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FACTORS INFLUENCING FARMER PARTICIPATION IN MAIZE PRODUCTION IN KADUNA SATE, NIGERIA

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ABSTRACT

Maize production in Kaduna State is the result of the decision of many farmers working under different environments with different motivations. Several policy instruments and other factors affect their decision to produce this crop. Using the double hurdle model and data from 600 farmers, this study analysed the factors influencing farmers' participation and intensity of participation in maize production. Results showed that 66.33% are into maize production as their main source of livelihood and 52% are seasonal farmers with an average farm size of about 2.08ha. The decision to produce maize is significantly determined by quantity of seeds, farm size, labour and amount of credit ($P<0.01$), and fertilizer ($P<0.05$). In terms of factors that affect the intensity of maize production seeds, farm size, years of farming experience ($P<0.01$) and amount of credit (proxy for access to credit) ($P<0.10$) were found to be statistically significant. Based on these findings it is clear that maize production remains a source of livelihood to majority of farmers where its production is predominantly rainfed. Both institutional and non-institutional factors of production affect farmers' decision to produce maize as well as the intensity or quantity he or she will produce. Therefore, to achieve double base maize production and an incentive for farmers to produce maize, policy makers must pay attention to timely and availability of these factors of production (seeds, fertilizer and credit). Private-public partnership by organizations dealing with agricultural inputs, developmental agencies as well as farmer-based associations, cooperatives, and societies can improve the intensity of maize production through contract farming and produce buying centres.

Keywords: Maize; Participation; Intensity; Decision

INTRODUCTION

The focus on maize farmers derives from the reality that maize is one of the important cereal crops in Kaduna State and Nigeria as a whole. Equally on the basis of the number of farmers who engage in its cultivation, as well as its economic value. The essential role of maize production can further be seen in the heavy reliance on maize as source of raw material for food and feed. In Nigeria, maize was introduced in the 16th century, it was the most

frequently produced and most frequently consumed staple food (Cadoni and Angelucci, 2013). The country is the 10th largest producer of maize in the world, and the largest producer in Africa (USAID, 2014 and IITA, 2022). However, the Global Agricultural Information Network (GAIN) report from the United States Department of Agriculture (USDA) indicated that Nigeria is expected to see a decrease in grain supplies because of persistent on-going conflict and other economic factors made worse by the secondary effects of COVID-19 (World Grain, 2021). Contrarywise, the report of the National Agricultural Extension and Research Liaison Services (NAERLS) and Federal Ministry of Agriculture and Rural Development (FMARD) projected that maize output in 2021 was expected to increase by 2.75% in spite of insecurity in the Nigerian Maize Belt (NAERLS and FMARD, 2021). Increase in maize production in Nigeria has been achieved greatly by expansion in both areas harvested and yield (FAOSTAT, 2018). Notably, in 2018 alone, about 10.2 million tons of maize was produced from 4.8 million hectares, taking over acreages from traditional crops such as millet and sorghum (FAOSTAT, 2018). However, the average yield of maize in Nigeria is 1.69 tons/hectare, which is very low compared to average 9.3 tons/hectare yield in United States (IITA, 2020).

The National Agricultural Imagery Programme (NAIP, 2010 in Cadoni and Angelucci, 2013 and FAO, 2022) pointed out that 70% of maize farmers are poor resource with an average of 5ha area of cultivated land accounting for 90% of total farm output. This is because maize has the ability to thrive under different ecological conditions, hence the widespread in its production across different parts of the country (Girei *et al.*, 2018). According to Edache (1999) in Olarinde (2011) the first major effort to promote maize production in Nigeria was in 1974, when the federal government launched the National Accelerated Food Production Programme (NAFPP), during which it introduced fertilizer use to farmers through the three phases of the program: mini-kit, production-kit and mass adoption. With the inception of the structural adjustment programme (SAP) in July 1986, the NAFPP was transformed to national accelerated industrial crop production programme (NAICPP) between 1989 and 1993 to stimulate industrial uptake of maize by the flour and feed mills and breweries and food and beverage sectors of the economy there by expanding maize production.

Further, from 2005 to 2006 a judicious initiative to Double Production of Maize (PIDOM) was implemented to enhance farmers access to improved seeds and to demonstrate novel maize production technologies (DT MAIZE in DTMA, 2014). Maize was part of President Umaru Musa 'Yar'adua's 7-point agenda on agricultural development and food security in 2007 (Gadzama, 2013). This has led to several research institutes in the nation like International Institute of Tropical Agriculture in collaboration with Institute of Agricultural Research and Training, National Rice/Maize Centre, National Accelerated Food Production Program, Institute for Agricultural Research, National Cereals Research Institute, National Agricultural Extension and Research Liaison Services came up with the initiative of doubling maize production (Gadzama, 2013). In 2012 the government of Nigeria initiated and implemented the growth enhancement support scheme (GES) aimed at improving the performance of maize value chains and other crops.

Recent agricultural programs in the country include Anchor Borrowers Programme (ABP, 2015), established by the Central Bank of Nigeria (CBN). It was intended to create a linkage between anchor companies involved in processing and small holder farmers (SHFs) of the required key agricultural commodities. The ABP provides farm inputs in kind and cash (for farm labour) to small holder farmers to boost production of these commodities.

Presidential Fertilizer Initiative (PFI) was introduced in 2016, it was the outcome of a partnership between the Governments of Nigeria and Morocco and implemented as a Public-Private Partnership in Nigeria. In 2017, the Presidential Economic Diversification Initiative (PEDI) supports the revival of moribund industries (especially in Agro-processing) by facilitating new investments, reducing regulatory bottlenecks and enabling access to credit. In 2018 the Food Security Council was established. The broad objectives of the Council included developing sustainable solutions to the farmers-herdsmen clashes; Climate Change and Desertification and their impact on farmland; grazing areas and lakes, rivers and other water bodies; oil spillage and its impact on Niger Delta Fishing Communities; piracy and banditry; agricultural research institutions and extension services and the problem of smuggling. The Council was also to take interest in regional and global policies and trends that bear implications for food security in Nigeria (Toromade, 2018).

The essential role of maize production can further be seen in the heavy reliance on maize as a source of raw material and diet in Nigeria (Grote, 2021). Maize production is thus the result of the decisions of many farmers working under different environments with different motivations. Therefore, a sound policy designed to obtain a desired level and composition of production and supply rests on a thorough understanding of how farmers decide what and how much to produce; what policy instruments and other factors affect their decisions to produce a particular commodity (maize), and how the decision to produce maize commodity affects the production level of other commodities. The focus of this study is therefore on production decisions and the intensity of production, where production decision depends on both fixed and variable inputs, while the quantity produced, conditional on production decision depends institutional and requisite factors of production. This study will attempt to analyse factors influencing farmer participation and intensity of participation in maize production in Kaduna State.

METHODOLOGY

Study Area and Sampling Procedure

The study was carried out in Kaduna State which lies between latitudes 9º to 11º N and longitudes 6º E to 8º E. The average annual rainfall and humidity are 1,272.5 mm and 56.64%, respectively, while the average daily minimum and maximum temperatures are 15.1ºC and 35.18ºC. The mean annual rainfall shows a marked decrease from South to North (1,524 mm to 635 mm). The State has 23 local government councils, with a population of about 6,113,503 (National Population Commission, (NPC), 2006), and it was estimated to increase to about 9,798,258 in 2021 based on the National Population Commission (NPC) annual growth rate of 3.18%. Primary data were collected through the administration of interview schedule using Computer Assisted Personal Interview (CAPI) to sampled maize farmers in Kaduna State. The State is divided by the Kaduna State Agricultural Development Programme (KADP) into four agricultural zones. Eight (8) Local Government Areas (LGAs), 2 from each agricultural zones of the State were selected. Based on the number of farmers in the LGA using Kaduna State Agricultural Development Project (KADP) village listings, 2016. The respondents were selected using proportionate stratified sampling from the registered maize farmers' cooperative society in each of the LGAs. Soba (730) Giwa (740) from (Maigana zone), Birnin-Gwari (650) and Chikun (940) from (Birnin-Gwari zone), Lere (1,090) and Igabi (860) from (Lere zone), Jaba (390) and Kagarko (600) from (Samaru Kataf

zone). It is sufficient to note that 10% of the sample frame from each cooperative was randomly selected. This gave a total of 600 respondents.

Analytical Technique

Model Estimation

The theory of utility assumes that individuals/farmers are rational, and they maximize utility in their decisions; utility includes every element of a decision made by a farmer. Farm households are assumed to maximize utility with respect to consumption, production, input use, sales and purchases of good. Thus, households produce agricultural products using labour, capital, other variable inputs and land. Consequently, maize production decision was treated as a choice variable, where a farmer's problem in this case is to maximize utility subject to certain constraints; equation (1) corresponds to the production function that relates all inputs and outputs, while equation (2) gives the resource balance equation.

$L(Q, p^q) = 0.$ . . . (1)
$Q_i - V_i + D_i - C_i + d_i - S_i \geq 0.$ . . . (2)
Q_i = production, V_i =variable input use, D_i = capital endowment, L = output, p^q = production characteristics and Q = labour.

Therefore, rural farm households are faced with a two-stage decision problem (Heltberg and Tarp, 2001; Key *et al*., 2000). In the first stage: the decision is whether to produce maize or not, the second is how much to produce. The decision on whether to produce maize or not is a logit model for maize production decision given as Hurdle 1

$Y_i^* = \sum \gamma_{1i} X_{1i} + \varepsilon_{1i}.$ . . . (3)
$\varepsilon_{1i} \sim N(0, \sigma_1^2)$
$Y_i = \begin{cases} 1 \; if \; Y_i^* > 0 \\ 0 \; if \; Y_i^* \leq 0 \end{cases}$

And $Y_i = \frac{\text{total maize output}}{\text{total land size}}$ (decision rule: $Y_i^* = 1$ if $Y_i > 75\%$ and $Y_i^* = 0$ if $Y_i \leq 75\%$)

Explicitly stated as

$$Y_i^* = \gamma_1 X_1 + \gamma_2 X_2 + \gamma_3 X_3 + \gamma_4 X_4 + \gamma_5 X_5 + \gamma_6 X_6 + \gamma_7 X_7 + \varepsilon_{1i}. \quad . \quad . \quad (4)$$

Where $Y_i^* = \text{Latent unobserved variable of } Y_i$
Y_i = (Y=1, if farmer produce maize and Y=0, otherwise), X_1=Quantity of seeds (kg), X_2=Farm size (ha), X_3=Total labour (man hours), X_4=Quantity of pesticides (L), X_5=Quantity of fertilizer (kg), X_6=Access to credit (₦), X_7=Age of the farmer (years), $\gamma_1 - \gamma_7$ =Parameters to be estimated, ε_i=error term.
The Tobit model for intensity of production is given as: Hurdle 11
$D_i^* = \beta_2 X_2 + \varepsilon_{2i}..$ . . . . (5)
$\varepsilon_{2i} \sim N(0, \sigma_2^2)$

$$D_i = \begin{cases} 1 \; if \; D_i^* > 0 \; and \; Y_i = 1 \\ 0 \; if \; D_i^* \leq 0 \end{cases}$$

And $D_i =$ Observed quantity of maize produced (household production level HPL)

Explicitly stated as

$$D_i^* = \beta_{21}X_{21} + \beta_{22}X_{22} + \beta_{23}X_{23} + \beta_{24}X_{24} + \beta_{25}X_{25} + \beta_{26}X_{26} + \beta_{27}X_{27} + \beta_{28}X_{28} + \beta_{29}X_{29} + \beta_{210}X_{210} + \beta_{211}X_{211} + \varepsilon_{2i}. \quad . \quad . \quad . (6)$$

Where D_i=Observed household production level (HPL_{maize} kg), X_{21}=Quantity of seeds (kg), X_{22}=Farm size (ha), X_{23}=Total labour (man hours), X_{24}=Quantity of pesticides (L), X_{25}=Quantity of fertilizer (kg), X_{26}= Age of the farmer (years), X_{27}=Maize farming experience, X_{28}=Amount of credit accessed (₦), X_{29}=Nonfarm income (₦), X_{210}=Household size (number of persons), X_{211}=Sex (1=male, 2=female) $\beta_{21} - \beta_{211}$ =Parameters to be estimated, ε_{2i}=error term.

RESULTS AND DISCUSSION

Characteristics of the Maize Producers

In the midst of the 600 farmers sampled, 419 produced maize representing about 70% of the total sample. While 181 did not produce maize amounting to about 30% of the sampled respondents. This is an indication that production of maize is very intensive in the sampled areas of the state. In Table 1, the outcome demonstrated that majority of the farmers (66.33%) are into maize production as their main source of on farm livelihood with an average farm size of about 2.08ha. That is, they produce maize to consume and sell part of the produce. Only 13.67% of the respondents produce maize for business purpose. They have a mean farm size of 2.88ha, while about 18.67% of the respondents possessing a mean farm size of 0.91ha produce for subsistence consumption only without any surplus for the market. The World Bank (2021) indicated that in Nigeria, 70 to 80% of smallholder farmers produce only or mainly for their own consumption at the beginning of the agricultural season. Only 1.33% of the respondents are into maize farming because they inherited it from their parents, they own an average of 1.2ha of farm size.

Table 1: Motive for maize production decision

Motive	Frequency	Mean farm size	Percentage
Consumption only	112	0.91	18.67
Source of livelihood	398	2.08	66.33
Profit only	82	2.00	13.67
Inherited	8	1.20	1.33
Total	600		100

Majority of the respondents (52%) were seasonal farmers that is, they produce maize during the rainy season only (Table 2). This signals the rainfed nature of the agricultural system of Nigeria. Only around 21% of the respondents had interest in irrigated farming. While others were involved in other artisanal work and civil service (24.8% and 2.2%, respectively) during and after the production season.

Table 2: Off-farm activities after maize production season

Activity	Frequency	Percentage
Dry season farming	127	21.17
Artisanal work	149	24.83
Civil service	13	2.17
Rainfed only	311	51.83
Total	600	100

Factors Influencing Farmers Participation in Maize Production

Various conditions for the production of agricultural commodities influence farmers' decision to produce a particular crop. These conditions regard to both social and economic factors of production which vary among all farmers, hence affect their production decision and its intensity. The results of the determinants of the probability that a farmer produces maize (hurdle 1) is presented in Table 3. The results revealed a good fit for the data as reflected by statistical significance of the chi-square at 1% level of probability, therefore, the model specified explained significant non-zero variations in factors influencing maize production decision. An indication that at least one of the explanatory variables included in the model jointly explain the probability of maize production decision and intensity of production.

Quantity of seed had a regression coefficient of 0.0063 and is positively related with the probability that a farmer produces maize ($P<0.01$). This shows that relatively, timely availability of seeds significantly influences farmers' decision on whether to produce maize or not by 0.0063. That is increase in seed quantity supply especially new and improved technologies is associated with the probability that a farmer will produce maize *ceteris paribus*. The coefficient of farm size (-0.1703) though significant ($P<0.01$) was negatively related with the probability that a farmer produces maize. That is, a hectare increase in farm size decreases the probability that a farmer produces maize, keeping all other variables constant. Possible explanation for this is that maize production in Nigeria is characterised by mixed pattern of production system, traditionally intercropped with sorghum or beans. Therefore, the bigger the farm size the higher the tendency that a farmer diversify or intercrop maize with other crops. Since maize is regarded as a bench-mark for food security in terms of calorie intake as well as significant in-take by industries in Nigeria, the decision to produce maize irrespective of the size of the farm.

Additionally, the coefficient of labour (0.0080) was found to be positive and statistically different from zero ($P<0.01$) with the odds that a farmer produces maize. That is for every unit increase in the availability of labour: a farmer decides to produce maize marginally by 0.80% *ceteris paribus*. This is probably because maize is a labour-intensive crop and cheap availability of labour will influence a farmers' decision. Labour is a major input in subsistence farming and largely determines the amount of land a farmer cultivates each farming season. Labour shortage is most critical at the time of land preparation, especially ridging which takes place during the peak period of labour demand (Leonardo *et al.*, 2015). While labour is underemployed for the best part of the year, there exists labour shortage at the peak of the cropping seasons. In economic theory this has been termed as "rural labour shortage in the labour surplus economy". Separately, Sani and Oladimeji (2017) and Nwaiwu and Onyeneke (2021) reported the importance of labour in farming, particularly in developing countries where mechanization is rare.

Table 3: Estimates of determinants of maize production decision and intensity of production

Variables	Probability of maize production (hurdle 1)			Intensity of maize production (hurdle 2)		
	Reg. coeff.	SE	t-value	Reg. coeff.	SE	t-value
Dependent variable	Produce maize (yes/no)			HPL (kg)		
Constant	0.6624***	0.403963	2.88	0.9735	0.6422	1.52
Seeds (kg)	0.0063***	0.1209	5.48	0.00011***	0.0025	4.32
Farm size (ha)	-0.1703***	0.0013	4.72	-0.3452***	0.0547	-6.31
Labour (man-day)	0.0080***	0.0245	-6.95	0.0227	1.0041	1.61
Agrochem (L)	0.0084	0.0008	0.97	0.00053	0.0004	1.42
Fertilizer (kg)	0.0034**	0.0041	2.06	0.1400	1.0058	0.89
Age(years)	0.0035	0.0032	1.08	0.0084	0.0076	1.11
Farming exp. (years)	-0.0105	0.0031	1.13	-0.0217***	0.0072	-3.00
Amount of credit (₦)	0.3797***	0.0030	-3.45	-0.0050*	7.6807	-0.07
Household size(number)				0.0037	0.0109	0.34
Sex (dummy)				-0.0704	0.2972	-0.24
Non-farm income (₦)				2.61e-07	1.41e-07	1.85
Sigma cons				1105.523	39.124 69***	28.26
Wald chi2(13)	48.23					
Log-likelihood function	-4487.0952			-537.39		
Prob > chi2	0.0000					
Number of observations	600			600		

*** significant at 1%, ** significant at 5%, * significant at 10%

Fertilizer had a coefficient of 0.0034 with a significant P-value of 0.05. The positive and significant coefficient of fertilizer shows that a unit increase in the quantity of fertilizer available will lead to the possibility that a farmer decides to produce maize by 0.34%. In essence, the affordability and availability of fertilizer can affect a farmer's decision when it comes to maize production. When applied in combination with other modern inputs, chemical fertilizers can significantly increase yields, yet most farmers in Africa have not fully taken advantage of fertilizers to generate a marketable surplus and move out of subsistence agriculture and into the mainstream market economy (World Bank, 2014). The bank further indicted that although fertilizer application rates may be influenced by variations in soil and agro-ecological conditions, fertilizer use is very low across Nigeria and most of Sub-Saharan Africa. There is therefore an indication that better availability and improved fertilizer use can result in higher quantity of maize supplied. In a study conducted by Shehu *et al.* (2017), they found a significant positive relationship with increase in the quantity of fertilizer use and maize output and that fertilizer is a major determinant of the output in Bauchi State, Nigeria.

Access to credit ($P<0.01$) is positively related with the probability of maize production and had a coefficient value of 0.3797. This implies that for every unit increase in access to credit, there is a 37.97 likelihood that the farmer will produce maize, all other inputs being equal. Arnold *et al.* (2021) reported that farmers who had access to credit have significantly higher technical efficiencies than farmers who did not access credit in Ghana. While Poole (2017) indicated that access to credit provide the financial strength farmers need to engage in intensive farming leading to more marketable surpluses.

Factors Influencing Farmers Intensity of Maize Production

The coefficient of quantity of seeds (0.00011) has a positive relationship with the intensity of maize production at P<0.01 level of significance. In other words, a unit increase in quantity of seeds will increase maize output marginally by 0.011%. This means that conditional on the decision to produce maize, the intensity of maize production will increase by 0.00011 *ceteris paribus*. The result is in line with the view of Daniel *et al*. (2007) and Sani and Oladimeji (2017), they stated that seeds carry potentials for improved crop productivity and are often the only technological innovation available to most resource-poor farmers. However, the National Agricultural Seeds Council (NASC, 2018) stated that Nigeria has an estimated national demand of over 350,000 metric tons of certified seeds every year, but it produces less than quarter of that national demand. This has resulted in poor smallholder farmer access to quality seeds a situation which has made the country's average yield far below global standard. The World Bank report of 2014 (WB, 2014) suggested that for Nigeria to develop an efficient, demand-driven seed market, the variety of investors and stakeholders active along the supply chain will need to coordinate planning, marketing, production, and timely distribution, which is one of the purposes of the government's Agricultural Transformation Agenda.

Farm size (regression coefficient of -0.3452) was negatively associated with the intensity of maize production at 1% level of significance after the decision to produce maize has been made. A hectare increase for maize production will reduce the volume of maize produced by 34% all other conditions kept constant. This finding is not in line with *a priori* expectation. Although, theory postulates that a larger farm size gives greater opportunity for surplus production, given the existing technology of other factors of production, it might be uneconomical to steer productivity through increase in land area as this may cause the farmers to be less efficient. In a study conducted by Wickramasinghe *et al.* (2014) they reported a negative correlation between sales and rising land ownership among smallholders in Papua New Guinea. Additionally, land fragmentation is a common practice in Nigeria and has been noted to be a particularly critical problem among farm households (Obayelu *et al.*, 2021). They further indicated that holding many land plots is a sign that farm households are merely trying to survive under difficult conditions, which is a result of expected farm failures, poverty and food insecurity.

The parameter estimates for years of farming experience (-0.0217), unconditional on maize production decision is negatively associated with the intensity of maize production (P<0.01). The result means that one year increase in farming experience will cause a decrease in quantity of maize output produced by 2.17%. Although the result negates *a priori* expectation, possible explanation is that farmers with many years of farming experience might be more concerned with being food secure and are not willing to take higher risks and /or adopt new technologies of production. However, Tanko (2019) averred that, the years spent in rice farming by farmers reduces inefficiency in the use of resources and boosts rice production in Kwara State. Similarly, access to credit had a regression coefficient of -0.0050 conditional with the decision to produce maize though significant (P<0.10) was negatively associated with the intensity of maize production by 0.50%. This is probably due to difficulties in accessibility and availability of credit facilities. From the survey conducted it showed that majority of the farmers did not have access to credit, this might be the reason it has an inverse relationship with the intensity of maize production. In spite of this, literature

postulates that access to credit provides the financial strength for farmers to engage in intensive farming and get out of poverty Iliyasu *et al*. (2017).

CONCLUSION

Based on the findings of the study, it is clear that maize production remains a source of livelihood to majority of farmers where its production is predominantly rainfed. Several factors of production affects farmers' decision to produce maize as well as the intensity or quantity he or she will produce. The double hurdle estimation results revealed that farmers decision to produce maize is positively and significantly affected by seeds, labour, fertilizer and amount of credit accessed by the farmer. While the determinant that significantly and positively explains changes in the output of maize production in the study area was seed. Among variables found significant in affecting maize production decision and intensity of production, farm size has strong explanatory power over other variables. Therefore, to achieve double base maize production and an incentive for farmers to produce maize, policy makers must pay attention to timely and availability of these factors of production (seeds, fertilizer and credit). On the other hand, farm area expansion by farmers has to be coupled with the intensive use of agricultural technology and adoption of new technology. Private-public partnership by organizations dealing with agricultural inputs, developmental agencies as well as farmer-based associations, cooperatives, and societies can improve the intensity of maize production through contract farming and produce buying centres.

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