



## FACTORS INFLUENCING THE USAGE OF ORGANIC FERTILIZER ON SESAME PRODUCTION IN KATAGUM ZONE OF BAUCHI STATE, NIGERIA

<sup>1</sup>Garba, M., <sup>2</sup>Murtala, N., <sup>1</sup>Salisu, A. and <sup>1</sup>Garba, M.

<sup>1</sup>Department of Agricultural Extension and Rural Development, ATBU Bauchi

<sup>2</sup>Department of Agricultural Economics, ATBU Bauchi

**Corresponding Author's Email:** mamugarba@gmail.com, **GSM:** 08032201977

### ABSTRACT

The study examined the factors influencing the usage of fertilizer on sesame production in Katagum Zone of Bauchi State, Nigeria. Multi stage sampling technique was employed to select 217 respondents randomly. Primary data were obtained using structured questionnaire and analyzed using both descriptive and inferential statistics. The result reveals that the mean age of the respondents was 44 years, most (93.5%) and 77% were male and married respectively with a mean household size of 8 persons and a mean annual income of ₦421,613.00. The finding further reveals that quantity of harvest, type of fertilizer, household size and membership of cooperatives were positive and significant ( $P < 0.01$ ) factors influencing the use of organic fertilizer among the respondents. The major constraints faced by the respondents were bulkiness of fertilizer (94.5%), adulteration (91.2%) and high cost of fertilizer (84.3%) which were ranked 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> respectively. Based on the finding, it was concluded that the factors influencing the usage of fertilizer on sesame production in Katagum Zone of Bauchi State were quantity of harvest, type of fertilizer, household size and membership of cooperatives. It was recommended that the respondents should practice crop rotation and mixed cropping to improve soil fertility, agro-dealers should be sincere and avoid adulteration of fertilizer and government should provide subsidy on fertilizer.

**Keywords:** Organic, Usage, Fertilizer and Sesame

### INTRODUCTION

Nigeria is predominantly an agricultural nation, in which agricultural production is central to the overall wellbeing of its citizens. Agriculture also accounts for 85% of the national export earnings (United Nation Development Programme, UNDP, 2016). Having all this importance, agriculture continues to face a number of challenges. Oilseeds play a significant role on the lives of Nigerian agrarian community and stakeholders in the national economy. A variety of oilseeds are grown in Nigeria, of which sesame is by far the most important both in terms of volume, value and export earnings (National Agricultural Bio-technology Council, NABC, 2015). According to Geremew (2012) promotion of export potential cash crop is governments' strategy for raising agricultural GDP and rural income. Despite the global demand for food and the growing population the food production still remains inadequate in African countries which was associated with natural disasters such as flood, drought sedimentation and fertility degradation (Sadiq *et al.* 2019a). Due to decades of soil nutrient mining, Africa's soils have become the poorest in the world (Abdullahi and Abdulkadir, 2020). It is estimated that the continent loses the equivalent of over \$4 billion worth of soil nutrients per year, severely eroding its ability to feed itself. Yet farmers have neither access to nor can they afford the fertilizers needed to add life to their soils (Ajiboye and Osundare, 2015).

Sesame is the second major cash crop for export in Nigeria, and the country is one of the world's leading producers and exporters. The crop is grown throughout the country for exports. In recent years, the sesame sector has been characterized by tremendous growth in production and export, which is driven by the increasing world demand. This equaled 21% of the country's agricultural export value. Given the inefficiencies related to the cotton sector, sesame production turns out to be a source of agricultural export diversification, an emerging economic sector, and another source of income for many farmers. However, the average sesame yield is relatively lower in Burkina Faso (550 kg/ha) compared to other leading producers such as Ethiopia (1,000 kg/ha), Nigeria (950 kg/ha), Tanzania (800 kg/ha), and China (1,600 kg/ha) (Achille *et al.*, 2020; FAO, 2022).



One of the commonly grown crops by farmers in Nigeria is Sesame. Sesame (*Sesamum indicum* L.) otherwise known as Sesame or Benniseed, a member of the family padaliaceae, is one of the most ancient oil seed known to mankind. Sesame plays a major role in human nutrition. Most of the sesame seeds are used for oil extraction and the rest are used for edible purposes (El- Khier *et al.*, 2018). It is one of the cash crops grown in Katagum Zone and Bauchi State in General. It is a very popular crop among the farmers in the area. Notwithstanding the good local and international market for its seed and oil, its production system is generally characterized by the use of traditional technique. Assessing the fertilizer usage of the sesame farmers may be one of the ways that will help in improving the performance of sesame production in the study area.

Despite all attempts to increase production of sesame in Nigeria, the average farmer still produces only at a subsistence level, using traditional system of farming and low-yielding varieties. Use of fertilizers among sesame farmers has not been very effective (Sharon, 2016). Researches have been carried out on other crops like maize, yam, groundnut among others but there are inadequate research findings on the level and what influence the use of organic and inorganic fertilizers in sesame production in Katagum Zone of Bauchi State, Nigeria as well as the constraints facing the farmers.

Sesame is one of the major cash crops highly cultivated in Katagum Zone of Bauchi State and makes significant contribution to household income. There have been various interventions by the State government to promote its production by encouraging farmers to increase its output. To increase the yield potential, the quality of the crop and achieve better profit requires the collaborative efforts of all stakeholders in capacity building on sesame crop improvement and post-harvest handling of the crop, development of high yielding widely adopted cultivars with better resistance to diseases and pest, development of improved agronomic and management practices and use of fertilizers among others (Zerihun, 2016).

The broad objective of the study was to determine the factors influencing the usage of fertilizer on sesame production in Katagum Zone of Bauchi state, Nigeria. The specific objectives were to;

- i. describe the socio-economic characteristics of the respondents in the study area;
- ii. determine the factors influencing the usage of organic fertilizers on sesame production; and
- iii. describe the constraints to organic and inorganic fertilizer usage on sesame production in the study area.

## **METHODOLOGY**

### **The Study Area**

The study was conducted in Katagum Zone of Bauchi State which is made up of Nine Local Government Areas, namely; Dambam, Gamawa, Itas-Gadai, Jama are, Katagum, Misau, Shira, Giade and Zaki. Katagum Zone lies in the northern part of Bauchi State. The Zone has a projected population of 4,500,000 with growth rate 3.3% as at 2025 (NaijaDetails, 2025) The climate of Katagum Zone falls within the semi-arid Sudan Savannah agro-ecological zone. The zone experiences a single, short rainy season, typically from May/June to September/October. Annual rainfall generally ranges from 700 mm to 1000 mm. A prolonged dry season extends from October/November to April/May. The natural vegetation is characterized by scattered trees (e.g., Acacia species, Combretum species, and baobab trees) The soils predominantly sandy loams to sandy clay loams. (BSADP, 2015).

Predominant tribes in the area are; Hausa's, Fulani's and Kanuri's, however, Hausa is the most commonly used language in the study area. The people of the area are predominantly farmers and they cultivated crops such as millet, sorghum, rice, cassava, wheat, sugarcane, groundnut, sesame and cowpea, while livestock such as camel, cattle, sheep, goats and poultry are raised at subsistence and commercial levels. The major climate issues in the study area is desert encroachment, frequent drought and lesser rains which have started shortening the cropping season thereby causing crop failure and food shortage, the farmers as a means of adaptation and mitigating measures against climate change in the study area start to adopt the production of cowpea, as a cover crop, millet and



sorghum. Also, farmers heavily adopted irrigation farming rather than relying more on rain fed agriculture that is highly unreliable and becoming more unpredictable (Oyiga *et al.*, 2011).

### Sampling Technique and Sample Size

A multi-stage sampling technique was used in selecting the respondents for the study. In the first stage a purposive sampling was employed due the concentration of sesame farmers from seven local government areas (LGA) of Katagum, Gamawa, Giade, Shira, Jama'are, Itas-Gadau and Zaki was made. In the second stage, simple random sampling was used to select two villages from each of the selected LGAs to make a sample of 14 villages. In the third stage, 10% of the sampling frame was used to determine the number of respondents from each of the selected villages making a sample of 220 respondents randomly drawn from the study area.

**Table 1: Sampling Frame and Sampling Size**

Zone	LGAs	Villages	Sample frame	Sample size (10%)
Katagum Zone	Katagum	Madangala	132	13
		Matsango	148	15
	Gamawa	Gamawa	124	12
		Udubo	194	19
	Giade	Giade	195	20
		Dogwa	186	19
	Shira	Zigau	150	15
		Faggo	180	18
	Jama'are	Dako-Dako	100	10
		Yola	120	12
	Itas-Gadau	Gadau	140	14
		Buzawa	154	15
	Zaki	Katagum	160	16
		Sakwa	174	17
<b>Total</b>		<b>14</b>	<b>2,157</b>	<b>220</b>

**Source:** Field Survey, (2023)

### Method of Data Collection

Primary data were collected using structured questionnaire which were administered to the respondents in the study area. Information collected was based on the stated objectives of the study that provided answers to the research questions which were structured sections by sections. Exactly 220 questionnaires were distributed but 217 were retrieved and used for the study.

### Method of Data Analysis

Data were analyzed using both descriptive and inferential statistics. Descriptive statistics were used to achieve objectives i, and iii, while inferential statistics (logit regression) was used to achieve objective ii of the study.

### Logistic regression model

Logistic Regression model was used to analyze objective i. The explicit form of the model was as follows:

$$Y = b_0 + b_1X_1 + b_2X_2 + \dots + b_{13}X_{13} + e \quad \dots(1)$$

Where:

Y = Fertilizer usage; (1= Organic (cow dung, poultry dropping, sheep and goat feces, domestic waste, compost and others, 2= inorganic fertilizer)

X<sub>1</sub> = Age of farmers (Years)

X<sub>2</sub> = Sex (male=1 or female=0)

X<sub>3</sub> = Marital status (single=1 married=2 divorce=3 widow=4)

X<sub>4</sub> = Occupation (farming=1 business=2 civil servant=3)

X<sub>5</sub> = Annual income (Naira)

X<sub>6</sub> = Quantity of harvest (Number of bags/100kg)



- X<sub>7</sub> = Level of education (1=primary, 2=secondary, 3=tertiary, 4=qur'anic, 5=non-formal)  
X<sub>8</sub> = Farming experience (Years)  
X<sub>9</sub> = Household size (Numbers)  
X<sub>10</sub> = Access to extension service (Yes=1, no=0)  
X<sub>11</sub> = Frequency of extension contact (1=Weekly, 2=Fortnightly, 3=Quarterly, 4=Annually)  
X<sub>12</sub> = Membership of association (Yes=1, no=0)  
X<sub>13</sub> = Distance to source of fertilizer (in Kilometers)  
e= error

## RESULTS AND DISCUSSION

### Socioeconomic Characteristics of the Respondents

The result from Table 2 depicts the socioeconomic characteristics of the respondents. The finding shows that 37.3%, 32.7% and 22.1% of the respondents were within the ages of 50 years and above, 30-39 years, 40-49 years, respectively. The result also shows that respondents had a mean age of 44 years. The finding implies that most of the respondents were within their active ages of sesame production in the study area. Maryam and Abdulqadir, (2020) reported that most farmers were in the middle- active age. Rukwe *et al.* (2020) reported sesame farmers were within the age of 20 – 50 years. The result further shows that most (93.5%) of the respondents were male, while 6.5% were female. The finding implies that male dominate sesame farming in the study area, which could be attributed to cultural values of the respondents which have restrictions on women participation in outdoor tedious activities such as farming in the study area. Oladimeji *et al.* (2014) and Adamu and Bakari (2015) reported that sesame farming was dominated by males than females. The finding further reveals that majority (77%) of the respondents were married, while 12%, 10.5% and 0.5% of the respondents were single, divorced and widows. The finding implies that most of the respondents were married and had certain level of responsibilities to care for in the study area. The result is in line with the findings of Abu *et al.* (2011) who reported that a high proportion of married sesame farmers will contribute widely to use of family labour. Similarly, Samuel *et al.* (2020) revealed that majority of sesame farmers were married. The result also indicates that majority (57.1%) of the respondents had a household size of 1-5 persons with a mean household size of 8 persons. This implies that most of the respondents had relatively small household size which indicates less dependence among households with inadequate cheap family labour for sesame production in the study area. Adole (2016) also reported similar result with mean household size of 8 persons.

The result further reveals that majority (70%) of the respondents had attended primary level of education with 23.5% and 6.55 of the respondents having secondary and qur'anic levels of education in the study area. This finding implies that most of the respondents had attained one form of education or another, with an average literacy level. Adole (2016) also reported similar result with majority of the respondents attending primary and secondary levels of education. The result also shows that 42.3% of the respondents had an annual income of ₦307,000 and above, with 24%, 18% and 15.7% of the respondents having an annual income of ₦208,000-₦306,000, ₦10,000-₦108,000 and ₦109,000-207,000 respectively, with a mean annual income of ₦421,613.00 in the study area. This finding implies that most of the respondents had relatively good annual income in the study area. Maryam and Abdulqadir, (2020) reported that most farmers were in the middle- active age with an average literacy level having low monthly income.



**Table 2:** Distribution of Respondents According to their Socioeconomic Characteristics (n=217)

Variables	Frequency	Percentage	Mean
<b>Age</b>			
20-29	17	7.9	44
30-39	71	32.7	
40-49	48	22.1	
50 and Above	81	37.3	
<b>Sex</b>			
Male	203	93.5	
Female	14	6.5	
<b>Marital status</b>			
Single	26	12.0	
Married	167	77.0	
Widow	1	0.5	
Divorced	23	10.5	
<b>Household size</b>			
1-5	124	57.2	8
6-10	60	27.6	
11-15	29	13.4	
16 and Above	4	1.8	
<b>Educational level</b>			
Primary education	152	70.0	
Secondary education	51	23.5	
Qur'anic education	14	6.5	
<b>Annual income (₦)</b>			
10,000-108,000	39	18.0	421,613.00
109,000-207,000	34	15.7	
208,000-306,000	52	24.0	
307,000 and Above	92	42.3	
<b>Farm size</b>			
0.5-1.0	98	45.1	1.7
1.1-1.6	1	0.5	
1.7-2.2	65	30.0	
2.3-2.8	4	1.8	
2.9 and Above	49	22.6	
<b>Farming experience</b>			
8-11	41	18.9	19
12-15	35	16.1	
16-19	43	19.8	
20-23	56	25.8	
24 and Above	42	19.4	

**Source:** Field Survey, 2024

The result further shows that 45.1%, 30% and 22.65 of the respondents had a farm size of 0.5-1.0ha, 1.7-2.2ha and 2.9ha and above, respectively in the study area. The result also shows that 1.8% and 0.5% of the respondents had a farm size of 2.3-2.8ha and 1.1-1.6ha. The result shows that respondents had a mean farm size of 1.7ha. This finding implies that most of the respondents were small scale sesame farmers with relatively small farm size in the study area. Samuel *et al.* (2020) reported that a reasonable proportion of the sesame farmers had relatively small farm size. The finding further shows that 25.8%, 19.8% and 19.4% of the respondents had a farming experience of 20-23 years, 16-19 years and 24 years and above, respectively. The result also shows that 18.9% and 16.1% of the respondents had a farming experience of 8-11 years and 12-15 years, with a mean of 19 years farming experience. This finding implies that most of the respondents had a good number of years in sesame farming which could contribute to their knowledge on the use of fertilizer in the study area. Samuel *et al.* (2020) reported that a reasonable proportion of the sesame farmers were having





farming experience of 6 - 10 years with a mean of 13 years. Adole (2016) reported that the average farming experience of sesame farmers in Nasarawa State and Benue State were 12.8 and 15 years.

### Factors Influencing Type of Organic Fertilizer Used by the Respondents

The result from Table 3 shows the factors influencing the type of organic fertilizer used by the respondents in the study area. The finding reveals that quantity of harvest ( $r=3.202$ ) was positive and significant ( $P<0.01$ ) factor influencing the use of organic fertilizer among the respondents. This implies that increase in quantity harvested will lead to increase use of organic fertilizer. This is not unconnected to the fact that the major aim of fertilizer application in agriculture is to improve soil fertility and increase yield, hence increase in quantity harvested will lead to increase in the use of organic fertilizer which is cheaper, readily available with little or no side effects on the soil in the study area. The result further shows that type of fertilizer ( $r=1.975$ ) was positive and significant ( $P<0.05$ ) factor influencing the use of organic fertilizer, which implies that increase in the type of fertilizer use i.e the use of both organic, inorganic and liquid fertilizer will lead to increase in the use of organic fertilizer which could not be unconnected to the availability and cheapness of organic fertilizer compared to inorganic fertilizer in the study area. The result further shows that age ( $r=-4.831$ ) was negative and significant ( $P<0.01$ ) factor influencing the use of organic fertilizer among the respondents in the study area. This is in contrast with Akinbile *et al.* (2017) and Ojehomon and Ojehomon (2020) who affirm that age and experience often correlate positively with agricultural knowledge and innovation adoption. This finding implies that increase in age will lead to decrease in the use of organic fertilizer on sesame production which is attributed to the tedious nature of processing and transporting organic fertilizer to the farm as respondents grow older they may be preferring the use of inorganic fertilizer which is a readily made products and less bulky compared to organic fertilizer in the study area.

**Table 3:** Factors Influencing Type of Organic Fertilizer Used by the Respondents (n=217)

Variables	B	Std. Error	Beta	t	Sig.
Constant	4.026	1.178		3.417	.001***
Age	-.045	.009	-.381	-4.831	.000***
Sex	-.955	.810	-.180	-1.179	.240
Marital status	.128	.140	.072	.916	.361
Household size	.007	.018	.029	.380	.705
Educational level	-.125	.294	-.076	-.426	.670
Annual income	-6.236E-7	.000	-.157	-1.862	.064*
Farm size	.050	.164	.032	.303	.762
Quantity of sesame harvested	.244	.076	.239	3.202	.002***
Sources of capital	.034	.086	.031	.397	.691
Occupation	.081	.063	.086	1.270	.206
Farming experience	-.009	.014	-.047	-.646	.519
Access to extension	.224	.384	.081	.583	.560
Frequency of extension	.032	.108	.040	.298	.766
Type of fertilizer used	.263	.133	.168	1.975	.050**
Membership of cooperatives	.484	.249	.138	1.946	.053*
Distance to sources of capital	-.071	.032	-.181	-2.203	.029**

Field Survey, 2024 \*\*\*, \*\*, \*Significant ( $P<0.01$ ,  $P<0.05$  and  $P<0.1$ )

The result also reveals that distance to source of capital (-2.203) was negative and significant ( $P<0.05$ ) factor influencing the use of organic fertilizer in the study area. This finding implies that increase in distance to source of capital will lead to decrease in the use of organic fertilizer among the respondents which could be attributed to the fact that lack of capital for sesame production could lead to decrease in participation in sesame production among the respondents. The finding also shows that membership of cooperatives (1.946) was positive and significant ( $P<0.1$ ), which implies that increase in membership of cooperatives among the respondents will lead to increase in type of organic fertilizer used by the respondents in the study area.



### Constraints to Organic Fertilizer Usage among the Respondents

The result from Table 4 depicts the constraints faced by the respondents in sesame production in the study area. The finding reveals that the major constraints faced by the respondents were bulkiness of fertilizer (94.5%), adulteration (91.2%) and high cost of fertilizer (84.3%) which were ranked 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> respectively.

**Table 4:** Constraints Faced by the Respondents in Sesame Production (n=217)

Variables	Frequency	Percentage*	Rank
Bulkiness of fertilizer	205	94.5	1 <sup>st</sup>
Adulteration	198	91.2	2 <sup>nd</sup>
High cost of fertilizer	183	84.3	3 <sup>rd</sup>
Poor road network	177	81.6	4 <sup>th</sup>
Unavailability of fertilizer	176	81.1	4 <sup>th</sup>
High cost of labour	170	78.3	6 <sup>th</sup>
High cost of transportation	157	72.4	7 <sup>th</sup>
Inadequate extension services	148	68.2	8 <sup>th</sup>
Inadequate storage facilities	148	68.2	8 <sup>th</sup>
Inadequate knowledge	122	56.2	10 <sup>th</sup>
Inadequate capital	121	55.8	11 <sup>th</sup>

Field Survey, 2024 \*Multiple response

The finding further shows that poor road network (81.6%), unavailability of fertilizer (81.1%), high cost of labour (78.3%) and transportation (72.4%) which were ranked 4<sup>th</sup>, 5<sup>th</sup>, 6<sup>th</sup> and 7<sup>th</sup> by the respondents respectively. These were followed by inadequate extension services (68.2%), storage facilities (68.2%), knowledge (56.2%) and capital (55.8%) which were ranked 8<sup>th</sup>, 10<sup>th</sup> and 11<sup>th</sup> respectively, by the respondents. This finding implies that though respondents had good knowledge and access to different fertilizers, there are certain constraints hindering smooth production or expansion of sesame production in the study area due to the aforementioned constraints. Relatively small farm size could constitute a major constraint to technology usage (Sani *et al.*, 2014). Druilhe and Barreiro-Hurlé (2019) asserted that among the problems hampering arable crop yield is availability and affordability of inorganic fertilizers. Samuel *et al.* (2020) reported that sesame farmers were constraints by inadequate fund, inadequate of extension services, problem of pest and disease, high cost of fertilizers, inadequate of good road network, inadequate of credit, poor market prices, poor storage facilities, scarcity of improved seed, weed control, high cost of transport, inadequate of modern cleaning technology and inadequate of agrochemicals.

### CONCLUSION AND RECOMMENDATION

Based on the finding, it was concluded that the factors influencing the usage of fertilizer on sesame production in Katagum Zone of Bauchi State were household size, quantity of harvest, type of fertilizer, membership of cooperatives, age and capital sources of the respondents which had significant influence on the usage of fertilizer in the study area. The respondents had adopted the use of different fertilizers in sesame production.

Based on the findings of the study the following recommendations were made;

- Agro-dealers should be sincere and avoid adulteration of agro inputs in the study area
- Government should provide subsidy on agricultural inputs especially fertilizer in the study area
- Government should construct feeder roads to link production areas to urban markets in the study area
- Cooperatives should purchase fertilizer and other inputs collectively and re-sell to their members in the study area



## REFERENCES

- Abdullahi, A., & Abdulkadir, M. (2020). Declining soil fertility and food insecurity in sub-Saharan Africa: Challenges and policy options. *African Journal of Agricultural Science*, **16**(3): 112–120.
- Abu, O., Ater, P. I., & Abah, D. (2011). Analysis of factors affecting sesame production in Nasarawa State, Nigeria. *Journal of Agricultural Extension and Rural Development*, **3**(8): 150–158.
- Achille, T., Olayemi, F., & Okon, B. (2020). Comparative analysis of sesame production in West Africa. *International Journal of Agricultural Policy and Research*, **8**(2): 43–51.
- Adamu, A., & Bakari, U. M. (2015). Gender participation in sesame production in Northern Nigeria. *Nigerian Journal of Rural Sociology*, **5**(1): 42–49.
- Adole, O. (2016). *Determinants of sesame production among farmers in Nasarawa and Benue States, Nigeria* (Master's thesis). University of Agriculture, Makurdi, Nigeria.
- Ajiboye, G. A., & Osundare, O. A. (2015). Soil nutrient depletion and agricultural sustainability in Nigeria. *Nigerian Journal of Soil Science*, **25**(1): 76–85.
- Akinbile, L. A., Ogunwale, A. B., & Oladoja, M. A. (2017). Socioeconomic determinants of fertilizer adoption among smallholder farmers in Southwest Nigeria. *Journal of Agricultural Extension*, **21**(3): 58–70.
- Bauchi State Agricultural Development Programme (BSADP). (2015). *Annual report of Bauchi State Agricultural Development Programme*. Bauchi, Nigeria: Ministry of Agriculture.
- Davidoff, F., Dixon-Woods, M., Leviton, L., & Michie, S. (2015). Demystifying theory and its use in improvement. *BMJ Quality & Safety*, **24**(3): 228–238.
- Druihe, Z., & Barreiro-Hurlé, J. (2019). *Fertilizer subsidies in sub-Saharan Africa*. Rome, Italy: Food and Agriculture Organization of the United Nations.
- El-Khier, M. K. S., Ishag, K. E. A., & Yagoub, A. A. (2018). Chemical composition and oil characteristics of sesame seed cultivars grown in Sudan. *Research Journal of Agriculture and Biological Sciences*, **4**(6): 761–766.
- Food and Agriculture Organization (FAO). (2022). *FAOSTAT statistical database*. Rome, Italy: Author.
- Funnel, S. (1997). Program logic: An adaptable tool for designing and evaluating programs. *Evaluation News and Comment*, **6**(1): 5–17.
- Geremew, T. (2012). Export potential and performance of cash crops in Sub-Saharan Africa. *African Development Review*, **24**(2): 123–132.
- Lawton, R., McEachan, R. R., Giles, S. J., Sirriyeh, R., Watt, I. S., & Wright, J. (2014). Development of an evidence-based framework of factors contributing to patient safety incidents in hospital settings: A systematic review. *BMJ Quality & Safety*, **21**(5): 369–380.
- Maryam, S., & Abdulqadir, M. (2020). Socioeconomic factors influencing sesame production among farmers in Northern Nigeria. *Journal of Agricultural Extension and Development*, **12**(4): 215–222.
- NaijaDetails. (2025). *Bauchi State demographic and population profile report*. Retrieved from <https://naijadetails.ng>
- National Agricultural Bio-technology Council (NABC). (2015). *Annual report on agricultural innovation and biotechnology in Nigeria*. Abuja, Nigeria: Federal Ministry of Agriculture and Rural Development.
- Ojehomon, V. E. T., & Ojehomon, S. O. (2020). Socioeconomic determinants of fertilizer adoption among smallholder farmers in Kwara State, Nigeria. *Nigerian Journal of Agricultural Extension*, **21**(2): 40–48.
- Oladimeji, Y. U., Damisa, M. A., & Abdulrahim, M. A. (2014). Gender participation and productivity among sesame farmers in North Central Nigeria. *Journal of Sustainable Development in Africa*, **16**(3): 75–89.
- Oyiga, B. C., Ogbonna, P. E., & Nwokocha, H. N. (2011). Climate change adaptation strategies among farmers in Bauchi State, Nigeria. *African Journal of Environmental Science and Technology*, **5**(8), 601–607.





- Rukwe, T., Sule, M., & Tukur, A. (2020). Socioeconomic determinants of sesame production in Gombe State, Nigeria. *International Journal of Agricultural Research*, **15**(2): 97–105.
- Sadiq, M. S., Singh, I. P., & Ahmad, S. (2019a). Climate variability and food security in Africa: The case of Nigerian agriculture. *Journal of Environmental Management*, **23**(1): 44–59.
- Samuel, O. J., Ibrahim, U. A., & Musa, M. (2020). Socioeconomic analysis of sesame farmers in North-East Nigeria. *Journal of Agricultural Extension*, **24**(2): 98–112.
- Sani, M. A., Musa, Y., & Bala, U. (2014). Farm size and technology adoption among arable crop farmers in Nigeria. *Journal of Development and Agricultural Economics*, **6**(9): 400–406.
- Sharon, A. (2016). Challenges of fertilizer adoption among smallholder farmers in Nigeria. *African Journal of Agricultural Research*, **11**(12): 1035–1042.
- United Nations Development Programme (UNDP). (2016). *Human development report: Nigeria 2016*. New York, NY: Author.
- Zerihun, A. (2016). Enhancing sesame production through improved agronomic practices in sub-Saharan Africa. *African Crop Science Journal*, **24**(3): 217–226.