www.coast.oaustech.edu.ng
COAST
JOURNAL OF THE SCHOOL OF SCIENCE
Special Issue 1, September, 2025 ISSN: 2714-3716
Coast, J. Sch. Sci. 7 (2): 1549 - 1564

THE INFLUENCE OF LIVELIHOOD STRATEGIES AND SUSTAINABILITY PRACTICES ON FOOD CROP PRODUCTION EFFICIENCY IN FEDERAL CAPITAL TERRITORY (FCT), ABUJA, NIGERIA.

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https://dx.doi.org/10.4314/coast.v7i2.30s

Abstract

The study examined the influence of livelihood strategies and sustainability practices on technical efficiency among food crop farmers in the Federal Capital Territory, Abuja, Nigeria. A multi-stage sampling method was used to collect data from 68 respondents via a structured questionnaire administered by trained enumerators. Data were analyzed using descriptive statistics and the Cobb–Douglas production function. Respondents were mostly aged 41–50 years (33.82%), male (77.94%), married (98.53%), with primary education (38.24%), 21–30 years of farming experience, and household sizes of 6–10 members. Common sustainability practices included sole cropping (76.47%), primary tillage (92.64%), construction of ridges across the slope (26.47%), and mulching (91.17%). The sigma square value of 1.8793 was significant at the 0.01 probability level, confirming the model's validity. Findings revealed that livelihood strategies and sustainable land management practices significantly influenced technical efficiency, while resource use remained below the frontier level. Farmers recorded an average technical efficiency score of 0.57, indicating an inefficiency level of 0.43 and suggesting room for improvement. It is concluded that enhancing the diversity and adoption of sustainability practices, alongside increased use of production factors, could improve efficiency and output among food crop producers in the study area.

Keywords: Livelihood Strategies, Sustainability Practices, Technical Efficiency, Food Crop Production, Nigeria.

Introduction

Many early reports on home studies, village studies, and agricultural techniques, such as Lipton and More (2003), informed and impacted studies of development and household assets as determinants of livelihood strategies among individuals. Until the 1970s, the phrase "sustainable livelihoods" was not used in development. In 20 years, increased acceptance of livelihood definitions came from increased attention to poverty reduction and a focus on people. Political sustainability elements, development theory, and practice resulted in wider adoption of livelihood definitions (Scoones, 2009). Many concepts and programs were intertwined in transforming the political system into the emergence of livelihood. First, a people-centered approach to development arose in reaction to the perceived inadequacies of top-down development thought in the 1950s and 1970s (Chambers and Conway, 2012; Abubakar, 2014; Scoones, 2016).

Scoones (2009) demonstrated how the theoretical basis of livelihood ideas shifted the focus away from the traditional community development practice and toward modernization from the people's viewpoint. Scoones (2009) says that in the 1990s and 2000s, poverty reduction became the rationale for and the main emphasis of international development plans.

The Department for International Development (DFID) (1999) definition of livelihoods is the most often used combination of livelihood, which is made up of skills, assets (both social and material), and commitments required for survival. According to Scoones (2016), livelihood encompasses more than simply the economic elements of people's lives. It encompasses how individuals earn a living and plan their future in a particular environment. Women with fewer opportunities to diversify their livelihoods due to specific talents, such as skills that demand energy, were also categorized as poor (Redhika *et al.,* 2024). The commitment of ideologies to eliminate poverty and people-driven methods to development are all aimed at different types of livelihoods (Conrad *et al.,* 2016). The significant points in the conclusion are access to capital assets, livelihood strategies, policies, and institutions to decrease poverty among communities and families, manage life's problems, and improve one's wellbeing. The local environment's sustainability is an essential element of not taking future generations' livelihoods for granted. According to Samuel *et al.* (2022), livelihood activities are those through which people meet their means of living. Individuals may take out livelihood activities to satisfy daily requirements if they can access household assets. The availability of these assets determines the success of livelihood activities. They are categorized as follows: (Abubakar, 2014; Scoones, 2016). Natural capital - the natural resources that flow and benefit individuals, such as land, water, air, wildlife (plants and animals), soil nutrients, and environmental services (hydrological cycle). The capital foundation (money, credit/debt, savings, pensions, income, and insurance) and other economic assets (basic infrastructure, manufacturing equipment, and technology) may be utilized to follow any lifestyle strategy. Human capital - skills, expertise, experience, household labor, health condition, education level, and age-are all factors that influence the effectiveness of various livelihood strategies. Social capital - Social capital includes individual association membership, sources of knowledge, involvement in government agricultural programs, and access to important adult education programs. Physical capital refers to fundamental infrastructures (access to excellent roads, transportation, manufacturing, and the value of physical assets) that people need to pursue their livelihoods.

Sustainability practices are measures taken to sustain or maintain the productive capacity of land to meet the immediate and future needs of humans from such land. Sustainability practices are necessary because land is an important factor of production, which passes through degradation due to human daily unsuitable activities. In its literal operation, sustainability means the capacity to maintain some organizational output or process over time. Agriculture, forest management, or financial investment might be deemed sustainable, meaning the activity does not exhaust the material resources it depends on. An analogous use of the term "sustainability" refers to dependent social conditions, for example, an economic policy, or a cultural practice may be called sustainable if it will not exhaust the support of a political community. In its increasingly common use, the concept of sustainability frames how environmental problems jeopardize the conditions of healthy economic, ecological, and social systems. On a global scale, the political challenge of sustainability raises a set of fundamental problems and a comprehensive goal (Scoones, 2016)

Land degradation is a significant issue in developing countries. It is expected to be severe (Pimental *et al*., 1995; Abubakar, 2014). It is seen from a decrease in the value of land, its real or prospective significance, and a loss of potential regarding current and future output (Abubakar, 2014). The depreciation in the value of land resources demonstrates that human activity is deteriorating the current natural environment more than anticipated due to too much human activity (Caulibaly *et al.,* 2021). If land rights are unclear or unavailable, land users may be less interested in resource protection, especially investments that help the environment (Abubakar, 2014). Farmers use a variety of agricultural and LMP for crop-producing operations. Land Management Practices (LMP) were categorized by Sheng (1984) and Agboola (2016) into the following categories: Terraces, contour bunds, building of ridges over the slope, land grading, wind barriers, and other structural and mechanical erosion control practices (SMECP). Multiple cropping, strip cropping, mulching, cover cropping, and crop rotation are agronomic practices. Compost, agricultural manure, green manure, and inorganic fertilizer application are all examples of soil management practices (SMP). Cultivation Practices (CP) are minimum, zero, and conventional, ridge tillage.

Efficiency describes the extent to which resources such as time, space, energy, etc., are well used for the intended task or purpose. In complexity theory, it is a property of algorithms for solving problems requiring several steps (or memory locations) bounded from above by some polynomial function. The size of the problem instance is considered when determining the bounding function. Typically, the efficiency of an algorithm could be improved at the cost of solution quality. This often happens in cases where approximate solutions are acceptable. We also interpret efficiency to mean shorter representations of redundant data strings. Economic efficiency measures how far we can get away from Brute Force by finding quick algorithms for complex problems studied in Complexity. Efficiency theory is derived from the universal algorithm known as the “Brute Force” approach. Brute Force is an approach to solving complex computational problems by considering all possible answers. Brute Force is a highly inefficient way of solving problems and is usually considered inapplicable in practice to complex problems of non-trivial size. It is an amazing and underappreciated fact that this simplest-to-discover, understand, and implement algorithm also produces the most accurate (not approximate) solutions to all difficult computational problems. This considers the nexus between livelihood strategies, which are aided by the availability of household assets, enabling the small-scale farmers to invest in sustainability practices to achieve the attainment of efficiency in production, considering the dwindling nature of production resources to meet numerous human wants. The problem with the statement of pertinence in this study is that there is a noticeable degradation of land, which contributes to inefficiency in production (Samuel *et al.,* 2022; Robel *et al.,* 2023). Numerous human activities bring this about over time, which has led to the degradation of land. The scale-up of livelihood combinations guaranteed by available household assets could serve as a reliable means of adding an income stream, which is investable in sustainability practices to allow farmers to reduce inefficiency in food crop production. The study also looked at research questions such as the socio-economic characteristics of the food crop farmers and the influence of livelihood strategies and sustainability practices on the technical efficiency of the food crop farmers. The objectives include examining the farmers' socio-economic characteristics, identifying the livelihoods and sustainability practices practiced among the small-scale farmers, and evaluating the influence of livelihood strategies and sustainability practices on the efficiency of the small-scale farmers in the Federal Capital Territory, Abuja, Nigeria. The study reveals several livelihoods and sustainability practices carried out among the small-scale farmers, as well as the efficiency attained in production due to using several livelihood methods, which enabled the farmers to carry out sustainability practices on a larger scale during production.

Materials and Methods

The study was conducted in the Federal Capital Territory (FCT), Abuja, Nigeria, between April and June 2024. It is located between the latitudes 80° 23' and 90° 20' N and the longitudes of 60° 45' and 70° 39' E. According to the United Nations Population Commission (UNDP), the Federal Capital Territory has six Area Councils with 8,832,035 people by 2024 (*Tsue et al.,* 2014; Samuel *et al.,* 2021). Gbagyi is the largest indigenous group. Nasarawa State and Niger State surround the Territory in the west, Kaduna State in the North, and Kogi State in the East. It has a land mass of around 7,315 km^2; the city occupies 273.3 km2. It is located in the Guinea Savanna area with a mild climate. Marble, tin, clay, mica, and tantalite are some of the natural resources found in the region (Tsue *et al.,* 2014). The crops grown are maize, rice, yams, cassava, tomato, potatoes, Koro farming, and animal rearing, such as cattle fattening, sheep, and goat. The off-farm activities include tailoring, petty trading, and commercial motorcycle driving, as well as wage and salary earning jobs, among the livelihood activities undertaken by the inhabitants. Agricultural production activities are improved by farming families using land management methods (structural and mechanical erosion control measures, agronomic practices, soil management procedures, and cultivation practices) (Federal Department of Agricultural Land Resources (FDALR, 2012). Some families' off-farm income-generating activities include trading, agricultural processing, carpentry, bricklaying, tailoring, crafts manufacture, driving, sawmilling, gathering, vulcanizing, and vehicle maintenance (Tsue *et al.,* 2014). A multi-stage sampling technique was used to collect primary data from 68 respondents through the proportionate sampling method in the three selected Area Councils. Structured questionnaires were used to collect the data with the help of trained enumerators from the Agricultural Development Authority (ADP), Gwagwalada, Abuja. The descriptive statistics, such as mean, percentage, and frequency, and inferential statistics, such as the Cobb-Douglas Stochastic Frontier Production analysis, were used to analyze the data collected.

Using the Proportionate Allocation Technique. The proportionate Allocation Technique is shown in Equation 1 (Ogaji, 2019; Samuel *et al.,* 2024):

$$Sh = \frac{n \times Nh}{NT} \quad (1)$$

Where: $S_{h=}$ Number of household heads to be selected,

n = Total number of household heads for the survey,

N_h = Farming households in each selected Sub-Cells, and

N_T= Sum of the farming households in the selected sub-Cells

Analytical Tools

The objectives were analyzed using descriptive statistics and the Cobb-Douglas stochastic frontier production function model. The Cobb-Douglas stochastic frontier production function was employed to estimate technical efficiency. Household assets, institutional variables, parcel-level factors, and livelihood strategies influence this analysis of individuals' choice of sustainable land management techniques. This is expressed below:

Y=value of output (Measured from grain equivalent table),

X_1= Farm size (ha),

X_2=Total Labor (family and hired Labor) (person-days),

X_3=Planting materials (seed) (kg), (Measured from grain equivalent table),

X_4=Fertilizer (kg),

X_5=Agrochemicals (Liters), and

X_6=Capital input (these include depreciation on fixed cost items such as hoes, cutlasses, diggers, etc, interest payment on borrowed capital, rent payment). This was achieved by using the straight line method given in Equation 2:

$$\text{Depreciation} = \frac{\text{initial cost} - \text{Salvage}}{\text{Life Span}} \quad (2)$$

β_0=intercept,

$\beta_1 - \beta_5$ = regression coefficients to be estimated or parameters to be estimated,

V_i= Error term measuring error not under the control of farmers, and

U_i=Error term measuring error under the control of farmers.

This inefficiency model was specified as shown in Equation 30:

$$-U_i = a_0 + a_1Z_1 + a_2Z_2 + a_3Z_3 + a_4Z_4 + a_5Z_5 + a_6Z_6 + a_7Z_7 + a_8Z_8 + a_9Z_9 + a_{10}Z_{10} + a_{11}Z_{11} + a_{12}Z_{12} + a_{13}Z_{13} + a_{14}Z_{14} + a_{15}Z_{15} + a_{16}Z_{16} + a_{17}Z_{17} + a_{18}Z_{18} + a_{19}Z_{19} + a_{20}Z_{20} + a_{21}Z_{21} \ldots\ldots + a_{43}Z_{43} \quad (30)$$

Where:

Z_1= Farm size (ha),

Z_2= Marital status (1=married, 0 otherwise),

Z_3=Household size (number),

Z_4=Age (years),

Z_5= Number of years spent in formal education (years),

Z_6= Access to credit (N),

Z_7= No of extension contacts (Number),

Z_8= = Farming experience (years),

Z_9=sex (male=1, female=0),

Z_{10}= Membership of association of the farmer (Yes = 1, No = 0),

Z_{11} = Herbicide usage (Litres),

Z_{12} = Level of involvement in farming (Full time = 1, 0 = otherwise),

Z_{13} = Distance from the house stead to the Farm (kilometers),

$Z_{14=}$Contour bounds (yes=1, No=0),

$Z_{15=}$ Construction of ridges across the slopes (yes=1, No=0),

$Z_{16=}$Terraces (yes=1, No=0),

$Z_{17=}$Land grading (yes=1,No=0),

$Z_{18=}$Wind breaks (yes=1,No=0),

$Z_{19=}$Mono cropping (yes=1,No=0),

$Z_{20=}$Mixedcropping (yes=1,No=0),

Z_{21}= Multiple cropping (yes=1, No=0),
Z_{22}= Strip Cropping (yes=I, No=0),
Z_{23}= Cover cropping (yes=1, No=0),
Z_{24}= Legumes Planting (yes=1,No=0),
Z_{25}= Crop rotation (yes=1, No=0),
Z_{26}= Agro-forestry (yes=1,No=0),
Z_{27}= Composting (yes=1,No=0),
Z_{28}= Mulching (yes=1,No=0),
Z_{29}= Green manure (yes=1,No=0),
Z_{30}= Farm yard manure (yes=1,No=0),
Z_{31}= Fertilizer application (yes=1, No=0),
Z_{32}= Primary tillage (yes=1,No=0),
Z_{33}= Secondary tillage (yes=1,No=0),
Z_{34}= Conventional tillage (yes=1,No=0),
Z_{35}= Zero tillage (yes=1,No=0),
Z_{36}= Ridge tillage (yes=1, No=0),
Z_{37}= Mould tillage (yes=1,No=0),
Z_{38}= Strip tillage (yes=1,No=0),
Z_{39}= Shifting Cultivation (yes=1,No=0),
Z_{40}=Staple crop/off farm income (yes=1, No=0),
Z_{41}= Staple crop/ wages and salaries (yes=1, No=0),
Z_{42}= Staple crop, fruits and vegetable crops, livestock product, and off-farm income (yes=1, No=0),
Z_{43}= staple crops, fruits and vegetables, livestock production, tree crops, and off-farm income (yes=1, No=0),
a_o= intercept or constant and
$a_i - a_{21}$ = parameters to be estimated.

Test of multicollinearity

A chi-square test was carried out to test the presence of multicollinearity in the above equation. The test statistic is given in Equation 3

$$:x^2=[n-1-1/6(2k+5)\ln D] \quad (3)$$

Where:
X^2= computed Chi-square statistic,
n = sample size,
k = number of explanatory variables, and
lnD = natural logarithm of the determinant of the matrix of pair-wise correlation coefficients.

According to Olayemi (1998), the chi-square distribution has ½k, where (k-1) is the degrees of freedom, the null hypothesis tested is that n = 0 (for |£j) against the alternative hypothesis that $r_{ij.}$

Results and Discussion

Socio-economic Characteristics of the Respondents:

Socio-economic characteristics of respondents in the study area are discussed below. This is because of their significance in production, especially among the small farm holders.

Table 1 shows the results of age, sex, marital

Table 1: Socio-economic characteristics of respondents

Variable	(n=68) Frequency/ percentage
Age (years)	
<31	6(8.82)
31-40	18(26.47)
41-50	23(33.82)
51-60	19(27.94)
>60	2(2.95)
Total	**68(100.00)**
Mean	45
Gender	
Male	53(77.94)
Female	15(22.06)
Total	**68(100.00)**

Marital Status	
Married	67(98.53)
Single	1(1.47)
Widower	-
Separated	-
Total	**68(100.00**
Level of Educatio	
Quranic Educatior	10(14.70)
Primary Education	26(38.24)
Secondary Educat:	12(17.65)
Tertiary Education	2 (2.94)
Adult Education	2(2.94)
None of the above	16(23.53)
Total	**68(100.00)**
Farming Experie: (years)	
<11	12(17.65)
11-20	19(27.94)
21-30	21(30.88)
31-40	14(20.59)
>41	2(2.94)
Total	**68(100.00)**
Mean	23
Household size	
<6	14(20.59)
6-10_	34(50.00)
11-15	16(23.53)
16-20	2(2.94)
>20	2(2.94)
Total	**68(100.00)**
Mean	**9**

Source: Field Survey, 2024. The figures in parentheses are corresponding percentages

status, level of education, farming experience, and household size, respectively. Respondents' results show that the age group is 41-50 years, with a mean of 45 years. This further indicates that the respondents were within their productive age group. Furthermore, this shows that the younger the farmer, the higher the expectation that such a farmer may accept innovations easily, including the choice of livelihood and sustainable land management. The finding agrees with the report of Dankyang (2014) and Ojo (2013), who reported that most respondents involved in farming activities are regarded as economically active and are likely to embrace new ideas in farming. Results on sex also show that males were the majority in farming than females, with 79.71%. This further signifies that male farmers, mostly household heads, dominate farming in FCT. This implies that sex is essential in farming livelihood and small-scale agriculture in Nigeria. This is also attributable to the fact that the energy requirements in farming livelihood are better met among menfolk(Ojo, 2013). These results also agree with the findings of Ibekwe (2010), who asserted that men are the backbone of the agriculture sector and are responsible for about 80% of the food produced. As shown in the Table, married respondents dominate agricultural activities among food crop farmers. The sample of the married was 98.53%. This revealed that most respondents were married because of the required family labor to carry out farm activities, as women contribute during planting and transportation of Farm produce to the home. Also, rural dwellers, especially in Northern Nigeria, get married mostly when an individual becomes reproductively mature.

The level of education at the primary level among the respondents was more than 38.24%. This is attributable to the quest for one form of education or another among food crop producers. The respondents had primary education mainly in the study location. The result agrees with the report of Simonyan *et al.* (2012) and Okonkwo (2015), who reported that small-scale farmers have one form of education or another, which significantly increases the farmers' ability to make correct and meaningful choices of farm operations. Farming experience of respondents also shows 30.88% and between 21 and 30years with a mean of 23years. The result agrees with the findings of Nurudeen (2012), who reported that older farmers have one form of education or another, which serves as a guide in the decision-making process. The respondents had 6-10 members per household, with a mean of 8 members/household. This revealed a medium to large household size, which assists the farmers in carrying out farming activities, as farming is labor-demanding. This finding agrees with the report of Ojo *et al.* (2013) and Ajani (2012), who reported that medium to large household sizes enable farmers to achieve division of Labor, especially when labor-intensive techniques are required.

About 66.18% of the respondents were also in full-time farming. This indicates that farming is primarily an inherited livelihood among small-scale farmholders, through which immediate needs are met. It also signifies that the rural people are predominantly into farming to make provision for food and other immediate needs of the family. The results also revealed that farming was the primary occupation for 75.00% of the rural inhabitants in FCT because they took farming as their primary occupation. This could be due to the possibility of more expected exposure among small-scale farmers on livelihood diversification involving farming among the respondents.

Sustainable land management practices identified: Descriptive statistics were also used to analyze the respondents' choice of sustainability practices. Table 2 shows that 76.47% was the most undertaken among the respondents who carried out agronomic practices. This could be because the arable land in the study area is relatively fertile and available for crop production, allowing small-scale farm holders to carry out such farming practices.

This agrees with the report of Abdullazeez *et al.* (2013), who reported that crop rotation, mixed cropping, and sole cropping were the standard agronomic practices among small-scale farmers.

The result also revealed that primary tillage was the most practiced among the cultural practices among the respondents (962.64%). This could be why most small-scale farmers use primitive tools to carry out tillage before planting. They also carry out zero tillage practice because it is cheaper, considering that it allows cultivation of a large farm size within a short period. The possible access to tractors through agricultural programs is why they chose primary tillage compared to other tillage practices. The result agrees with the finding of Oyeneke and Mmagu (2017), who reported that smallholder farmers mostly carry out primary, ridge, and zero tillage practices among other sustainability practices.

Results on structural and mechanical erosion

Table 2: Distribution of farmers according to sustainable land management practices

Sustainable LMPs	(n=68) Freq. /Perc./score
Agronomic Practices (A	
Crop rotation	37 (54.41)
Multiple cropping	19 (27.94)
Strip cropping	3 (4.41)
Cover cropping	38 (55.88)
Legumes planting	37 (54.4)
Mixed cropping	28 (41.17)
Sole cropping	52 (76.47)
Agro-forestry	3 (4.4)
Bush fallowing	4 (5.8)
Shifting cultivation	10 (14.70)
Cultivation Practice (C	
Conventional tillage	22 (32.35)
Minimum tillage	23 (33.82)
Zero tillage	29 (42.64)
Mold tillage	21 (30.88)
Ridge tillage	46(67.64)
Primary tillage	63(92.64)
Structural and mechanical erosion control practice	6 (8.82)
Land grading	2 (2.94)
Contour bunds	18 (26.47)
Construction of ridges across the field slope	
Soil Management	54 (79.41)
Practices	43 (63.23)
Fertilizer application	17 (25.00)
Composting	36 (52.94)
Organic manure/farm	62 (91.17)
yard	
Green manure	
Mulching	

Source: Field survey, 2024. (Figures in parentheses are percentages) * Multiple responses were recorded control practices (SMECP) revealed that the construction of ridges across the field slopes, 26.47% and land grading, 8.82% were the most practiced structural and mechanical erosion control practices. The possible reasons for carrying out more of the construction of ridges across the field slope are that the study area is hilly in topography, which could cause erosion. The practice might be used to control such possible erosion. Land grading may also be practiced to level the undulating surface of the land in the study area, allowing cultivation to be carried out. The measures undertaken for structural and mechanical erosion control practices were land grading, construction of ridges across field slopes, and contour bunds. Francis (2015) reported in variance with the result of these findings that among structural and mechanical erosion control practices undertaken in Uganda are terraces, wind breaks, and the construction of ditches. This could be due to regional differences in research areas. The least used soil management practices were organic or farm yard manure, 25.00% and green manure, 52.94%. This may be because the small-scale farm holders have appreciable access to fertilizer through different agricultural projects and programs in the Federal Capital Territory. Amusa's report (2015) concurred with this finding that mulching, composting, and fertilizer use were among farmers' frequently practiced soil management measures.

Production Factors Included in Cobb-Douglas stochastic frontier production function

The coefficient of production factors included in the Cobb-Douglas stochastic frontier production function among staple food crop producers in the Federal Capital Territory is shown in Table 3. The factors of production contribute to a farmer's level of output. The coefficient for farm size was significant at 1%. This means that if farm size is increased by 1% while other factors of production are held constant, it will result in an additional output of 0.15012%. The larger the farm size, the higher the output level if other production factors are available, namely, Labor, which was significant at 10%. Holding other factors constant and increasing labor usage by 1% will result in about 0.111% additional output for food crop producers. This is aided by the availability of Labor, which is essential during crop cultivation to realize more production output. According to Inoni's (2007) research, an increase in labor supply allows small-scale farmers to scale up resource usage, increasing the output level. Planting material was significant at 1%. The significance is that if planting material input increases by 1% and other factors are constant, output will increase by 0.1237%. Planting good-quality material, such as good viability, disease/pest resistance, quick maturity, high-yielding varieties, and drought resistance, will produce more output. The result of this finding agrees with the report of Gana (2018), who stated that good planting material usage, primarily pest- and disease-resistant crops, as well as high-yielding varieties, contributes to more crop output. The coefficient for fertilizer was significant at 10%. This implies that if all factors are held constant and fertilizer is increased by 1%, it will reduce the output level by about -0.0293%. At this level, an increase in fertilizer usage is discouraged to avoid inefficiency in food crop production. The finding of Ogunleye (2018) was in line with this result, which is that fertilizer usage is among the significant factors that reduce production inefficiency if other production factors are available. Table 3 shows the inefficiency factors of food crop producers.

The results show that the estimated sigma square for FCT was 0.8793, which is significant at a 0.01% probability level. This

Table 3: Factors of production included in the production function

Production Factors	Coeff .	t-ratio
Constant	4.3732	12.5949***
Farm size (ha)	0.15012	3.4924***
Total labour /man -days (family and hired)	0.1110	1.6115*
Planting materials (seed)/kg	0.1237	4.9090***
Fertilizer	-0.0293	-1.6415*
Agrochemical	0.00679	0.1434
Capital input (including depreciation and fixed cost)	0.0017	0.4157

Source: Field survey, 2024.

indicates a good fit and correctness of the specified distributional assumption of the composite error term. The finding agrees with the research of Okwonkwo (2015), who reported similar results. The result shows that gamma was estimated to be high, 47.5%. This suggests systematic influences not explained by the production function and dominant sources of random error.

The coefficients for inefficiency factors are shown in Table 4. Inefficiency factors show the level of output at which the farmer operates. The lower the level of inefficiency of a producer, the better his/her level of efficiency in production. Marital status(Z_1) was significant at 1% and negatively signed. This means that an increase in the involvement of married households in farming activities could decrease the level of inefficiency. Also, the more involvement of the unmarried in farming, the more likely the inefficiency is because farming as a production activity is Labor- and energy-demanding, which is readily primarily available among the married households, where division of Labor possibly results in more output. This agrees with the *a priori* expectation. Farmsworth (2015) revealed that inefficiency could be reduced through labor availability, which is found among married small farm holders. Age (Z_3) was significant at 5% and positively signed. This means that increasing age involvement in farming activities will increase inefficiency. This is because farming is energy-demanding and should be occupied mainly by the young and middle-aged people who could reduce inefficiency. The result conforms with the report of Alabo (2013) that farmers within the productive age, that is, the young age group, are energetic enough to meet farm labor demands and accept innovations easily, contributing to the output level. The years spent in school (Z_4) were significant at 10% and negatively signed. This means that as farmers are educated and active in farming, there is a tendency for their level of inefficiency in production to decrease. This is because more educated farmers accept new farm innovations faster due to their level of education, which could result in the attainment of efficiency. In line with this finding, Tanko and Jirgi (2008) reported that the level of farmers' education positively influences output improvement.

The coefficient for mono/sole cropping (Z_{18}) was also significant at 10% and positively signed, which implies that as more mono/sole cropping is used in farming livelihood, the level of inefficiency in the farm sector will

Table 4. Inefficiency factors of food crop producers

Variables	Parameters	Coeff.	t-ratio
The inefficiency factors			
Marital status	Z_1	-2.4070	-2.7848***
Household size	Z_2	0.0023	0.0694
Age	Z_3	0.0345	2.1329**
Number of years spent in formal edu	Z_4	-0.0644	-2.0885*
Access to credit	Z_5	0.0000034	0.1110
Extension contacts	Z_6	0.9742	1.5190
Farming experience	Z_7	-0.0229	-1.5511
Gender	Z_8	0.3205	0.8439
Membership of a farmers' association	Z_9	-0.1675	-0.5249
Herbicide usage	Z_{10}	-0.0200	-1.2322
Level of involvement in farming	Z_{11}	0.0815	0.3114
Distance from home to the Farm	Z_{12}	-0.0214	-0.1854
Soil and mechanical erosion control practice	Z_{13}	-2.2217	-1.5039
Contour bonds			
Construction of ridges across the slope	Z_{14}	-0.4478	-1.1715
Terraces	Z_{15}	0.0000	0.0000
Land grading	Z_{16}	0.6799	0.8498
Wind breaks	Z_{17}	-0.3880	-0.4931
Agronomic practice			
Mono/sole cropping	Z_{18}	1.4773	1.8397*
Mixed /inter cropping	Z_{19}	0.0000	0.0000
Multiple cropping	Z_{20}	-0.0273	-0.0463
Strip cropping	Z_{21}	-1.4798	-1.7543*
Cover cropping	Z_{22}	0.2516	0.4392
Legumes planting	Z_{23}	-0.8907	-1.2803
Crop rotation	Z_{24}	-7.9702	0.5908
Soil management practice			
Composting	Z_{25}	0.2048	0.6461
Mulching	Z_{26}	0.2462	0.4508
Green manure	Z_{27}	-0.9536	-2.5319**
Farmyard manure	Z_{28}	0.2762	0.7271
Fertilizer application	Z_{29}	1.5864	2.0504**
Tillage practice			
Primary tillage	Z_{30}	0.4769	0.8704
Secondary tillage	Z_{31}	-0.5216	-1.2107
Conversional tillage	Z_{32}	-0.0607	-0.1821
Zero tillage	Z_{33}	2.273	2.7864***
Ridge tillage	Z_{34}	0.2446	0.7208
Mold tillage	Z_{35}	0.4463	0.4993
Shifting cultivation	Z_{36}	0.0000	0.0000

Livelihood strategies			
Staple crops/off -farm income	Z_{37}	0.6980	1.599
Staple crops/ wages and salaries	Z_{38}	0.1692	0.3063
Staple crops, fruit and vegetable crops, livestock production, and off -farm income	Z_{39}	0.3860	0.9860
Staple crops, fruit and vegetable crops, livestock production, tree crops, and off - farm income	Z_{40}	25.3573	44.4712***
Sigma square	∂^2	0.8793	3.1654***
Gamma	Y	0.4755	3.9960***

Gamma Y0.47553.9960***Source: Author's Field survey (2024). Log likelihood function= 0.92584417E+0, LR test= 81.0679***= 1% level of significance. ** = 5%level of significance, * =10% level of significance.

increase. The contributing factor is that the sole/mono-cropping pattern of farming does not allow farmers to harvest more than one crop on a plot of land, and where the crop planted yields low output, inefficiency will increase. Strip cropping (Z_{21}) is encouraged where the land is undulating to control erosion. This is because strip cropping is mostly practiced only in hilly lands to control erosion and reduce inefficiency in production. Strip cropping was significant at 1% and negatively signed. The green manure (Z_{27}) value was also significant at 5% and negatively signed. It signifies that as more green manure is used, the inefficiency in food crop production will be reduced. Green manure serves as fertilizer to the crops, contributing to increased crop output. The coefficients of fertilizer (Z_{29}) application and zero tillage (Z_{33}) were significant at 5% and 1%, and were positive in sign. This implies that the more fertilizer is used, the less inefficiency there is. Carrying out zero tillage could reduce inefficiency because the use of Labor available is saved to carry out other farm operations, which could reduce inefficiency. The findings on green manure, zero tillage, and fertilizer application are not in variance with the report of Samuel (2010) that soil management practices adopted by small-scale farmers contribute significantly to sustaining yields of staple food crops. The coefficient for LS4 (Z_{40}), which was significant at 1% and positive, means that an increase in the level of practice of LS4 (Livelihood strategy four) will increase the level of inefficiency. The results of Awoyinka *et al.* (2010) and Rodhika *et. al.* (2024) were in variance with this finding. The result showed that livelihood diversification among small-scale farmers reduces inefficiency.

Resource use efficiency among food crop producers

Resource usage among the food crop producers shows their level of efficiency in production. Table 5 shows the technical efficiency of food crop producers in the study area, which ranges from 0.10 to 0.94. This implies that an average farmer in the study area could obtain 57% using resources. The result indicates that food crop farmers were generally technically inefficient because their production level was below the frontier level. They have room to increase the technical efficiencies of about 43% efficiency gaps from the optimum (100%) yet to be obtained by a typical farmer. Food crop farmers in FCT used resources 0.57. Therefore, food crop farmers in FCT were less inefficient. The result agrees with the findings of Nandy *et al.* (2014) that productivity growth and inefficiency among food crop farmers could be reduced through the more widespread use of available technology resources.

Table 5: Distribution of resource use efficiency indices

Class of indices	FCT(n=68) frequency/ Percentage
0.10 -0.20	-
0.21 -0.30	-
0.31 -0.40	3 (4.4)
0.41 -0.50	5 (7.3)
0.51 -0.60	10.(14.7)
0.61 -0.70	8 (11.7)
0.71 -0.80	8 (11.7)
0.81 -0.90	10 (14.7)
0.91 -10.0	24 (35.2)
Total	68 (100)
Mean	0.57
Minimum	0.10
Maximum	0.94

Source: field survey, 2024. Mean efficiency = 0.5729255E+00.

Conclusion and Recommendation: The study shows that the respondents were mainly within the age group of 41-50years (33.82%), males 77.94% and married98.53% with predominantly primary level of education 38.24% and farming experience of 21-30years, as well as household size of 6-10members/household. The sustainability practices carried out mostly were sole cropping 76.47%, primary tillage 92.64%, construction of ridges across the field slope 26.47% and mulching 91.17%. The result also shows that the sigma square was 1.8793 and significant at a 0.01% probability level, which indicates a good fit and correctness of the specified distribution assumption of the composite error term. Livelihood strategies and sustainable land management practices affects technical efficiency in food crop production among the food crop producers, while resource usage in production among the food crop producers was below frontier level, as a result there is room to improve on level of efficiency as food crop producers were technically inefficient in production with technical efficiency value of 0.57, that is inefficiency of 0.43. It is therefore concluded that livelihood strategies and land management practices affect the attainment of technical efficiency in food crop production. In the Federal Capital Territory, Nigeria.

Therefore, the respondents should scale up their usage of sustainability practices to include different practices as they affect efficiency in production. The respondents should also increase the usage of production factors to reduce their inefficiency level, from 0.43 since the efficiency level among the farmers was 0.57, to attain a higher production output level.

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