



SOCIO-ECONOMIC DETERMINANTS OF TECHNICAL EFFICIENCY AMONG DRY SEASON CROP FARMERS IN GOMBE STATE, NIGERIA

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ABSTRACT

This study examined determinants of technical efficiency among dry season crop farmers in Gombe State, Nigeria. Data were collected using structured questionnaires complemented with interview administered on 337 purposively and randomly selected farmers. The data collected were analyzed using descriptive and inferential statistics. The results revealed male dominated and literate population having large household of 11-15 persons. In addition, 94.07% of the farmers in the study area are married, cultivating an average farm size of 2.54. The mean efficiency obtained was 78 percent indicating that there was a 22 percent allowance for improving efficiency. The result also shows that farmers' educational level and farming experience positively and significantly influence farmers' efficiency at 1% level. The study recommended farmers enrolment in adult education to acquire basic skills for proper planning and management of farm business activities.

Key words: Determinants, Dry season, Technical efficiency, Gombe, Nigeria

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INTRODUCTION

Dry season farming involves small holder farmers who cultivate between 0.5 hectare (ha) and 1.0 ha of fadama lands during the dry season. They use water pumps to draw water from streams/rivers, lakes, boreholes, tube wells ponds for irrigation and take responsibility for investment and management of their farms (Umar, 2016). Many families in Nigeria cultivate small areas in fadama during the dry season, using water manually drawn from shallow wells or streams. Irrigation as the name implied, is the application of water to the soil for the purpose of supplying moisture essential for plant growth. It is undertaken to provide an insurance against droughts, for cooling the soil and atmosphere. It is a science of planning and designing a water supply system, usually man made, for agricultural land to produce crops where there is virtually little or no precipitation and to protect the crops from bad effect of drought or low rainfall (Oladimeji and Abdulsalam, 2014). Irrigation is therefore regarded as a powerful factor in increasing crop productivity, more stable incomes, and employment and for increasing prospects for multiple cropping and crop diversification (Oruonye, 2011). The establishment of large-scale dry season scheme in Nigeria is highly capital intensive and requires the

expenditure of huge sums of money in an already scarce foreign exchange. Scientific advances have led to the development of productivity- increasing inputs such as inorganic fertilizer, improved seed, and agrochemicals (Yakubu, 2018). In Nigeria 39% of the land mass is potentially suitable for agriculture and out of this, about 4.5 to 5.0% are suitable for irrigated agriculture (Sanda and Kaka, 2013). Fadama is a Hausa word that refers to low-lying areas or valley bottom adjacent to stream channels and is seasonally flooded or waterlogged. It is a product of seasonal or almost permanent flood with the source of water from direct run-off and or capillarity from seepage water in the surrounding catchment. The objective of this study is to provide empirical information on socio-economic characteristics and determinants of small-scale irrigated crop production in Gombe State, the Northeastern part of Nigeria.

MATERIALS AND METHODS

Gombe State lies between latitudes 9⁰30' and 12⁰ 30' north of the equator and between longitudes 8⁰ 45' and 11⁰ 45' east of the Greenwich meridian. It shares boundaries with Bauchi State to the west, Taraba, and Adamawa States to the southwest, Borno State to the east and Yobe State to the north (Gombe State Ministry of Economic Planning (GSMOEP), 2014). The State has a land area of 20,265km² with a population figure of 1.85 million people (NPC, 2006). The projected 2015 population figure is 2,321,195.69 people using 2.83% annual population growth rate. Gombe State is divided into eleven (11) Local Government Areas (LGAs). Gombe State is characterized by two distinct wet and dry seasons. The mean annual rainfall ranges from 600 mm to 1200 mm with the minimum and maximum temperatures of 22.7⁰C and 33.5⁰ C respectively (Gombe State Economic Empowerment Strategies (GOSEEDS), 2006). The vegetation of Gombe State is open savannah woodland with trees occurring singly or in clusters. The state is traversed by river Gongola and numerous tributaries that are seasonal. There are also facilities for irrigation which include Dadin Kowa multipurpose Dam, Balanga Dam and Cham Dam. The major ethnic groups are Fulani, Tangale, Waja, Tera, Pero, Bolawa, Tula, Chamawa, Lunguda, Dadiya, Kamo and Awak Kanuri.

Sampling Technique

A multi-stage sampling technique was used in the study. A purposive sampling was adopted to select five (5) LGAs as well as fifteen farming communities based on their dry season farming history. A random selection of 337 respondents from the 15 farming communities based on the list of farmers obtained from Gombe State Agricultural Development Programme (GADP) was carried out. The farmers were visited on fortnight bases to collect information on inputs used in production as well as output harvested. Information on socio-economic characteristics of the farmers was also obtained with the use of questionnaires.

Analytical Techniques

The data obtained were analyzed using both descriptive and inferential statistics. Means, standard deviations, percentages and frequencies were used in analyzing the socio-economic characteristics of farmers and the distributions of efficiency levels.

A stochastic frontier production function that incorporated inefficiency factors were estimated using Maximum Likelihood Estimation (MLE) technique to obtain farm specific technical efficiencies as well as their determinants.

Model specification: The model is given by the specified production function;

$$\ln Y_{ij} = \beta_0 + \beta_1 \ln X_{1ij} + \beta_2 \ln X_{2ij} + \beta_3 \ln X_{3ij} + \beta_4 \ln X_{4ij} + \beta_5 \ln X_{5ij} + \beta_6 \ln X_{6ij} + V_{ij} - U_{ij} \dots \dots \dots (1)$$

Where:

L_n = Logarithm to base e

Y_1 = Output of food crops (kg)

X_1 = Total land area under irrigation (ha)

X_2 = Labour used in production (man-days/ha)

X_3 = Quantity of agrochemicals (lit/ha)

X_4 = Quantity of inorganic fertilizer (kg/ha)

X_5 = Quantity of seed (kg/ha)

$\beta_0 - \beta_5$ = co-efficient to be estimated.

v_{ij} = are assumed to be independent and identically distributed normal random errors, having zero mean and unknown variance.

u_{ij} = are the technical inefficiency effects which are assumed to be independent of v_i 's.

Some farm/farmers characteristics were incorporated into the frontier model with the belief that they have a direct influence on efficiency. The efficiency function was specified as:

$$TE = \delta_0 + \delta_1 Z_{1ij} + \delta_2 Z_{2ij} + \delta_3 Z_{3ij} + \delta_4 Z_{4ij} + \delta_5 Z_{5ij} + \delta_6 Z_{6ij} + \delta_7 Z_{7ij} \dots \dots \dots (8)$$

Where:

TE = Inefficiency effect

Z_1 = Age of farmer (years)

Z_2 = Farming experience (years)

Z_3 = Educational level of farmers (years)

Z_4 = Household size (Number of people)

Z_5 = Extension contact (number of meetings)

δ_0 = Constant

δ_1 = Coefficient to be estimated.

RESULTS AND DISCUSSION

Socio-Economic Characteristics of the Respondents

The socio-economic characteristics of the respondents studied include sex, age, marital status, educational level among others. These are presented in Table 1.

Table 1: Distribution of Respondents Based on Socio-Economic Characteristics

Socio-Economic Variables	Frequency	Percentage
Sex		
Male	311	92.28
Female	26	7.72
Total	337	100
Age (years)		
20 – 29	14	4.15
30 – 39	76	22.55
40 – 49	148	43.92
50 – 59	77	22.85
60 – 69	19	5.64
≥70	3	0.89
Total	337	100
Mean	44.42	
Marital status		
Single	13	3.86
Married	317	94.07
Divorced	1	0.30
Widow	6	1.78
Total	337	100
Educational level		
Non-formal education	128	37.98
Primary school	70	20.77
Secondary school	86	25.52
Tertiary education	53	15.73
Total	337	100
Household size (Number)		
1 – 5	39	11.57
6 – 10	84	24.93
11 – 15	108	32.05
16 – 20	63	18.69
≥21	43	12.76
Total	337	100
Mean	13.5	
Farming experience (Years)		
1 – 10	229	67.95
11 – 20	68	20.18
21 – 30	28	8.31
31 – 40	9	2.67
≥41	3	0.89
Total	337	100
Mean	10	
Farm size (ha)		
≤ 2.0	199	59.05
2.1 – 3.9	55	16.32
4.0 – 5.9	61	18.10
≥ 6.0	22	6.53
Total	337	100
Mean	2.54	
Extension contact		
None	154	45.69
Once in a year	31	9.20
Twice in a year	70	20.80
More than twice in a year	82	24.33
Total	337	100

Source: Field survey, 2023

Table 1 revealed that majority (92.28%) of the respondents were males. This conforms to a priori expectation that in some northern State, male tends to dominate agricultural production probably, due to tedious nature of farming activities as well as cultural and religious inclination. This agrees with the findings of Kefas (2012) who argued that females were mostly involved in light activities such as planting, weeding, harvesting as well as processing. The result further agrees with Oladimeji and Abdulsalam (2014) who reported that the male gender dominated small-scale irrigation farming. This result is however at variance with the findings of Maurice (2012) who found that food crop production in Adamawa state is dominated by female. The age distribution shows that 95.85% of the respondents were within the age bracket of 30-49 years, with a mean age of 44 years. This shows that the respondents were in their active and productive age bracket and will be willing to adopt and practice new technology effectively (Kefas, 2012). Younger farmers have the tendency to operate more efficiently than the older farmers (Onu and Edon, 2009). The distribution of marital status showed that married farmers dominate (94.07%) in the study area. This implies that there will be more labour supply from married households. Comparable results were obtained by Dary and Kunnibe (2012) who found that 90 percent of food production in this country comes from rural household who are married. The education level of the respondents reveals that majority (63.02%) had some levels of formal education with secondary school accounting for 25.52%. It shows that the respondents were literate. Household size of the respondents revealed that 56.98% of the respondents had household size of 6-15 with mean household size of about 18 persons. Household size affects income and expenditure. Thus, household size in the state is large. The distribution of the respondents by farming experience shows that majority (88.13%) of the respondents had farming experience between 1-20 years. The mean farming experience was 10 years. Indicating that the farmers had adequate experience in dry season crop production in the study area. This then means that as farmer gets experienced, their innovative ability increases. This agrees with the studies conducted by Ayoade (2010) who reported that increase in farming experience increases farmer's ability to adapt to climate change and vice versa. Majority (59.05%) have farm size of not more than 2 hectares. Indicating that the respondents were small scale farmers. This is in line with the findings of Afolabi (2010) who reported that food production in Nigeria is usually undertaken by small and medium scale farmers. The distribution of respondents based on extension contact revealed a greater number (45.69%) did not have any contact with extension agents in the last 12 months. This has denied the farmers accessing and utilizing new technology that could improve their skills and technical knowhow thereby improving their productivity.

Maximum Likelihood Estimates of the Stochastic Frontier Production Function in Dry Season Crop Production in Gombe State, Nigeria.

The stochastic frontier production function estimates of the dry season crop production in the State are presented in Table 2. The Table shows that the entire coefficients have the expected positive signs. The coefficient of farm size and seed were significant at one percent level, while agrochemicals and fertilizer were significant at five percent level. Labour was not significant, meaning that majority of the dry season crop farmers might have opted for agrochemicals method of weed control instead of physical labor. The sum of elasticity (1.85) indicates that the dry season crop farmers were operating in the increasing return to scale region (inefficient stage). The gamma (γ) value was 0.049 and significant at one percent level. It is an indication that only 4.9 percent variation in output of dry season crop production is attributed to technical inefficiency. The sigma-square (σ^2) on the other hand was 0.017 and significant, indicating the correctness of the specified assumptions of the distribution of the composite error term.

Table 2: Maximum Likelihood Estimates of the Stochastic Frontier Production Function in Dry Season Crop Production in Gombe State

Variable	Coefficient
Constant	4.14 (128.5295)***
Labour	0.004 (0.0736)
Farm size	1.447 (33.7766)***
Agrochemicals	0.104 (2.3357)**
Fertilizer	0.155 (2.3357)**
Seed	0.274 (19.0322)***
Sum of elasticity's	1.847
Diagnostic statistics	
Gamma (γ)	0.049 (17.1804)***
Sigma-square (σ^2)	0.017 (5.7940)***
Log likelihood function	59.963

Source: Field survey, 2023

Individual Farm Technical Efficiency Levels of Dry Season Crop Farmers in Gombe State, Nigeria

The results presented in Table 3, indicate a technical efficiency range from 0.44 to 0.96. The mean estimate was 0.78. The efficiency distribution had shown that about 86.35 percent of the dry season crop farmers attained efficiency level between 0.60 and 1.00. This high level of efficiency is an indication that only small fraction of the output can be attributed to wastage. The result further revealed that there are allowances for the farmers to improve their efficiency by about 22 percent. This corroborate the finding of Joseph, 2018, which revealed the allowance of small scale maize-based farmers to increase efficiency by 36 percent.

Table 3: Technical Efficiency Levels of Dry Season Crop Farmers

Efficiency level	Frequency	Percentage
0.40-0.49	4	1.19
0.50-0.59	42	12.46
0.60-0.69	47	13.95
0.70-0.79	58	17.21
0.80-0.89	140	41.54
0.90-1.00	46	13.65
Mean	0.78	
Minimum	0.44	
Maximum	0.96	

Source: Derived from output of computer programme frontier 4.1

Determinants of Technical Efficiency of Dry Season Crop Farmers

The maximum likelihood Estimates (MLEs) of determinants of technical efficiency of dry season crop farmers in the study area is presented in Table 4.

Table 4: Maximum Likelihood Estimates of Determinants of Technical Efficiency of Dry Season Crop Farmers in Gombe State

Variables	Coefficient	t-ratio
Gender	0.61	1.23
Age	-0.114	1.85
Education	0.66	2.67**
Farming experience	0.58	2.33**
Household size	-0.11	1.82
Extension contact	0.12	1.06
Membership association	2.03	2.97**

** Significant at 1%

Source: Output of frontier 4.1

The results indicates that the coefficient of gender, years of schooling (education), farming experience, extension contact, and membership association have positive signs. However, only education and farming experience were significant. Maurice (2013) in his work on technical efficiency of food crops however revealed education, gender and age were positive but not significant. This implies that, dry season crop farmer's efficiency will increase with increase in the years of schooling, farming experience and membership of association. The coefficient of age and household size had negative signs and were also not significant. Education enhances the ability of farmers to acquire and utilize information on improved technology more easily. On the other hand, farming experience exposes the farmer to the understanding of when and how to plant crops to achieve the desired goal. Membership of farming affords the farmers the opportunity of sharing information on modern irrigation technique by interacting with other farmers. On the other hand, coefficient of gender and extension contact had the expected positive sign but was not significant this agrees with finding of (Tahir *et al.*, 2019). This means that differences in gender and access to extension contact was not enough to significantly cause a farmer to attain high levels of efficiency without rearranging his inputs to obtain higher output level with a given technology.

CONCLUSION

This study has revealed that small-scale dry season farmers are not fully technically efficient and therefore there is allowance for efficiency improvement by addressing some important policy variables that could negatively or positively influence farmers' level of technical efficiency in the area.

Policy Implications and Recommendations: It was shown that education (years of schooling) had a positive correlation with technical efficiency; therefore, farmers should be encouraged to improve their levels of education by registering in adult education centers in the area. Farmers

experience was also positively related to technical efficiency, implying that farmers are encouraged to stay on the farm to be able to gain experience of farming activities as well as forecast the weather for better timing.

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