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# ECONOMIC EFFICIENCY OF TOMATO PRODUCTION IN KHARTOUM STATE, SUDAN

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## ABSTRACT

This study was carried out in Khartoum state Sudan during 2017, to measure the farmer's technical efficiency of producing tomato and to determine the main socio-economic factors affecting farmer's technical efficiency of tomato production. The stochastic production frontier model was utilized to achieve the study's objectives. The data were collected from 60 tomato farmers' through questionnaire. Secondary data were also obtained from the ministry of Agriculture and bank of Sudan. The study indicated that the mean technical efficiency of tomato production was 0.599, which means that tomato could have been increased by 40%at the same level of inputs, if resources had been efficiency utilized. The results show that the cost of labour, cost of seed and education had a significant positive effects in tomato production levels, while cost of pesticides, fertilize and irrigation number show a negative and significant effects.

It was recommended that policies that will increase farmers' economic efficiency level will be targeted at improving their agronomic practices to enhance productivity through the reduction of the unit average cost of production.

**Keywords:** technical efficiency; tomato production; stochastic frontier

## INTRODUCTION

Sudan highly depends on agriculture which constitutes about 31.5 of the gross Domestic product (GDP). It is the main source of government revenue in the form of both direct and indirect taxes. Khartoum State is considered as one of the main areas of producing and consuming tomato crop in the Sudan. Constraints facing tomato production and marketing included low productivity due to irrelevant varieties, poor seeds, pests and diseases. Producers and traders do not have access to credit (Emam.2011). Sudan, and particularly Khartoum State, faces many problems in tomato production, processing and marketing, which are captured in shortage of finance, unstable prices, high taxes and fees, in addition to weak infrastructure and seasonality.

  

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Tomato is a perishable product that needs more efficient production and marketing activities.

Efficient farms are more likely to generate higher incomes and thus stand a better chance of surviving and prospering (Boris E. Bravo-Ureta and Laszlo Rieger, 1991).

The major purpose of this paper is to measure the technical efficiency of tomato production in Khartoum state, Sudan and the factors effecting in Tomato efficiency.

## MATERIAL AND METHODS

This study carried out in Khartoum, Sudan during 2017. The primary data was collected from random sample of 60 tenants through a questionnaire.

The stochastic production frontier (SPF) model was utilized. The SPF functions have been the subject of large study during the last two decades (Farrell, 1957). Farrell (1957) proposed measure of firm efficiency consists of two components: technical efficiency, which demonstrate the capacity of a firm to get the maximal output from a given number of inputs, and the allocative efficiency, which demonstrate the capacity of a firm to utilize the inputs in optimal ratio, given their respective prices and the production technology. These two measures are then mixed to extend a measure of total economic efficiency. Aigner and Chu (1968) conceived the evaluation of a parametric frontier production function of Cobb-Douglas form, using data on a sample of N firms. The model is written as follows

$\ln(y_i) = X_i B - u_i$ (1)

i= $1, 2 \ldots N$

Where ($y_i$) is the logarithm of the (scalar) output for the i-th firm

$X_i$ is a (k+i) row vector; whose first element is i and the residual elements are the logarithms of the k-input quantities utilized by the i-th firm.

$B=B_0, B_1 \ldots B_K$ is a (k+i) column vector of undefined factor to be evaluated.

$u_i$ Is non- negative random variable connected with technical inefficiency in production of firms in the industry implicated.

The proportion of the observed output for the i-th firm relative to the potential output known by the SPF function given the input vector x is utilized to define the technical efficiency (TE) for the i-th firm

  

ISSN: 2455-6939

Volume:04, Issue:06 "November-December 2018"

$TE = \frac{y_i}{\exp(x_i B)} = \frac{\exp(X_i B - u_i)}{exp(X_i B)} = \exp(-u_i) \quad (2)$

The above declared measure of technical efficiency is output –orientated. Farrell's measure of technical efficiency takes a value between zero and one.

Aigner et al (1977) model suggested the SPF function in which an additional random error ($v_i$) is added to non- negative random variable $u_i$ in equation (1) to provide

Ln ($y_i$) =$X_i$B+$v_i$-$u_i$ (3)

i=1, 2… N

Aigner et al., (1977) assumed that the $v_i$'s were independently and identically distributed (IID) normal variables with zero mean and constant variance independent of the $u_i$.s which were assumed to be IID. Exponential or have normal random variables.

The study objectives are attained through the estimation and analysis of the SFP model. The most commonly used package for estimation of SPF is Frontier 4-1 (Coelli, 1996).

The model used is

$\ln(y_i) = \sum_{j=1}^{4} B_0 + B_{ij} X_{ij} + v_i - u_i \quad (4)$

$where$

$In = natural\ logarithm$

$Y_{i=}$yield of tomato
X1= annual cost of labour
X2=annual cost of seed
$X_{3=}$annual cost of pesticide
$X_4$=annual cost of fertilize
$B_0$ and $B_1$ are unknown parameters to be estimated for variables , respectively.
$v_i$ = Clarifies the statistical error and other parameters which are behind the farmers dominance like weather, and other factors which are not involved and may be positive, negative or zero.
$u_i$ = is a non-negative random variable, associated with the tenants technical inefficiency in production and assumed to be independently distributed .For the technical inefficiency effect for the ith tenant, it will be get by truncation(at zero) of the normal distribution with mean, $u_i$ and variance $\sigma^2$ .such that

$U_i = {}_{\delta}0 + \sum^{6}_{s=i} {}_{\delta s} Z_{si}$ (5)

  

ISSN: 2455-6939

Volume:04, Issue:06 "November-December 2018"

Where,

$Z_1$= Age

$Z_2$=Education

$Z_3$=Experience

Z4= Number of watering

$Z_5$= Extension services

$Z_6$=Family size

**Table 1: Tests of the stochastic production frontier hypothesis**

| Hypothesis | z-values | decision |
|---|---|---|
| H0: u =0 | 10.64 | reject |
| LRH0: no technical inefficiency | 37.82 | reject |

Table1 declared the Z-values for the tests of the stochastic frontier production function hypotheses. It's clear from Table 1 both null hypotheses are rejected, which means that the deviations from normal are not entity due to noise and some technical inefficient factors are present in the model. Contract result obtained by Osman, 2015.

The mean technical efficiency of tomato production in Khartoum state is0.599this implies that respondent can increase their tomato output by 41from given mix of production input if the farmers are technically efficient .This result less than result obtained by Osman, 2015.

An important result is that variance is considerable and has value of 0.86. This result expresses that around 86 percent of tomato output deviations are caused by difference in farms level of technical efficiency as inverse to the traditional random variability. The significant estimate of y and σ2s for tomato production indicates that the supposed distribution of ui and vi is acceptable

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Volume:04, Issue:06 "November-December 2018"

**Table 2: Parameters estimates of the stochastic production frontier function**

| Variables | Parameters | Estimates |
|---|---|---|
| constant | $B_0$ | -0.995 (0.7683) |
| Cost of labour | $B_1$ | 0.481*** (0.176) |
| | | |
| Cost of seed | $B_2$ | 0.319* (0.1972) |
| Cost of pesticide | $B_3$ | -0.122** (0.250) |
| Cost of fertilize | $B_4$ | -0.328* (0.151) |
| Sigma-squared | v 2 σ + σ = 2 s σ | 0.104(0.031) |
| Gamma | | 0.868(0.0815) |
| Mean efficiency | | 0.59 |
| Log likelihood function | | 10.82 |

Note: Values between brackets are the standard errors of the parameters

***significant at 1%
**significant at 5%
* Significant at 0.1%.

The coefficient of labour is positive and significant at level 1%. This means the cost of labour is one of the mains determinant of tomato production. Similar result get by Osman, 2105 and Eltoum, 2008 and s.j, ibitoyeetc 2015. Labour took the highest share of total variable costs. This agrees with other studies which indicate that vegetable production is labour intensive, and also needs equipment and other inputs such as seed, fertilizer for maximum production (Banuwa, 2018).

  

ISSN: 2455-6939

Volume:04, Issue:06 "November-December 2018"

The coefficient of seed cost is positive and has coefficient 0.319 and significant at level 5%. This means that increasing seed cost by 1% would increase tomato production per feddan by 31%. Similar result obtained by Justice Tambo JA and GbemuT,2010.

The coefficient of the pesticides cost is negative the negative sign reflects the harm effect of infestation on the tomato and not significant .similar result get by Osman 2015. This results in contrary with the finding of (Eltoum, 2008).

The coefficient of the fertilize cost is negative and significant at 0.1%.this means that reducing the cost of fertilize would reduce the efficiency of tomato production. 326 this may be attributed to the fact that fertilizer level used in the developing countries is very low relative to the recommended level because of the lack of credit, and knowledge of Fertilizer input (Velk, 1990) .The similar result obtained by Osman 2015 the result contract the result obtained by Eltoum, 2008

**Table 3: Tomato production inefficiency model parameters**

| variable | parameters | Estimates |
|---|---|---|
| Constant | $^{\delta}0$ | 1.45(0.6872)* |
| Age | $^{\delta}1$ | -0.0122(0.1553) |
| Education | $^{\delta}2$ | 0.227(0.1126)* |
| Experience | $^{\delta}3$ | 0.0054(0.0105) |
| Number of watering | $^{\delta}4$ | -0.0938(0.03446)* |
| Extension services | $^{\delta}5$ | 0.1793(0.1402)* |
| Family size | $^{\delta}6$ | 0.01209(0.03222) |
| Mean efficiency | | 0.59 |
| Log likelihood function | | 10.82 |

Note: Values between brackets are the standard errors of the parameters

* Significant at 0.1%.

  

The coefficient of Age is negative and insignificant. Negative sign means that the increase in age of farmers reduces inefficiency .similar outcome get by osman 2015. also agrees with findings of Usman j, Bakar UM, 2013 and Baruwa, 2018 who found that tomato production was dominated by adults. The coefficient of education is positive and significant. That means technical inefficient increase with increase of education .One of the reasons may be that educated farmer found alternative income sources (Rahman, 2002). The result obtained contract to the result by Osman 2015. The coefficient of experience is positive and insignificant indicates that inefficiency increases with the rise of experience .similar result obtained by Baruwa, 2018

The coefficient of irrigation number has negative sign and significant .This means that irrigation is one of the main determinants of tomato production .similar result obtained by Ahmed 2004.

The coefficient of extension has positive sign and insignificant. However, extension awareness of the farmers had a negative relationship with the economic efficiency. This result is in line with the findings of Baruwa, 2018 that extension contact received by farmers negatively affect technical inefficiency. The results contract the findings of Ahmed2007 and Al-feel etc, 2011. The coefficient of family size is positive and insignificant. The result obtained is contract to result obtained by osman 2015 and Al-feel etc 2011. The unexpected result may be due to fact that tenants with large family spend most of their income for their living needs.

## CONCLUSIONS

The result show that the mean technical of tomato production was0.599 which indicates that tomato production could have been 40% as the same levels of input had resources efficiency utilized. The result revealed that cost of labour and seeds had a positive and significant relation with tomato production. The study also showed the cost of fertilize was negative and significant related to tomato production. Education, irrigation number and extension services had significant influence of the estimated farmers technical inefficiency. The 86% of tomato production deviation from normal is due to difference in farmers level of technical efficiencies as inverse to traditional random variability.

It was recommended that policies that will increase farmers' economic efficiency level be targeted at improving their agronomic practices to enhance productivity through the reduction of the average cost of unit production.

  

ISSN: 2455-6939

Volume:04, Issue:06 "November-December 2018"

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