Technoscience Journal for Community Development in Africa 2:1 (2021) 1–9
ISSN 2659-0573

Research Article

Determinants of cashew farmers' willingness to adopt bee pollination technology in Kwara State, Nigeria

O. P. Olabanji*, I. Ogunlade, S. A. Mustapha

Department of Agricultural Extension and Rural Development, Faculty of Agriculture, University of Ilorin, Ilorin, Nigeria

Abstract: The consistent drop in cashew nuts production due to decline in the population of animal pollinators is a growing concern for farmers and other actors in the cashew sector. Improving production through the use of technologies has been identified as a strategic way to combat the situation. This study is designed to assess the determinants of farmers' willingness to adopt assisted bee pollination technology in Kwara State, Nigeria. A multi-stage sampling procedure was used to select one hundred and sixty-two respondents for the study. The data collected using structured interview schedule were presented and analysed using descriptive statistics and binary logistic regression. Findings of the study revealed that the mean age of the respondents was 52.3 years, mostly males (94.4%) and were married (95.1%) with an average household size of 8 persons and 24.2 years of farming experience. Only 11.7% of the farmers had high level of awareness of the bee pollination practices and 63.5% are willing to adopt the technology. The logistic regression analysis revealed that marital status, household size and years of farming experience had significant contribution to the farmers' willingness to adopt the innovation at 0.05 level of significance. The study concluded that the cashew farmers are willing to adopt the technology despite their poor level of awareness suggesting they are high risk takers. It was recommended that adequate information should be made available to guide them in their adoption decisions.

Keywords: Bee pollination technology; cashew farmers; logistic regression; willingness to adopt

1. Introduction

Cashew (*Anacardium occidentale L.*) is an important tree crop in Nigeria with great exportation and economic development potentials. The crop which was originally introduced to combat desertification in Africa has within the last decade proven to possess valuable economic benefits. Cashew is known for its edible kernels and industrial oil, which are of great financial value to the economy of many developing countries (Monteiro et al., 2017). It is drought resistant crop that can grow successfully in area with extreme temperature and relatively low annual rainfall. The many importance of cashew makes it a topmost tree crop cultivated by most farmers in Nigeria.

The demand for cashew nuts on the world market is increasing annually (CBI, 2021). Today, most African countries, Nigeria inclusive, face the challenge of meeting the demands for cashew nuts and sustaining the cashew sector. To worsen this scenario, there has been consistent drop in cashew nuts production (Alawode & Adeniranye, 2020). According to Food and agriculture Organization (2020), about 90% of flowering plant species, including many important crops rely on animal pollinators such as birds, butterflies, bees etc. Globally, the population of these animal pollinators are declining.

In order to improve cashew production, breeders and other scientists are evaluating various options that can help farmers sustain cashew production. One of

* Corresponding author:
Email: folabanji21@yahoo.com

KWASU PRESS AND PUBLISHING

such efforts generated the introduction of bee-aided pollination (Matimelo, 2021). This was recommended based on the knowledge that low nut set of commercially grown cashew is attributable to lack of adequate pollination (Free, 1993).

In agriculture, pollination is an important input of crop production, comparable to any other input such as fertilizer, labor or pesticides (Alemberhe & Gebremeskel, 2016). Since cashew is dependent on pollination by insects, visitation of bees to its flowers is crucial to increase yield. Beekeeping in cashew orchard to enhance productivity is therefore an important technology that can boost cashew production in Nigeria.

Bees form an important component of agro-ecosystem in tropical regions. Like butterflies, bees are favourite flower visitors of cashew plantations and have been registered as cashew's major pollinators (Eradasappa & Mohana, 2016; Vanitha, & Raviprasad, 2019). Bee as a pollinator has the tendency to increase yield significantly (Stein et al., 2017). Cashew farmers in some African countries such as Ghana and Benin are aware of the benefits of integrating beekeeping with cashew farming (Aidoo et al., 2013). In this case, the bees do not only serve as pollinators but also as income generator through the sale of the bee products thereby improving the livelihood of those farmers. Unfortunately, this narrative is not yet so in Nigeria.

For Nigerian farmers to profit from and adopt any technology, and put them to use, they must be aware of it (Olabanji & Ogunlade, 2020). Farmers' awareness of the existence of beekeeping practices for the sustainability of cashew production and their willingness are important route towards adoption of the technology. In light of these, it is important to look into the external and internal characteristics of the farmers that might affect their willingness to adopt bee pollination technology. This study therefore considered how characteristics pertaining to the farmers could determine willingness to adopt bee pollination technology. Specifically, the objectives of the study were to:

1. determine the socio-demographic background of the cashew farmers,
2. assess the farmers' level of awareness of the bee-assisted pollination technology,
3. determine the factors influencing willingness to adopt the technology, and
4. identify possible constraints to the adoption of the technology.

2. Methodology

2.1. The Study area

The study was carried out in Kwara State, Nigeria. Kwara State which was created in 1967 covers eight percent of the total land area of Nigeria, that is an area of 74, 256 square kilometers. The predominant agricultural system is a combination of bush fallow and mixed cropping with emphasis on subsistence crop cultivation. The state extends from latitude 7° 45`N in its southern end, latitude 2° 45`E to the west and longitude 6° 40`E to south east. It has a total population of 3,192,893 (NBS, 2017) with a population density of 66 people/km^2. The State is typically agrarian. Eighty percent of the population resides in the rural areas and 90% of this rural population are farmers (Yusuf, Tiamiyu & Aliu, 2016). It lies exclusively within a tropical hinterland. The State has sixteen (16) Local Government Areas. Agricultural Development Project (ADP) classified the 16 LGAs into four (4) Agricultural zones, 23 blocks and 184 cells in consonance with ecological characteristics and cultural practices. The zones comprise Zone A (with headquarters at Kaiama), Zone B (with headquarters at Lafiaji), Zone C (with headquarters at Ilorin East) and Zone D (with headquarters at Igbaja). The population for the study comprises all cashew farmers in Kwara State.

2.2. Sampling technique and sample size

Four-stage sampling technique was used to collect the data. The first stage was a purposive selection of zone C and D due to the predominance of cashew production activities in the area. In the second stage, 2 Local Government Areas (LGAs) were purposively selected from each of the zones (Zone C: Asa and Ilorin East; Zone D: Irepodun and Oyun). This selection was based on the cosmopolitanism of farmers in that area making them early adopters of innovation in the State. In the third stage, 3 communities were randomly selected from each of the local government areas, making 12 communities in all. The communities were Ogbondoroko and Afon from Asa LGA; Oke-oyi and Lajiki from Ilorin East LGA; Ijara-isin and Edidi from Irepodun LGA; and Ilemona and Erin-ile from Oyun LGA. Lastly, a probability proportionate sample to size method was used to select the respondents from a list of cashew farmers compiled through the assistance of the community representatives. Fifty per cent of the farmers from the list in each community were randomly selected. Thus, the sample size comprised one hundred and sixty-two (162) respondents.

2.3. Measurement of variables

Data were collected using interview schedule. To determine farmers' level of awareness of bee pollination technology, ten questions on various aspects of the technology were asked. The respondents were made to respond *aware* or *not aware* to the questions. Each time a respondent indicated awareness; a score of 1 was given, not aware were scored 0. A respondent can have a maximum score of 10 and minimum of 0. Each of the respondents were categorized based on their scores into: High awareness for 5-10 positive responses; Low awareness for 1-4 positive responses; and No awareness if no positive answers was obtained. Willingness to adopt the technology was examined using dichotomous response 'willing =1', 'not willing =0'. Possible constraints that could prevent farmers adoption of the technology was assessed using 3-point likert type scale of 'very severe =2', 'severe =1'and 'not severe =0', such that the frequency values on the scale were added to obtain 3 and a mean score of 1; hence variables with mean scores of 1 or above were regarded as important constraint while mean scores below 1 were considered as not important constraint. Objectives 1, 2 and 4 were analyzed using descriptive statistics such as frequencies, percentages, means, and standard deviation while objective 3 was analyzed using binary logistic regression analysis at 0.05 level of significance. The choice of logistic regression was based on its ability to predict the outcome irrespective of the measurement scale of the given predictors whether nominal, ordinal, interval, or ratio (Sharma, 1996; Starkweather & Moske, 2011).

The model form for the predicted probabilities is given as:

$$\log \frac{p}{1-p} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_m x_m$$

$$\frac{P(Y)}{1-P(Y)} = e\beta o + \beta 1X1 + \beta 2X2 + \cdots \beta mX\beta m$$

Y is the dichotomous outcome (willingness to adopt bee assisted pollination technology):

X_1, X_2, X_3, X_4..............X_m are the predictor variables

Where,

X_1 = Sex of respondents (1 for male and 0 for otherwise)
X_2 = Age of respondents (in years)
X_3 = Marital Status (1 for married and 0 for otherwise)
X_4 = Educational Level (in years)
X_5 = Household Size (in numbers)
X_6 = Land Ownership (1 for self-owned 0 for otherwise)
X_7 = Years of Experience (in years)
X_8 = Number of Cashew planted (in numbers)
X_9 = Extension Contacts (1 for Yes 0 for otherwise)
X_{10} = Awareness of technology (1 for Yes 0 for otherwise)
$\beta o, \beta_1, \beta_2, \ldots, \beta m$ are the regression (model) coefficients
βo is the intercept.
= Error term

3. Results and discussions

3.1. Socio-economic characteristics of the respondents

Data in Table 1 reveals that majority (94.4%) of the respondents were males while about (5.6%) were females. Kiptot and Franzel (2012) mentioned that few women are involved in tree planting activities in many African countries due to cultural reasons which gives women limited rights to land except in isolated cases. Also, Nelson (2014) noted that women are more risk averse when compared to male counterpart and this often affect their willingness to adopt new technologies. The age distribution ranges from 29 to 78 years, averagely, the respondents were aged 52.3 years. This implies that the farmers are aging. Martey et al., (2014) and Mwangi and Kariuki (2015) mentioned that older farmers are assumed to have gained experience and assessed attributes of technology over time than younger farmers. Majority (95.1%) were married and 59.3% of them had non-formal education. Nankhumwa (2004) and Olabanji and Olabanji (2020) observed that married farmers due to their family obligations usually follow stepwise decision-making process on whether to adopt an innovation or not and on the extent of adoption. The relatively high percentage of farmers without formal education limits their chances of engaging in off-farm jobs to farming and other activities that requires no education. Though this could be a boost in the number of available farm labour, Mwirigi (2009) concluded that low education level is a restraining factor in the uptake of innovation among small scale farmers. A notable proportion of the respondents (59.9%) have 6-10 household size with an average of 8 persons. Household size has been linked to the availability of "own" farm labour in adoption studies. Amsalu and De Jan (2007) pointed out that household size had a significant and positive effect among the determinants of adoption and continued use of stone terraces for soil and water conservation in an Ethiopian highland watershed. The argument was that larger households have the capacity to relax the labour constraints required during the introduction of new technologies. Most of the farmers (66.0%) acquired their orchard land by inheritance. Land tenure provides the farmer with ownership and user rights which are necessary in long term projects and collateral which allows the farmer to access credit facilities to fund the investment (Mwirigi et al., 2009). The mean years of experience in cashew production by the respondents was 24.2 years. Most of the farmers have orchards with

Table 1: Distribution of respondents according to their socio-economic characteristics

Variables	Frequency (N)	Percentage (%)	Mean	Std. Dev
Sex				
Male	153	94.4		
Female	09	5.6		
Age of Respondents				
<20	0	0.0		
20-40	14	8.6	52.3 years	7.455
41-60	138	85.2		
>60	10	6.2		
Marital Status				
Single	07	4.3		
Married	154	95.1		
Divorced	01	0.6		
Educational Level				
Non-formal education	108	59.3		
Primary	44	28.1		
Secondary	09	8.1		
Tertiary	01	4.4		
Household Size				
1-5	45	27.8	8 Persons	2.631
6-10	97	59.9		
11-15	20	12.3		
Pattern of orchard land ownership				
Inheritance	107	66.0		
Purchased	32	19.8		
Rented	23	14.2		
Years of Farming Experience				
<10	05	3.1		
10-20	47	29.0		
21-30	60	37.0	24.2 years	8.423
>30	50	30.9		
Numbers of cashew trees planted				
<20	38	23.5		
21-40	41	25.3	43 trees	17.880
41-60	48	29.6		
>60	35	21.6		
Extension Contact				
Yes	12	6.8		
No	151	93.2		

Source: Field survey, 2019

cashew population of about 40 trees. More than two-third of the respondents (93.2%) have not received extension contacts in the last two years. Dolisca, et al., (2006) and Uwandu, et al., (2018) posited that the number of contacts with extension agents could translate to access to information which according to the innovation diffusion theory contributes to the awareness and subsequent adoption of an innovation.

3.2. Awareness of bee pollination practices

Farmer awareness on assisted bee pollination technology is expected to play a pivotal role in their adoption decisions. The result as shown in Table 2 indicated that a very large proportion of the respondents (75.3%) had no awareness of the technology, 13.0% had low level of awareness. While only 11.7% had a high awareness level of the technology. The high percentage of respondents with no awareness may be due to the impact of their poor educational background. Esturk and Oren, (2014) noted that educated farmers can easily access information from various sources, and can be able to generate knowledge out of those sources.

Table 2: Distribution of the farmers according to their level of awareness

Level of knowledge on DTMA	Frequency (N=162)	Percentages (%)
High awareness (5-10 scores)	19	11.7
Low awareness (1-4 scores)	21	13.0
No awareness (0 scores)	122	75.3

Source: Computed from field data, 2019

To get a deeper insight into the awareness level on the practices, the researcher made a specific question-wise percentage analyses of the farmers awareness. This is illustrated in Table 3. The cumulative average result in Table 3 indicates that 75.2% of the cashew farmers were not aware of the practices, only 24.8% of them were aware of the practices. The implication of these results is that there is low awareness of the technology and hence might affect the acceptance and subsequent adoption. Olabanji and Ogunlade (2020) posited that farmers need to be aware of the existence of a technology, its benefit, and usage for them to adopt it. Awareness enables farmers to learn about the existence of an innovation as well as the effective use of the technology and this facilitates its adoption. Farmers will only adopt the technology they are aware of or have heard about it.

Table 3: Percentage analysis of awareness of bee pollination practices

SN	Awareness Statement	Aware (%)	Not Aware (%)
1.	One or two bee hives per acre is ideal for bee assisted pollination orchards	18.5	81.5
2.	To attract bee pollinators, brightly coloured flower should be planted around the orchards during the rainy season	24.7	75.3
3.	Bee hives should be placed in or near cashew orchards	17.3	82.7
4.	Assisted pollination by deploying beehives can enhance cashew yield	30.9	69.1
5.	To promote bees that nest in the soil, bare patches of ground should be left unploughed	25.9	74.1
6.	In a bee-cashew farm weeding with herbicides should be avoided	34.0	66.0
7.	To preserve bee pollinators, pesticides should be applied just after sunset when bees are not flying around	37.0	63.0
8.	Use pesticides that are less toxic to bees such as neem or insect growth regulators	20.5	79.5
9.	Excessive use of pesticides should be avoided, cultural and mechanical pest control strategies should first be used	17.3	82.7
10.	Do not apply pesticides when cashew trees or nearby crops are flowering	21.6	78.4
	Cumulative Average	24.8	75.2

Source: Field Survey 2019

3.3. Willingness to adopt bee assisted pollination technology

Data in Table 4 reveals that 63.5 percent of the respondents are willing to adopt the bee assisted pollination technology. By contrast, 36.5 percent of the respondents declined willingness to adopt the practice. This means that the farmers will favourably be willing to accept a technology when they are informed of the potential benefits. Hall (2008) in his study of farmers' adoption, concluded that farmers are apparently willing to wait, either to be convinced of the benefits of the technology or to be convinced of its potential risks.

Table 4: Distribution of the respondents based on willingness to adopt the technology

SN	Willingness to Adopt	Willing (%)	Not willing (%)
1.	Enhancement of cashew yield through assisted pollination by deploying beehives	74.1	25.9
2.	Mounting of one or two bee hives per acre in the orchard for bee assisted pollination	64.8	35.2
3.	Planting of brightly coloured flower around the orchards during the rainy season to attract bee pollinators	43.2	56.8
4.	Placement of the bee hives in or around the cashew orchards	55.6	44.4
5.	Leaving bare patches of ground to promote bees that nest in the soil	61.7	38.3
6.	Preservation of natural vegetation of surrounding trees and shrubs to promote pollinators	80.2	19.8
7.	Application of pesticides just after sunset when bees are not flying around anymore	73.5	26.5
8.	Use of pesticides that are less toxic to bees such as neem or insect growth regulators	68.5	31.5
9.	Avoidance of excessive use of pesticides, use of cultural and mechanical pest control strategies first	52.5	47.5
10.	No application of pesticides when cashew trees or nearby crops are flowering	61.1	38.9
Cumulative Average		63.5	36.5

Source: Field survey 2019

3.4. Determinants of farmers willingness to adopt bee technology

Binary logistic regression model was used to identify the determinants of willingness to adopt the bee pollination technology. The model was chosen because there is widespread literature showing that farmers' adoption decisions can be analyzed using the model (Adesina et al., 2001; Pattanayak et al., 2003; Conteh et al., 2015; and Wondale, 2016). The results emanating from the model were presented in Table 5. From the Table 5, it is observed that the estimated odds ratio 0.149 indicates those farmers who are married are 0.149 times more likely to be willing to adopt the technology compared to those who were not married controlling for other variables in the model. Similarly, the estimated odds ratio 0.435 indicates that farmers with more household members are 0.435 times more likely to show willingness to adopt the bee pollination technology compared to those with fewer households controlling for other variables in the model. The estimated odds ratio 1.058 indicates that farmers with more years of farming experience are 1.058 times more likely to show willingness to adopt the innovation. Also, the estimated odds ratio 1.242 indicates that with more awareness farmers will be 1.242 times more likely to be willing to adopt the bee technology. Based on these findings, it could be inferred that a married farmer is more likely to have a bigger household than others, hence the need to provide more food as required by the household. This makes farmers to seek for ways to improve their production capacity to meet the household needs. The larger the family size the more labour is available to adopt an innovation. Assisted bee pollination technology requires substantial monitoring and so the farmer decision to accept such innovation may be influenced by the availability of family labour proxied by the household size. Mwangi and Karuiki, (2015) posited that human capital of a farmer is assumed to have a significant influence on farmers' decision to adopt new technologies. The years of farming experience of the farmers in cashew production enables a famer to have witnessed trends overtime that could prompt need for improvement in production system. Ntshangase, Muroyiwa and Sibanda (2018) indicated that length of time of farming business and experience in farming activities can enhance the tendency to adopt new technology. Willingness to adopt an innovation can be prompted only when farmers are aware of them. Simtowe et al. (2012) reported that technology awareness is an important requirement for adoption to occur.

3.5. Constraints to adoption of bee pollination technology

Table 6 shows that inadequate technical knowledge of the bee pollination technology ranked first among the possible constraints that can affect the adoption of the technology with a weighted mean score of 1.62.

Table 5: Logistic Regression on Willingness to adopt bee pollination technology

	Variables	B	S. E	Wald	Exp(B)	95% C.I for EXP(B)	
						Lower	Upper
Step 1	(Constant)	24.395	13062.914	0.000	39306081306.614		
	Sex	-19.725	13062.913	0.000	0.000	0.000	.
	Age	-0.017	0.022	0.562	0.983	0.941	1.027
	Marital Status	-1.903*	0.924	4.243	0.149	0.024	0.912
	Educational Level	0.355	0.327	1.180	1.426	0.752	2.705
	Household Size	-0.833*	0.351	5.648	0.435	0.219	0.864
	Land ownership	0.277	0.274	1.021	1.319	0.771	2.255
	Years of Experience	0.057*	0.027	4.425	1.058	1.004	1.115
	Number of Cashew planted	0.009	0.011	0.588	1.009	0.987	1.031
	Extension Contacts	-0.801	0.773	1.073	0.449	0.099	2.042
	Awareness	0.217*	0.489	0.197	1.242	0.476	3.239
	Constraint	-0.510	0.471	1.173	0.601	0.239	1.511

Data computation, 2019

*p< 0.05; Hosmer and Lemeshow Goodness-of-Fit= 1.63, -2 Log L= 149.825

Table 6: Frequency and Percentage distribution of respondents based on perceived constraint to adoption of bee pollination technology

SN	Possible Constraints	Very Severe	Severe	Not a Constraint	WMS	Rank
1.	Bees are not friendly insects	119(73.4)	21(13.0)	22(13.6)	1.60	3rd
2.	Bees are exposed to all kinds of diseases	90(55.6)	25(15.4)	47(29.0)	1.27	9th
3.	The practice could be strenuous	100(61.7)	28(17.3)	34(21.0)	1.41	7th
4.	Owning or hiring bee hives is cost implicative	120(74.1)	21(13.0)	21(13.0)	1.61	2nd
5.	Poor land tenureship	99(61.1)	43(26.5)	20(12.3)	1.49	8th
6.	Managing the bee hives could be time demanding	106(65.4)	32(19.8)	24(14.8)	1.51	6th
7.	Inadequate technical knowledge of the practice	122(69.1)	19(11.7)	21(13.00	1.62	1st
8.	The practice may be labour intensive	113(69.8)	30(18.5)	19(11.7)	1.58	5th
9.	Fear of the bees escaping into the wild/ risk of losing the colony	115(71.0)	27(16.7)	20(12.3)	1.59	4th
10.	Not compatible with the existing practices and cultural believes	61(37.7)	34(21.0)	67(41.3)	0.96	10th

Source: Field Survey 2019; Bench Mark =1

this was followed by the considerations that owning or hiring bee hives could be cost implicative (WMS= 1.61), unfriendly nature of bees (3rd, WMS=1.60), fear of bees escape (4th, WMS=1.59), perceived labour concerns (5th, WMS=1.58), perceived time demand (6th, WMS=1.51), perceived energy demand (7th, WMS=1.41), poor land tenureship (8th, WMS=1.49), possibility of the bees playing host to diseases (9th, WMS=1.27), compatibility with existing practices and cultural believes (10th, WMS=0.96). Farmers are usually skeptical about practices that will make them incur additional production cost and strain their available labour.

4. Conclusion and recommendations

The results from the study shows that most of the cashew farmers were not aware of the technology. In spite of this, a large proportion of them indicated willingness to adopt the technology. This implies that the farmers are eager to try new things when information are made available to them. It can be concluded that these farmers have low risk aversion. Therefore, making information available to the farmers will enable them make informed decision to adopt the technology. Extension service system is the most important public information service in Nigeria, with the responsibilities of transmitting agricultural information to famers. Inadequacy, in extension workers' contact with cashew farmers could restrain the development of the cashew sector. The study recommends that more extension services should be deployed to service cashew farmers. Adequate training on the bee pollination technology should be promoted to ease the adoption of the technology.

References

Adesina, A.A., Mbila, D., Nkamleu, G.B., & Endamana, D. (2001). Econometric analysis of the determinants of adoption of alley farming by farmers in the forest zone of southwest Cameroon. Agriculture, *Ecosystem and Environment*, *80*(3), 255–265.

Aidoo, K.S, Adzanyo, M, Weidinger, R & Tandjiekpon, A. (2013). The study of the effects of integrating beekeeping into cashew farms in Ghana and Benin. www.africancashewinitiative.org/imglib/downloads/140218_beekeeping%20study.pdf

Alemberhe, K, & Gebremeskel, K. (2016). A Review on: Role of Honey Bee Pollination in Improving Crop Productivity and Seed Quality in the Northern Ethiopia. *Food Science and Quality Management, 47,*7-13

Amsalu, A. & De Jan, G. (2007). Determinants of adoption and continued use of stone terraces for soil and water conservation in an Ethiopian highland watershed. *Ecological economics, 61,* 294–302.

Centre for the Promotion of Imports from developing Countries (2021). The European market potential for cashew nuts. https://www.cbi.eu/market-information/processed-fruit-vegetables-edible-nuts/cashew-nuts/market-potential accessed 13th July, 2020

Conteh, M.H., Moiwo, J.P & Yan, X. (2015). Using a Logistic Regression Model to Analyze Alley Farming Adoption Factors in Sierra Leone. *Small-scale Forestry, 15*(1). doi:10.1007/s11842-015-9311-0

Dolisca, F., Carter, D. R., McDaniel, J.M., Shannon, D.A. & Curtis, M. J., (2006). Factors influencing farmers' participation in forestry management programs: A case study from Haiti. *Forest Ecology and Management, 236*, 324–331.

Eradasappa, E. & Mohana, G. S (2016). Role of pollination in improving productivity of cashew -A review. *Agricultural Reviews*, *37*(1), 61-65.

Estruk, O. & Oren, M. (2014). Impact of household socio-economic factors on food security: Case of Adana, Turkey. *Pakistan Journal of Nutrition*, *13*(1), 1-6.

Food and Agriculture Organisation (2020). Nectar Sucrose Proportion type of Pollination. http://www.fao.org/agriculture/crops/thematic-sitemap/theme/biodiversity/pollination/en/ accessed on 3rd December, 2020

Free, J. B. (1993). *Insect Pollination of Crops.* 2nd Enlarged Edition, Academic Press, London, 684.

Hall, C. (2008). Identifying farmer attitudes towards genetically modified (GM) crops in Scotland: are they pro- of anti-GM? *Geoforum*, *39*(1), 204-212.

Kiptot E. & Franzel S. (2012). Gender and agroforestry in Africa: a review of women's participation. *Agroforestry Systems*, *84*, 35–58. https://doi.org/10.1007/s10457-011-9419-y

Martey E., Wiredu A.N., Etwire P.M., Fosu M., Buah S.S.J., & Bidzakin J. (2014). Fertilizer adoption and use intensity among smallholder farmers in Northern Ghana: A case study of the AGRA soil health project. *Sustainable Agriculture Research*, *3*(1), 24-36.

Matimelo M. (2021). Increasing pollinators for more fruits in cashew. Available at https://www.plantwise.org/KnowledgeBank/factsheetforfarmers/20177801255 accessed on 13th July, 2020

Monteiro F., Catarino L., Batista D., Indjai B., Duarte M.C., & Romeiras M.M. (2017). Cashew as a High Agricultural Commodity in West Africa: Insights towards Sustainable Production in Guinea-Bissau. *Sustainability*, *9*(9),1-14. doi:10.3390/su9091666

Mwangi M. & Kariuki S. (2015). Factors determining adoption of new agricultural technology by smallholder Farmers in developing countries. *Journal of Economics and Sustainable Development*, *6*(5), 208-216.

Mwirigi, J.W., Makenzi, P.M. & Ochola, W.O. (2009) Socio-economic constraints to adoption and sustainability of biogas technology by farmers in Nakuru Districts, Kenya. *Energy for Sustainable Development, 13,* 106–115

Nankhumwa, T.O. (2004). Dynamics costs of soil degradation and determinants of adoption of soil conservation technologies by smallholder farmers in Malawi. PhD Thesis, University of Pretoria.

National Bureau of Statistics (NBS), (2017). Demographic Statistics Bulletin. Federal Republic of Nigeria. May, 2018.

Nelson J. (2014). Are women really more risk-averse than men? A re-analysis of the literature using expanded methods. *Journal of Economic Surveys* 29(3). doi:10.1111/joes.12069

Ntshangase, N.L., Muroyiwa B., & Sibanda B. (2018). Farmers' Perceptions and Factors Influencing the Adoption of No-Till Conservation Agriculture by Small-Scale Farmers in Zashuke, KwaZulu-Natal Province. *Sustainability, 2018*, 10, 555.

Olabanji O.P & Olabanji F.A (2020). Risk Management Attitude and Practices of Backyard Poultry Farmers in Ifelodun Local Government Area of Kwara State, Nigeria. *Journal of Information, Education, Science and Technology (JIEST*), *6*(1), 105-110.

Olabanji, O.P., & Ogunlade, I. (2020). Scale Development and Validation for Farmers' Knowledge Exchange: Implication for Agricultural Extension in Nigeria. *Journal of Bangladesh Agricultural University*, *18*(4), 1029–1034.

Pattanayak S.K., Mercer D.E., Sills E., & Yang J. (2003). Taking stock of agroforestry adoption studies. *Agroforestry System*, *57,* 173–186

Sharma, S. (1996). *Applied multivariate techniques*. United States: John Wiley & Sons, Inc

Simtowe, F., Kassie, M., Diagne, A., Asfaw, S., Shiferaw, B., Silim, S., & Muange, E., (2011). Determinants of agricultural technology adoption: The case of improved pigeon pea varieties in Tanzania. *Quarterly Journal of International Agriculture, 50*(4), 325-345.

Starkweather, J. & Moske, A. K. (2011). Multinomial Logistic Regression. Retrieved from http://www.unt.edu/rss/class/Jon/Benchmarks/MLR_JDS_Aug2011.pdf

Stein K, Coulibaly D, Stenchly K, Goetze D, Porembski S, Lindner K, Konaté S, & Linsenmair E.K. (2017). Bee pollination increases yield quantity and quality of cash crops in Burkina Faso, West Africa. *Science Reports*, *7*, 17691. doi: 10.1038/s41598-017-17970-2

Uwandu, C.N., Thomas, K.A & Okoro, C.M. (2018). Utilization of Agricultural Information Sources and Adoption of Animal and Crop Technologies Among Farming Households in Imo State, Nigeria. *Journal of Agricultural Extension*, *22*(1), 143-155. https://dx.doi.org/10.4314/jae.v22i1.13

Vanitha K, & Raviprasad T.N (2019). Diversity, Species Richness and Foraging Behaviour of Pollinators in Cashew. *Agricultural Research, 8,*197–206

Wondale L., Molla D. & Tilahun D. (2016). Logit analysis of factors affecting adoption of improved bread wheat (Triticum aestivum L.) variety: The case of Yilmana Densa District, West Gojam, Ethiopia. *Journal of Agricultural Extension and Rural Development*, *8*(12), 258-268. doi: 10.5897/JAERD2016.0768

Yusuf T.M., Tiamiyu S.A & Aliu R.O (2016). Financial analysis of poultry production in Kwara State, Nigeria. *African Journal of Agricultural Research*. *11*(8), 718-723.