



ADOPTION OF GINGER (*Zingiber officiale*) PRODUCTION TECHNOLOGIES IN SOUTHERN ZONE OF KADUNA STATE, NIGERIA

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ABSTRACT

The study assessed the adoption of ginger production technologies in Southern Agricultural Zone of Kaduna State, Nigeria. Multistage-sampling technique was used in selecting 172 respondents. Data were collected using structured questionnaire and analysed using descriptive and inferential statistics. The results revealed that majority (54.1%) of the respondents were male with a mean age, household size and farming experience of 43 years, 7 persons and 17 years, respectively. Similarly, the respondents had an average farm size and annual income of 1.9 hectares and ₦707,907, respectively. The results also revealed that majority (77.3%) of the respondents sourced information on ginger production technologies from fellow farmers. Farm operation technology and recommended land preparation practices were the most adopted ginger production technology. The result further revealed that educational background ($P < 0.01$) and annual income ($P < 0.05$) significantly influenced the adoption of ginger production technologies. The major constraints to the adoption of ginger production technologies were inadequate capital ($\bar{X} = 3.31$) and inadequate processing facilities ($\bar{X} = 3.09$). The study concluded that educational level, annual income and years of experience were the factors influencing the adoption of ginger production technologies in the study area. The study recommended that there is a need for Government to increase farmers' capital and credit facilities and make these services accessible to the farmers to improve technology adoption, farmers should form cooperative to enable them get access to credit and enjoy economics of scale.

Keywords: Adoption, Ginger, Production and Technologies.

INTRODUCTION

Nigeria is predominantly an agricultural nation, in which agricultural production is central to the overall wellbeing of its citizens. Agriculture also accounts 85% of the national export earnings (United Nation Development Programme, UNDP, 2016). It is an important sector of the economy of Nigeria with high potentials for employment generation, food security and poverty reduction. However, these potentials have remained largely untapped due to low adoption of new and improved technologies (Gizaki and Madukwe, 2019). Technology adoption has been the key to improving productivity and welfare of farmers (Biru, *et al.*, 2020; Workineh, *et al.*, 2020). Technology is one of the resources for agricultural production. Adoption is defined as the stage a respondent decides that ginger production technologies is good enough for full scale and continued use. While Adopter can be defined as any farmer who allocated 30% and above of his land to ginger production technologies. Technology adoption refers to the acceptance of a group or an individual to use a new product or innovation (Oyewole, 2020).

Studies such as Getacher *et al.*, 2013; Teklewold *et al.*, 2013) reported that the effective way to improve agricultural productivity is through adoption of improved



technologies. In addition to productivity improvement, technology adoption can lower per unit cost of production, increase the supply of food, and raise incomes of adopting producers. It can also improve nutritional status and reduces risks of crop failure (Hagos, *et al.*, 2012). Increasing adoption rates of productivity enhancing technologies is, therefore, essential for boosting crop production and improves the welfare of the rural community (Musa *et al.*, 2016). To increase agricultural production, the OECD-FAO (2016) noted that there must be either a significant increase in farm input resources or changes in current farming processes. Ginger (*Zingiber officinale L*) is an important cash crop introduced into southern Kaduna nearly a century ago (KADP, 2020). The rhizomes are used as a spice in cooking many local foods. It is also used widely in industry for making a wide range of beverages. The crop provide income, and employment opportunities for numerous farmers and contributes immensely to the growth of the agricultural sector (Sodangi, 2020). Nigeria is the second largest producer of ginger in the world with an estimated 768,304 metric tonnes from an area of 86,911 hectares (FAOSTAT, 2021). Nigerian ginger is known to produce the highest quality essential oils mainly Oleoresin and Gingerol which are responsible for their aroma and pungency (Asumugha *et al.*, 2019).

Nigeria is the leading producer of ginger in Africa producing 523,000 metric tonnes annually, about 90% of Nigerian ginger production is exported which makes Nigeria the third highest exporter of the crop globally (NEPC, 2018). However, despite the potential in the production of the crop, the country is yet to fully harness the economic benefits from growing ginger, on account of low-quality seeds and low use of technology. In Nigeria, the average yield on a hectare of farmland is about 13-27 metric tonnes in comparison to the global average of about 35-40 metric tonnes (ThriveAgric, 2020). This study therefore aims at assessing the adoption of ginger production technologies in Southern Zone of Kaduna State, Nigeria and specifically to;

- i. describe the socio-economic characteristics of ginger farmers in the study area;
- ii. describe the ginger production technologies adopted;
- iii. determine the factors influencing the likelihood of adoption of ginger production technologies; and
- iv. describe the constraints associated with the adoption of ginger production technologies in the study area.

MATERIALS AND METHODS

The Study Area

The study area is Southern Zone of Kaduna State, Nigeria. Kaduna State is one of the 36 states in the Federal Republic of Nigeria, situated between latitudes 9° 2' N, 11° 35' N and between longitudes 7° 15' E and 9° 6' E. It is bordered by the Federal Capital Territory and Nasarawa State in the South, South East by Plateau and Bauchi State, North East by Kano State, in the North by Katsina State, North West by Zamfara State and South West by Niger State, (KADP 2021). Kaduna South is located in Kaduna State, about 200 Km away from the headquarters. It is made up of seven Local Government Areas: Kachia, Jaba, Kagoro, Jema'a, Zangon Kataf, Kaura and Sanga Local Government Areas with a projected population of 3, 060,761 people (NPC, 2023). The major ethnic groups are: Atyap, Bajju, Ham, Kagoma, Adara, Koro, Maro'a, Kagoro, Kaninkon, Ninzo, Fantsuwam, Atakad, Ikulu, Angan, amongst others. The climate is predominantly tropical with two distinct seasons (dry and wet seasons). The rainy season starts from April to October with August and September as the wettest months having an annual average temperature of 23°C-28°C (KADP 2021). The Zone is predominantly agricultural with over 75 percent of the active population engaged in farming



as their primary occupation (KADP 2021). Ginger is one of the important cash crops in the state where commercial quantities (1,728.930 Metric tonnes) are produced annually (KADP 2021).

Sampling Technique and Sampling Size

A multistage sampling procedure was employed for the study. In the first stage the Southern Agricultural Zone was selected among the four Agricultural Zones in the State. In the second stage two Local Government areas in Southern Agricultural Zone of the state were purposively selected. In the third stage, two districts in each of the selected local government areas were purposively selected. The selection was purposive because of the intensive ginger production in the areas. In the fourth stage in each of the two districts, three villages were randomly selected making a total study are of twelve villages. In the final stage 172 ginger farmers were randomly selected using proportionality sample of 5% using Taro Yamane sample determination formula as:

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

where:

n = sample size

e = level of significance

N = population

Table 1: Sample Size Selection Plan of the Study

S/N	LGA	Districts	Villages	Population (N)	Sample size (n)
1	Kachia	Kachia	Agunu	410	20
			Kutura	321	16
			Awon	205	10
		Sabon Sarki	Gidan Mana	401	20
			JabanKogo	301	15
			Kwataru	321	16
			2	Kagarko	Katugal
Kubacha	315	15			
Gora	290	14			
Gwakuru	Janjala	209			10
	Akoti	198			9
	Angwanmakama	180			9
	Total				3501

Method of Data Collection

Data collection was used using structured questionnaire administered to the selected respondents.

Analytical Techniques

A combination of analytical tools was used to analyse the data collected for the study. The tools are discussed according to the objectives of the study. They included:

Descriptive statistics

Descriptive statistics such as the Frequency distribution, percentages, mean, standard deviation, and ranking was used to achieve objectives, ii, iii and iv.

Inferential statistics

Multiple regression was used to achieve objective v. Multiple Regressions refers to a set of techniques for studying the straight-line relationships among two or more variables. Multiple regression estimates the b's in the equation.



$$Y = F (x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8, x_9) \quad \dots 2$$

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + U_1 \quad \dots 3$$

The X's are the independent variables. Y is the dependent variable.

The β 's are the unknown regression coefficients. Their estimates are represented by b 's. Each β represents the original unknown (population) parameter, while b is an estimate of this β .

The U_1 is the error (residual)

Where:

y = Number of technologies adopted.

x_1 = Sex (1= male, 2= female)

x_2 = Age (Years)

x_3 = Marital status (1=single, 2=married, 3=Divorced, 4=widowed)

x_4 = Household size (number of people in the house)

x_5 = Level of education (0=none, 1=primary, 2=secondary, 3=tertiary, 4=adult)

x_6 = Annual Income (Amount in Naira)

x_7 = Farm size (ha)

x_8 = Years of Experience (Number of years)

x_9 = Member of cooperative (1= member, 0= non- member)

$b_1 \dots b_9$ = Regression coefficients

U = random errors

RESULTS AND DISCUSSION

Socio-Economic Characteristics of the Respondents

The socio-economic characteristics of farmers considered in this study includes; age, sex, marital status, educational background, household size, annual income, farm size group, years of farming experience and member of cooperative. The results are presented in Table 2.

The result in Table 2 revealed that 37.8% of the farmers were between the age bracket of 41-50 years while 27.9%, 12.8% and 5.8% were between the age bracket of 31-40, 21-30 and 61-70 years, respectively with a mean age of 43 years. This implies that most of the farmers were within their active stage of life. This agrees with the findings of Sati and Bala (2017) which reported that most of the ginger farmers are within their active age of life.

The result in Table 2 also revealed that majority (54.1%) of the farmers were male, while 45.9% were female. this implies that the production of ginger in the study area is dominated by male. This result revealed that ginger production in Kajuru Local Government Area of Kaduna was male dominated.

The result further shows that majority (68.0%) of the farmers were married, 25.6% of the farmers were single, while 5.8% of the farmers were widowed. This implies that majority of the farmers in the study area were from married household. This could be because being married comes with responsibility and engaging in ginger production will help this household provide basic needs to their families. This corroborates with the findings of Nwaekpe *et al.* (2022) which reported that married individuals for both farmers and processors of ginger in the study area.

Similarly, a large proportion (43.6%) of the farmers had a farming experience in ginger production of 11-20 years while 27.3%, 19.8% and 9.3% had of 1-10, 21-30 and 31-40 years, respectively, with mean farming experience of 17 years. This implies that majority of the farmers in the study area have been involved in ginger production for a very long time, this could be because it is the major trade of people in that area. This finding is in agreement with Ibrahim *et al.* (2019) which reported that respondents have been involved in farming activities for a long period of time.



Majority (71.5%) of the farmers had a farm size of 0.1-2 hectares while 20.3%, 5.8% and 1.2% had 2.1-4, 4.1-6 and 8.1-10 ha, respectively with a mean farm size of 1.9 hectares. This implies that majority of the farmers are small-holder farmers due to the small area cultivated for ginger production. This corroborates with the findings of Jakkawad *et al.* (2017) which reported that majority of ginger farmers in the study area were having small area under ginger cultivation.

Table 2: Socio-characteristics of the Ginger Farmers (n = 172)

Variables	Frequency	Percentage	Mean
Age (Years)			
21-30	22	12.8	43 years
31-40	48	27.9	
41-50	65	37.8	
51-60	27	15.7	
Sex			
Male	93	54.1	
Female	76	45.9	
Marital Status			
Single	44	25.6	
Married	117	68.0	
Divorced	1	0.6	
Widowed	10	5.8	

Source: Field Survey, 2022

Table 2 Socio-characteristics of the Ginger Farmers (n = 172) Cont'd

Variable	Frequency	Percentage	Mean
Educational Level			
None	6	3.5	
Primary	28	16.3	
Secondary	71	41.3	
Tertiary	62	36.0	
Adult	5	2.9	
Household size (Number)			
1-10	128	74.4	7 persons
11-20	43	25.0	
21-30	1	0.6	
Farming experience (Years)			
1-10	47	27.3	17 years
11-20	75	43.6	
21-30	34	19.8	
31-40	16	9.3	
Farm size (ha)			
0.1-2	123	71.5	1.9 ha
2.1-4	35	20.3	
4.1-6	10	5.8	
6.1-8	2	1.2	
8.1-10	2	1.2	

Source: Field Survey, 2022

*Multiple responses recorded

The result in Table 2 also revealed that 41.3% of the farmers had secondary school as their level of education while 36.0%, 22.9%, 16.3% and 3.5% had tertiary, adult, primary



and no formal education . This implies that majority of the farmers had one form of education or another which in turn favours adoption. This result is in line with the findings of Adegboye (2011) which reported that most of the respondents in this study area have completed secondary and tertiary education.

Households refers to the total number of individuals in a family who live in and eat from the same pot. The result in Table 3 further revealed that majority (74.4%) of the farmers had a household size of 1-10 persons 25.0%, and 0.6% 11-20 21-30 persons, respectively with a mean household size of 7 persons. This implies that the farmers in the study area had a relatively large household size. This agrees with the result of Ukamaka *et al.* (2018) which reported that large household size have high dependency ratio and has more hand for cheap labour.

The result in Table 3 also revealed that majority (77.3%) of the farmers in the study area received information on ginger production technologies from their fellow farmers, 27.3% of the farmers obtained information from extension agents while, 20.3% of the farmers get their information on ginger production technologies from their neighbors. Also, 9.3% of the farmers received information from the ministry of agriculture, while 2.3% of the farmers received information on ginger production technologies from the News Papers. This implies that majority of the farmers rely on the word of mouth from their fellow farmers for information on ginger production technologies. This could be because the trusted farmers in the study area might be successful in ginger production and therefore their recommendation are accepted. This result is in line with the findings of Onwunali *et al.* (2023), which reported that parents, friends and experienced farmers was the major source of information of farmers in the study area for ginger production. However, the result does not agree with Nwaekpe *et al* (2022) and Ibrahim *et al.* (2019) who reported that the major source of information for ginger production were ADP extension agents and Radio respectively.

Table 3: Distribution of the Respondents according to Sources of Information

Source	Frequency	Percentage*
Fellow farmers	133	77.3
Neighbours	35	20.3
Radio	16	9.3
Extension Agents	47	27.3
Newspapers	4	2.3
Ministry of Agriculture	5	2.9

Source: Field Survey, 2022

*Multiple responses recorded

Adoption of Ginger Production Technologies

This refers to the level by which the farmers in the study area adopted the various ginger production technology that were available to them. The result in Table 4 reveals that most (98.3%) of the farmers use farm operation technologies like tractor for ploughing and harrowing in the farm, 97.1% of the farmers adopted the use of recommended fertilizer and post-harvest technology. Also, 95.9 of the farmers adopted the use of recommended land preparation practices while 81.4% adopted the use of improved varieties. This implies that majority of the respondents adopted one form of ginger production technology or another. This could be because of the benefits of the used of improved production technologies such as higher yields. This finding is in agreement with Ibrahim *et al.* (2019) which reported that ploughing and harrowing with tractor were one of the major production technologies used by farmers in the study area. Furthermore, Nwaekpe *et al.* (2022) and Jakkawad *et al.* (2017)



reported that the use of the combination of manure and fertilizers were among the major production technologies adopted by farmers in the study areas. Also, Jakkawad *et al.* (2017) reported that the use of improved varieties was highly adopted in their study area.

Table 4: Distribution of the Respondents according to Adoption of Ginger Production Technologies

Technologies	Frequency *	Percentage
Improved varieties	140	81.4
Recommended land preparation practices	165	95.9
Recommended fertilizer	167	97.1
Farm operation technology	169	98.3
Post-harvest technology	167	97.1

Source: Field Survey, 2022

*Multiple responses recorded

Factors Influencing the Adoption of Ginger Production Technologies

This refers to those factors that may hinder or promote the adoption of ginger production technologies in the study area. The factors influencing the adoption of ginger production technologies are presented in Table 5. The result in Table reveals that the coefficient of sex (0.156) was positive and significant ($P < 0.10$) which implies that as the number of female engaged in ginger production increases adoption also increases and vice-versa. This is however contrary to the findings of Nwaekpe and Anyaegbunam (2022), on the study of the factors influencing ginger productivity among small holder farmers in Anambra and Enugu states of Nigeria which reported that the coefficient for sex was positive and not significant.

Also, the coefficient of Age (0.012) was positive and significant ($P < 0.10$), which implies that the older the farmer, the more the farmers want to adopt ginger production technologies. However, this is in line with the *a priori* expectation, as the older farmers tend to be more risk averse than the younger ones. This does not agree with the findings of Nwaekpe *et al.* (2022) which reported that the coefficient of age was negative and significant. Similarly, the coefficient of Educational Background (0.182) was positive and significant ($P < 0.01$) which implies that the more educated the farmer is the more he will tend to adopt more production technologies. This is because as an educated farmer he or she will understand the benefits he or she will derive from the adoption of ginger production technology. This finding is in line with that of Mazza *et al.* (2019) which reported that educational level of farmers was positive and significant in the study area.

Table 5: Factors Influencing the Adoption of Ginger Production Technologies

Variable	Coef	Std error	T-value
Constant	3.556	0.313	11.310***
Sex	0.156	0.092	1.698*
Age	0.012	0.007	1.737*
Marital status	0.98	0.69	1.419 ^{NS}
Household size	0.013	0.010	1.325 ^{NS}
Educational background	0.182	0.48	3.773***
Annual income	0.157	0.000	2.094**
Farm size	-0.043	0.026	-1.650 ^{NS}
Years of Experience	-0.018	0.008	-2.276**
Member of cooperative	-0.158	0.082	-1.933*
R ²	0.534		
T-statistics	5.914		

***= $P < 0.01$, **= $P < 0.05$, *= $P < 0.1$, NS= Not Significant

Source: Field Survey, 2022



Furthermore, the coefficient of annual income (0.157) was positive and significant ($P < 0.05$) which implies that the higher the income of farmers the more the farmer will want to adopt more ginger production technology. This is because farmers with higher income have more disposable income hence can venture into new areas of innovations. This finding is in agreement with Nwaekpe *et al.* (2022) which reported that the coefficient of income was positive and significant in the study area.

The coefficient of years of production experience (-0.018) was negative and significant ($P < 0.05$) which implies that the longer the farmers have been in ginger production the less they would want to adopt ginger production technologies. However, this is contrary to *apriori* expectations as more experience farmers are expected to be high adopters. This is contrary to the findings of Nwaekpe and Anyaegbunani (2022) which reported that years of farming experience was positive and significant in the study area. Also, the coefficient of member of cooperative (-0.158) was negative and significant ($P < 0.10$), which implies being a member of any form of cooperative lessen the farmer's chances of adopting more ginger production technology. This is however contrary to *apriori* expectation as being part of a cooperative provides farmers with benefits such as education and access to credit all of which favours adoption of innovation. This finding is contrary to Makarau *et al.* (2013) which reported that membership of organization was positive and significant in the adoption of ginger production technologies in Southern Kaduna State, Nigeria.

Constraints to the Adoption of Ginger Production Technologies

This refers to the challenges the farmers faced toward the adoption of ginger production technology in the study area. The result in Table 6 revealed that inadequate land, inadequate capital and inadequate processing facilities were the major constraints to the adoption of ginger production technologies with a mean of 3.09, 3.31 and 2.93, respectively. Also, poor market ($\bar{X} = 2.86$), pest and disease ($\bar{X} = 2.82$) and inadequate information ($\bar{X} = 2.78$) were among the notable constraints reported by the respondents toward the adoption of ginger production technologies in the study area. This result is in line with that of Makarau *et al.* (2013), Ibrahim *et al.* (2019) and Onwunali *et al.* (2023) which reported that inadequate capital and inadequate information are among the major constraints farmers faced in the study areas. Also, the result agrees with the findings of Jekkawad *et al.* (2017) who reported that very low market price for ginger was the major constraints of ginger production technology in the study area.

Table 6: Distribution of Farmers according to their Constraints to Adoption of Ginger Production Technology

Constraint	SA	A	D	SD	Mean	Decision
Inadequate processing facilities	66(38.4)	70(40.7)	21(12.2)	15(8.7)	3.09	S
Inadequate capital	82(47.7)	64(37.2)	24(14.0)	2(1.2)	3.31	S
Inadequate land	56(32.6)	48(27.9)	68(39.5)	-	2.93	S
Poor market	67(39.0)	38(22.1)	43(25.0)	24(14.0)	2.86	S
Pests and Disease	36(20.9)	78(45.3)	49(28.5)	9(5.2)	2.82	S
Inadequate information	38(22.1)	72(41.9)	48(27.9)	14(8.1)	2.78	S

Figures in parenthesis are percentages; Mean ≥ 2.5 =Significant. S=Significant. SA=Strongly Agree, A=Agree, D=Disagree, SD=Strongly Disagree.

Source: Field Survey, 2022



CONCLUSION AND RECOMMENDATIONS

The study concluded that most of the farmers in the study area adopted farm operations, post-harvest, fertilizer and land preparation on ginger production technologies. Furthermore, the farmers educational background, annual income and years of experience are major factors influencing the adoption of ginger production technologies. The study recommended that;

- i. Farmers should form cooperatives, as this will enable them to access more credit which will in turn translate to more investment and subsequently higher yields in ginger production.
- ii. Major stakeholders (Governments at all levels, Non-Governmental Organisations, Communities members etc) should invest in ginger processing and value chain in the study area, so as to add value to the product and make more profit.
- iii. More information about recommended ginger production technologies should be dispersed to farmers through various means such as extension agents, electronic media (television, radio, mobile phones etc). This will create awareness on the benefits of such technologies and enhance adoption that will lead to better yields and higher income.

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