



Drivers and Pattern of Fertilizer Usage Among Cereal-Based Farmers in Kwara State, Nigeria

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Received: April 25, 2022

Published: May 18, 2022

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Abstract

This paper presents the result of a study initiated to examine the pattern and determinants of fertilizer usage by smallholder cereal-based farmers in Kwara State, Nigeria. A randomize sampling technique was employed to select representative of cereal-crop farmers for the study. A well-structured questionnaire was used to collect data from 200 cereal-crop farmers and data was analyzed using descriptive statistics and ordinary least square (OLS) regression. The result showed that the mean age of the cereal-crop farmers in the study area was 49.7 years. The result further showed that 91.5% of the cereal-crop farmers interviewed were men and mean household size was 6 persons per household. Majority (77.6%) claimed to be using inorganic fertilizer. The result shows that household size, access to credit, cost of fertilizer, distance to point of purchase and marital status were statistically significant at 10%, 1%, 1%, 1% and 10% respectively. This study concluded that the farmer' inability to meet up with the recommended fertilizer-use affected the yield response of the cereal-based farms. It is therefore recommended that a more sustainable fertilizer support programme be designed by the government for the farmers; the existing fertilizer programme should be strengthened towards crop-specific fertilizer use (inorganic or organic-based).

Keywords: Drivers; Pattern; Cereal-Based Farmers; Determinants; Fertilizer Usage

Introduction

There is ample evidence from experience outside Africa that increased use of inorganic fertilizers has been responsible for an important share of world-wide agricultural productivity growth. Some authors claimed that fertilizer was as important as seed in the Green Revolution [20], contributing as much as 50% of the yield growth in Asia [8]. Others have found that one-third of the cereal-crop production world-wide is due to the use of fertilizer and related factors of production [2], citing FAO). The growing contrast between the productivity role played by fertilizer in other regions of the world and the very limited use of fertilizer in

Sub-Saharan African (SSA) has stimulated a great deal of debate about what role of fertilizer should be in Sub-Saharan African, and what types of policies and programmes will be most likely to help SSA farmers realize the benefits of fertilizers or use the expected amount of fertilizer. Recognizing the complexity of the agricultural production process, the World Bank Africa Region Environmental, Rural and Social Development Unit has nevertheless decided to focus attention on a single input-fertilizer-because there remains significant debate about the underlying technical and economic evidence on fertilizer potential in SSA and the types of policies, investments, and institutional changes needed to realize that

potential. The underlying presumption is that SSA needs to increase fertilizer consumption if it is to meet both agricultural productivity growth and environmental (particularly soil and water conservation) objectives [16].

Large areas in Africa are increasingly becoming marginal for agriculture and arable land has become scarce [6]. This makes the need for intensification of land use through adoption of productivity enhancing technologies such as fertilizer crucial for achieving food security. Despite the growing evidence that fertilizers can substantially increase yields in sub-Saharan Africa (SSA) as well as slow down environmental degradation, farmers in this region still lag far behind other developing countries in fertilizer use

[9]. The fertilizer supply is limited and the cost is prohibitive for SSA farmers because fertilizer may cost as much as five times the global market price [11]. There is this assertion that says; among the problems hampering arable crop yield is availability and affordability of inorganic fertilizers, [5]. However, [19] claimed that inorganic fertilizer may increase yield in the short term but may be both uneconomical and environmentally unsound. A number of studies have analyzed the drivers of fertilizer usage among cereal crop farmers in different countries of the world. Nevertheless, there seems not to be a consensus in the results and this call for more research to examine the drivers in the particular setting (see table 1 in the appendix) as an evident of varying fertilizer usage.

Country	Fertilizer consumption (Kg/ha)					Cereal Yield (Kg/ha)				
	2015	2014	2013	2012	2011	2015	2014	2013	2012	2011
Canada	91.6	89.4	84.2	94.2	84.1	36,596	36,751	41,700	34,575	35,213
Cameroon	13.6	9.6	10.1	10.3	11.0	16,106	16,292	16,766	15,918	17,148
China	506.1	567.3	559.0	551.0	533.4	59,820	58,932	58,941	58,271	57,094
Cote d'Ivoire	50.2	42.0	37.2	26.9	19.4	21,564	21,352	21,778	20,808	18,829
France	168.7	171.8	172.2	160.8	141.3	75,700	75,560	70,848	72,545	69,193
Germany	202.2	217.7	203.5	198.9	191.5	74,978	80,503	73,180	69,649	64,583
Ghana	23.8	15.7	25.3	34.8	13.2	18,303	17,034	16,888	17,681	15,942
Nigeria	8.3	13.1	16.0	8.7	6.6	14,435	14,498	12,347	13,997	13,346
South Africa	58.5	65.0	57.7	59.5	60.3	35,367	48,940	40,409	42,396	40,138
Togo	3.1	2.8	11.7	5.3	10.2	12,372	11,581	10,901	11,124	12,262
United Kingdom	246.9	243.4	246.6	235.0	238.7	79,809	76,965	66,316	62,151	69,847
United States	137.0	135.7	137.9	132.6	132.3	74,306	76,381	73,009	59,119	68,036
India	171.0	163.5	156.5	163.1	180.7	28,567	29,604	29,699	29,635	28,607

Table 1: Fertilizer consumption (Kg/ha) and Cereal Yield (Kg/ha) in selected countries, 2011-2015.

Source: www.knoema.com/agriculture-FAO, 2017.

Low fertilizer use has been identified as a major challenge that must be overcome in order to increase Nigeria's agricultural productivity. This study therefore analyzed the drivers of fertilizer usage among cereal-based farmers in Kwara State, which happens to be located in the cereal belt of Nigeria. The specific objectives of the study were to

- Examine the socio-economic characteristics of smallholder cereal-based farmers in the study area
- Examine the pattern of fertilizer usage among smallholder cereal-based farmers in the study area
- Assess the determinants of fertilizer usage by smallholder cereal-based farmers in the study area

Research Methodology

This study was conducted in the Agricultural Development Project Zones (ADP Zones) of Kwara State, Nigeria. The state was divided into four agricultural zones by the Kwara State Agricultural Development Project (KWADP) based on ecological and cultural characteristics, cultural practices and project administrative convenience (8b). The zones are: Zone A (Baruteen and Kaima Local Government Areas), Zone B (Edu and Patigi Local Government Areas), Zone C (Asa, Ilorin East, Ilorin South, Ilorin West and Moro Local Government Areas), Zone D (Ekiti, Ifelodun, Irepodun, Offa, Oyun, Isin and Oke-Ero Local Government Areas). And for this study two LGAs each were picked from Zone C and D in which Asa and Moro LGAs were selected from zone C while Irepodun and Oyun LGAs were selected from zone D.

In determining the sampling frame for this study a total number of 200 cereal-based farmers were randomly selected from eight communities of the selected LGAs in the ADP zones of Kwara state, Nigeria. The name of the selected communities are; (Moro-Malete and Yeregi, Asa- Pampo and Ballah, Irepodun- Oro and Ajasepo and Oyun- Igosun and Erin-ile. The study was based on primary data collected through the use of structured questionnaire from a cross-section of smallholder cereal-based farmers. A questionnaire design was based on the socio-economics factors influencing the fertilizer usage. The questionnaire was divided into five sections namely; socio-demography information, information on the type of crop planted, information on fertilizer usage, household farm assets and non-farm asset and general constraints to fertilizer usage. The questionnaire and interview were administered using KWADP enumerators. All the variables used in this study were in the form of nominal, ordinal or interval data.

Data analysis

Simple descriptive statistics and Ordinary Least Square (OLS) regression analyses were used to analyse the data obtained from the farmers 'survey.

Inorganic fertilizer use intensity

The level of the analysis involved the determination of the factors that influence fertilizer use intensity. The model uses the ordinary least square regression model to determine the extent of fertilizer use intensity. Fertilizer use intensity (FUI) as defined by [10] and [17] was described as follows

$$FUI = \frac{\text{Quantity of fertilizer used (Kg)}}{\text{Area of land (Ha)}}$$

The decision to intensify fertilizer use is modeled as a regression truncated below the average fertilizer use intensity as expressed below:

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, X_{11})$$

$$Y = FUI$$

$$X_1 = \text{Age of farmer (years)}$$

$$X_2 = \text{Gender of farmer (1 = Male, 0 = female)}$$

$$X_3 = \text{Education Status of farmer (years)}$$

$$X_4 = \text{Household size of farmer (number)}$$

$$X_5 = \text{Access to farm credit by farmer (1 = accessed and 0 otherwise)}$$

$$X_6 = \text{Marital Status of Farmer}$$

$$X_7 = \text{Cost of fertilizer per bag (Naira)}$$

$$X_8 = \text{Farmers (Farm-asset) holding (Naira)}$$

$$X_9 = \text{Extension agent Visiting during a Production Season (number of times)}$$

$$X_{10} = \text{Membership of farmers' organization (yes = 1, no = 0)}$$

$$X_{11} = \text{Distance to fertilizer purchase point (in kilometer)}$$

$$f = \text{Functional Relationship. (1)}$$

$$FUI = B_0 + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 + B_5X_5 + B_6X_6 + B_7X_7 + B_8X_8 + B_9X_9 + B_{10}X_{10} + B_{11}X_{11} + U_t \dots (2)$$

Where B_0 = explaining fertilizer use intensity when the explanatory variables are equal to zero.

$B_1 - B_{11}$ is coefficients attached to the explanatory variables explaining their effects on the dependent variable. Where, B_0 is the constant term while $B_1, B_2, B_3, \dots, B_{11}$ are the parameters of the respective explanatory variables in the model, and U_t is the error term.

Results and Discussion

Socio-economic characteristics of the cereal-crop farmers

The socioeconomic characteristics of the cereal-based farmers that were descriptively analyzed include age, gender, household

size, marital status, years of schooling, extension awareness, access to credit, primary occupation, and farmers' association. Table 2 presents the socioeconomic characteristics of the cereal-based farmers in the study area. The result of the analysis shows that most (94.5%) of the cereal-crop farmers interviewed, their age ranges between 36 -65years. The mean age of the cereal-crop farmers in the study area was 49.7 years. This means that, the smallholder cereal-crop farmers interviewed were relatively old. This was a confirmation of the fact that agriculture is seen as an occupation for the old ones while the youth are looking for white-collar jobs that lead to migration from rural to urban areas. This corroborates the work of [1,4,7,18] which say, age is expected to influence fertilizer use intensity positively. Table 2 shows that 91.5% of the cereal-crop farmers interviewed were men while just 8.5% of them were women. This suggests that men are more involved in cereal-crop production farming than women. Since farming is a tedious activity, the result is in line with the findings of [14] who indicated that women are more involved in the less laborious activities. In Table 2, the result shows that most 63% of the cereal-based farmers have up to 4-6 people per household. The mean household size of the respondents stood at 6 persons per household in this study which likely to contribute to cereal production.

Table 2 shows that 35% of the cereal-crop farmers interviewed had years of farming experience which ranges between 11-20years. The mean years of farming experience is 23.4years. This suggests that the farmers have the necessary experience in cereal-crop production which likely to have positive contribution to method and innovation adoption by cereal crop farmers in the study area. As shown in Table 2, 64.5% of cereal-crop farmers interviewed had formal education ranges from primary school to tertiary institution. This means that majority of the farmers will find it easy to adopt new innovation of farming generally and having adequate knowledge on fertilizer usage. In the Table 2, most (97%) of cereal-crop farmers interviewed were married and the result simply mean that majority of the respondents were expected to be responsible people because marriage in one way of the other attach to being responsible. This finding corroborates [13] which says marriage also increases a farmer's concern for household welfare and food security which is therefore likely to have a positive effect on their decision to adopt and increase fertilizer use intensity. In Table 2, large numbers (93.5%) of cereal-crop farmers in the study areas claimed to have contact with Agricultural Extension Agents. In this

view, contact with extension agent could have a positive effect on fertilizers usage on cereal crop production based on innovation-diffusion theory.

Table 2 shows that majority (76%) of cereal-based farmers did not have access to credit. In this result, not having access to credit could have negative impact on the production of cereal crops because the role of credit in agricultural development in any country cannot be ignored, having access to credit could influence or capable of increasing fertilizer usage level and lead to high yield and better productivity of cereal crops. Table 2 shows that most of the respondents (80.5%) reported farming as their primary occupation, this suggests that most rural dwellers engage in farming activity than any other occupation. In table 2, less than average (48.5%) of respondents claimed to belong to association while 51.5% claimed not to belong to any association. The implication of this result is that less than an average of cereal-crop farmers interviewed are less structured in terms of interaction with their counterparts within and outside the communities.

Variables	Categories	Frequencies	Percentage
Age	25-35	7	3.5
	36-45	59	29.5
	46-55	84	42.0
	56-65	46	23.0
	>65	4	2.0
Mean Age	49.7		
Gender	Male	183	91.5
	Female	17	8.5
Household Size	1-3	17	8.5
	4-6	126	63.0
	7-9	51	25.5
	10-12	6	3.0
Mean Household Size	6.0		
Years of Farming Exp.	1-10	17	8.5
	11-20	70	35.0
	21-30	67	33.5
	31-40	38	19.0
	> 40	8	4.0
Mean of Yrs of Farming Exp.	23.4		

Education	Non-Formal	71	35.5
	Adult -Education	0	0.0
	Primary	47	23.5
	Secondary	54	27.0
	Tertiary	28	14.0
Marital Status	Single	2	1.0
	Married	194	97.0
	Widow	4	2.0
	Divorced	0	0.0
Extension Awareness	Yes	187	93.5
	No	13	6.5
Access to Credit	Yes	48.0	24.0
	No	152.0	76.0
Primary Occupation	Farming	161.0	80.5
	Artisan/ Technician	28.0	14.0
	Civil Servant	8.0	4.0
	Others	3.0	1.5
Farmers' Association	Yes	97.0	48.5
	No	103.0	51.5

Table 2: Socioeconomic Characteristics of Cereal-Based Farmers. **Source:** Field Survey, 2018.

Pattern of fertilizer usage

Table 3 shows that less than an average 42.3% of the cereal-based farmers interviewed claimed that, land they are using for farming were inherited from their ancestors. From the table 3, large (77.6%) proportion of the cereal-crop farmers in the study area claimed to be using inorganic (chemical) fertilizer and 10.4% of them claimed to be using organic fertilizer only. This finding supports [3] which says over the past 25 years, chemical fertilizers have been the primary means of enhancing soil fertility in small farm agriculture. Finding shows that large number (74.6%) of the respondents combined both NPK and Urea fertilizers together for use on their farms. Many of the cereal-crop farmers claimed that the major fertilizer types used were Urea and Nitrogen-Phosphorus-Potassium (NPK). Urea was mainly used for rice production while NPK was used for maize, sorghum and millet production as they

claimed. In table 3, the result shows that most common (71.6%) form of inorganic fertilizer used was in granulated form and most common (73.1%) pattern of applying inorganic fertilizer among the cereal-based farmers interviewed was by placing the fertilizer near the root of plants. Table 3 shows that (34.3%) of cereal-crop farmers purchased their inorganic fertilizers at wholesaler shop, and the result shows that large number (91%) of the respondents were claimed to be buying their fertilizers in bags.

Variables	Categories	Frequencies	Percentage
Mode of Land Ownership	Purchase	16.0	8.0
	Hired/Lease	65.0	32.3
	Inherited	85.0	42.3
	Gift	16.0	8.0
	others	18.0	9.4
Inorganic or Organic Usage	Non-use of Fertilizer	9.0	4.5
	Inorganic	156.0	77.6
	Organic	21.0	10.4
	Both Inorganic and-Organic	14.0	7.5
Types of Inorganic Used	Non-use chemical Fertil.	30.0	15.0
	NPK	16.0	7.9
	Urea	4.0	2.5
	NPK and Urea Together	150.0	74.6
	Potash	0.0	0.0
Forms of Inorganic	Non-use of chemical Fert.	30.0	15.0
	Liquid Form	8.0	4.0
	Powder Form	0.0	0.0
	Tablet Form	2.0	1.4
	Granulated Form	144.0	71.6
	Other Forms	16.0	8.0
Application Pattern	Non-use of Fertilizer	9.0	4.5

	Broadcasting	25.0	12.4
	Foliar	9.0	4.5
	Place Near the Root	147.0	73.1
	Others	10.0	5.5
Point of Purchase	Non-use of Fertilizer	9.0	4.5
	Open Market	63.0	31.3
	Retailer Shop	39.0	19.4
	Wholesaler Shop	69.0	34.3
	ADP Office	9.0	4.5
	Ministry/ Government	0.0	0.0
	Extension Agents	1.0	0.5
	Others	10.0	5.0
Mode of Purchase	Non-use of Fertilizer	9.0	4.5
	In Unit	4.0	2.0
	In Bag	183.0	91.0
	Both in Unit and Bags	4.0	2.0

Table 3: Pattern of Fertilizer Usage in the Study Area.

Source: Field Survey, 2018.

Determinants of fertilizer usage

The factors influencing fertilizer usage among the cereal-crop farmers in the study area are shown in Table 4. Household Size, access to credit, cost of fertilizer, distance to point of purchase and marital status of the cereal-crop farmers were statistically significant. This implies that cereal-farmers with high household size will definitely influence fertilizer use intensity negatively, that is to say cereal-crop farmers with high household size will devote more resources in caring for the household which will cause reduction in fertilizer purchase and when this happened it will lead to low fertilizer usage. This finding supports that of [15] that says majority of the farmers in the rural area have large household size. Also in tandem with [21], which says, it is expected that a farmer with large household size would have more responsibility to undertake in agricultural activities (include labour) which may have consequence on the use of modern adaptation strategies-include input use (fertilizer use intensity). In the same way, access

to credit by cereal-based farmers was found to have negative impact with fertilizer use intensity in the study area. The significance level of access to credit is at 1% level among the respondents but the t-value is negative (-2.88) which means that cereal-based farmers that could not access credit have low fertilizer use intensity. In nutshell, increasing access to more credit by cereal-crop farmers is likely to increase the fertilizer use intensity. The coefficient of cost of fertilizer is significant at 1% level with positive t-value of 8.01. This implies that cereal-based farmers use more fertilizer when the price of inorganic fertilizer is low than when its price is high. The high cost of fertilizers in the market is likely due to middlemen in the supply chain, vis a vis the location of the respondents and the high cost of transportation due to bad roads and lack of feeder roads in the rural areas. The finding supports the saying of [12] which states that governments in Nigeria procured fertilizer independently and distributed the fertilizer through sales agents and the extension agents.

The distance to the point of purchase is significant at 1% level with the negative t-value of (-3.64). This simply means that the farther the point of purchase to cereal-crop farmers the lower the fertilizer use intensity. The finding shows that the longer the distance, the less the probability of fertilizer use intensity by cereal-crop farmers in the study area. The result shows that one kilometre increase in the distance to the nearest fertilizer market reduces fertilizer use intensity by 3.07685. [18] confirmed that distance to fertilizer market significantly influenced the use of fertilizer by smallholder farmers. Moreover, the finding also shows (in table 4) that marital status has a negative correlation coefficient with fertilizer use intensity at 10% level of significance with negative t-value of -1.91. This result implies that cereal-based farmers who married used less fertilizer than those that are single; this may be as result of the influence of their spouses. This may be due to the fact that married farmers will have more financial obligation than the unmarried farmers, the fund that would have used to purchase fertilizer may be diverted for another pressing issues in the family which may hinder farmers from buying fertilizer needed and this will definitely affect the fertilizer use intensity.

Conclusion and Policy Implications

This study concluded that the farmers' inability to meet up with the recommended fertilizer-use was due to the factors which include; not having access to credit facility by most cereal-crop

Variables	Coefficient	Standard Error	t-value
Constant	415.3464***	147.9033	2.81
Age	-0.3930962	1.423021	-0.28
Gender	-49.3715	37.98413	-1.30
Household Size	-11.47296*	6.754596	-1.70
Access to Credit	-77.66357***	26.98311	-2.88
Cost of Fertilizer	0.0292771***	0.0036559	8.01
Farm Asset	0.0001375	0.0001384	0.99
Extension Agent Visit	0.1049505	3.625594	0.03
Membership of Farmers' Ass.	37.9718	24.00975	1.58
Distance to Point of Purchase	-3.076846***	0.8457156	-3.64
Marital Status	-123.6354*	64.79994	-1.91
Education Status	6.349952	7.42706	0.85

Table 4: Determinants of Fertilizer Usage Using Ordinary Least Square (OLS) Regression

* Significant level at 10% ***significant level at 1% Prob > F = 0.0000

R-squared = 0.3576 Adj R-squared = 0.319

Source: Field Survey, 20180

farmers interviewed, cost of fertilizer which was considered to be too expensive for them to afford thus, hindered them from using the required quantity. Another factor that the respondents claimed to be a challenge to them was the distance to point of purchase which said to be rather too far from their various locations and in this respect, the cost of transportation also contributed to exorbitant price of inorganic fertilizer. Other factors that had to do with the socioeconomic lives of the cereal-based farmers in the study area include the marital status and household size of the respondents. From the analysis, marital status and household size were found to be negatively affecting the use of fertilizer in the study area and this could be as a result of having more wives and thus, a consequent higher household size; this may lead to more financial commitment and responsibility for the cereal-crop farmers.

In order to achieve optimum fertilizer use intensity among the cereal-based farmers, the study offered the following recommendations based on the research findings

- It is recommended that meaningful and sustainable fertilizer support programme from government should be designed and the existing ones like E-wallet and Anchor Borrowers Scheme should be restructured in such a way that will cut across all farmers including small scale farmers in the rural areas and this will bring about equitable access to fertilizer by all farmers.
- It is important that some level of subsidy regime on fertilizer should be reintroduced and sustained in order to make the price of fertilizer more affordable to all farmers especially small scale farmers in the rural areas irrespective of their location.
- Research on the development of alternative to fertilizer (i.e organic fertilizer) in the rural areas should be stepped-up on, in order to reduce the dependency on the use of inorganic fertilizer. Extension agents will be useful in helping the dissemination of knowledge in this regard.
- Finally, cereal-based farm households in the state should be sensitized on the current method of family planning as this would help to reduce non -farm cost and help increase fertilizer procurement that will lead to optimum fertilizer use intensity.

Contribution/Originality

This study attempts to assess the drivers of the current fertilizer usage among cereal-based farmers and to determine the likely factors responsible for low fertilizer usage as compared to the stated recommendation by Food and Agricultural Organization (FAO); factors responsible for the low fertilizer usage were determined using the fertilizer use intensity (FUI) as dependent variable and this was defined as a ratio of quantity of fertilizer used in Kilogram to area of land in hectares. No doubt, in Nigeria low fertilizer usage had been talked about by previous authors but hence, this study was able to sought out those factors contributing to low fertilizer usage in Nigeria.

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