.49	0.42	0.46
Farming experience	0.45	0.48	0.43	0.47
Household size	0.45	0.39	0.49	0.46
Farm size	0.48	0.50	0.49	0.56

Variables (Mean T.E =0.43). Source: Computed from survey data (2025)

The outcomes of simulation of policy variables prove that the mean technical inefficiency would reduce with the rising level of education, farm size and farming experience. A rise in the level of education from 5% through 10% raised the mean technical efficiency from the current level of 46% to 49% for uMdoni and 42% to 46% for uMgungundlovu municipality, while an increase in the level of farming experience from 5% through 10% led to an increase in the mean technical efficiency from the current

level of 45% to 48% and 43% to 47% for the respective municipalities. Whereas a rise in land size from 5% to 10% only led to a marginal rise in the mean technical efficiency. An increase in age of the farmers from 5% through 10% led to a noticeable fall in the mean technical efficiency from 47% to 44% (uMdoni) and 43% to 41% (uMgungundlovu) while on the other hand, household size and from 45% to 39% and 49% to 46% respectively for the two municipalities.

Apart from age having a significant impact on agricultural output in smallholder farming, education is also one of the main determinants affecting production. Education is one of the variables which can be used by policymakers to improve the adoption of new technologies to enhance production and increase technical efficiency. It is important for the government to institute policies that encourage people to be educated through skills training and workshops on farming to increase the level of technical efficiency of the farmers. This implies that any agricultural policy in the country would encourage smallholder farmers to remain in the farming as long they have the necessary skills to produce at the technical efficient level. In addition, agricultural policies should attract young people into farming and maybe that could increase the level of technical efficiency. Young farmers tend to adjust and adopt innovative farming skills more quickly than the old and illiterate farmers. Tackling agriculture has been a topical issue in South Africa, political parties, the private sector and most importantly agricultural economists have been encouraging youths to participate actively in farming. The wealth of the economy is locked in farming and yet youths prefer urban life.

Conclusion

In summary, the study utilized a sample size of 173 farmers to investigate the impact of old age on agricultural production. A stochastic frontier was used to measure technical efficiency using various independent variables such as labour, seed, fertilizer and many other inputs which were controlled. All the estimated coefficients for inputs showed a direct influence on agricultural output of farmers. Moreover, the sum of the elasticities of the inputs shows diseconomies of scale production especially looking at age and household size. It is imperative that this group of farmers has an average technical efficiency which is low, and age and household size are the factors affecting the efficiency of farmers. In this respect, it is still possible for smallholder farmers to re-allocate these inputs to improve their technical efficiency.

In this study, land size does not improve the technical efficiency of the farmers but rather lack of education and experience in farming could possibly increase technical efficiency. Only land size, level of education and number of years in farming (experience) were found to be statistically significant. Nonetheless, technical assistance from being a cooperative member and access to credit did contribute positively to the levels of technical efficiency, hence, they were not statistically significant.

In addition, the study considered a set of measures to assess the technical efficiency in the use of inputs, namely, returns to scale. According to these results, farmers in KwaZulu Natal Province are struggling because of old age and their physical contribution to labour. Hence, there is a need for youths to participate in this rural economy to unlock the wealth associated with it. Therefore, these farmers can increase their technical efficiency by making use of youth labour and machinery in farming.

It is clear from these results that government that is interested in investing in agriculture should direct its policies in youth development. Old people in rural can only

do so much but the possibility of encouraging young farmers can be fruitful to the South African rural people. Young people in South Africa and many other developing countries do not regard farming as a business but rather as something taking their time. Greater efforts must be made by government institutions regarding providing support to farmers and initiatives must be done to encourage young people to venture into agriculture. Government should also provide technical assistance and promote skills development in new technologies that will help farmers to boost their current levels of efficiency.

In conclusion, efforts must be made to support both young and old-aged smallholder farmers with innovative skills that better prepare them to take advantage of increases in farm size and access to credit which is necessary to stimulate technological innovations that foster increases in crop yields.

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