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Analysis of Gender Differentials in Technical Efficiency among Smallholder Maize Farmers in Rwanda

Dr. RUVUNA ERIC
Lecturer, Kibogora Polytechnic, Rwanda
Dr. RUTURWA DANIEL
Lecturer, University of Rwanda
Dr. MURWANASHYAKA THEOPHILE
Lecturer, Kibogora Polytechnic, Rwanda

Abstract

One of the ways to achieve food security and poverty reduction among smallholder farmers in developing countries is to ensure efficient use of the scare agricultural resources. Objective of this study was to estimate maize output for male and for female farmers. To achieve this objective data on the socio-economic and institutional factors were collected among 80 male managed farms and 80 female managed farms based on the simple random sampling method. To analyze the data, descriptive and inferential statistics were adopted. The findings of the maximum likelihood estimates confirmed that farm size, seed, organic fertilizer, inorganic fertilizer and labour affected maize production for the male farmers while farm size, seed, organic fertilizer and labour affected maize production for female farmers therefore considered as important factors in determining maize output. Higher return to scale was observed in male managed farms because male's RTS was greater than 1 while that of female was less than 1 implying that male farmers were operating in the increasing return to scale while female farmers were in the decreasing return to scale. Analysis of technical efficiency results reported that higher mean technical efficiency (86%) was found in male managed farms compared to that of female managed farms (61%). Based on the findings of the study, the author recommends that there is a need of initiating programs that lead to the empowerment of female farmers and *focusing on the use of scarce resources. This will lead to increase maize production and thereby enable female farmers to operate in a zone of increasing return to scale and contribute to increase the levels of female farmers' technical efficiency in Musaza sector.*

Keywords: Males, Females, Smallholder, Technical efficiency, Maize.

RESEARCH HIGHLIGHTS:

- For male managed farms, farm size, seed, organic fertilizer, inorganic fertilizer and labour positively affected maize output.
- For female managed farms, farm size, seed and labour were positively associated with maize output while organic fertilizer was negatively associated.
- It was observed that return to scale (RTS) in male managed farms was high compared to that of female managed farms.
- Male farmers were found to be more technically efficient compared to their female counterparts.

INTRODUCTION

The topic of gender in agriculture sector has had an increasing interest for many researchers across the world because of the discussions on the role of women in the economic development of their countries and the challenges that they faced in all the aspects of their lives. The World Bank, through various researches concluded that countries can directly increase their gross domestic product by acknowledging the role of women in the economic development (https://www.livemint.com).

In Rwanda, agriculture sector is the mainstay activity of the majority of rural people on which they depend on for their livelihoods and contributes 31 % to the GDP (NISR, 2018). The Government of Rwanda (GoR) is committed to achieve gender equality and women empowerment, the sustainable development goal number 5 as defined in the economic development for poverty reduction strategy (MINAGRI, 2010). In this regard, Rwanda has established several policies and government bodies that will implement the initiated policies including Gender National Policy, Ministry of Gender and Family Promotion, Gender Monitoring Office and Women's National Council and specifically in agriculture sector; agriculture gender strategy. These initiatives made Rwanda to be ranked as the second country in the world in promoting gender equality after Sweden. Rwanda was the first country in the world to have more than 50% female members in the parliament (UNDP-Rwanda, 2014).

Rwanda has made a significant progress towards gender equality in all the areas. In the national gender policy; it is stated that women's contribution in economic activities at national level was about 56.4% while men's contribution was 43.6%. Out of 56.4% of the economically active women, 87.6% of them were involved in agricultural based activities (Ministry of gender and family promotion, 2010).

To deal with the problems faced by the farmers and recognize women role in the decision making in rural development agriculture gender strategy has been initiated. This strategy is in line with the constitution of Rwanda, economic development and poverty reduction (EDPRS), national gender policy (NGP) and the main purpose of this strategy is to mainstreamed equality between men and women and boys and girls in all the domains of socio-economic development (MINAGRI, 2010).

Despite the efforts made by the GoR, women are still facing continuous challenges in rural areas especially inequality in the decision making in the use of resources, household income and so forth while women's contribution in the income generating activities is of a great importance. Hence the objective of this study is to understand gender differences in technical efficiency among smallholders' maize farmers. However, modelling gender differences in technical efficiency implies estimating the production functions that yield the maximum output produced by the vector of inputs for a given technology (Dossah and Mohammed, 2016).

A number of factors may contribute to the differences in crop production and thereby technical efficiency between male and female farmers. Differences reside on how the factors like land rights, credit market, access to extension services, production inputs (seed, fertilizers, labour, etc.) are benefited between male and female farmers and the powers of each group in the decision on how the resources will be allocated. Literatures show that there are differences in the decision making between males and females in which males have powers over females especially in rural areas (Sixsmith, 2017). These factors lead to the differences in output between male and female and thereby create difference in frontier line. As the result of these inequalities, the frontier line for female production lies down to that of males indicating that females are less productive and less technically efficient than males.

Therefore, the study of gender differences in technical efficiency will add knowledge to the existing studies and the findings from it will help policy makers to develop policies that will focus on the reduction of gender inequalities in agricultural system.

METHODS AND MATERIALS

Description of the study area

This study was carried out in the district of Kirehe. The District of Kirehe is one of the eight districts constituting the Eastern province. It is located at the south-east of the Republic of Rwanda to 133 Km of the Kigali city. In the east, the Kagera river constitutes the natural limit between the district and

Tanzania. In the south, the district of Kirehe is frontier to the Republic of Burundi and the Republic of Tanzania. In the west, the district divides its border with the district of Ngoma and the district of Kayonza. In north, it is bordered with the district of Kayonza. The economy of Kirehe district is based on agriculture and livestock in which at least 90% of the population heavily depends on. Fertile soils are exploited and give satisfactory production for food crops like banana, maize, beans, soya beans cassava and marshlands suitable for rice growing rather than fruits like pineapples, oranges, mangoes, etc. Moreover, these crops are on a consolidated land of 39,300 Ha**.** Kirehe district is divided into twelve sectors (Imirenge): Gahara, Gatore, Kigarama, Kigina, Kirehe, Mahama, Mpanga, Musaza, Mushikiri, Nasho, Nyamugari and Nyarubuye. Among these sectors Musaza sector was selected as the study area. The rationale behind choosing Musaza sector was that this sector consists of farmers' cooperative of cereals of Musaza (COACMU-cooperative) and maize was found to be the most produced crop followed by beans.

Techniques of data collection

This study used both primary and secondary data and the various techniques were employed to collect the data. Documents review was used to collect the secondary data in which the reviews of different papers, reports, and books were reviewed. In addition to secondary data, a survey was conducted from between 14 January/2016 and 16 March/2016 and the questionnaire was used as the tool of collecting the primary data. An interview schedule and observation techniques were also adopted.

Sampling method

The list of all maize farmers which comprises of 1213 farmers was given by the president of the cooperative in which 725 farmers were females and 488 were males. Note that the present study focuses on gender differences among smallholder maize farmers. In this context the analysis was made based on the gender status of the farmer. To determine the sample size; this study employed the simplified formula of Kotari (2004) at 95% confidence level as given below:

$$n = \frac{Z^2 pqN}{e^2(N-1) + Z^2 pq}$$

Where:

n: sample size for a finite population

N: size of population

P: population reliability (or frequency estimated for a sample size n) where p is given as 0.5 and p+q=1

e: margin of error considered is 10% for this study

$Z_{\alpha/2}$: Normal reduced variable at 0.05 level of significance z is 1.96

When this formula is applied to the above sample, we get:

$$n = \frac{(1.96)^2 \times 0.5 \times 0.5 \times 488}{(0.1)^2(488-1) + (1.96)^2 \times (0.5 \times 0.5)} = 80.3 \simeq 80 \text{ male farmers}$$

To compare male farmers with female farmers another set of 80 female farmers were selected based on the simple random sampling technique.

TOOLS OF DATA ANALYSIS

1. Descriptive statistics

Mean as the measure of central tendency was computed, minimum and maximum values were also generated to indicate the range.

2. Inferential Statistics

Inferential statistics was applied for two main reasons: (i) to determine the probability of characteristics of population based on the characteristics of the sample and (ii) to assess the strength of the relationship between independent (causal) variables and dependent (effect) variable. The relationship between maize production and the inputs used was studied through the stochastic frontier model and analyzed the effect of each predictor on the predictand.

THEORETICAL FRAMEWORK

Measuring technical efficiency of farmers has been an area of interest to many agricultural economists. In this regard, stochastic frontier approach has been applied to measure the technical efficiency of production processes in order to assign the responsiveness of the yield to different resulting inputs. Thus, changes in this responsiveness are mainly due to differences in the level of technology that is applied by the farmers. Stochastic frontier model is mostly used particularly to model agricultural production because of its features that enable to generate inefficiency effect from measurement error and random shock.

Francesco (2009) reviewed the parametric and non-parametric methods of measuring the technical efficiency and concluded that the stochastic frontier method is the most suitable in measuring the technical efficiency as it provides the variation of actual output from the frontier due to inefficiencies and random shocks.

Coelli and Battese (1995) revealed that a non-parametric method has been criticized as it does not consider the existing influence of random shocks such as measurement errors and other noises in the data. They concluded that the most advantage in the application of the stochastic frontier method over non-parametric is the consideration of the stochastic random noises that are beyond farmer's control in addition to the inefficiency errors.

The stochastic frontier production model is defined as:

$$Y_i = f(x_i, \beta) + v_i - u_i \qquad (1)$$

Where Yi is the quantity of output

Xi is the set of inputs and and β is the vector of parameters to be estimated by the maximum likelihood method. $v_i$represents the random variation in output due to the factors beyond farmers control such as temperature, precipitation, natural calamities). It is assumed to be independently and identically distributed with zero mean and constant variance statistically given as $N(0, \sigma^2)$.

$u_i$is a non- negative term which defines all the controllable factors represent the technical inefficiency.

The technical efficiency of a farmer is defined as the ratio between observed output (Y) and frontier output (Y*) it is shown in (2)

$$TE_i = \frac{actual\ output}{potential\ output} = \frac{Y_i}{{Y_i}^*} \qquad (2)$$

$$= \frac{exp(X_i\beta_i + V_i - U_i)}{exp(X_i\beta_i + V_i)} = exp(-U_i) \qquad (3)$$

Where TE stands as technical efficiency and the inefficiency effect U_i which lies between 0 and 1, when it is equal to zero, the production is on the frontier which indicates that $Y_i = exp(X_i\beta_i + V_i)$ then TE= 1 and therefore a farmer is technically efficient. When U_i is greater than zero (U_i>0) the farmer is technically inefficient (TE<1), since the production figure will be below the frontier line Kumbakhar and Lovell(1989).

Model specification for stochastic frontier production function

The Cobb-Douglas functional form for maize farm in Musaza sector is defined as follows:

$$LnY = \beta_0 + \beta_1 LnX_1 + \beta_2 LnX_2 + \beta_3 LnX_3 + \beta_4 LnX_4 + \beta_5 LnX_5 + V_i - U_i \quad (4)$$

Where:
Ln is the natural logarithm
Y is the total output of maize measured in kg, X_1 is the farm size in hectare, $X_2$is the seed in kg, $X_3$is the organic fertilizers in Kg, X_4 is the inorganic fertilizers applied in Kg and X_5 is the labour employed in man days. The choice of these inputs was motivated by the fact that these inputs are very important and commonly used in maize production process in the study area. β's the parameters defined as the coefficients of inputs to be estimated by Maximum Likelihood Estimation Method. V_i is the random assumed to be independently, identically and normally distributed i.e. N(0,σ_v^2) and Ui is a non-negative random variable assumed to be independently and identically distributed i.e N(μ, σ_μ^2).

RESULTS

1. Socio-economic characteristics of the sampled maize farmers

Socio-economic characteristics of the respondents are described because they provide information on their distribution and subjected to influence farmers' production as well as farmers' technical efficiency. This study considered these factors because they were always the main to cause changes in the crop production. Therefore, this study included farm size, seed, labour, organic and inorganic fertilizers in the model. Apart from these factors, educational status of male and female farmers was described. Training was considered as an institutional factor to enable the researcher understands the differences in training considering both male and female farmers. This helped to get insight on the distribution of training factor between male and female farmers.

Table-1
Summary statistics of the continuous variables

Predictors	**Male**			**Female**		
	Mean	**Max**	**Min**	**Mean**	**Max**	**Min**
Age	39.13	78	18	44.83	80	21
Experience	1.93	4	1	2.69	12	1
Household size	6	12	2	5.57	10	3
Farm size	0.63	1.54	0.01	0.56	1.50	0.01
Labour	12.7	80	3	13.24	90	3

Source: Computed

The results given inTable-1summarized the statistics descriptive of the important continuous variables. The minimum and maximum ages of male farmers are 18 and 78 years while the minimum and maximum ages of females are 21 and 80. Results revealed that the average ages of maize farmers were 39 and 45 years for male and female farmers respectively. However, mean age of female farmers was high compared to that of males.

Results showed that on the average male and female farmers have about 2 and 3 years of farming experience respectively. The size of the household was also described due to the place it occupies in the crop production and technical efficiency of the farmers. Results revealed that mean household size of male and female farmers is almost similar with 6 and 5.57 respectively. According to the results, average farm size indicates that male and female farmers operate on the small-scale plots with farm size of 0.63 and 0.56 ha respectively. Regarding the labour force employed by both male and female farmers, results showed that mean of the man power employed between male and female is almost similar as the difference of man days is meager. Thus, males accounted an average labour force of 12.7 man days while females recorded 13.24 man days.

Table-2
Distribution of the categorical variables

Predictors	**Male**		**Female**	
	Literate	**Illiterate**	**literate**	**Illiterate**
Educational status	52 (65)	28 (35)	48 (60)	32 (40)
	Yes	**No**	**Yes**	**No**
Training	43 (53.8)	37 (46.2)	41 (51.2)	39 (48.8)

Source: Computed
Values in parentheses indicate percentages.

Table-2 presents the results of the descriptive statistics of the categorical variables. Educational status of the sampled maize farmers was considered as categorical variable because the researcher wishes to capture information on how males and females were distributed in the study area based on their respective educational categories. Hence, education variable was classified in two categories viz literate and illiterate. Therefore, it was found that the majority (65%) of males are literate compared to their female (60%) counterparts. With regard to the training received, it is indicated that the majority (53.8%) of male farmers were trained compared to females (51.2%).

2. Factors influencing maize production

Fitting maize output as dependent variable and inputs as independent variables stochastic frontier production model was applied to examine the factors influencing smallholder maize production in Musaza sector of Kirehe district and through it technical efficiencies for the sampled maize farmers were generated. Therefore, the maximum likelihood results are obtained and presented in Table-3.

Table-3
Maximum likelihood estimates of the stochastic frontier for maize production

Variables	Male			Female		
	Coeff.	**Std.error**	**t-value**	**Coeff.**	**Std.error**	**t-value**
Intercept	5.429	0.216	25.541	5.758	0.381	15.121
Farm size	0.455	0.06	6.663***	0.399	0.07	5.343***
Seed	0.190	0.126	1.509*	0.452	0.05	6.026***
Organic fertilizer	0.049	0.034	1.628*	-0.021	0.048	-2.252**
Inorganic fertilizer	0.249	0.052	4.868***	0.042	0.091	0.464[NS]
Labour	0.109	0.049	2.197**	0.102	0.068	1.504*
Variance Parameters/Diagnostic statistics						
Sigma squared (σ^2)= $\sigma u^2 + \sigma v^2$	0.056	0.025	2.234**	0.572	0.173	3.300***
Gamma(γ)= $\sigma u^2 / \sigma^2$	0.696	0.326	2.138**	0.868	0.127	6.802***
Lambda (λ)= $\sigma u / \sigma v$	0.09			2.551		
LR test	0.589			3.732		
Log likelihood function	25.769			- 56.487		
Mean technical efficiency	0.86			0.61		
Mean technical inefficiency	0.14			0.39		
Number of observations	80			80		

Source: Computed
*** t-ratio is significant at 1%
**t-ratio is significant at 5%
* t-ratio is significant at 10%
NS- Non-Significance

Results presented in Table-3 are the estimated parameters of the stochastic frontier maize production for male and female farmers in Musaza sector as well as the variance parameters for both male and female farmers. Data of the variance parameters are represented by sigma squared, gamma, and lambda parameter. Results showed that for female farmers lambda value is greater than one ($\lambda = 2.55$) which indicates that one sided error term u_i dominates the measurement error v_i. This proves that there is way to conclude the presence of technical inefficiencies in the sampled female farmers. Results showed that technical inefficiency effects existed in maize production in the study area for both male and female production. For male model it is confirmed by the gamma (γ) value of 0.86 which is significant at 5 percent level. The gamma ratio indicates the relative magnitude of the variance σ^2, associated with the technical inefficiency effects. Hence, the obtained value of 0.86 implies that about 86 percent variation in the total output of maize was due to technical inefficiency and the remaining 14 percent was due to the factors beyond the farmer's control. The mean technical efficiency (MTE) of the sampled male farmers is 86 percent indicating that maize output can be raised by 14 percent without increasing the level of inputs and technology. Similarly, the technical inefficiency effects were found in female maize production as it is proved by the gamma (γ) value of 0.61 which is highly significant at 1 percent level. This finding implies that that maize output can be raised by 39 percent without increasing the level of inputs and technology. Thus, it can be concluded that the level of male farmers' technical efficiency was high compared to that of female counterparts which means that output produced by male farmers was closer to the frontier line and above to that of female farmers.

Stochastic frontier model for male maize farmers

To conclude on the hypothesis and inference, t-statistic results were computed by the help of frontier 4.1 version software. The results of the t-ratio showed that for male managed farms all the estimated coefficients were statistically significant and different from zero at 1, 5 and 10 percent level of significance. The variables farm size, seed, organic fertilizer, inorganic fertilizers and labour were found to improve maize production for male managed farms and therefore increase male farmers' technical efficiency thus leading to increase economic efficiency of male farmers. The positive sign on farm size indicates that an increase in farm size would result in an increase in maize output. The estimated coefficient of farm size was positively associated with maize output at 1 percent level of probability. It implies that an increase of 1 percent in farm size would increase maize output by 46% ceteris paribus. In other words, maize output in the study area would increase when farm size increases.

The estimated coefficient of seed was positively associated with maize output at 10 percent level of significance. It implies that an increase in the quantity of seed, leads to an increase in maize output. Thus, an increase of 1percent in the quantity of seed would increase maize output by 19 percent ceteris paribus. The positive sign of seed variable is in accordance to that which was hypothesized. Hence, the significance of seed is due to the fact that seed is a major input in the sense that it increases the productivity by increasing crops yield per hectare. Organic fertilizer variable has a positive influence on maize production which means that organic fertilizer is an important factor to consider in maize production due to its influence on maize production. Results show that an increase of 1 percent in organic fertilizer enables to increase maize production by 5 percent other things being equal. The estimated coefficient of inorganic fertilizer revealed that inorganic fertilizer was positively and highly significant at 1percent level. Thus, an increase of 1 percent of inorganic fertilizer would lead to an increase of 25 percent of maize production. Lastly, labour was positive and significant at 5 percent level implying that the quantity of man days employed by the male farmers were the determining factor in maize production. Hence, an increase of 1 percent increases maize output by 11 percent ceteris paribus.

Stochastic frontier model for female maize farmers

The results shown in the Table-3 revealed that except inorganic fertilizer which was observed to be insignificant other variables, farm size, seed and labour were positively and significantly associated with maize production while organic fertilizer was negatively related to maize output. The variables farm size, seed and labour were found to improve maize production for female managed farms and therefore increase female farmers' technical efficiency. Thus, an increase of 1 percent in farm size increases maize production by 39.9 percent. With regard to seed variable, there is a positive effect since an increase of 1 percent of seed increases maize production by 45.2 other things being equal. Organic fertilizer variable for female model was found to affect negatively maize output. The main reason can be attributed to this finding and explained the implication of the finding:

It was observed that Girinka programme enabled farmers to obtain organic fertilizers for their farms. However, farmers argued that there is still lack of organic fertilizer which obliged them to buy them for those who can afford to buy it while those who cannot afford to buy applied low quantity. Consequently, these changes in the use of fertilizers might be the reason for this relationship. Hence an increase of 1 percent in organic fertilizer leads to decrease maize production by 2.1 percent. The estimated coefficient of labour was positively affecting maize output in the study area indicating an increasing tendency between labour and maize production. Thus, an increase of 1 percent of labour enables farmers to increase10.2 percent of maize ceteris paribus.

3. Type of return to scale of male and female farmers in maize production

Returns to scale explains the technical property of production that shows changes in output due to a change of all inputs. To understand the differences in the levels of technical efficiency of male and female farmers is another objective of this study.

Hence, Table-4 shows the results of the input elasticities for the two models.

Table-4
Return to scale (RTS) and the parameters of SFP function

Predictors	**Male**	**Female**
	Elasticities	**Elasticities**
Farm size	0.455	0.399
Seed	0.190	0.452
Organic fertilizer	0.049	-0.021
Inorganic fertilizer	0.249	0.042
Labour	0.109	0.102
RTS	**1.052**	**0.974**

Source: Computed

For male farmers, the RTS of 1.052 which was found by adding the inputs elasticities reports that maize production in the study area was in the stage I of the production meaning that the type of RTS in maize production was an increasing return to scale or decreasing costs because the summation of elasticities is greater than 1. Result showed that the RTS for female was 0.97 implying that maize production was found to be in the stage III which is the stage of decreasing return to scale or a diminishing return to scale or increasing costs because the addition of elasticities is less than 1.

In this stage, maize output increases in a smaller proportion than that of the inputs. Hence, at this stage, farmers are advised to maintain the same level of input utilization and try to reduce the costs of each input or to reduce the quantity of input applied in the farms as these will enable maximum output from a given level of input other things being equal.

DISCUSSION

The research was conducted with the objective of analyzing gender differences in technical efficiency of small-scale maize farmers in Musaza sector, Rwanda. The study adopted the stochastic frontier approach to analyze the technical efficiency of small-scale male and female maize farmers. Hence, Cobb-Douglas stochastic frontier production function was modeled for both males and females and the parameters of the model were estimated by employing the maximum likelihood estimate method and thereafter the levels of technical efficiency of male and female maize farmers were obtained.

The MLE results indicated that in male and female model, farm size was highly significant at 1 percent level and positive. This shows that farming is the livelihood strategy adopted by the majority of residents who are depending on land. These findings are in line with that of Dossah and Mohammed, 2016 who reported that the coefficient of farm size for male and female were positive and significant at 1 percent level in plateau state of Nigeria and consistent with the findings of Adeoti and Oleyami, 2003 who revealed an increasing relationship between farm size and fadama output in savannah zone of Nigeria. They are in consistency with the findings of Oladeebo and Fajuyigbe, 2007 found that the estimated coefficient of farm size for male and female upland rice farmers were positive and significant. They are also consistent with the findings of Simoyan et al., 2011 showed that the coefficients of farm size were positive and significant at 1 percent level of probability for male and female farmers respectively.

With regard to seed variable, results confirmed a positive relationship between seed and maize output in the study area for both male and female managed maize farms. These findings oppose to that of Dossah and Mohammed, 2016 showed a negative sign of the estimated coefficient of seed for male and female vegetable farmers.

In relation to organic fertilizer, findings showed that organic fertilizer was positive for male and negative for female. Simoyan et al., 2011 found a positive influence of fertilizers on maize farmers in Essien Udim Local Government Area, Nigeria for both male and female managed farms. It indicates that there is consistency in male managed farms and inconsistency in female managed farms. Regarding maize production for male managed farms Oladeebo and Fajuyigbe, 2007 found the same result which revealed a positive relationship between fertilizer and rice output in Osun state of Nigeria. Similarly, to the findings of Dossah and Mohammed, 2016 who examined the effects of fertilizer and agrochemicals use on the irrigated vegetable farming in plateau state of Nigeria. Their findings showed that fertilizer for male vegetable farmers was positive and significant at 1 percent level. The contradiction of their findings to these findings resides in female model in which their finding indicated a positive relationship while the finding of this study revealed a negative relationship between organic fertilizer and maize production.

It was observed that inorganic fertilizer was positively and significantly influencing maize production for male managed farms. This follows the findings of Dossah and Mohammed, 2016 in their study on who confirmed that agrochemical variable was positively associated with vegetables output of male farmers in plateau state of Nigeria.

Results indicated that labour variable for male and female were positive and statistically significant in maize production. Similarly, to the findings of Dossah and Mohammed, 2016 reported that labour for male and female vegetables farmers were positive and statistically significant in savannah zone of Nigeria. They partially related to the results of Simonyan, et al., 2011in their study on the gender differentials in technical efficiency among maize farmers in Essien Udim local government area, Nigeria. They found that the estimated coefficient of labour was negative in male farmers maize production and positive in female farmers. Thus, the contrast of their findings and this finding is observed in male maize production model in which a negative relationship between labour and maize production was confirmed by Simonyan et al., 2011.

Regarding the type of return to scale that male and female maize farmers operated in, based on the observed results higher return to scale was seen in male managed farms concluding that male farmers were operating in the increasing return to scale indicating an increasing relationship between inputs and maize output while female managed plots were in decreasing return to scale implying that inputs increment was high to that of maize output. Simply, a higher increase in inputs leads to the smaller increase in output. In this scenario, female farmers are advised to reduce smaller the quantity of inputs applied in order to increase maize production and levels of technical efficiency. These results are in relation to those of Dossah and Mohammed, 2016 revealed that the return to scale for male farmers was greater than 1 indicating an increasing return to scale while for the female farmers it was less than 1 implying a decreasing return to scale. Higher mean technical efficiency (86%) was found in male managed farms compare to that (61%) of female managed farms. These findings were similar to that of Addison et al., 2016 who reported that higher mean technical efficiency was observed in male managed rice farms in Ahafo Ano North district in Ashanti region of Ghana.

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1. Prof. Dr. Alfred R. Bizoza, Professor at University of Rwanda, Agricultural Economics. Email: Alfredbiz23@gmail.com
2. Dr. Jonas Musabwa Mugabe, Forum for Agricultural Research in Africa (FARA), Accra-Ghana. Email: jmugabe@faraafrica.org
3. Prof. Dr. Sundavaradarajan K.R., Former Head of the department of Agricultural Economics, Annamalai University. Email: suvaraau@gmail.com