IJAFLS
e-ISSN: 2602-4381
International Journal of Agriculture, Forestry and Life Sciences
Original Article | Open access | Int J Agric For Life Sci (2022) 6(1): 18-23

Technical efficiency analysis of melon (*Coloncynthis citrullus l*) production among smallscale farmers in federal capital territory, Nigeria

Elizabeth EBUKIBA[1] **Glory AKPEJI**[1] **Luka ANTHONY**[1*]
[1]Department of Agricultural Economics, University of Abuja, PMB 117, Gwagwalada, Federal Capital Territory, Nigeria
***Correspondence:** gqluka11@gmail.com*

Citation
Ebukiba, E., Akpeji, G. and Anthony, L. (2022). Technical efficiency analysis of melon (*Coloncynthis citrullus* l) production among smallscale farmers in federal capital territory, Nigeria. Int J Agric For Life Sci (2022) 6(1): 18-23.

Received: 09 March 2022
Accepted: 20 June 2022
Published Online: 30 June 2022

Year: 2022
Volume: 6
Issue: 1 (June)
Pages: 18-23

Available online
https://dergipark.org.tr/ijafls

Abstract
This study evaluated technical analysis of melon production in Federal Capital Territory, Nigeria. The specific objectives were to**:** evaluate the technical efficiency in melon production among smallholder farmers, determine the factors influencing the technical efficiency in melon production among smallholder farmers, and identify the constraints of melon production in the study area. Primary data were used for this study. Multi-stage sampling technique was adopted and used for the study. Data were obtained using structured questionnaire. The questionnaires were administered to two hundred and sixteen (216) smallholder melon farmers in the study area. Data were analyzed using descriptive statistics, and Stochastic frontier production function. The results showed that majority (80.65%) of the sampled smallholder melon farmers had mean age of 44 years. Majority (76.9%) were married, (44.9%) had no formal education. The average member per each household was 5 persons in the study area. The average years of experience in melon production by the smallholder farmers was 7.4years. The average farm size cultivated by melon farmers was 2.15ha. The results of the stochastic frontier of the production function revealed that the statistically significant factors influencing the total output of melon were; seed input ($P<0.01$), family labour ($P<0.01$), and Chemical input ($P<0.01$). The findings of this study also revealed that, the average technical efficiency score level of the smallholder melon farmers was 50% this implies that farmers were able to attain 50% level of resource use but have a gap of 50% to reach the optimum level of melon production while the factors influencing technical inefficiency were age of the farmer ($P<0.10$) and farming experience ($P<0.05$). The Smallholder melon farmers were faced with the following constraints in melon production: unavailability of improved seed varieties, lack of extension agent, inadequate capital, inadequate transportation and bad roads. The study recommended that farmers should be encouraged to engage in melon production entrepreneurial activities should also be introduced to farmers in order to earn income from non-farm business enterprise. Inputs like improved seeds, and chemicals, should be made available by governments and non-governmental organizations to melon farmers at subsidized rate to increase profit among melon farmers in the study area. Extension agents should teach farmers and provide necessary supports that can boost melon production. Credit facilities should also be made available to farmers at affordable interest rate. Farmers should be encouraged to join farm organizations for easy accessibility of credit and other farm inputs. Melon farmers should be encouraged by making a provision of capital to enhance their productivity.

Key words
Melon, Production, Technical Efficiency, Profitability, Nigeria

Introduction
Agriculture still remains the largest sector of Nigerian economy and employs two thirds of the entire labour force; the production hurdles have significant stifled the performance of the sector (Food and Agriculture Organization- FAO, 2013). The sector is almost entirely dominated by small scale resource poor farmers living in rural areas, with farm holdings of 1- 2 hectares, which are usually scattered over a wide area (Idisi, Ebukiba & Anthony, 2019). Agricultural sector plays a significant role in food security and poverty alleviation. It employs more than 70% of the labour force, accounts for over 70% of non-oil export and most importantly provides over 80% of the food needs of the country (Adegboye, 2004). However, over the years there has been a marked decline in the performance of the sector. Nigeria, consequently, had to resort to large importation of food produce to cope with increasing demand for food (International Institute of Tropical Agriculture- IITA, 2015). The small-scale famers who constitute about 85% of the farmers in Nigeria occupy the vertex in the hierarchy of players in food production and produced about 90% of food consumed in the country (Food and Agricultural Organization, 2017).
Egusi (Colocynthiscitrillus L) generally known as honey dew, is a vegetable crop of West Africa. Melon seed (*Egusi)* plays a vital role in the farming system of West African rural dwellers as cover crop, weed suppressant and soil fertilization through the formation of root nodules that improves the nitrogen status of the soil (Abiola & Daniel,2012). The origin of the crop is Africa. It can be cultivated as mixed cropping system with other crops like yams and cassava in peasant farms and traditional farming systems (Sadiq, Muhammed & Yusuf, 2013). The mainly harvested melon seed is commonly consumed in Nigeria as thickening for sauces and soups, also fried and eaten as snack. Melon seed (*egusi*) is a good source of oil, protein, minerals, vitamins, and energy in form of carbohydrates. The seed contained 4.6g carbohydrates, 0.6g proteins, 0.6 crude fibre, 33mg vitamin C, 17g per100g of edible seeds (Olayniyi, 2008). Valuable vegetable oil is extracted from the seed while the ground seed is used to prepare various delicacies (Yusuf, Sanni, Ojuekaiye &Ugbabe, 2008). Melon is well known and widely cultivated in West Africa (Nigeria, Ghana, Togo and Benin) and many other African Countries for the food in the seeds (Van der Vossen, Denton & Eitahir, 2004). Among the Yorubas in Southwestern Nigeria, it is known and popularly referred to as *Egusi*. Melon plays vital roles in the farming system and in the well-being of West African rural farmers as a good source of energy, weed suppressants and for soil fertilization (Achigan-Dako, Vodouche & Sangare, 2008). It is also used as mulch, leaving high residual nitrogen in the soil after harvesting. Melon is one of the most economically important vegetable crops worldwide and is grown in both temperate and tropical regions (Bisognin, 2002). A high-energy, high-protein concentrate, melon seed ideally complement Africa's prevalent diets based on starch-rich grains (rice, sorghum and maize, for instance) and roots (notably cassava, yam and potato). Although *egusi* is consumed in Nigeria, the cultivation hardly attracts any significant attention and even government has not developed any programme to promote its inherent potentials to hugely improve the household income in poor communities. At the moment only sesame can

compete with the product in the market ten 170kg bags of *egusi* will give a farmer between N900, 000 Naira and N1.1 million under current market price depending on market location, a bag of melon now is N100, 000. Melon is a vital tool against marasmus (lack of calories), kwashiorkor (lack of protein), and other debilitations (Gurudeeban, Satyavani & Ramanathan, 2010). A traditional food plant in Africa, this vegetable has potential to improve nutrition, boost food security, foster rural development and support sustainable land care (National Research Council, 2006). Melon has been recognized as an affordable source of vitamins and micronutrients especially in the rural areas. There is also a prospect for use of the melon seed in the improvement of infant nutrition in view of its high protein and fat content (Van der vossen *et al*. 2004). Almost all the big markets in Nigeria, Benin, Cameroon, Ghana, Togo, and other nearby nations sell the seed. Melon is in high demand in tropical markets, especially in the peri-urban and urban markets. It is also exported to Ethiopia and Sudan where the consumption is high and the extracted yellow oil is in high demand (Schippers, 2000). The World Bank's Rural Development Strategy defines smallholder farmers as those with a low asset base, operating less than 2 hectares of cropland and depending on household members for most of the labour (World Bank, 2003). The crucial role of efficiency in increasing agricultural output has been widely recognized by researchers and policy makers alike. The efficiency of a farm/firm refers to its success in producing as large amount of output as possible given a set of inputs. To determine the efficiency of a particular firm, there is need for efficiency measurement through the production factor inputs and processes. Efficiency measurement has received considerable attention from both theoretical and applied economists. From a theoretical point of view, there has been a spirited exchange about their relative importance of the various components of firm efficiency. From an applied perspective, measuring efficiency is important because this is the first step in a process that might lead to substantial resource savings these resource savings have important implications for both policy formulations and firm management (Omonona *et al.* (2010). Production of melon in Nigeria amounted to 370,000.00ton. Cameroon produced 57,000.00ton; Sudan 45,000.00ton; DR Congo 40,000ton; Central African Republic 23,000.00ton; and Chad 20,000.00ton. Outside Africa, China is important with a production of 25,000.00ton (Van der vossen et al., 2004). This reflected that Nigeria is leading in melon production in Africa by 64.24% of total production as against the China production. To date, very few studies focused on the importance of traditional practices related to African vegetables such as melon, its nutritional value and contributions to rural livelihood. Melon farmers depend on the income generated from the crop to send their children to school, provide shelter and improve their lives. As a household food, it is the most affordable and suitable dietary sources of vitamins and minerals. It includes other bioactive compounds, that are important protective food and highly beneficial for the improvement of diets, provision of vitality of health and prevention of diseases (De Mello, 2000). Despite the socioeconomic, cultural, agronomic and culinary importance of melon, information is lacking on the cultural background that contributes to the traditional farming system (Schippers, 2004; Achigan-Dako *et al*. 2006). It is therefore essential to assess these challenges as it will have bearing on the contributions of melon production to sustainable rural livelihood in the study area. In Nigeria, the problems with smallholder agriculture dwell on the use of traditional technology which is associated with low productivity, the extension services which are not properly funded, and lack of farmers' access to agricultural inputs due to lack of credit facilities. There is dearth of studies on the use of farm plot size, agrochemicals, machinery, labour, improved seeds (which are the inputs involved in melon production) as well as resource use efficiency of smallholder melon farmers in Federal Capital Territory, Nigeria. Nwaru (2011); Nsikak-Abasi, Etim & Onyenweaku, (2013); and Onumadu (2014) observed that the acute shortage of agricultural resources has been complicated by gross inefficiency in resource use. Therefore, issues relating to how these resources are utilized to enhance income of farmers thus impacting on the growth of the economy of the FCT need to be addressed. Many researchers (Udoh, 2005; Mbanasor &Kalu 2008; Eze, 2010; Oluwatusin, 2011; Simonyan, Olukosi, Omolehin &Atala, 2012; Masakure &Henson, 2012; Onubuogu, Chidebelu & Eboh, (2013) have identified resource use inefficiency to be responsible for the poor performance of the agricultural sector in Nigeria. Some critical resources which have been identified with low levels of productivity are capital, labour and land use (Oladeebo & Oyetunde, 2013; Girei & Dire, 2013; Girei, Yuguda & Salihu, 2014; Ohen, Ene & Umeze, 2014).

Despite the nutritional and commercial value of melon, its production remains low in Nigeria (Dauda, Ajayi & Ndor, 2008). To date, very few studies focused on the importance of traditional practices related to African vegetables such as melon, its nutritional value and contributions to rural livelihood. The productivity of farmers can be raised by adoption of improved production technologies or improvement in efficiency or both. But with the low rate of adoption of improved technologies by farmers in Nigeria, improvement in efficiency becomes the best option in productivity enhancement in the short run (Idiong, 2007). Problems of melon production also include inappropriate decision on how best to allocate resources, inadequate use of corresponding production inputs and inadequate adoption of improved technologies by farmers, also farmers might use resources rationally but not at economic optimal level, all these contribute to inefficiency (Idisi, *et al.*,2019). Melon is consumed in many parts of Nigeria, but despite the nutritional and commercial value, its production remains low. Even with its good market price, melon is still produced by farmers on a small scale. Despite the socio-economic importance of melon, production output has been on the decline in recent time. The reason for this decline could be attributed to the problem of scarcity of land resulting from land fragmentation, high cost of inputs, use of traditional techniques, and inefficient allocation of resources or what the factors responsible for inefficiency among melon farmers are. To achieve economic optimum output and thus profitability, resources have to be optimally and efficiently utilized (Abiola and Daniel, 2012). It has been observed that Nigeria has the potential particularly in terms of land and human resources needed to produce enough food for the country. Melon consumption in the Federal Capital Territory is on the increase due to the increasing awareness of its nutritional value and the diversity of its inhabitants, while its production is on the decrease due to inefficiency in the resources use, poor access to modern inputs and credit, poor infrastructure, inadequate access to market, land and environmental degradation, and inadequate research and extension services. Despite the nutritional value of melon, its production remained low in the Federal Capital Territory (Dauda *et al.*,2008). The poor output of melon realized by farmers may be an indication that resources needed in the production of the crop are not being used at their optimal level and this raises the question as to whether it is profitable to grow the crop or not? This situation calls for an examination of the profitability of growing the crop, an assessment of the resources needed for its production and how their resources are managed by its cultivators. Since there is no documented study on cost efficiency of melon production in the area, this study therefore became imperative. There is therefore, the need to provide empirical information on farm level production efficiency in small-scale melon production in the study area. For this to be fully realized there is need to address the problems of rural farmers who produce the bulk of Nigerian agricultural product. This study is significant as it will contribute to research by bridging the information gap in efficiency studies as most of the previous work focused on agronomic issues (Adekunle *et al*., 2003; Dauda *et al*. 2008; Gambo *et al*, 2008). The production of melon is declining in the study area, even though the crop plays many vital socio-economic and cultural roles in the wellbeing of the farmers' and communities in its entirety. Even then, smallholder and traditional melon farmers who use rudimentary production techniques, with resultant low yields, cultivate most of the degraded lands. Empirical evidence remains largely scanty, hence, to fill this dearth in empirical research, this study becomes imperative and essential to assess the efficiency of melon production so as to enhance its productivity, profitability, and sustainability among smallholder farmers in the Federal Capital Territory, Nigeria.

Research Questions

The study is designed to answer the following research questions;

i. What is the level of technical efficiency in melon production among smallholder melon farmers in the study area?
ii. What are the factor influencing technical efficiency among Smallholder melon farmers in the study area?
iii. What are the constraints of melon production in the study area?

Objective of the Study

The broad objective of this study is to analyze the technical efficiency analysis of melon production among smallholder farmers in Federal Capital Territory, Nigeria.

The specific objectives were to:

(i) evaluate the technical efficiency in melon production among smallholder farmers,
(ii) determine the factors influencing the technical efficiency in melon production among smallholder farmers,
(iii) identify the constraints of melon production in the study area.

Methodology

Area of Study

This study was conducted in Federal Capital Territory. Federal Capital Territory is the capital city of Nigeria located in the center of the country. FCT has latitudes $9^{o}\,4^{'}\,60^{o}$ N and longitude $7^{o}\,3^{'}\,60^{o}$ E of the equator. FCT is bounded on the north by Kaduna state, the west by Niger state, at the south east by Nassarawa State and at the North West by Kogi state as shown in fig. (3.1). It is predominantly a

grassy savannah region, thus has potentials to produce both root crops and tubers such yam, and cassava. It also sustains legumes (groundnut & cowpea); grains (maize, sorghum & rice); seeds and nuts (melon seeds & benniseed); animal products (goats, cattle& sheep); fruits and vegetable, the people are predominantly farmers. It has a total land area of about 8000km^2 with a total population of about1,405,201 people according to 2006 population census but has grown to 2,245,000 in 2010 (NPC, 2006). Abuja is characterized with two main seasons; rainy season within April to November and dry seasons within December to march, with a temperature of 30^{oc} -37^{oc}, which drops to about 25^{oc} - 27^{oc} during rainy seasons.

Sampling Technique and Sample Size

Multistage sampling technique was adopted for this study, in the first stage purposive sampling procedure was adopted for selecting FCT because of the dominance and, the number of the smallholder melon farmers in the study area. In the second stage, two (2) area councils Gwagwalada and Kwali were also purposely selected because of the concentration of the small holder melon producers in the Area Councils. In the third stage simple random sampling was employed to select three (3) districts from each of the ten (10) wards in the two Area council selected. The required sample size was determined by Cochran's proportionate probability to sample size sampling methodology (Cochran, 1977). A total sample frame of 4,300 farmers is available, and a total sample size of 216 respondents was selected as shown in Table 1. The required sample size (216) was determined as used by Cochran (1977), as shown in equation 1

$$n = \frac{pqZ^2}{e^2} = 216 \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (1)$$

Where,
n= Sample Size
p=0.17
q=0.83
Z=1.96($\alpha = 0.05$)
e = 0.05 Allowable Error

Table 1. Sample size and sample frame of the melon farmers in the study area

Area Councils	Ward No of Farmers	Proportion	Sample Size	Area Councils
Gwagwalada	Paiko	400	0.093	20
	Tunga-maje	800	0.186	40
	Gwako	700	0.163	35
Kwali	Ashara	900	0.209	45
	Kilankwa	906	0.210	46
	Kwali ward	600	0.139	30

(Author's Computation, (2021)

Methods of Data Collection

Data were collected through primary source. Primary data were obtained through the use of a well-structured questionnaire. Data were collected based on the socio-economic variables such as gender, age, farming experiences, educational status, household size and income level of the respondents, as well as costs, returns, profitability variables and factors influencing melon production in the study area. The structured questionnaire was administered directly to the sampled respondents by the researcher with the help of trained research assistant who also interpret the questions in local language where necessary. The instrument for data collection for this study were checked for its validity and reliability by the team of researchers and the other scholars.

Method of Data Analysis

The data collected were scrutinized, collated and coded for analysis using both descriptive and inferential statistics in order to achieve the stated objectives. The following tools of analysis were employed to achieve the stated objectives of the study:

(i) Stochastic Frontier Model (ii) Test Statistics

Stochastic frontier Cobb-Douglas production function

This tool was used to achieve objective (i), which was to analyze the technical efficiency in melon production**.**

The implicit form of the model is specified as:

$$Y_i = f(X, \beta) + \varepsilon_i(V_i - U_i) \dots\dots\dots\dots (2)$$

Where,

$$\varepsilon_i = (V_i - U_i) \dots\dots\dots (3)$$

Y_i= Quantity of Melon Output of the ith farm
X_{ii} = Vector of the Inputs used by the ith farm
β = Vector of the Parameters to be Estimated
ε_i= Two sided Error term
V_i= Error Term due to measurement or faulty data
U_i = Random Error Outside Farmers Control
The explicit model is specified as follows:

$$LnY_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + (V_i - U_i) \dots\dots (4)$$

Where:
Ln = The Natural Logarithm
Y = Output of Melon (kg)
β_0 = Constant term
$\beta_0 - \beta_1$ = Regression Coefficients
X_1 = Quantity of Melon Seed (kg)
X_2 =Quantity of Fertilizer (kg)
X_3 = Family Labour used (Man days)
X_4 = Hired Labour used (Man days)
X_5 = Farm Size
X_6 = Chemical
V_i = Random variability in the production that cannot be influenced by the farmer.
U_i = Technical inefficiency effects predicted by the model.
The Inefficiency model is stated as follows:

$$U_i = \alpha_0 + \alpha_1 Z_1 + \alpha_2 Z_2 + \alpha_3 Z_3 + \alpha_4 Z_4 + \alpha_5 Z_5 + \alpha_6 Z_6 + \alpha_7 Z_7 + \alpha_8 Z_8 \dots\dots (5)$$

Where,
U_{ii}= Inefficiency Component
Z_1=Gender (Dummy Variable (1= Male and 0= Female)
Z_2 =Age of Farmers (years)
Z_3=Household size (Number of Persons)
Z_4 =Educational level (Number of Years of Formal Education)
Z_5 = Marital status (dummy variable: 1, Married and 0 Otherwise)
Z_6 = Membership of Cooperative Society (Years of Participation)
Z_7= Access to Credit (Amount borrowed in Naira\)
Z_8= Extension visit (Number of Visit per year)
α_0= Constant Term
α_1 –α_8 = Parameters to be estimated
This were included in the model to indicate their influence on the technical efficiency and it was used to achieve objective (ii).

Results and Discussion

Estimates and Distribution of Technical Efficiency Level in Melon Production Among Smallholder Farmers

Table 3 presents the distribution of technical efficiency score of melon production among the small holder farmers. The results showed that 5.09% of the sampled farmers had a technical efficiency score of 0-0.20 while 40.28% of the melon farmers score 0.21-0.4.0 level of technical efficiency 22.69% had a technical efficiency score 0.41-0.60, also about 24.07% of the sampled respondent attained 0.61-0.80 level of technical efficiency and only 7.87% were able to reach 0.81-1.0 level of technical efficiency. The maximum value of technical efficiency attained by individual farmer was 0.9990 while the minimum value was 0.01 with mean technical efficiency of 0.445 level of technical efficiency on individual basis. This implies that melon farmers were technically efficient to some extent but having a gap of 50% of inefficiency that need to be filled up to attain the level of perfection in technical efficiency by adopting innovation, new technology and the use of modern method of agricultural practices.

Table 2. Distribution of technical efficiency score level in melon production among smallholder farmers

Technical Efficiency	Frequency	Percentage
0-0.20	11	5.09
0.21-0.40	87	40.28
0.41-0.60	49	22.69
0.61-0.80	52	24.07
0.81-10	17	7.87
Total	216	100
Minimum Value	0.01	
Maximum Value	0.9990484	
Mean Value	0.4450571	
Standard Deviation	0.230582	

Source; Field Survey Data, (2021)

Maximum Likelihood *Estimates and Factors Influencing Technical Efficiency of Melon Production Among Smallholder Farmers in the Study area*

Table 2 presents the results of the maximum Likelihood (MLE) of the parameters of the Stochastic production frontier model and the inefficiency component model was also estimated for smallholder melon farmers. The MLEs stochastic production frontier model with half-normal distributional assumptions on the value of efficiency error term were estimated. The value of gamma estimated showed the measure of the level of the inefficiency in the various parameters included in the model and the values ranges from 0 to 1. Gamma estimate was 0.0092024. This indicates the total output of inefficiency of the melon farmers in the study area. The parameter of sigma square was 0.0522657 and the value of Log likelihood estimated was 12.211062 and was significant at (P<0.01) probability level. The computed average value of technical efficiencies for smallholder melon farmers was 0.45. This implies that, averagely the sampled smallholder farmers were able to obtain 50% of potential output of melon from a given combination of farm inputs, in a short run, there is a shortfall scope of (50%) of increasing the efficiency of melon production among smallholder melon farmers, through adoption of innovation, new technology and techniques used by best smallholder farmers in the study area. This result shows that small-holder melon farmers were technically efficient to some extent in melon production in the study area. The coefficient of seed input was statistically significant at (P<0.01), seed input influence the total output of melon positively. The coefficient of seed input (1.7270) signifies that a unit/percentage increase in the quantity of seed planted by farmers results in the increase of the total output of melon by (1.727%) among smallholder farmers in the study area. This result is in line with (Ibrahim et al, 2014) who reported that the quantity of seed determines to a large extent, the output obtained. If correct seed rates and quality of seeds are not used, output will be low even if other inputs are in abundance. Quality of seed planted is a determinant factor of the quality and quantity of total output of produce among farmers in the study area. Family labour influence the total output of melon positively the magnitude of the coefficient of family labour was (0.000147) and was statistically significant at P<0.01). This indicates that a unit increase in the family labour by one person will lead to increase in the total output of melon seed by (0.000147%) in the study area. Chemical input was statistically significant at (P<0.01) and it influence the total output of melon positively. The magnitude of the coefficient of chemical input (0.04669) implies that a unit change in the quantity of chemical input applied by the farmers in order to protect the melon seed from damage from pests and diseases will results in the increase in yield of melon total output by (0.0467%) among smallholder farmers in the study are. The inefficiency component of the model was also estimated and presented in table 2. The negative sign of the estimated parameters indicates that the variable reduces total output inefficiency (increases efficiency). The positive signs of the estimated coefficients increase inefficiency (decreases technical efficiency). The results revealed that the age of the smallholder melon farmers and farming experience were the only significant variables, and therefore reduces technical inefficiency (or increase technical efficiency). The coefficient of the age of the smallholder farmer was positive and statistically significant at (P<0.01) the positive sign of the age of farmer increases technical inefficiency (decreases efficiency). The coefficient of the age of farmer (0.103) implies that a unit increase in the age of farmers will result in the decrease in technical efficiency in melon production by (0.103%) in the study area this could be as the result of the fact that as age increases energy for farm operations decreases and productivity slows down with increase in age also older farmers are risk averse and they don't embrace or adopt new innovations and technology easily. This is in line with Ebukiba et al, (2020) who opined that as a result of old age, farmers could become unproductive as they advance in age. Farming experience influence the technical inefficiency negatively and it was statistically significant at (P<0.01). The coefficient of farming experience was (-0.0073) this implies that a unit increase in farming experience by one year will results in the decrease in technical inefficiency (by 0.00735%) this result show that as farmers experience increases technical inefficiency decreases while technical efficiency increases with increase in experience of a farmer in the study area. This is in agreement with Ebukiba *et al* (2020) who reported that Farming experience increases the level of efficiency as the farmers accumulated experience results in increase in farm productivity. This result is also consistent with the findings of (Ibrahim *et al*., 2014) which indicates that the negative sign on the years of farming experience variable indicates that an increase in the number of years in melon production, decreases farmers experience enhances technical efficiencies.

Table 3. Results of the maximum likelihood estimates of the stochastic frontier model of mellon production among smallholder farmers

Variables	Parameter	Coefficients	Standard Error	Z-score
Total Output (Y_i)				
Constant	β_0	1.726899	0.1976439	8.74
Seed Input	β_1	0.1030078	0.01638	6.29
Fertilizer Input	β_2	-0.0002228	0 .0002184	-1.02
Family Labour Input	β_3	0.0001478	0 .0000256	5.77
Hired Labour	β_4	-6.78e-06	0 .0000121	-0.56
Farm Size	β_5	0.0197973	0.0194992	1.02
Chemical Input	β_6	0 .0466952	0 .0070991	6.58
Inefficiency Component				
Age	Z_1	0.0034965	0.001988	1.76
Education Level	Z_2	-0.0116905	0.0175816	-0.66
Cooperative Association	Z_3	-0.02008	0.0458424	-0.44
Household Size	Z_4	-0.0031938	0.0060213	-0.53
Farming Experience	Z_5	-0.0073553	0.0042424	-1.73
Access to Credit	Z_6	-7.77e-10	4.76e-08	-0.02
Extension Visit	Z_7	0.0107203	0.0153138	0.70
Farm Size	Z_8	-0.0184086	0.014473	-1.27
Diagnostic Statistics				
Sigma^2	σ^2	0.0522657	0.0050834	
Gamma	γ	0.0092024	0.2450031	
Log likelihood		12.211062		

Source: Field Survey (2021) Computed from STATA Version 12
***, **, ***. Significant at 1%, 5% and 10% Respectively**

Constraints Faced by Smallholder Farmers in Melon Production in the Study area

Table 4 shows that 31.9% among the sampled respondents were faced with the constraint of unavailability of improved seed varieties and it was ranked first out of the various challenges based on the opinion of the smallholder farmers in the study area. Also 23.6% of the melon farmers were faced with lack of extension agents to explain to them the new innovations and use of technology involved in melon production and it was ranked 2nd table 4.5 depicts that 19.0% of the sampled respondents were faced with the constraint of inadequate transportation and it was ranked third 3rd 17.6 faced challenge of capital to in large melon production while other constraints militating against melon production in the study area according to the farmers include bad roads, outbreak of pest and diseases and high costs of farm inputs and availability. This result finding is in consonant with the findings of Sodiya et al., (2011); Ibrahim et al., (2014) von Braun and Torero, (2008)

Table 4. Results of the analysis of constraints face by smallholder melon farmers in the study area

Constraint	Frequency	Percentage	Rank/ Remarks
Unavailability of improved seed	69	31.9	1st
Lack of Extension agent	51	23.6	2nd
Inadequate transportation	41	19.0	3rd
Inadequate capital	38	17.6	4th
Bad roads	26	12.0	5th
Outbreak of pest and Diseases	24	11.1	6th
Lack of land availability	22	10.2	7th
High cost of farm inputs and affordability	**22**	10.2	7th
Inadequate marketing system	20	9.3	8th
Unattractive Price i.e fluctuations	19	8.8	9th
Poor information network	14	6.5	10th
Government policies	14	6.5	10th
Limited scale and uneven distribution	11	5.1	11th
Unavailability of hired labour	9	4.2	12th

Source: Field Survey (2021)

Conclusion

Based on the results of the findings emanating from this research work the study concludes that melon production were not technically efficient in resource use in the study area. That is farmers were making profits even though the level of profit was low. The determinant factors influencing the total output of melon among the smallholder farmers were: seed input, household size, access to credit, family labour, chemical input and extension visit. The mean value of the technical efficiency attained by individual smallholder melon farmer was 50% with a gap of 50% that need to be filled in the short run by adopting farm practices that must be efficient. The factors influencing technical inefficiency was age of the farmer and farming experience accumulated by the farmers over the years in melon production. Smallholder melon farmers were faced with the following constraints in melon production in the study area: unavailability of improved seed varieties, lack of extension agent, inadequate capital, inadequate transportation and bad roads.

Recommendations

The following recommendations were made based on the findings emanating from the study.

1. Inputs like improved melon seed varieties and chemicals should be made available to melon farmers at subsidized rate by the government to increase profit among melon farmers in the study area. Credit facilities should also be made available to farmers at affordable interest rate in the study area.
2. Extension agents should teach farmers and provide necessary supports that can boost melon production in the study area. Credit facilities should also be made available to farmers at affordable interest rate in the study area.
3. Farmers should also be encouraged to by non-governmental agricultural agencies to join farm organizations for easy accessibility of credit and other farm inputs.
4. Agricultural development projects (ADP) in the F.C.T should intensify *egusi* melon production awareness and mobilize the local industries for *egusi* melon processing and extraction of oil for better utilization in the study area thereby boost more interest in production which will in turn increase profit and reduce the labour cost involved in its production.

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