Australian Journal of Science and Technology

ISSN Number (2208-6404)
Volume 7; Issue 1; March 2023

Original Article

Technical efficiency of tiger nut (*Cyperus esculentus*) production in Katsina State, Nigeria: Socio-economic drivers and implications for consumers health benefits

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ABSTRACT

This study evaluated technical efficiency of tiger nut (*Cyperus esculentus*) production in Katsina State, Nigeria: Socio-economic drivers and implications for consumers' health benefits. Multi-stage sampling technique was employed. About 100 tiger nut farmers were sampled and selected. Data were collected from target tiger nut farmers using well-designed and structured questionnaire. The tools used for data analysis include: Descriptive statistics, farm budgetary technique, stochastic production frontier model, and principal component analysis. Analysis of the result shows that about 75% of tiger nut producers were between 31 and 50 years. The mean age was 45 years. Tiger nut production is profitable and worthwhile enterprise with gross margin and net farm incomes of 939, 480 Naira and 933, 790 Naira, respectively. The statistical and significant factors influencing output of tiger nut production were seed input, and farm size. The statistical and significant socio-economic factors influencing technical efficiency of tiger nut production were: Age, educational level, and experience in tiger nut farming. The constraints faced by tiger nut producers include: lack of farm input, and lack of credit facilities. The study recommended that improved seed inputs, credit facilities, fertilizer input should be adequately provided for tiger nut producers at affordable prices.

Keywords: Health benefits, Katsina State, Nigeria, technical efficiency, tiger nut production

Submitted: 08-02-2023, **Accepted:** 03-03-2023, **Published:** 30-03-2023

INTRODUCTION

Tiger nut (*Cyperus esculentus*) is a perennial grass-like plant, it belongs to the sedge family (*Cyperaceae*) which ranks among the oldest cultivated plant in the world, and it is a potential under-utilized crop. Tiger nut is a tuber and it is cultivated in many parts of the world including Spain, India, Turkey, Sierra Leone, Ghana, Benin, Niger, Mali, Togo, Senegal, and Nigeria.[1] In Africa, annual tiger nut production in Niger Republic was 125 metric tonnes; in Ghana it was 50 metric tonnes, and in Nigeria it was 36.3 metric tonnes in 2015.[2] In Spanish Mediterranean region, tiger nut production was 9000 metric tonnes in 2012.[3] In 2021, the export value of tiger nut in Nigeria was USD 93.23 thousand and the export volume of tiger nut was 122.07 thousand metric tonnes. Tiger nut farming is one of agricultural businesses that may provide Nigeria with a return of around 20 billion Naira yearly provided the crop's value chain is fully tapped.[4] Three (3) varieties of tiger nuts are grown in Nigeria they are: The brown, black, and yellow varieties. The yellow variety is fleshy, more attractive in color, and larger in size.[5] It is available in fresh, semi-dried and dried form in the market, where it is sold locally.[6] Tiger nuts are eaten raw mainly as snacks or fried and eaten mixed with roasted groundnuts.[7] It can be processed to obtain juice for beverage production and as animal feed.[8] It can be used as food, as applications in pharmaceutical and agricultural industries.[6] Tiger nuts have edible oil which is useable in the cosmetic and pharmaceutical industries because of its high content of vitamin E content. The oil has physiochemical properties that are ideal for soap and other related cosmetics production. Tiger nut oil is good for lubricants and brake fluid formulations. Tiger oil is a high quality oil suitable for making salad, the oil has high Vitamin E, oleic acid and low polyunsaturated fatty acid (linoleic acid and linolenic acid), the high oleic acid content of the nut

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helps to reduce cholesterol level in the human body. The tiger nut oil compares favorably with soybean, corn, cotton seed, and olive oil and can serve for substitute for this oil in terms of scarcity. Tiger nut oil is a potential source of biodiesel.[6] Tiger nut milk is a refreshing drink, nourishing, and energetic product recommended by expert to be taken during any season of the year, it stimulates digestive juices and prevents constipation, and it is a substitute of traditional cow milk with natural sweet taste. Tiger nut milk has been recognized as an important food for growing children and for infants. Recently, researchers have shown strong interest in these milk sources from plant due to its high economic potentials and nutritive values. Tiger nuts are also used to make soap, starch, and biscuits.[9] Tiger nut flour is used in pharmaceutical industry for tablet production. The flour is quite ideal for making biscuits, candy, and cakes. Tiger nut flour can be blended with other flours to improve the confectioneries and nutritional properties. It is used as ointment and in fumigants to sweeten the smell of homes or clothing.[10] Studies have shown that tiger nut can be used as an alternative source of fuel which is safer, cheaper, and environmental friendly in comparison with widely used burning fuels.[11] Tiger nuts tubers are also rich in Vitamins B1 which help central nervous systems to function properly. Tiger nut contains magnesium, calcium, potassium, phosphorous, Vitamins C, A, E, and amino acids.[12,13] Tiger nut consumption is regarded as treatment for indigestion, dysentery, and mouth ulcer. It improves fertility in both male and female, as a result of Vitamin E that is present in the tubers. Vitamin E also delays aging in human cells, bring about improvement in the elasticity of the skin, and get rid of wrinkles, acne, and undesirable changes that may affect the skin. Regular consumers of tiger nut might not suffer health complications such as prostate cancer, fibrosis, diabetes, cardiovascular diseases, hernia, colon cancer, and abnormal menstruation.[1,14,15] Tiger nuts can be propagated by seeds, creeping rhizomes, and tuber sands and they are harvested usually in November and December.[10] Improved consumption of processed tiger nuts (*C. esculentus*) can provide solutions to health and nutritional problems of rural populace, increase potential source of income of producers, and other value chain actors such as marketers and processors.[11] Technical efficiency refers to ability of tiger nut producers to get maximum output out of a given set of resource input. Improving the technical efficiency of tiger nut producers will lead to an increase in the yield of producers which will in turn lead to increase in food supply, food security, higher farm incomes, and better standard of living.[16] High demand of tiger nuts will encourage farmers to go into more intensive production, this will reduce unemployment especially in the production, processing and marketing areas. Tiger nuts producers will therefore maximize their profits, reduce poverty and good health of consumers will be assured.

Objectives of the Study

The broad objective is to evaluate technical efficiency of tiger nut (*C. esculentus*) production in Katsina State, Nigeria: Socio-economic drivers and implications for consumers' health benefits. The specific objectives were:

(i) Determine the socio-economic profiles of tiger nut farmers,
(ii) Analyze the costs and returns of tiger nut production,
(iii) Evaluate factors influencing output of tiger nut production,
(iv) Evaluate socio-economic factors influencing technical efficiency of tiger nut production, and
(v) Determine the constraints faced by farmers in the course of tiger nut production in the study area.

METHODOLOGY

This study was conducted in Katsina state, Nigeria. Katsina state is located between Latitudes 11° 08′ North and 13° 22′ North and Longitudes 6° 52′ East and 9° 20′ East. The state is bounded by Niger Republic to the north, Kano and Jigawa states to the east, Kaduna state to the south, and Zamfara state to the west. There are 34 Local Government Areas in the State. The land area was 24, 235 Sq Km. The population of the state in 2006 was 5, 801, and 584 people, the population projection of the state in 2016, 2019, and 2022 were 7,831,319 people, 9,300,382 people, and 10,368,500 people, respectively. The state extends from the tropical grassland known as the savannah to the arid zone to the north. There are two (2) main seasons, dry, and wet seasons. The average temperature of the state is between 21°C and 30°C. Agriculture is the main occupation of the people. Crops produced in the state include: maize, tiger nut, guinea corn, millet, groundnut, cassava, rice, beans, sugarcane, cocoyam, cotton, and wheat. Livestock production is also a major occupation of the people.

Sampling Techniques and Sample Size

A multi-stage sampling technique was adopted for this study. In the first stage, simple random sampling technique using ballot box was used to select Katsina State based of the numerous numbers and concentration of tiger nut producers in the area. The second stage involved random selection of three area councils using ballot box method. In the third stage, three villages were selected randomly from each area council based on the intensity of tiger nut farmers. In the fourth stage, proportionate and simple random sampling technique was used in each village to select the desired sample size of 100 tiger nut farmers. This study employed the formula advanced by Yamane[17] in the determination or estimation of the sample size. The formula is stated thus:

$$n = \frac{N}{1 + N(e^2)} \quad (1)$$

Where,
n = Desired sample size
N = Finite size of the population
e =Maximum acceptable margin of error as determined by the researcher

Methods of Data Collection

The data for this study were collected through the use of well-designed structured questionnaire. The data collected were cross sectional data from primary source, the data collected from the tiger nut producers were socio-economic profiles of the farmers, prices of production inputs, quantity of inputs used, and constraints faced by farmers in the course of tiger nut production in the study area. Data were analyzed using the following tools:

Descriptive statistics

Data collected from field survey on tiger nut farmers were summarized through the use of mean, frequency distributions, and percentages. Descriptive statistics was used to summarize the socio-economic profiles of tiger nut farmers as stated in specific objective one (i)

Farm budgetary technique

Gross margin and net farm income analysis of tiger nut production was estimated using the following models:

$$GM = TR - TVC \tag{2}$$

$$GM = \sum_{i=1}^{n} P_i Q_i - \sum_{j=1}^{m} P_j X_j \tag{3}$$

$$NFI = \sum_{i=1}^{n} P_i Q_i - \left[\sum_{j=1}^{m} P_j X_j + \sum_{k=1}^{k} GK \right] \tag{4}$$

Where

P_i = Price of Tiger Nut ,($\frac{₦}{Kg}$)

Q_i = Quantity of Tiger Nut (Kg),

P_j = Price of Variable Inputs ($\frac{₦}{Unit}$),

X_j = Quantity of Variable Inputs (Units),

TR = Total Revenue obtained from Sales from Tiger Nut (₦),

TVC = Total Variable Cost (₦),

GK = Cost of all Fixed Inputs (Naira)

NFI=Net farm Income (Naira)

The farm budgetary technique was used to analyze the profitability of tiger nut production as stated in specific objective two (ii).

Financial analysis

According to Alabi *et al.*,[18] gross margin ratio is defined as:

$$\text{Gross Margin Ratio} = \frac{\text{Gross Margin}}{\text{Total Tevenue}} \tag{5}$$

According to Olukosi and Erhabor,[19] operating ratio (OR) is defined as:

$$\text{Operating ratio} = \frac{TVC}{GI} \tag{6}$$

Where,

TVC = Total variable cost (Naira),

GI = Gross income (Naira).

The financial analysis was used to analyze the profitability of tiger nut production as stated in specific objective two (ii).

Stochastic Production Frontier Model

According to Alabi *et al.*,[20] the stochastic production frontier model is stated thus:

$$Y_i = f\left(X_i, \beta_i\right) e^{v_i - u_i} \tag{7}$$

$$l_n Y = \beta_0 + \beta_1 l_n X_1 + \beta_2 l_n X_2 + \beta_3 l_n X_3 + \beta_4 l_n X_4 + \beta_5 l_n X_5 + V_i - U_i \tag{8}$$

Where,

Y_i = Output of Tiger Nut (kg)

X_i = Vectors of Factor Inputs

β_i = Vectors of Parameters

V_i = Random Variations in Tiger Nut Output

U_i = Error Term due to Technical Inefficiency

X_1 = Seed Input in kg

X_2 = Farm Size (ha)

X_3 = Fertilizer-Input in kg

X_4 = Labour-Input in mandays

X_5 = Chemical-Input in litre

$$U_i = \alpha_0 + \alpha_1 Z_1 + \alpha_2 Z_2 + \alpha_3 Z_3 + \alpha_4 Z_4 + \alpha_5 Z_5 + \alpha_6 Z_6 \tag{9}$$

Where,

Z_1 = Gender (Dummy; 1, male; 0, otherwise)

Z_2 = Age Tiger Nut Producers in years

Z_3 = Marital Status (Dummy; 1, married; 0, otherwise)

Z_4 = Educational Level Attained (Likert; 0, non-formal; 1, primary; 2, secondary; 3, tertiary)

Z_5 = Experience in Tiger Nut Farming (years)

Z_6 = Size of Household (number)

α_0 = Constant Term

$\alpha_1 - \alpha_6$ = Parameters to be Estimated

U_i = Error Term due to Technical Inefficiency

Cost saving formula

The cost saving formula for average technical efficient (ATE) tiger nut farmers and most technical inefficient or least technical efficient (MTI) tiger nut producers is stated as:

$$\text{Cost Savings} = \left[\left[1 - \frac{ATES \text{ or } MTIS}{MaxTES} \right] \times 100 \right] \tag{10}$$

Where,
ATES = Average Technical Efficiency Score (Units)
MTIS = Most Technical Inefficiency Score (Units)
MaxTES = Maximum Technical Efficiency Score (Units)

This was used specifically to achieve objective two (ii), which is to evaluate factors influencing output of tiger nut production, and objective three (iii), which is to evaluate socio-economic factors influencing technical efficiency of tiger nut production.

Principal component analysis

The constraints facing tiger nut farmers and militating against tiger nut production were subjected to principal component analysis. This was used to achieve specific objective five (v).

RESULTS AND DISCUSSION

Socio-Economic Profiles of Tiger Nut Producers

The socio-economic characteristics of tiger nut producers under consideration were gender, marital status, level of education, age, farming experience, household size, memberships of cooperatives, extension contact, and farm size (Table 1). A gender analysis of tiger nut producers shows that 62% were male, while 38% were female. In terms of marital status of tiger nut farmers, about 18% were single, 07% were divorced, and 75% were married. Furthermore, 84% of tiger nut producers were literate and had formal education, this include: primary (49%), secondary (23%), and tertiary (12%). In addition, about 16% of tiger nut producers had non-formal education. This result is in line with Akerele *et al.*[21] who reported in his findings that better knowledge of the health and nutritional values of tiger nuts among producers and consumers are expected to be positive related with advances in level of education. Age classifications of tiger nut producers show that 60% were between 31 and 50 years. The mean age of tiger nut farmers was 45 years. This means the tiger nut producers were young, active, energetic, and resourceful. This implies that the average tiger nut farmers belong to an economically active age group, therefore an improvement in their health is critical for higher productivity and economic prosperity of the nation.[21] Similar results were reported.[11,22] In addition,[23] reported that incidence of certain diet-related non-communicable disease may be more pronounced among people of this age group or above, this suggests increase preference for food with health claims such as tiger nuts by an average producers or consumers in the area. Furthermore, 60% of producers had <10 years' experiences in tiger nut farming. Averagely, producers had 9.5 years' experiences in tiger nut farming. About 76% of tiger nut farmers had <10 members as household size. The average household size was seven (7) members. This result is consistent with similar results of Wongnaa *et al.* & Bee and Selamat[11,24] About 68% of tiger nut producers were members of cooperative organizations, while 32% do not belong to any cooperative organizations. Furthermore, 74% of tiger nut farmers had contact with extension officers, while 26% had no contact with extension agents. The mean farm size was 0.90 ha of planted farm land. About 78% of tiger nut producers had <1 ha of farm land. This implies that they are small scale or smallholder farmers. Tiger nut producers with farm size of <5 ha of planted farm land are defined as smallholder, small scale, or peasant farmers.

Table 1: Socioeconomic profiles of tiger nut producers

Variables	Frequency (%)	Mean
Gender		
Male	62 (62.00)	
Female	38 (38.00)	
Marital status		
Single	18 (18.00)	
Divorced	7 (07.00)	
Married	75 (75.00)	
Level of education	16 (16.00)	
Nonformal	12 (12.00)	
Tertiary	23 (23.00)	
Secondary	49 (49.00)	
Primary age (years)		
31–40	28 (28.00)	45.00
41–50	47 (47.00)	
51–60	25 (25.00)	
Farming experience (years)		
1–5	26 (26.00)	9.50
6–10	34 (34.00)	
11–15	24 (24.00)	
16–20	16 (16.00)	
Household size (units)		
1–5	37 (37.00)	7.35
6–10	39 (39.00)	
11–15	24 (24.00)	
Memberships of cooperative		
Yes	68 (68.00)	
No	32 (32.00)	
Extension contact		
Yes	74 (74.00)	
No	26 (26.00)	
Farm size (ha)		
<1.0	78 (78.00)	0.90
1.1–2.0	12 (12.00)	
2.1–3.0	6 (06.00)	
3.1–4.0	4 (04.00)	
Total	100 (100.00)	

Profitability Analysis of Tiger Nut Production in the Study Area

The costs, returns, and profitability analysis of tiger nut production is presented in Table 2. The costs incurred and revenue obtained from tiger nut production was based on the prevailing market price as at the time of the field survey. The total cost of tiger nut production includes: the total variable cost and total fixed cost. The total variable cost includes: Cost incurred in purchase of tiger nut seeds, fertilizer input, insecticides, herbicides, and labor cost. The total variable cost of 80, 520 Naira accounted for 93.40% of the total cost of tiger nut production. The total fixed costs of 5, 690 Naira accounted for 6.60% of the total cost of tiger nut production. The total cost amounted to 86, 210 Naira. The total revenue and gross margin were calculated at 1,020,000 Naira and 939, 480 Naira, respectively. The net farm income (NFI) was estimated at 933, 790 Naira per production cycle. This signifies that tiger nut production was profitable and worthwhile enterprise in the study area. Operating ratio (OR) was used to measure profitability and operating efficiency of tiger nut production. Low operating ratio is regarded as a positive sign and mostly preferable. The operating ratio was estimated at 0.08, this implies that 8% of sales of tiger nut produce were used to cover cost incurred in process of tiger nut sold and other operating expenses. The gross margin ratio (GMR) was estimated at 0.921, this means that for every one (1) Naira invested in tiger nut production by small scale farmers, 92 kobo covered expenses, taxes, depreciation, and profit. Similar results were reported by Akerele *et al.*[21] who reported average monthly expenditure of 171.86 Naira on tiger nut consumption, while the mean monthly income of tiger nut consumers was approximately 42, 446 Naira in Ogun State, Nigeria. Furthermore, Wongnaa *et al.*[11] reported that the average monthly income for tiger nut consumers was calculated at 145.29 USD in Kumasi metropolis, Ghana.

Table 2: Profitability analysis of tiger nut production per cycle

Items	Amount (Naira)	Percentage of total cost
Total revenue/gross income variable cost	1,020,000	
Tiger nut seeds	11,000	12.76
Fertilizer input	25,000	28.99
Insecticides	4000	4.39
Herbicides	3000	3.48
Labor cost		
Land clearing and preparation	12,000	13.91
Planting	3500	4.06
Weeding	4700	5.45
Fertilizer application	3750	4.35
Chemical application	2560	2.97
Harvesting	4760	5.52
Transportation	3500	4.06
Loading and offloading	2750	3.19
Total labor cost	37,520	43.52
Total variable cost	80,520	93.40
Fixed cost		
Estimated depreciation value on tools (hoes, machetes)	2570	2.98
Rent on land	3120	3.62
Total fixed cost	5690	6.60
Total cost	86,210	100.00
Gross margin	939,480	
GMR	0.921	
NFI	933,790	
OR	0.08	

GMR: Gross margin ratio, NFI: Net farm income, OR: Operating ratio

Factors Influencing Output of Tiger Nut Production in the Study Area

The maximum likelihood estimates of factors influencing output of tiger nut production is presented in Table 3. The predictors included in the stochastic frontier production model include: seed input, farm size, fertilizer input, labor input, and chemical input. The statistical and significant predictors influencing output of tiger nut production includes: Seed input ($P < 0.05$) and farm size ($P < 0.10$). A 1% increase in farm size will lead to 32.06% increase in output of tiger nut production. The return to scale (RTS) is the sum of coefficients of estimated elasticities of production. The estimated return to scale (RTS) was 1.1235, which implies increasing return to scale. At this stage, every additional unit of production inputs would lead to more than proportionate addition to tiger nut output. The coefficient of variance ratio (γ) was 0.7209, this implies that 72.09% of variations in the output of tiger nut production were due to differences in technical efficiency. The coefficient of total variance (σ^2) was 1.6201, which was statistically significant at ($P < 0.01$). This signifies a good fit for the model. The Log-Likelihood function was 308.01.

Socio-Economic Factors Influencing Technical Efficiency of Tiger Nut Production

The maximum likelihood results of socio-economic factors influencing technical efficiency of tiger nut production are presented in Table 3. The socio-economic variables included in the technical inefficiency component of the stochastic frontier model include: Gender, age, marital status, educational level, experience in farming, and size of households. The statistical and significant socio-economic factors in the technical inefficiency component include: Age

Table 3: Maximum likelihood results of the stochastic frontier production model

Variables	Parameters	Coefficient	SE	*t*
Constant	β_0	2.0360*	0.9297	2.19
Seed input	β_1	0.2109**	0.0784	2.69
Farm size	β_2	0.3206*	0.1406	2.28
Fertilizer input	β_3	0.1209	0.0999	1.21
Labor input	β_4	0.2904	0.2664	1.09
Chemical input	β_5	0.1807	0.1704	1.06
RTS		1.1235		
Inefficiency component				
Constant	α_0	0.5640*	0.2698	2.09
Gender	α_1	−0.1502	0.1472	−1.02
Age	α_2	−0.2309**	0.0849	−2.72
Marital status	α_3	−0.3109	0.2960	−1.05
Educational level	α_4	−0.2508**	0.0889	−2.82
Experience in farming	α_5	−0.3104*	0.1379	−2.25
Size of household	α_6	−0.2013	0.1917	−1.05
Diagnostic statistics				
Total variance	σ^2	1.6201***		
Variance ratio	γ	0.7209		
Log-likelihood		361.07		
Likelihood ratio test		308.01		

*Significant at (P<0.10), **Significant at (P<0.05), ***Significant at (P<0.01). Source: Data analysis (2021). SE: Standard error, RTS: Return to scale

($P < 0.05$), educational level ($P < 0.05$), and experience in tiger nut farming ($P < 0.10$). A 1% increase in educational level of tiger producers will lead to 25.08% decrease in technical inefficiency or 25.08% increase in technical efficiency of tiger nut production.

Technical Efficiency Scores of Tiger Nut Producers in the Study Area

Table 4 shows the summary statistics of technical efficiency scores of tiger nut producers. Majority (60%) of tiger nut producers were between 21% and 60 % efficiency levels, this implies that most farmers were average technically efficient. The mean technical efficiency was 52.47% leaving a gap of 47.53% for improvement. In addition, the least technical efficiency score was 13.0%, while the best performing tiger nut farm had the maximum technical efficiency of 92.0%. If the average tiger nut producers were to achieve the level of technical efficiency like most of its efficient counterparts, then the average tiger nut producers could make 42.96 % cost savings calculated as $\left[\left[1-\frac{52.47}{92.00}\right]\times 100\right]$. The calculated value for the most technically inefficient tiger nut producers reveal a cost savings of 85.86 % calculated as $\left[\left[1-\frac{13.0}{92.0}\right]\times 100\right]$.

Table 4: Summary statistics of technical efficiency scores

Efficiency score	Frequency (%)
0.00–0.20	7 (07.00)
0.21–0.40	18 (18.00)
0.41–0.60	42 (42.00)
0.61–0.80	24 (24.00)
0.81–1.00	9 (09.00)
Mean	0.5247
SD	0.2067
Minimum	0.13
Maximum	0.92

Source: Field survey (2021). SD: Standard deviation

Constraints Faced by Tiger Nut Producers in the Study Area

The constraints faced by tiger nut producers were subjected to analysis using principal component model (Table 5). Six constraints with Eigen-values greater than one (1) were retained by the principal component model. Lack of farm input (Eigen–Value = 1.9034) was ranked 1st and this explains about 17.29% of all the constraints retained by the model. Lack of credit facilities (Eigen-value = 1.9002) was 2nd based on the

Table 5: Principal component model of constraints encountered by tiger nut producers

Constraints	Eigen-value	Difference	Proportion	Cumulative
Lack of farm inputs	1.9034	0.2249	0.1729	0.1729
Lack of credit facilities	1.9002	0.2208	0.1687	0.3416
Inadequate extension officers	1.7065	0.2008	0.1549	0.4965
Bad road infrastructures	1.6609	0.1994	0.1503	0.6468
Insecurity situations	1.5802	0.1781	0.1489	0.7957
High input cost of fertilizers	1.5401	0.1682	0.1320	0.9277
Bartlett test of sphericity				
χ^2	782.09***			
KMO	0.8206			
Rho	1.00000			

***Significant at 1% probability level. Source: Computed from data analysis (2021). KMO: Kaiser-Meyer-Olkin

perception of tiger nut producers, and this explains 16.87% of all constraints retained by the model. The other constraints facing tiger nut producers were inadequate extension officers (Eigen–value = 1.7065, rank 3rd), bad road infrastructures (Eigen–Value =1.6609, rank 4th), insecurity situations (Eigen–Value= 1.5802, rank 5th), and high cost of fertilizer (Eigen–Value = 1.5401, rank 6th). All constraints retained in the principal component model jointly explains 92.77% of all constraints included in the model militating against tiger nut production. The Chi-square value of 782.09 was statistically significant at ($P < 0.01$). This signifies that the principal component model is of good fit.

CONCLUSION

This research study has established that tiger nut production is profitable and worthwhile in the study area. Tiger nut can be bought in the market all year round. Tiger nut tubers are used to produce milk, starch, oil, flour, cakes, candy, biscuits, formulations of lubricants, and brake fluid. Tiger nut producers were young, energetic, active, agile, and resourceful and can adopt innovations of research findings or new agricultural technologies easily. They are small scale, smallholder farmers who had on the average 7 planted tiger nut farms. The estimated gross margin and net farm incomes of tiger nut farmers were 939, 480 Naira and 933, 790 Naira per production cycle, respectively. The statistical and significant factors influencing output of tiger nut production were seed input, and farm size. The statistical and significant socio-economic factors influencing technical efficiency of tiger nut production were age, educational level and experience in tiger nut farming. The mean, minimum, and maximum technical efficiency scores of tiger nut producers were 0.5247, 0.13, and 0.92, respectively. The constraints faced by tiger nut farmers in the course of tiger nut production were: Lack of farm inputs, lack of credit facilities, and inadequate extension officers.

RECOMMENDATIONS

Based on the findings, the following recommendations were made:

(i) Credit facilities should be made available for tiger nut producers at low interest rate. Cumbersome administrative procedures in accessing credit facilities by tiger nut farmers should be removed.
(ii) Farm inputs, improved seed inputs, fertilizer input should be adequately provided for tiger nut producers at affordable prices.
(iii) Adequate security should be provided for the farmers for increase tiger nut production
(iv) Feeder roads should be constructed for easy movement of tiger nut tubers from producing areas to nearby market centers
(v) Extension officers should be adequately employed to disseminate research findings, innovations and new agricultural technologies to tiger nut producers.

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