ajfand AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT

SCHOLARLY, PEER REVIEWED

Volume 24 No. 1
January 2024

PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

Afr. J. Food Agric. Nutr. Dev. 2024; 24(1): 25126-25144 https://doi.org/10.18697/ajfand.126.23700

STOCHASTIC FRONTIER TECHNICAL EFFICIENCY ANALYSIS OF WATERMELON (*Citrullus lenatus*) PRODUCTION IN NIGERIA

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AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
SCHOLARLY, PEER REVIEWED
Volume 24 No. 1
January 2024
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

ABSTRACT

The study analysed the efficiency of Watermelon (*Citrullus lenatus*) Production in Nigeria. A multi-stage sampling technique was used in selecting three hundred and sixty (360) respondents. Selection was done with purposive and simple random sampling, and data collected with a structured questionnaire. The objectives of the study were to identify the socio-economic characteristics of the respondents, determine the technical efficiency and measure the total resource productivity of watermelon production in the study area. The data were analyzed using descriptive statistics and quantitative analytical tool of stochastic frontier model (Cobb Douglas production function). Socio-economic attributes like age, farm size, educational status and farm experience were described to show their relationship with watermelon production in the study area. Results of the stochastic frontier model showed that all the estimated coefficients of the variables of the production function were positive except fungicide. They included: farm size (0.0795), labour (0.0201), number of seed grown (0.926) and fertilizer (0.0207). This implied that watermelon output increases with increase in these variables. It was also shown that labour (0.441), fertilizer (0.475) and fungicide (-1.662) did not exert any significant effect on watermelon output as shown by their t-ratio values. For the factors affecting technical inefficiency of watermelon farmers, age of farmers and farm size were negative and significant at 0.05 levels of probability, while household size, educational qualification and farming experience were all positive and significant at 5% levels of significance and type of cropping was positive and significant at 10% level of significance. Non-farm income was positive and significant at 5% level of probability. This means that one unit increase in these variables would increase technical inefficiency of the farmers and hence decreasing their technical efficiency. Finally, the return to scale parameter returned the value 0.967 which indicated that watermelon production in the study area was in the Stage II of the production surface. Based on the results of the analysis the following were recommended. Watermelon farmers should be provided and encouraged to take loans, be assisted with extension services and become members of farmer associations, in order to boost their production. Also inputs such as farm size, labour, seeds, fertilizer and fungicide should be increased for optimum production.

Key words: Watermelon, production, stochastic frontier model, technical efficiency, Nigeria

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ISSN 1684 5374

INTRODUCTION

Watermelon (*Citrullus lenatus*) is a warm season crop that is cultivated worldwide ostensibly for it numerous nutritional benefits [1,2]. The fruit contains nutrients and phytochemicals beneficial to human health and a good source of vitamins B, C, and E as well as minerals such as phosphorus, magnesium, calcium, and iron [3,4]. As one of the *cucurbitaceae* family alongside cucumber, pumpkin and zucchini, regions with well drained soils whether clayey or sandy but preferably sandy loams are home to the crop. This is why it is widely grown in Nigeria, with the country alongside Mali Tanzania and South Africa topping the crops' production countries in the region [5,6,7]. The global production in 2020 reached 99.3million tonnes and currently, China is reported to be the world largest producers of the crop followed by Turkey, United States, Iran and Republic of Korea [8].

Watermelon is generally believed to have originated from Africa, and the sub-Saharan portion of the continent, having potentials of surpassing any other region of the world in production and utilization of the crop [9]. There are over 1,200 varieties of watermelon worldwide and quite a number of these varieties are also cultivated in sub-Saharan Africa like many other regions of the world. Watermelon is highly cherished as a fresh fruit because of its thirst-quenching attribute in addition to many other identified nutritional values and advantages [10]. Therefore, the consumption and production of watermelon in recent times have witnessed remarkable increase in consumption, it cuts across all social classes and the latter ensures all round income, potentials for poverty alleviation, improvement of food security, nutrition and employment generation [10]. The country with the largest production of the crop in sub-Saharan Africa is Nigeria, because farmers in this area have taken the advantage of the possibility of growing the crop twice a year to generate additional income and, therefore, increase their overall annual farm income [11]. The first planting is with the first or second rain which mostly occurs around February or early march. The produce at this time will hit the market between May and June, when the supply of other crops from the northern part of the country must have diminished completely. While the second planting is done in September to be harvested around December when there will be no supply from the north again [11]. Therefore, the farmers take advantage of this opportunity to increase their farm income.

Potentials of watermelon as a quick cash generating crop is significant to farmers, especially those residing near the rural areas of Nigeria, who are mostly below the poverty line [11]. About 92% of this fruit is mostly water and is filled with nutrients, vitamins, organic compounds and minerals (pic. 1 below). This means every juicy intake of this fruit has high amounts of Calcium, Vitamin C, protein, fibre, magnessium and large amount of potassium. The seeds contain lycopene antioxidant and amino acids. Lycopene is aphyto-nutrient that is a naturally occurring compound in fruits and vegetables good to the human body [12]. There is nothing as refreshing as having a chilled slice of watermelon on a sunny afternoon (pic. 1 below). Some of the notable benefits of consuming watermelon often include: prevention of kidney disorder, because it has components very helpful in the cleansing and washing off of toxic deposition in the kidney, it helps to reduce the concentration of uric acid in the blood. Health professionals claimed that constant intake of the fruit leads to frequent urination which is also a way of flushing the kidney, it reduces signs of ageing, regulation of blood pressure, prevention of cancer and a cure for erectile dysfunction, dehydration, supplement for diabetic patients and prevention of heat stroke [13].

The basic resources in watermelon cultivation are land, labour, capital and management. Knowledge of efficiency and availability of aggregate farm level resources and differences in their production are essential in order to enhance production capacity of the smallholder watermelon farmers as this indicates the direction of resource use, adjustment and allocation [13]. Efficiency measurement is important because it leads to resource savings and efficient farms, which are likely to generate higher incomes and then stand a better chance of surviving [14]. Against this backdrop, the study specifically seeks to realize the following specific objectives:

I. analyse socio-economic characteristics of respondents
II. determine the technical efficiency of watermelon farmers in the study area and
III. measure the total resource productivity.

https://doi.org/10.18697/ajfand.126.23700

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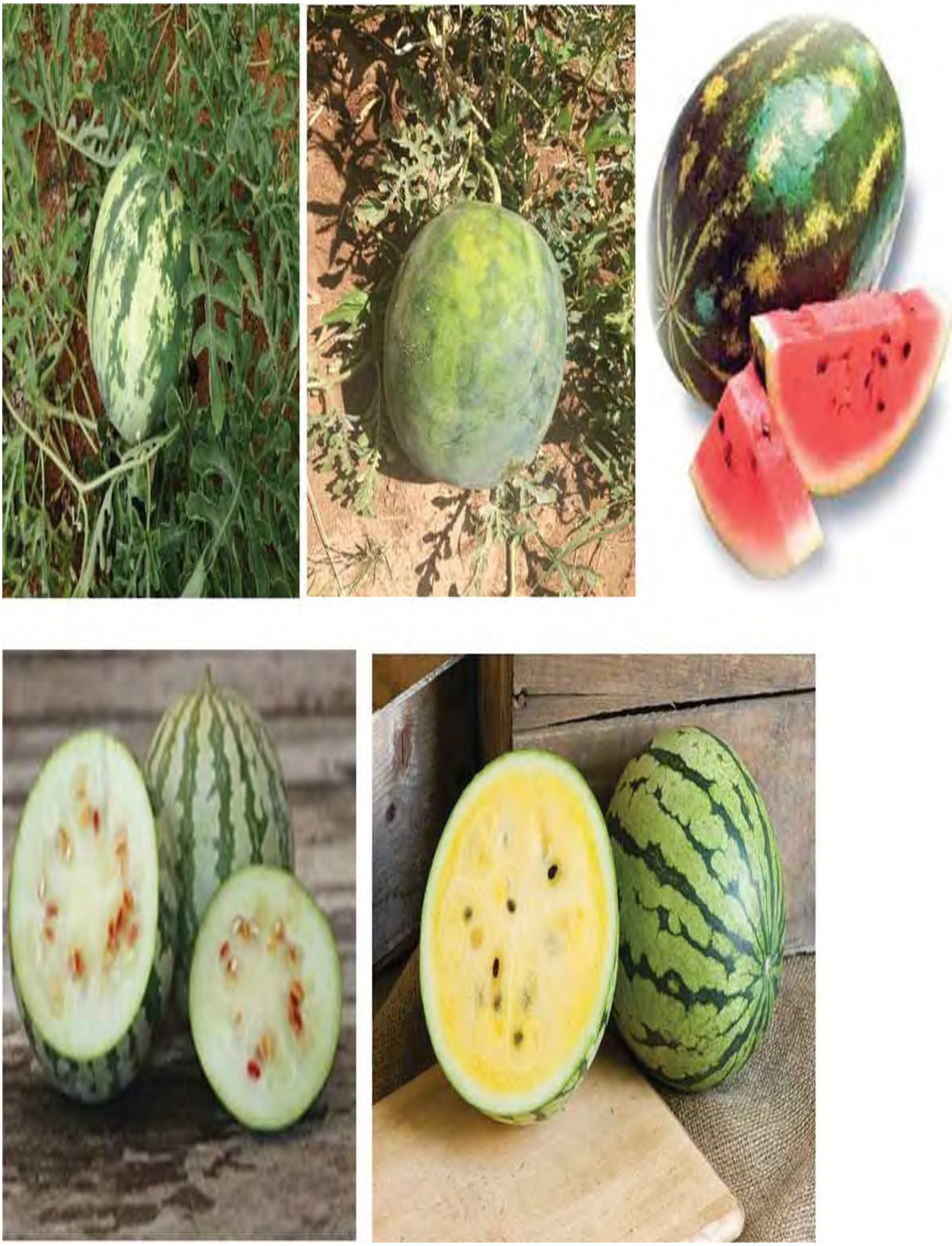
ISSN 1684 5374



Pic. 1: Pictorial view of watermelon

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MATERIALS AND METHODS

Study area

The study area is the south region of Nigeria, an area with a population of about 26 million people, representing around 12% of the total population of the country. The south-south region is located within Latitude 6.2059' N and Longitude 6.6959° E of the Greenwich Meridian and stretches along the Atlantic Seaboard from the Bight of Benin coast in the East. It is sometimes called the Niger Delta because of the extensive oil and natural gas reserves, which is instrumental in the environment and economic development of the region and is purposively chosen for it large-scale contribution to the total Nigeria's watermelon production and the peculiarity of resource efficiency problems in the area [14]. Nigeria is a country on the Gulf of Guinea covering an area of 923,769 square kilometres (356,669 sq. mi.), with a population of over 217,527, 220 million according to *worldomoter* as at 2022 and comprises 36 states [15]. The country has a tropical climate with variable rainy and dry seasons. The dry season spans from November to late March, while rainy season spans from April to October with a short spell in August called "August break" [15]. The mean annual rainfall is between 1,300mm to 3,000mm, which varies from place to place across the country. Highest temperature is recorded between February and March and does not exceed 37°C and the lowest between May and October and does not go below 18°C and also varies from place to place [16]. Agriculture is the major activity of Nigerians, accounting to about 75% of the population, distributed in agricultural production, processing and distribution [15,16].

Sampling Procedure, method of data collection and Sample size

The six states the region is made up of: Cross River, Akwa Ibom, Rivers, Bayelsa Delta and Edo states were covered in the study, with focus on the areas where large scale production is found. A multi-stage sampling procedure as used by Ettah and Kuye [17] was then adopted to select respondents as follows: stage 1 purposive selection of 2 Local Government Areas (LGA's) in each of the six States, bringing the total number of LGA's in the sample to twelve. The selection was based on the States with massive production of the crop, stage 2 purposive selection of five watermelon farming communities in each of the twelve LGA's earlier selected in stage 1. Again, this selection was based on the preponderance of water melon production, bringing the total number of farming communities in the sample to sixty, in stage 3, six farmers were randomly selected through the use of balloting and gave a total number of three hundred and sixty (360) respondents for the study. Data were collected with the use of structured and validated questionnaire.

https://doi.org/10.18697/ajfand.126.23700

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ISSN 1684 5374

Data analysis

Stochastic frontier model (Cobb Douglas production function) was used to realize objective ii. It is given as: $Y = F(X\beta) \exp^{ect}$ i

Where Y = value of farm outputs (₦)

X = Vector of Input Quantities β

β = a vector parameter

E = Stochastic disturbance term consisting of two independent elements U and V

$E = V - U$ [18] ii

The symmetric component, V, accounts for factors outside the farmers' control. It is assumed to be independent and identically distributed normal random variable (O, SV^2). A one side component $U < 0$ reflects the technical inefficiency relative to the stochastic frontier, F (Xβ) E [18]. The distribution of U is half normal. The frontier of the farm is given by combining (i) and (ii) as shown below:

$Y = F(X\beta) \exp^{(y-u)}$ iii

The empirical stochastic frontier production model that was used is specified as follows

$\ln Y_2 \ \beta_0 + \beta_1 \ln X_{1i} + \beta_2 \ln X_{2i} + \beta_3 \ln X_{3i} + \beta_4 \ln X_{4i} + \beta_5 \ln X_{5i} + \beta_6 \ln X_{6i} + V_1 - U_1$ iv

Where Subscripts ij refers to the jth observation of ith farmer

In	=	logarithm to base e	
Y	=	Value of watermelon output in aggregate (₦)	
X_1	=	farm size (hectares)	
X_2	=	labour used in watermelon production (man hours)	
X_3	=	seeds cost	(₦)
X_4	=	Equipment cost	(₦)
X_5	=	fertilizer	(kg)
X_6	=	others	

It is assumed that inefficiency effects are independently distributed and Uij arises by truncation (at zero) of the normal distribution with mean Uij and variance δu^2 where Uij [19].

Specified as:

$U_1 = \delta_0 + \delta, \ln Z_{1i} + \delta_2 \ \ln Z_{2i} + \delta_3 \ln Z_{3i} + \text{----------} \ \delta_{12} \ln Z_{12i}$ v

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ISSN 1684 5374

Where
U_i = technical inefficiency of the ith farmer
Z_1 = Gender of the ith farmer measured as dummy (If male 1, female 0)
Z_2 = farmers age (years)
Z_3 = Year of formal education of the farmer (years)
Z_4 = Household size of the ith farmer (number of people)
Z_5 = years of farming experience of the ith farmer in watermelon production (years)
Z_6 = Membership of cooperative (yes/No)
Z_7 = access to credit (₦)
Z_8 = Amount of credit obtained by the ith farmer (₦)
Z_9 = extension service (no.)

RESULTS AND DISCUSSION

Socio-economic characteristics of respondents

The socio-economic characteristics of the respondents are shown in Table 1. The results showed that female (53 %) was more actively engaged in watermelon production than the male (46 %). This shows that there are more female involved in watermelon production than male. The mean age distribution of the farmers was 40 years, with majority of the farmers within the age of 21-30 years (26.66%). The mean age of the farmers indicated that they were at their active stage of life to undertake the level of operations involved in watermelon production and the farmers interviewed were mainly in their middle age. The result, therefore, indicates that most of the watermelon farmers are young and energetic, since they are in their active age. The result conforms to the works of Ettah, Udumo and Abamyam [19] whose result showed that farmers in this study area had 69.8% respondents between the age brackets of 21-50. It was also showed that majority of the farmers were married (44.4 %), single (35.8 %), 10% were divorced, while 9.7 % widowed.

The educational status of respondents showed that majority of them (30.3 %) had primary education, 25 % had no formal education, while 21.94 and 20 % had secondary and tertiary education, respectively. Overall, this implies that respondents in the study area were literate, with these levels of education, farmers would be able to adopt new technology and also understand and evaluate information on new techniques of farming. The result obtained is in line with that of Dauda, Ajayi & Ndor [5] who observed that 85 % of the watermelon farmers in their study had one form of the formal education or the other while 25 % did not attend school.

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The mean household size was about 5 persons per household and with 57.3 % of the respondents having household size of less than 5 persons; others were between 5-10 persons, which accounted for 38.7 % of the population, while 4 % have household size greater than 10 persons. The average farm size of the respondents was 2.27ha, which indicate watermelon farmers in this region are smallholder ones [20], this result is corroborated by that of Oluwole & Omolala [4] what farmers in this part of the world are smallholders, with not more than 3 ha of farm land. The result also shows that farmers with 5-10 years had the highest farming experience (45.3 %), with an average farming experience of 4.8 years. This shows that the farmers in the study area have not been into watermelon production for a long period to afford them proficiency in resource use and hence production.

Furthermore, results showed that 71.9 % did not belong to any association, with this result, cooperative benefits are not likely to be harnessed by these farmers. Similarly, 66.1 % did not have access to credit. Farmers in this area rely on their income and that of their family for watermelon production. This implies that majority of the farmers cannot afford to purchase critical inputs necessary for boosting their watermelon production. The result conforms to that of Ettah & Angba [23] who held that the poor economic state of farmers in the area cannot guarantee them access to necessary farm inputs. Results also showed that majority (59.2 %) of the respondents had no access to extension services, hence awareness and practical demonstration of innovations in watermelon production is lacking in the study area; hence, watermelon farmers in this area rely on their old system of production. Table 1 also showed that most of the respondents sourced credits from friends and family (35.6 %), which indicates that the amount of credit available for watermelon production would be low. The mean loan obtained was ₦70,706.67 ($56.56), with 65.6 % of the respondents getting just ₦100,000 ($80.00) and below. This result is expected as they do not have formal sources of credit acquisition, which can guarantee large credit amount. Farmers in this area mostly depend on friends and families for their credit needs as said earlier [16, 20].

Technical Efficiency of Watermelon Farmers

The result in Table 2 presents the estimated parameters for the stochastic frontier production functions for watermelon farmers in the study area. The maximum likelihood estimation of the frontier function showed that σ^2 and γ are significant at 5 percent level. The significant value of the sigma square (σ^2) indicates a good fit and correctness of the specified distribution assumption of the composite error term and also shows the presence of inefficiency effects and random error in

https://doi.org/10.18697/ajfand.126.23700

watermelon production in the study area. The high gamma (γ) value of 97 % shows the variability in the output of watermelon farmers that are unexplained by the function used. This implies that that 97 % of the variation in watermelon production is a consequence of technical inefficiency and random error. Thus, the presence of one-sided error component in the model is confirmed and the average production function (Ordinary Least Square, OLS) is inadequate in representing the data, hence the justification for the use of MLE [21].

The maximum likelihood estimation of the parameters of the stochastic frontier production function and their corresponding levels of statistical significance are shown in Table 2 below. The result showed that all the estimated coefficients of the variables of the production function were positive except fungicide. The positive coefficient of farm size, labour, number of seeds grown and fertilizer were in line with *a priori* expectation and this implies that watermelon output increases with increase in these variables. Though labour, fertilizer and fungicide did not exert any significant effect on watermelon output as shown by their t-ratio values. The implication of this is that increases in the level of use of these inputs will not significantly increased output of watermelon in the study area [21].

The estimated coefficient of farm size was found to be positive (0.086) and statistically significant at one percent level of significance. This implies that a unit increase in this variable would increase the output by 8.6 kg of watermelon in the study area, that is, if the farmer expands or increases his land by one percent then the watermelon production in kg would increase by 0.086 kg. This finding is in agreement with those of Egbuchua & Enujeke [6] in which they found out that watermelon output and farm size were directly related. The estimated coefficient of labour and fertilizer were found to be 0.011and 0.0207, respectively, and were not statistically significant. The estimated coefficient of fungicide was found to be -0.0772 and was not statistically significant. The estimated coefficient of number of seeds grown was found to be 0.926 and was statistically significant at 1 %. This implies that if the number of seeds used is increased by one unit, then the watermelon output also would increase by 0.926 kg.

Factors affecting technical inefficiency of watermelon farmers are shown in table 2. Age of farmers and farm size were negative and significant at 0.05 levels, while household size, educational qualification and farming experience were all positive and significant at 5 % levels of significance and type of cropping was positive and significant at 10 % level of significance. Non-farm income was positive and significant at 5 % level of probability. This means that unit increase in these variables would increase technical inefficiency of the farmers and hence,

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Volume 24 No. 1
January 2024
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

decreasing their technical efficiency. The larger the household size the more resources are diverted to non - farm activities like medical care, education, welfare among others. This development causes watermelon farmers to be inefficient in the use of farm resources. The result agrees with findings of Adekunle *et al.* [1] that family demands affect the efficient use of resources to farm production.

The more farmers are educated, the more they turn away from watermelon farming, to other businesses perceived to bring quicker returns on investment. The less educated ones who cannot efficiently utilize resources dominate the farm industry. Highly experienced farmers tend to stick to their old methods of production, which may be inefficient. Most watermelon farmers do not invest their non-farm income in their farm because they concentrate on investments on high return ones. This result agrees with that of Figuero, Sanchez & Arjimand [7], who found out that most farmers give priority to investments outside agriculture because they are relatively fast in return to capital.

Resource Productivity of Watermelon Farmers

The return to scale analysis (RTS) which serves as a measure of total resource productivity is given in Table 3. The scale parameter (0.967) is obtained from the summation of the coefficients of the estimated inputs (elasticities), which indicates that watermelon production in the study area was in the Stage II of the production surface where production increases at decreasing rate. Stage II is the stage of decreasing positive return to scale. Hence, it is advisable, according to Oluwole & Omolala [4] that production units should maintain current levels of input utilization, as this will bring about maximum output from a given level of output, *ceteris paribus*. The RTS reported in this study was in line with that reported by Ettah & Angba [23] who obtained a RTS value of 0.703. Agbachom *et al.* [24] also reported a value of 0.654 for watermelon farmers in Nigeria. This implies that the value reported in this study is not an isolated case, thereby further underscoring the need to expand the scope of agricultural production.

CONCLUSION, AND RECOMMENDATIONS FOR DEVELOPMENT

Watermelon is an important fruit crop, regarded as a cash crop gaining a high level of economic importance in the generation of income and provision of nutritional value. Watermelon flesh contains high quantity of vitamins, minerals and other antioxidant compounds which play important role in human metabolism. Production and productivity of the crop has been low in Nigeria despite its nutritional and commercial value. This low production of watermelon calls for a close examination of the resources used in its production. Result of the stochastic frontier model showed that all the estimated coefficients of the variables of the production function were positive except fungicide. (-1.662). For the factors affecting technical inefficiency of watermelon farmers, age, farm size was negative and significant at 0.05 levels of probability, while household size, educational qualification and farming experience were all positive and significant at 5 % levels of significance and type of cropping was positive and significant at 10 % level of significance. Non-farm income was positive and significant at 5 % level of probability. This means that a unit increase in these variables would increase technical inefficiency of the farmers and hence decreasing their technical efficiency. Finally, the RTS parameter returned the value 0.967 which indicated that watermelon production in the study area was in the Stage II of the production surface. Base on the result of the analysis, the following were recommended: watermelon farmers should be provided and encouraged to take loans, extension services and become members of farmer associations, in order to boost their production. Also, inputs such as farm size, labour, seeds, fertilizer and fungicide should be increased for optimum production.

ACKNOWLEDGEMENTS

The authors express their appreciation to the faculty of Agriculture of the University of Calabar, Nigeria for providing necessary facilities and audience during interview sections for this research study.

CONFLICT OF INTEREST

The authors declare that there was no conflict of interest of any type in the course of this research.

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AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
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Volume 24 No. 1
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ISSN 1684 5374

Table 1: Socio-economic characteristics of respondents

Variable		Frequency	Percentage	Mean
	Male	167	46.38	
Gender	Female	193	53.61	
	Total	360	100	
Age	<20	30	8.33	
	21-30	96	26.66	
	31-40	77	21.38	
	41-50	75	20.83	39.72
	51-60	43	11.94	
	>60	39	10.83	
	Total	360	100	
	Single	129	35.83	
Marital status	Married	160	44.44	
	Divorced	36	10.00	
	Widowed	35	9.72	
	Total	360	100	
	No Formal Education	90	25.00	
Educational level	Primary	109	30.27	
	Secondary	79	21.94	
	Tertiary	72	20.00	
	Total	360	100	
	<5	156	43.33	
Household Size	5-10	168	46.66	4.71
	>10	36	10.00	
	Total	360	100	
	<2	214	59.44	
Farm size (ha)	3-5	104	28.88	2.27
	>5	42	11.66	
	Total	360	100	
	<5	137	38.05	
Farming experience	5-10	163	45.27	
	11-15	37	10.27	
	>15	23	6.38	
	Total	360	100	4.77

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Access to credit	Yes	122	33.88	
	No	238	66.11	
	Total	360	100	
M/ship of association	Yes	101	28.1	
	NO	259	71.9	
	Total	360	100	
Credit source	Commercial bank	23	6.38	
	NACRDB	51	14.1	
	Cooperative society	40	11.11	
	Money lenders	19	5.27	
	Friends & family	128	35.55	
	Personal savings	99	27.50	
	Total	360	100	
Extension service	Yes	147	40.83	
	No	213	59.16	
	Total	360	100	
Obtainable loan	<100000	236	65.55	
	101000-200000	47	13.5	
	201000-300000	38	10.55	
	301000-400000	23	6.38	
	>400000	16	4.44	
	Total	360	100	70706.67

Source: Computed from field Survey, 2022. NACRDB Nigeria agricultural cooperative and rural development bank

https://doi.org/10.18697/ajfand.126.23700

ajfand AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
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ISSN 1684 5374

Table 2: Maximum Likelihood Estimates of the Parameters of the Stochastic Frontier Production Function

Variables	Parameters	Coefficient	Std. error	t-ratio
Production Factors				
Constant	b_0	2.066	0.310	6.66***
Farm size (X_1)	b_1	0.0795	0.0811	0.98***
Labour (X_2)	b_2	0.0201	0.0455	0.441
Number of seeds grown (X_3)	b_3	0.926	0.0276	24.35***
Fertilizer (X_4)	b_4	0.0207	0.0755	0.475
Fungicide (X_5)	b_5	-0.0772	0.0511	-1.662
Inefficiency effects				
Constant	δ_0	6.138	2.479	1.541**
Gender (Z_1)	δ_1	-0.311	0.418	-1.744
Age (Z_2)	δ_2	-0.689	0.612	-1.125
Education (Z_3)	δ_3	-0.241	0.168	-1.434
Household size (Z_4)	δ_4	-2.110	1.224	-1.723**
Farming experience (Z_5)	δ_5	-0.89	0.69	-1.289**
Member of co-operative (Z_6)	δ_6	-2.87	0.990	2.54**
Access to credit (Z_7)	δ_7	-3.067	1.20	-2.898**
Amount of credit obtain (Z_8)	δ_8	0.0894	0.165	0.541
Extension service (Z_9)	δ_9	2.291	0.982	2.33*
Diagnostic statistics				
Sigma squared	(σ^2)	1.236	0.263	3.202***
Gamma	(γ)	0.969	0.2808	3.450***
LR test		132.61		
Log Likelihood function	(Λ)	7.01		
Sample size	N	300		

Source: computed from field survey, 2022

*** (P <0.01); ** (P<0.05); * (P<0.10). All explanatory variables were expressed in natural log form. A negative sign of the parameter in the inefficiency function implies that the associated variable has a positive effect on technical efficiency level while a positive sign indicates otherwise.
Source: computed from field survey, 2021

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Table 3: Elasticities and return to scale analyzes of production function

Variables	Elasticities
Farm size	0.0795
Labour	0.0201
Number of seeds grown	0.926
fertilizer	0.0207
fungicide	-0.0772
Return to scale	0.969

Source: computed from field survey, 2022

REFERENCES

1. **Adekunle AA, Fatunbi AO, Adisa S and OA Adeyemi** Growing watermelon commercially in Nigeria: An illustrated guide. USAID ICS-NIGERIA and IITA, *retrieved on March, 12 2022* from http://www.fao.org/sd/erp/toolkit/ BOOKS/watermelon_illust_guidebook.pdf

2. **Adeoye AS, Jatto KA, Abegunrin OO, Eniola O and OO Oke** Economic Analysis of Watermelon Production in Ibarapa Central Local Government Area of Oyo State, Nigeria. *Journal of Agriculture and food environment,*. 2020; **7(2):** 35-44.

3. **Ogunbanwo ST, Sado A, Adeniji O and LF Fadahunsi** Microbiological and nutritional evaluation of watermelon juice (*Citrullus lanatus*). *Journal of Academic Aren,.* 2021; **5(3):** 36–41.

4. **Oluwole OO and CA Omolola** Level of heavy metals in sliced watermelon fruits in selected markets in Akure, Nigeria. *Bulletin of the National Research Centre* 44. 2000; Article number: **102:** 10-14.

5. **Dauda SN, Ajayi FA and E Ndor** Growth and yield of watermelon (*Citrullus lanatus*) as affected by poultry manure application. *Journal of Agriculture and Social Sciences* (Pakistan), 2008; **4(3):** 121-126.

6. **Egbuchua C and EC Enujeke** Yield responses of watermelon (*Citrullus lunatus*) in a coastal plain soil under variable fertilizer rates and irrigation regime in a dry season production cycle. *International journal of research – granthaalayah*, 2021; **9(3):** 204–210.

7. **Figueroa A, Sanchez-Gonzalez MA, Wong A and BH Arjmandi** Watermelon extract Supplementation reduces ankle blood pressure and carotid augmentation index in obese adults with prehypertension or hypertension. *American Journal of Hypertension*, 2012; **25(6):** 40–47.

8. **Food and Agriculture Organization (FAO).** FAO statistics. China is the World's Leading Producer of Watermelon. Luxembourg. Belgium. Trinidad and. Tobago. United Arab. Emirates. World. CHART 33: Per capita food supply variability, top 20 countries in 2021.

9. **Federal Ministry of Agriculture, Water Resources and Rural Development.** Agriculture as a tool for sustainable living. 2020; Abuja, 12-18.

10. **Mbata CA, Nwagu C, Adegoke OA, Nyenke CU and A Wali** Bacteriological status of watermelon (Citrullus Lanatus) sold in mile III market Port Harcourt. *International Journal of Engineering Innovation Resources,* 2016; **5(1):** 46–49.

11. **Lilly V** Watermelon Production in Tamilnadu at a Glance. Cultivation patterns, health Benefits of watermelon. *Indian Journal of Applied Research*, 2013; **3(6):** 38-46.

12. **Ajibade AS** Productivity of the Nigerian Agriculture. In: Ekemode, K.O (Ed) Introduction to Agriculture for Sustainable Development. Lagos: *The Nigerian Association of Agricultural Educators* (NAAGRED). 2000; 28-35.

13. **Ajibefun IA, Battesse GE and AG Daramola** Determinants of technical efficiency in smallholder food crop farming: Application of stochastic frontier production function. *Quarterly Journal of International Agriculture*. 2002; **41(3):** 225-240.

14. **Yusuf SFG, Lategan FS and IA Ayinde** Profitability and Adoption of Watermelon Technologies by Farmers in Moro Local Government of Kwara State. Nigeria. *Journal of Agricultural Science*, 2021; **5(5):** 97-109.

15. **Boundaries Commission Newsletter**. A publication of national boundaries Commission. Abuja, Nigeria, 2020; 16 – 20.

16. **Nigeria's Tourism Bulletin.** Annual publication of tourism potentials of Nigeria. Federal Ministry Tourism. Abuja, Nigeria. 2021; 3-9.

17. **Ettah OI and OO Kuye** Analysis and Determinants of Profit Efficiency of Cassava Farmers in Cross River State. *Nigeria, International Journal of Environment Agriculture and Biotechnology* (IJEAB), 2017; **2(1):** 225-229.

18. **Battese GE and TJ Coelli** A model for technical efficiency effect in stochastic frontier production for panel data. Empirical economics.1995; **5(2):** 32 – 35.

19. **Ettah Otu I, Udumo, Bassey O. and Victor B. Abamyam** Resource use in potato production in Delta State. A technical efficiency approach. *Global Journal of Agricultural Sciences*. 2021; **21(1):** 35-40.

20. **Isibor A and CO Ugwumba** Analysis of watermelon (Citrullus lanatus) Marketing in Nnewi Metropolis of Anambra State, Nigeria. *Journal of Sciences and Multidisciplinary Research*, 6(2), 1–8. Jeffrey, C. (2001). Curcurbitaceae: Mansfield ornamentals. (Hanelt, P. Ed.) (3rd ed.). 2000; Berlin, Germany: Springer Publishers. 45-51.

21. **Awoke MU** Econometrics. Theories and applications. Willy Rose and Apple seed publishing Coy. 2003; Abakaliki 12-105.

22. **Kainga EP** Marketing margin and determinants of net return of watermelon marketing in Yenagoa Metropolis of Bayelsa State, Nigeria. *Journal of Experimental Biology and Agricultural Sciences,* 2021; **1(4):** 241–247.

23. **Ettah OI and AO Angba** Analysis of cost and returns among cassava farmers in Cross River State, Nigeria. *International journal of Science and Research* (IJSR), 2016; **6(4):** 5-14.

24. **Agbachom EE, Amalu ME, Uzoikwe AI, Ettah OI and GM Ubi** Strategic Policies in Expanding Frontiers of Food Security among Cassava-based Farmers in Cross River State, Nigeria. *Annual Research & Review in Biology,* 2020; **33(5):** 1-12.