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editor@iajavs.com
iajavs.editor@gmail.com

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A Stochastic Frontier Analysis of the Technical Efficiency of Smallholder Tobacco Farmers in the Makoni District of Manicaland Province, Zimbabwe: A Case Study of Contract Farming

Dube[1*], Kudashe Emmanuel Mugwa[2]

Abstract: This research examined the technical efficiency of smallholder tobacco farmers in Zimbabwe's Makoni area. It used a sample of 98 randomly chosen farmers, with 78% being contract farmers and 22% not being on contracts, to determine the influence of contract farming on technical efficiency. The research estimated the production function and technological efficiencies using stochastic frontier analysis. A mean technical efficiency of 94% was seen among contract farmers, compared to 67% among non-contract farmers. Tobacco smallholders in the Makoni area have an average technical efficiency of 73%. These findings demonstrate that contract tobacco growers outperform their non-contract counterparts in terms of efficiency. Fertilizer and fixed expenses are significant inputs in smallholder tobacco production, according to the data. Even more crucially, the research showed that farmers' technical efficiency is much enhanced by contract farming. The difference in efficiency between contract and non-contract farmers is 10.84 percentage points, which is statistically significant at the 5% level. Technical efficiency is enhanced by factors such as a farmer's degree of education, total cropping area, and gender, but it is diminished by factors such as access to loans other than contract farming financing. The study's conclusions suggest that, in order to boost tobacco growers' total output, the government should encourage more people to get into contract farming agreements, especially women farmers (there are now only 4.5% female contract farmers).

Keywords: Stochastic frontier analysis, smallholder tobacco growers, technical efficiency, contract farming, Zimbabwe

INTRODUCTION

If farmers work to become more efficient with the resources they use, the agricultural industry may grow and thrive. The majority of previous policies have focused on addressing growth by increasing the use of agricultural inputs and expanding agricultural enterprises by cultivating more land, rather than on making the most efficient use of the resources that are already available. A growing number of development professionals in sub-Saharan Africa are coming to the conclusion that increasing agricultural productivity efficiency is key to reducing rural poverty and boosting economic growth [1]. The majority of Zimbabwe's smallholder farmers have gone from subsistence to commercial farming since the country gained independence, thanks to the remarkable structural and legislative changes that have taken place in the agricultural sector. Institutional innovations in value chain growth with respect to inputs and outputs are just as responsible for this shift as structural changes like the fast-track land reform exercise in the 2000s and technology revolutions like the one in the 1980s.

[1]Faculty of Commerce and Law, Zimbabwe Open University, Harare, Zimbabwe

[2]Faculty of Agriculture and Natural Resources, Africa University, Mutare, Zimbabwe

increasing sales by creating CF, or contract farming. Improved agricultural productivity, job creation, and household sufficiency are outcomes of contract farming's implementation, which aims to increase smallholder household incomes through better access to agricultural financing, improved production inputs, specialized extension support, output markets, and better prices.

Contract farming is a way to boost production and the well-being of small-scale farmers. If we want to increase agricultural output and incomes while decreasing rural poverty, contract farming is the way to go [2]. Most of these small-scale producers are rural peasant farmers who work for big processing companies. Contract farming, as pointed out by Olomola [3], may assist small-scale farmers in overcoming obstacles such a lack of access to public extension services, knowledge about markets and markets, financing, land, labor, and insurance markets. Zimbabwe is one of many Sub-Saharan countries with a promising future for contract farming due to the lack of a well-established framework for smallholder marketing. Contractors provide farmers with loans, inputs, transportation, marketing facilities, and extension services via contract farming agreements in exchange for farmers' land, labor, and produce. Therefore, economists should be ecstatic that supply and demand are balancing out and that market inefficiencies are becoming fixed.

Due to their smaller scale, smallholder farmers face unique challenges when trying to gain access to agricultural financing and input/output markets. However, with the rise of farmer organizations and contract farming, these challenges can be overcome, leading to greater productivity and less rural poverty [3]. Because it has the ability to solve most problems encountered by smallholder farmers, contract farming has gained widespread acceptance in Zimbabwe and across Africa. More and more, people are thinking about how to bring together smaller farms and bigger processing corporations to make and sell specific agricultural goods. Among African countries, Zimbabwe ranks first in tobacco leaf production, and among countries in the globe, it ranks fourth in flue-cured tobacco production, behind only China, Brazil, and the USA [4]. Due to the lack of a sizable tobacco manufacturing sector, the nation ships out 98% of its tobacco crop. With a 30% share of total exports, over 12% of GDP, and over 50% of agricultural exports, tobacco is a major player in Zimbabwe's economy [4, 5]. Taxes levied on farmers and consumers alike on the value of crops sold contribute significantly to the national coffers, and the sector employs a large number of people in rural areas. Contract farming accounts for about 80% of the country's tobacco production, in contrast to nations like Mozambique, Malawi, and Zambia where both cotton and tobacco are grown exclusively under contract. Countries that produce a lot of tobacco leaves, such as China, Turkey, and the USA, also employ contract farming as a means of financing their farmers [6].

Contract farming has been around for a while for crops like cotton, sugarcane, and tea; however, in 2004, Zimbabwe implemented a program to grow tobacco under contract in an effort to increase output, which had dropped after the fast-track land reform exercise devastated agricultural production around the new millennium [7]. Before contract farming became popular, new tobacco smallholder farmers had a tough time getting loans from the commercial banks that usually backed the crop. This was because most of these farmers lacked the necessary experience and knowledge to produce quality tobacco, and they lacked bankable collateral. Unbanked smallholder tobacco producers were subject to severe credit restriction due to information asymmetry issues [6]. As a result of these difficulties, tobacco output dropped from 237 thousand kilos in 2000 to 48.7 thousand kilos in 2008 [7, 8]. Limited empirical evidence on the effects of contract farming on smallholder tobacco sector productivity exists, despite the fact that the Zimbabwean government, contractors, NGOs, and development actors have been advocating for contract farming as a means to increase smallholder tobacco production.

Research from other nations is the backbone of the case for and against contract farming. Therefore, studies examining the effects of contract farming on the agricultural output of Zimbabwe's smallholders are necessary for policymaking purposes.

This research aims to examine the influence of contract farming on the technical efficiency of smallholder tobacco farmers in Zimbabwe and to quantify their technical efficiency using stochastic production frontier. In order to increase the yield of tobacco grown by smallholders in Zimbabwe, this research also makes some suggestions.

METHODOLOGY

Study Area and Sample

This study was conducted in Makoni district, Manicaland region where tobacco is the main cash crop with more than 75% of all farmers being regular tobacco growers. A total of 6.726 households are engaged in tobacco production and the total area under tobacco production is 3.200ha. Other main economic activities of the residents in the area are livestock husbandry, maize, groundnuts and horticulture farming.

Data was collected from a randomly selected sample of 98 farmers using a structured questionnaire between February and March 2016.

Analytical Framework

Through contract agreement, producers may learn more skills and knowledge relating to the efficient use of resources, methods of input using, record keeping, the significance of product quality and characteristics of different markets. These contribute to improve productivity of agricultural production [9]. This therefore implies that the impact of contract farming services on farm productivity can be measured through output gain due to elimination of technical inefficiency.

The effect of contract farming on farm productivity can be estimated using the stochastic frontier approach (SFA) whereby the frontier production function specifies what output can beachieved, if all decisions were taken according to their best practices. A smallholder farm's technical efficiencyis a measure of their ability to produce relative to the smallholders' best-practice frontier, which is a measure of the maximum output possible from a given set of inputs and production technology [10, 11]. Technical inefficiency on the other hand is the deviation of an individual smallholder farm's production from the best practice frontier. The level of technical efficiency of a particular farm is based upon deviations of observed output from the efficient production frontier [12]. If the actual production point lies on the frontier it is perfectlyefficient. If it lies below the frontier then it istechnically inefficient. The distance between the actual to the achievable optimum production from given inputs, indicates the level of production inefficiency of the individual firm [12].

A stochastic frontier production function is estimated to analyze differences in technical efficiency between contract participating and non-participating smallholder tobacco farmers in Makoni district. As in Battese and Coelli [13], the study follows a two-step estimation model. The first step involves the specification and estimation of the stochastic frontier production function and the prediction of the technical inefficiency effects, under the assumption that these inefficiency effects are identically distributed. The second step involves the specification of a regression model for the predicted technical inefficiency effects. The effect of participating or not participating in contract farming is captured by use of dummy variables.

The estimated stochastic production function was specified as follows:

$$\ln BALESOLD = \alpha_0 + \alpha_1 \ln FERT + \alpha_2 \ln LAB + \alpha_3 \ln HRS_{processing} + \alpha_4 \ln \text{Other Costs} + \alpha_5 \ln FixedCosts + (\nu - \mu)$$

Where:

$\alpha_0 - \alpha_5$ are the production function model parameters;
ln denotes the natural logarithm (base e);

BALESOLD denotes the total number of bales sold
$FERT_{TOT}$ is the total amount of fertilizer used by the i^{th} farmer;
LAB_{TOT} denotes the total of family labor and hired labor used in man-days;
$HRS_{processing}$ is total hours spent on tobacco curing andprocessing;

Other Costs denotes the total amount of other tobacco production costs in dollars;
Fixed Costs is the total amount of tobacco production fixed costs in dollars. Quantity of fertilizer per hectare used;

The investigation of factors influencing the inefficiencies of extension participant and non-participant farmers is carried out by estimating the following model:

$E = ß_0 + ß_1$ FARMERTYPE $+ ß_2$FEDUC $+ ß_3$TENURE $+ ß_4$CROPAREA $+ ß_5$GENDER $+ ß_6$ OTHERLOAN + µ

Where E is technical inefficiency effects andßs are inefficiency model parameters. The variable definitions are presented in Table 1**.** The *a priori* or hypothesized impact of the independent variables on thedependent variable is also shown. A (+) means the independent variable is expected to have a positive impact on the dependent variable while a (-) means the independent variable is expected to have a negative impact on the dependent variable.

Table 1: Independent Variable Definition and Measurement for Inefficiency Function

Variable	Description	Variable Measurement	Hypothesis
INDEPENDENT / EXPLANATORY VARIABLES			
FARMERTYPE	Whether farmer participates in contract farming	Dummy: 1= Non-contract farmer 0= Contract farmer	+
FEDUC	Education level of farmer at least secondary education	Dummy: 1= yes, 0= otherwise	-
TENURE	Whether farmer has individual tenure or not	Dummy: 1= yes, 0= otherwise	-
CROPAREA	Total cropped area	hectares	+
GENDER	Gender of farmer	Dummy: 1= male, 0= otherwise	-
OTHERLOAN	Access to other loans other than contract farming credit	Dummy: 1= yes, 0= otherwise	+

RESULTS AND DISCUSSION

Socioeconomic Characteristics of the SampleFarmers

Seventy-eight percent of the sample farmerswere contract farmers compared to 22% who were non- contract farmers (Figure 1).

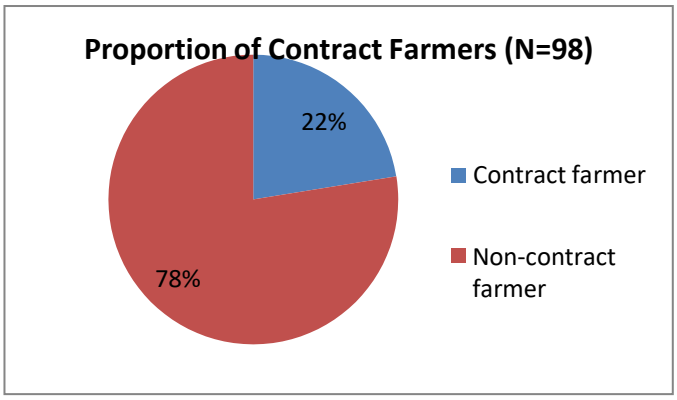

Figure 1: Proportion of contract farmers

The average age for both contract farmers and independent farmers was 48 years. None of the contract farmers were aged more than 70 years (Figure 2).

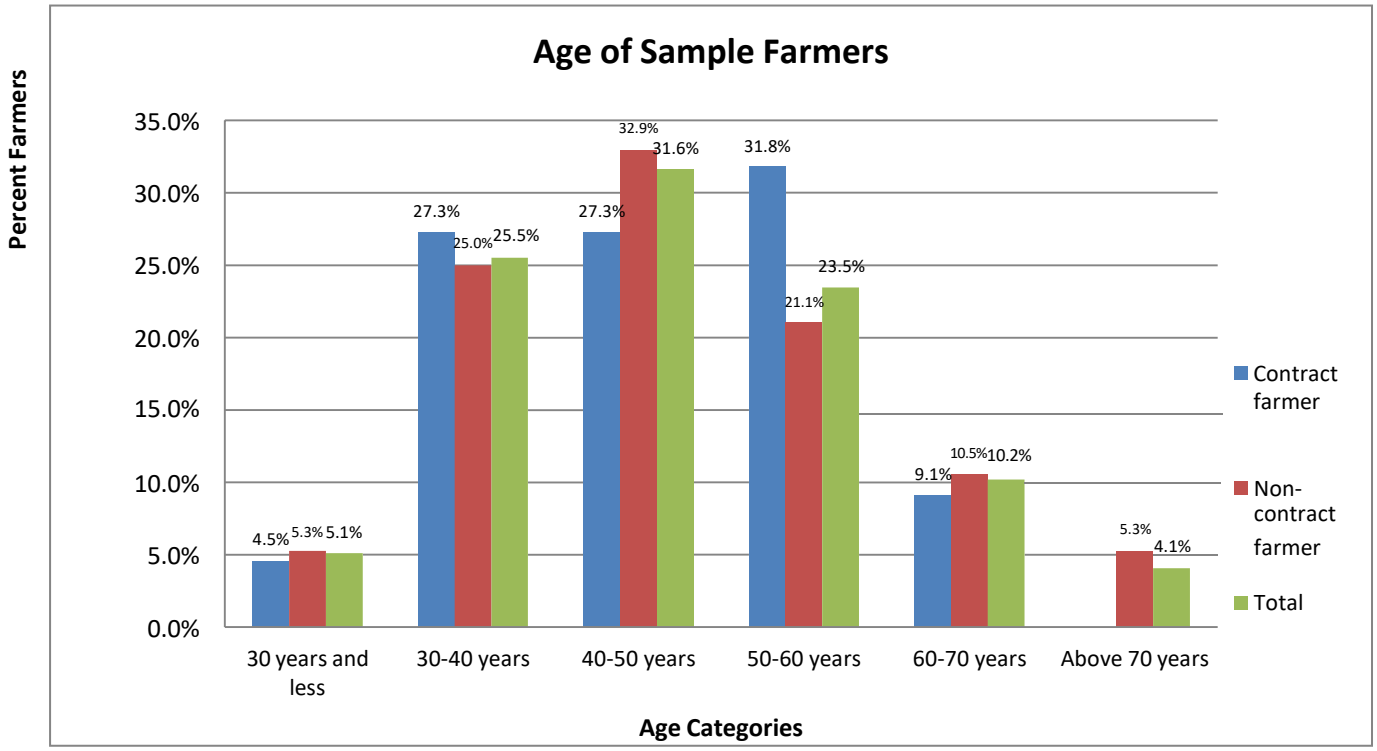

Fig-2: Age distribution of sampled farmers

In terms of gender distribution, tobacco is a men's crop as depicted by Figure 3 where men constitute 95% of the contract farmers and 74% of the independent farmers respectively. The very low proportion of women contract farmers may be an indication of contractual arrangements and tools that still discriminate against women participation andaccess. In most patriarch societies like Zimbabwe, women still require the approval of men when borrowing money and this therefore tends to limit women's participation and access to contract farming.

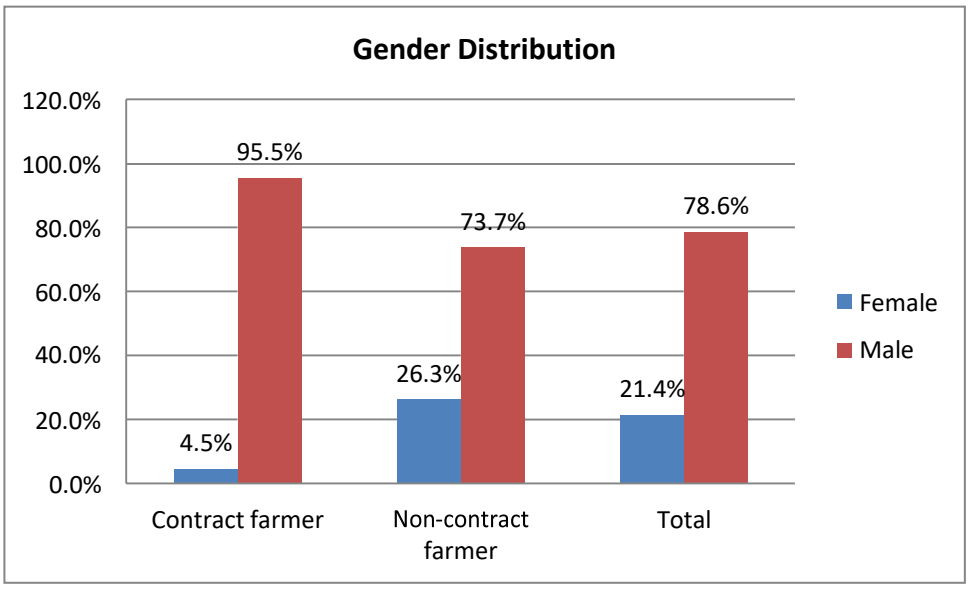

Fig-3: Gender distribution

Eight-two percent of the contract farmers had attained at least secondary education compared to 67% of the non-contract farmers (Figure 4). This clearly shows that a majority of the farmers had attained a goodlevel of education to enable

them to have a better understanding of how contractual arrangements work.

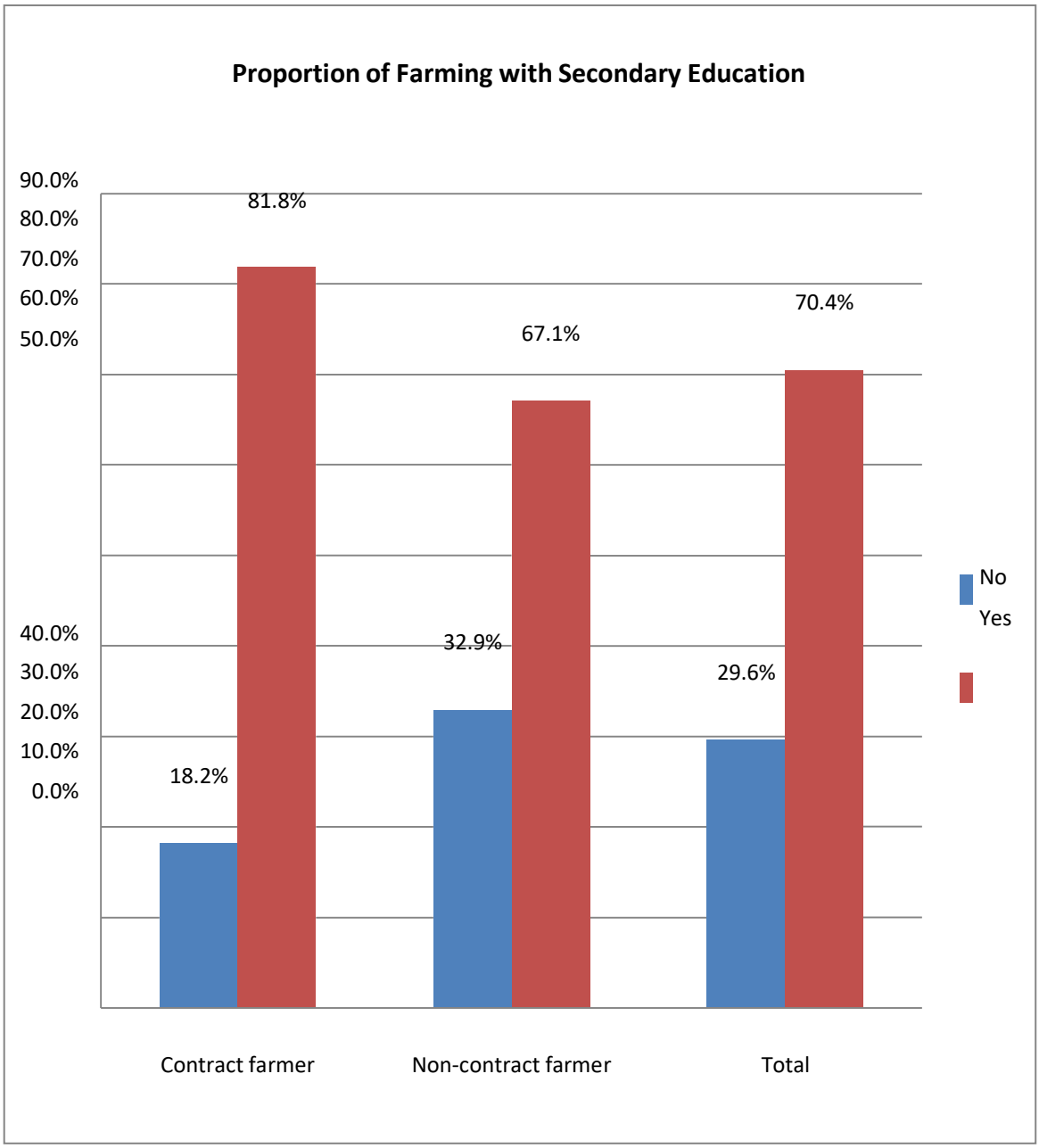

Fig-4: Education level

Fifty-nine percent of the contract farmers had individual land title compared to 37% of the non- contract farmers (Figure 5). Land tenure status still play a critical role in accessing credit in Zimbabwe where a majority of financial institutions

CONCLUSION AND RECOMMENDATIONS

The goals of this research were to(1) assess the technical efficiency of smallholder tobacco farmers and(2) identify the effect of contract farming on this efficiency. Some claim that contract farming boosts farmers' output because it makes it easier for them to work with other parties to coordinate the growing, processing, and selling of their crops [17, 19]. In addition to improving access to and efficiency with agricultural inputs, contract farming agreements solve the liquidity issue. During the 2015–2016 tobacco production season, the survey indicated that contract farmers sold an average of 26 bales of tobacco, while non-contract farmers sold an average of 16 bales. On the other hand, a mean technical efficiency of 94% for contract tobacco growers and 67% for non-contract farmers was determined. Further evidence that contract farming greatly enhances tobacco production efficiency is provided by the outcomes. The difference in efficiency between contract and non-contract farmers is 10.84 percentage points, which is statistically significant at the 5% level. Results like these lend credence to the claims made by Desai and Mellor (1993) [45] and Nwagbo et al. (1989) [46] that, when used correctly, farm level financing promotes diverse agriculture, which in turn stabilizes and, maybe, boosts resource productivity and agricultural output.

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