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Assessment of maize (*Zea mays* L.) farmers' productivity in Hong Local Government Area of Adamawa State, Nigeria

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ABSTRACT: The study assessed the productivity of maize farmers in Hong Local Government Area of Adamawa State, Nigeria. A multi-stage sampling procedure was employed to select 216 maize farmers. Data were generated using a structured questionnaire, while analysis of farmers' productivity was based on production in 2021. Analyses were carried out using descriptive statistics, the total factor productivity model and multiple regression analysis. The distribution of the total factor productivity (TFP) reveals that 42.13% of the respondents had TFP <1, 38.89% had TFP of 1.01-2.00, (10.65%) and (8.33%) had TFP>2 and TFP=1 respectively. Respondents' education of farmers (p>1), farming experience (p>1), labour (p>5) and fertilisers (p>10) were key determinants of productivity among maize farmers in the study area. The study, therefore, recommends the need to train farmers adequately on new and improved farm practices; this will boost their experience in maize production. There is a need for the provision of power machines and other farm implements by the government to reduce dependence on manual labour so as to improve productivity.

Keywords: Assessment, determinants, maize farmers, resource utilisation, total factor productivity.

INTRODUCTION

For most developing countries, enhancing productivity through efficient utilisation of resources is not an option; rather, it is a must and top priority in their production considerations. Productivity can be boosted by using two methods. The first method is through increased use of inputs and/or improvement in technology, given the same level of input (Belete, 2020), and the other option is by enhancing the efficiency of producers or firms, given a fixed level of inputs and technology (Wassie, 2014). Population growth in many developing countries continues to widen the gap between food production and demand, necessitating major improvements in input use efficiency and productivity of agricultural products (Tasila-konja *et al*., 2019).

The relationship between world population growth and agricultural growth was first postulated by the pessimist economist Thomas Malthus in 1803. He pointed out that an exponential increase in population cannot be sustained in the long run since land is fixed in supply while soil nutrients and managements varied. Considering this, there is a growing concern about the ability of some nations, especially in sub-Saharan Africa, to produce enough food to be self-sufficient. Though countries that have undertaken initiatives to expand producers' access to agricultural technologies such as improved seeds, fertilisers, and other agrochemicals have been the most effective at increasing agricultural productivity, Africa Continental Free Trade Area (ACFTA, 2021).

Resources are considered to be optimally utilised when put into use with the highest comparative advantage to

other uses. According to Ettah *et al.* (2018), scarce resources should be allocated to the production of crops with high yield potentials to attain the optimum production level. Maize, being one of the most versatile emerging crops have wider adaptability under varied agro-climatic conditions and is also known as the queen of cereals because of its higher yield potential among other cereals (IITA, 2019). This crop has thus achieved a prominent status in Nigeria's food system and established itself as a crop well integrated into the national economy and local diets, notwithstanding the presence of enormous diversity in test, traditions, aesthetic choices, and agro-climatic zones (Ananthi *et al.,* 2017).

Nigeria has approximately 36.9 million hectares dedicated to agricultural crop production in 2021 (FAO, 2023), with maize cropping dominating due to its wider adaptability to various agroclimatic conditions (Yakubu, 2016; FAO, 2023). Despite its prolific potential and availability of arable lands, the production increases have not kept pace with population growth, resulting in rising food imports and declining levels of national food self-sufficiency. As such, it was also reported by Ummi (2021) that the average maize productivity in Nigeria stood at 1.8MT/Ha which is one of the lowest among the top 10 producers in Africa lagging behind countries such as Egypt and South Africa, where their average productivity was recorded at 7.7MT/Ha and 5.3MT/Ha respectively, making it difficult to totally meet the domestic and industrial maize demand. Yakubu (2016) further assert that the productivity of certain crops within the same location may differ from time to time, but can be replenished through the use of organic matter to update the soil nutrients.

For sustainable maize production, the thought of whether a relationship exists between inputs and maize productivity is an empirical question that can be settled through research findings. Is production input efficiently utilised across heterogeneous farms? Are there factors responsible for the productive state? As such, this created an information gap that the study attempted to explore. The study sought to evaluate maize (*Zea mays* L.) productivity in Hong Local Government Area of Adamawa State, Nigeria, with specific objectives as to;

1. describe the socio-economic characteristics of maize farmers.
2. assess the level of productivity of maize farmers.
3. examine the determinants of farmers' productivity.

METHODOLOGY

Hong Local Government Area of Adamawa State is located along latitude 7º and 11º13'54"N and longitude 11º and 14º55'49"E of the Greenwich Meridian (Adebayo *et al*. 2020). The Local Government Area is bounded by Mubi Local Government Area to the East, Gombi Local Government Area to the West, Song and Maiha Local Government Areas to the South and Askira Uba Local Government Area to the North. It has seven (7) districts, which are: Hong, Dugwaba, Pella, Kullinyi, Hildi, Gaya and Uba, with a projected population of about 228,400 using 3.2% annual increase rate (National Population Commission, NPC, 2006), having a total land area of about 117,240 square kilometres. The area falls within the Sudan Savanna zone and has a tropical wet and dry climate. The area has an agro-based economy with numerous agricultural potentials (Adebayo *et al*. 2020). The major occupations of the people in the area are farming, trading, civil servants and transporters. The major crops grown include maize, groundnut, sorghum, rice, cowpea and millet (Gandapa, 2018).

A multistage sampling procedure was adopted for the study. Initially, four (4) out of the seven (7) districts were randomly selected. In addition, 12 villages were purposively selected from the four (4) districts, on the basis of a high concentration of maize producers (Table 1). Furthermore, random selection of producers from each village was carried out. In conclusion, from a sample frame of 493 registered maize farmers obtained from the Northeast Commodity Association (NECAS), the sample size (216) and proportion of maize producers were determined using Yamane (1967) and Cochran (1977), respectively. Yamane's (1967) formula for a finite population is expressed as:

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

Where: n = sample size, N= the finite population of maize farmers, 1= constant, e = margin of error (5%).

Cochran's (1977) formula of the proportional allocation technique was also expressed as:

$$M = \frac{h \times n}{N} \quad (2)$$

Where: M = Proportion of sample in each of the villages, h = population of each village sampled, n = sample size used for the study, N = total number of maize farmers in the sampled districts.

Descriptive statistics were used to describe the socio-economic characteristics of maize producers (objective i), total factor productivity model was used to assess the level of Maize farmers' productivity in the study area (objective ii). This measure allows farmers who run different types of operations to assess their productivity and evaluate the effect of different productivity drivers, which are stated as:

$$\text{Total Factor Productivity} = \frac{Value\ of\ total\ output}{Value\ of\ total\ input} \quad (3)$$

Multiple regression techniques were used to examine the determinants of farmers' productivity (objective iii). The model is implicitly specified as;

$$Y = f(X_1, X_2, X_3, X_4 \ldots\ldots\ldots\ldots\ldots X_6), e \quad (4)$$

Table 1. Sample frame, size and proportion of maize producers

Sampled Districts	Sampled Villages	Number of Registered Maize Farmers (N=493)	Proportion of Sampled Farmers
	Ndzakwa	35	16
Hildi	Kwarhi	48	22
	Jablamba	27	12
Sub-Total	3	110	50
	Sikalmi	55	24
Gaya	Gartsanu	42	19
	Fa'a	33	15
	Kuva	64	28
Sub-Total	4	194	86
	Pella	44	20
Pella	Zhedinyi	37	17
	Dakza	21	09
Sub-Total	3	102	46
Kulinyi	Kala'a	41	18
	Kwambla	46	21
Sub-total	2	87	39
Total	12	493	221

Source: NECAS, 2021.

Where: Y = (Farmers Productivity = output in kg), X_1 = Education (years spent in school), X_2 = Farming experience (in years), X_3 = Farm size (hectares), X_4 = labour in man days (family labour = 0, if otherwise 1), X_5 = agro chemicals (kg), X_6 = fertilizer (kg), e = Error term

Four functional forms of the model were tried (Linear, semi-log, double-log, and exponential forms). The double log function form was selected based on the statistical, economic and econometric criteria, which include the number of significant variables, the magnitude of the t-ratio, R-squared estimates and the standard error, as well as consistency with *apriori* expectations.

RESULTS AND DISCUSSION

Socio-economic characteristics of maize farmers

The age distribution in Table 2 shows that 58.80% of the respondents were between the age bracket of 21–40 years, which implies that the majority of maize farmers in the study area were young and energetic, since they are in their active ages. Thus, the labour productivity of maize farmers in the study area is expected to be high. This confirmed the position of Ukaoha *et al.* (2022) that age is one of the socio-economic attributes that affects the level of farmers' productivity. Sex distribution of the respondents indicates that 77.31% of the respondents were male. This shows that the majority of the farmers in the study area were male, and this could be attributed to the tedious work involved in maize production, mostly endured by males who are believed to be more virile and energetic than their female counterparts. The result also indicates that 86.11% of the respondents attended formal schools, implying that maize farmers in the study area are literates who can read and write, capable of managing farm resources to achieve high productivity. This is in line with the findings of Ibitola *et al.* (2019), who reported that the majority of maize farmers in Oyo State, Nigeria, had formal education and hence, will possibly be innovative, increasing farm productivity through efficient use of resources. The result of farming experience indicates that 93.52% of the respondents had over 10years of experience in maize production. This implies that the majority of the farmers have been into maize farming for a long and these accumulated years of experience could help them in identifying farming practices that can give maximum output with less cost.

The result of the farm size in Table 2 shows that 64.81% of the farmers cultivated 0.5-2.0ha of farmland. This implies that maize farmers in the study area are small-scale farmers with a mean farm size of 1.89ha, which is expected to be more efficient in the allocation of resources and management. This finding agrees with that of Ebukiba *et al*. (2020), who reported that the majority of maize farmers in Abuja were small-scale farmers cultivating 2.0 ha or less, but efficient in terms of resources used

Table 2. Socio-economic characteristics of maize farmers.

Socio-economic characteristics	Frequency	Percentage
Age (years)		
21-40	127	58.80
41-60	82	37.96
61and above	7	3.24
Mean = 35.89		
Sex		
Male	167	77.31
Female	49	22.69
Level of Education		
No-Formal Education	30	13.89
Primary School	86	39.81
Secondary School	84	38.90
NCE/ND	12	5.55
B.SC./HND	4	1.85
Experience (Years)		
5 – 10	14	6.48
11- 15	109	50.46
16 -20	76	35.19
21- 25	17	7.87
Mean = 14.49years		
Farm Size (ha)		
0.5 – 2.0	118	64.81
2.1 – 4.0	74	24.08
4.1 – 6.0	24	11.11
Mean = 1.89(ha)		
Sources of Farmland		
Inheritance	159	73.60
Hired	57	26.40
Household Size		
1 – 10	157	72.69
11 – 20	53	24.54
21 – 25	6	2.77
Mean = 8persons		
Access to Credit		
Yes	74	34.26
No	142	65.74
Access to Extension Services		
Yes	6	2.78
No	210	97.22

Source: Field Survey, 2021.

compared to Medium and large-scale farms. Result on source of land shows that 73.60% inherited their farm land. This implies that the majority of farmers in the study area do not hire land. This is in line with the findings of Urbanus (2022), who reported inheritance as the major source of farmland for agricultural production in Song Local

Table 3. Summary of expenditure and income of maize production in the study area.

Parameters	Frequency (n=216)	Percentage (%)
Expenditure (₦)		
≤ 200,000	43	19.91
200,001 – 300,000	119	55.09
300,001 – 400,000	35	16.20
≥ 400,000	19	8.80
Mean = ₦255,350.50.		
Income (₦)		
≤ 200,000	109	50.46
200,001 – 400,000	62	28.70
400,001 – 600,000	25	11.57
≥ 600,000	20	9.26
Mean = ₦378,550.00.		

Source: Field Survey, 2021.

Government Area of Adamawa State, Nigeria. The results also reveal a mean household size of 8 persons. Farmers with large household sizes could pool their energy and resources for the supply of farm labour to reduce the cost of labour incurred. This agrees with the findings of Yusuf (2022) that most Africans farmers with larger households incur less production cost compared to those with smaller households. The result further shows that most (65.74%) did not have access to farm credit. It can be inferred by saying that farmers in the study area do not enjoy financial support from financial institutions. However, the majority (97.22%) of the farmers did not have access to extension agents, which could be attributed to the low ratio of extension agents to farmers in the study area. This agrees with the findings of Jonah *et al.* (2020), who reported inadequate extension service among crop farmers, which has a negative effect on productivity and production efficiency in Yobe State.

Expenditure and income of maize farmers

Income and expenditure in the production season were used for measuring total factor productivity among farmers in the study area. Table 3 shows that the majority (55.09%) of the farmers spent between ₦200,001 and ₦300,000 in the production season, 19.91% spends ≤ ₦200,000 follow by 16.20% of the respondents who spent between ₦300,001 and ₦400,000, while 8.80% spends ≥ ₦400,000. The average expenditure spent by these farmers was approximately ₦255,350.50. From the above, it is obvious that producers spend less on the production of maize, which is one of the characteristics of subsistence farming. This confirms the findings of Yakubu (2016), who reported that the majority of maize farmers in Doguwa Local Government Area of Kano State, Nigeria, were subsistence farmers.

Table 3 further revealed that the majority (50.46%) of the respondents realized an income of ≤ ₦200,000 in the production season, 28.70% realized between ₦200,001 and ₦400,000 follow by 11.57% of the farmers who realized between ₦400,001 and ₦600,000 while 9.26% of the respondents realized an income of ≥ 600,000 with an average income ₦₦378,550.00. This indicates that despite low investment, the producers still make a profit, judging from the differences between total cost (TC) and total return (TR). This agrees with the findings of Urbanus (2022), who reported that the majority of maize farmers in Song Local Government of Adamawa State, Nigeria, make a substantial profit in maize production.

Level of maize farmers' productivity in the study area

The total factor productivity (TFP) of the respondents in Table 4 shows a range of 0.89 – 4.21 TFP among maize farmers in the study area. The latter value shows that the farmer has an extra 3.21 unit of output, which could be a result of an excellent combination or efficient use of inputs available, such as improved seed, fertiliser, agrochemicals and extension services. The table further reveals that (42.13%) of the respondents had a low level of productivity, which indicates that one unit of input used results in less than one unit of output produced. Exactly (8.33%) were on break-even productivity, that is, they were neither losing nor gaining. In addition (38.89%) made gains, having more than 0.01 extra units of output, while (10.65%) had more than 2 units of extra units of output. The implication of the group that has more than 0.01 is that they have extra output, which can help in expanding their production capacity, thereby increasing their income and also allowing them to save for the future. This aligns with the findings of Ibitola *et al.* (2019), who reported that the majority of maize farmers in Oyo State, Nigeria, operate

Table 4. Level of maize farmers' productivity in the study area.

Total Factor Productivity	Frequency	Percentage (%)
TFP< 1.00	91	42.13
TFP= 1.00	18	8.33
TFP=1.01 -2.00	84	38.89
TFP>2	23	10.65
Total	216	100

Source: Field Survey, 2021.

Table 5. Total factor productivity distribution based on sex in the study area.

Sex	TFP< 1.00	TFP=1.00	TFP=1.01-2.00	TFP>2	Frequency
Male	59	5	80	23	167
Female	32	13	4	0	49
Total	91	18	84	23	126

Source: Field Survey, 2021.

Table 6. Total factor productivity distribution based on age in the study area.

Age	TFP< 1.00	TFP=1.00	TFP=1.01-2.00	TFP>2	Frequency
21-40	21	6	79	21	127
41-60	66	10	4	2	82
61 and above	4	2	1	0	7
Total	91	18	84	23	216

Source: Field Survey, 2021.

on ≤ break-even productivity level.

Total factor productivity distribution based on sex

Total factor productivity distribution based on sex, as presented in Table 5, compares the gender that has a high level of productivity with that of a low level of productivity among maize farmers. The findings revealed that male farmers had higher productivity at all levels (TFP<1, TFP=1, TFP= 1.01-2.00 and TFP=>2) as compared to their counterparts. This agrees with the opinion of Ettah and Kuye (2017), who opined that men tend to endure every facet of farm operation and provide more energy required for farm activities than women, which in turn increases labour productivity and reduces the cost of non-family labour.

Total factor productivity distribution based on age

Result on Table 6 shows the distribution of TFP based on age. The result revealed that farmers between the age brackets of 21-40 are on the higher side in terms of an extra unit of output produced, implying a higher level of productivity. This could be because they were within their active age; young, strong and energetic to withstand strenuous farm activities like land clearing, sowing and weeding. More so, maize is considered an alien crop in the study area that require high financial commitment compared to traditional sorghum. As such, younger age dominated the sector due to their innovative minds and risk-taking. Farmers with an age bracket of 41-60 had either a lower unit of output produced or a breakeven point of output produced, implying low and middle-level productivity, respectively. This may be due to their advanced age, where they have little or no energy for strenuous farm activities. More so, farmers above 60 years of age have a lower unit of output relative to a given level of input used, implying a lower level of productivity. This agrees with the findings of Yakubu (2016), who reported that the level of productivity among maize producers in Doguwa Local Government Area of Kano State, Nigeria, decreases as the farmer advances in age.

Determinants of farmers' productivity

The result in Table 7 shows that the R-square value was estimated at 0.7760, which implies that 77.6% of the variation in productivity level among farmers was

Table 7. Factors determining farmers' productivity in the study area.

Variables	Coefficients	Standard Error	t-Value
Constant	2.163687	0.5526701	3.91***
Education	3024772	0.1020076	2.97***
Farming experience	0.2934518	0.1177579	2.49*
Farm size	0.0659334	0.0902497	0.73
Labour	0.1271363	0.0395525	3.21**
Agrochemicals	0.1043592	0.0963663	1.08
Fertilizer	0.5273345	0.0679302	3.91***
F value	30.99***		
R-squared	0.7760		
Adjusted R-squared	0.7581		

Source: Data analysis, 2021. *, **, *** = Significant at 10%, 5% and 1% respectively.

explained by the independent variables included in the model, while the remaining 22.4% was accounted for by error. The F-statistic was also significant at 1% level, which means that the model was adequately fit for use in the analysis.

Results further show that education, farming experience, labour and fertiliser were the factors influencing farmers' productivity among maize farmers in the study area. Education, fertiliser, labour and farming experience were significance at 1%, 1%, 5%, 10% respectively, with all carrying a positive sign, which implies a positive relationship between maize output and each of them. The result tallies with the findings of Ibitola *et al.* (2019), who reported the existence of a positive and significant relationship between labour, farming experience and education to farm productivity among maize producers in Oyo State, Nigeria.

Conclusion and Recommendation

The study concludes that the education of farmers, farming experience, labour and fertiliser, determined the productivity among maize farmers in the study area. Therefore, it was recommended that training farmers on new and improved farm practices would boost their experiences and improve productivity in maize production.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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