Factors influencing demand and supply of formal credit among vegetable producers in north west, Nigeria.

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Abstract

This research evaluated factors influencing demand and supply of formal credit among vegetable producers in North West, Nigeria. Primary data were used based on a well-designed questionnaire. The data were analyzed using descriptive statistics, Heckman 2-stage model, Tobit regression model, and principal component analysis. The results show that the mean age, years of vegetable farming experience, education level approximate 45 years, 8 years, and 11 years respectively. In the 2nd stage of Heckman model, the value of saving, level of education, income from vegetable production, cost of borrowing, availability of collaterals, distant from financial institutions, and inverse mill ratio were significantly different from zero in influencing the amount of formal credit demanded. The experiences in lending, liquidity of lender, interest rate, business leverage and type of credit were significant different from zero in influencing the supply of credit by financial institutions. The utmost constraints facing the vegetable producers were lack of collaterals (1st), insufficient loan approval (2nd), high interest rate (3rd). The utmost constraints facing the financial institutions were high rate of default(1st), lack of skilled staff (2nd), and insufficient capital (3rd). Interest rate of single digit, more bank branches, with sufficient capital devoid of cumbersome administrative procedures are suggested.

Keywords: Demand; Supply; Formal Credit and Heckman Selection; Tobit Regression and Vegetable Producers; North West; Nigeria.

1. Introduction

1.1. The Significance and Importance of Vegetables

Vegetables can be defined as plant parts, or plants, edible leaves of different colors having less starch that can be eaten with meal, commonly boiled, salted, used as salads, and have been a significant part of human diets around the globe or world (United State Agency for International Development (USAID), 2019; Agbugba *et al.,* 2013). Vegetables are widely grown by smallholder farmers in sub-Saharan Africa including Nigeria due to its economic and nutritional importance. Vegetables make a significant contribution to economy of Nigeria by generating employment and income for smallholder farmers. Vegetables in fresh form have 75% water, and 25% dry matter (Ajayi and Nwalieji, 2010). Vegetables are good source of anti-oxidants, phytochemicals, essentials micro-nutrients and it's a good source of vitamin B6,

carbohydrate, dietary fiber, protein, vitamin K, vitamin A, minerals, magnesium, potassium, calcium, thiamin, folate, and iron (De la Rosa *et al.,* 2010; Aju and Popoola, 2010). According to FAO (2024), in 2021 and 2022, approximate 15.8 million tonnes, and 16.1 million tonnes of vegetables are produced in Nigeria, respectively. In 2021 and 2022, the area harvested for vegetables in Nigeria approximate 4.0 million ha, and 4.3 million ha, respectively. The world production of vegetables in 2021 and 2022 approximate 1160.6 million tonnes, and 1173.1 million tonnes, respectively (FAO, 2024). It can generate high yield per unit area of land and thus can generate high income for vegetable producers (Nwaiwu *et al.,* 2022). Vegetable value chains significantly contributes to income and food requirements of poor farmers in developing nations like Nigeria (Fischer *et al.,* 2020). Vegetables producers are faced with low production, inadequate access to production inputs such as credit, fertilizers, chemicals, and seeds, poor market linkages, difficulties in accessing high value markets, low farm efficiencies among other factors (Mburu *et al.,* 2014). Vegetables as affordable dietary sources, that is sustainable, serves as source of livelihood diversification for smallholder farmers, generate profits, create job opportunities for the populations and reduce poverty (Shettima *et al.,* 2016; Olanrewaju *et al.,* 2021). Vegetable production in sub-Saharan Africa has evolved overtime (Alulu *et al.,* 2021), producers gain profits from the sales of these vegetables, they have limited production capacity as a result of many constraints, therefore the supply does not meet up with the demand.

1.2. The Importance of Credit to Smallholder Farmers and the Research Gap

Agricultural credit can be defined as all advances and loans granted for borrowers, the smallholder farmers, to service and finance production related farm activities in agriculture such as crop, fisheries, forestry, marketing of agricultural products, and distribution related to all these activities (Alabi *et al.,* 2016). Credit can be defined as small loan or advances given to small-scale farmers, often secured, unsecured or awarded based on applicants' character and business cash flow (CBN, 2012). In other words, credit can be defined as the ability to obtain money, goods and services presently in exchange for promise to pay in future. There is a gap between supply and demand of credit among smallholder farmers particularly vegetable producers (Olasunkanmi, 2012). Credit demand refers that a smallholder farmer has chosen to borrow and has already borrowed (Tinh *et al.,* 2010). Demand for credit can be defined as the borrowers' choice of the optima loan amount. According to Chen and Chivaku (2008) the demand for credit is the likelihood that a smallholder farmers answered 'yes' to the question' did you apply for credit before?' and it include also those smallholder farmers that are discouraged (but needed credit) and those already applied but constrained. On the supply side, financial institutions have for many years now not willing to lend to smallholder farmers who form the major parts of the farming population (Alabi *et al.,* 2016). Availability of credit and timely access to credit are significant to smallholder farmers to procure the required farm inputs and equipment's necessary to carry out farm operations (Saboor *et al.,* 2009). Credit is a significant part of agricultural production and access to finance (credit) guarantee food security and increased output (Diange and Zeller, 2000). Credit can enhance smallholder farmers' profitability, managerial efficiency, and efficient allocation of resources (Bashir *et al.,* 2010). An efficient credit market enables the smallholder farmers the privilege to meet the consumption requirements and adequate input use, thus leading to improvement in livelihood of smallholder farmers (Saqib *et al.,* 2018). In sub-Saharan Africa, lack of credit form a major problem to adoption and use of modern innovations and improved inputs for farming (Akudugu *et al.,*

2012). Lack of finance (credit) limit the potentials of smallholder farmers to purchase farm inputs, increase efficiency and enhance productivity. Lack of finance (credit) give rise to inadequate use of improved farm inputs such as pesticides, fertilizers, seeds, and others (Nyoro, 2002). Inadequate capital (credit) is a main underlying factor of low productivity because smallholder farmers cannot finance their farm operations. If smallholder farmers are expected to play a significant role to increasing demand for food, they should be provided with credit, Access to credit would enable smallholder farmers plant early, choose good varieties, and stand for sustainable practices (Ogunleye, 2000). For formal credit to be effective, it depends on accessibility, availability, and demand by the smallholder farmers. Agriculture is capital intensive with investment in buildings, farmland, equipment, machineries, crop and livestock, hence credit plays as a significant source of liquidity and responses to risk. The major differences between informal and formal sources is that the former operates outside the regulations and rules imposed by the formal financial institutions (Lemessa and Gemechu, 2016). On the supply side, financial institutions do not serve the need of smallholder farmers due to high transaction cost associated with loans and the high risk involved in farm operations. Efforts to deliver financial services and formal credit to smallholder farmers over the years have failed (Otunaiya *et al.,* 2014). There is no adequate data on demand and supply of formal credit among vegetable producers in the north west, Nigeria.

1.3. The Research Questions
The study provided answers to the following research questions:
(i) What is the socio-economic characteristics of vegetable producers?
(ii)What are factors influencing the demand of formal credit among vegetable producers?
(iii)What are factors influencing the supply of credit among the financial institutions?

(iv) What are the major constraints faced by vegetable producers in the study area?

1.4. Objectives of the Study
The aim of the paper is to analyzed factors influencing demand and supply of formal credit among vegetable producers in North West, Nigeria. Specifically, the objectives are:
(i) determine the summary statistics data of factors of interest,
(ii)evaluate the factors influencing the demand of formal credit among vegetable producers,
(iii)estimate the factors influencing the supply of formal credit to vegetable producers, and
(iv) determine the major constraints faced by vegetable producers and financial credit institutions.

1.5. The Hypotheses of the Study
This study provided answers to the following null-hypotheses:
$H0_1$: There is no significant relationship between the selected independent variables (socio-economic, value of savings, cost of borrowing, available collaterals, and distant to financial institutions) and demand for formal credit among vegetable producers.
$H0_2$: There is no significant relationship between the selected independent variables (experience in lending, liquidity of the lender, interest rate, business leverage, and type of credit) and supply of formal credit among financial institutions.

2. Materials and methods

This study was conducted in Kano and Kaduna States, Nigeria. The two states were randomly selected through ballot-box methods. In addition, the two states are also known to be the highest vegetable production in the north west region. The sample frame of vegetable producers in the study area approximately 171. A multi-stage sampling technique was used, at the fourth stage, a proportionate and random sampling method was to select 120 vegetable producers, while purposive sampling was used to select all the

targeted population of 30 financial institutions from each state. All the financial institutions identified were specifically chosen through purposive sampling method because of their impact, size and relevance to the research questions. Primary data were used based on a

well-designed questionnaire, the reliability and validity test was conducted with reliability coefficient of 81%. The sample number of vegetable producers was based on the documented Yamane (1967) formula given as:

$$n = \frac{N}{1+N(e^2)} = \frac{171}{1+171(0.05^2)} = 120 \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where,

n = The sample number

N = The sample frame of vegetable producers (Number for the 2 States)

The data were analyzed using descriptive and inferential statistics as follows:

$$DL_i = y_0 + \sum_{n=1}^{6} y_k X_k + \mu_i \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where,

DL_i =Decision to Demand for Credit (1, Demand; 0, Otherwise)

X_1 =Value of Savings (Naira)

X_2 = Level of Education (Years)

X_3 = Income from Vegetable Production (Naira)

2.1. Heckman Selection Model
This follows Orinda *et al.* (2017) the selection model is explicitly stated as:

2.1.1.   The First Stage (The Decision Stage):

X_4 = Cost of Borrowing (Naira)

X_5 = Experience in Credit Use (Years)

X_6 = Distant to Financial Institution (Kilometer)

y_0 = Constant Term

μ_i = Noise Term

2.1.2.   The Second Stage (The Outcome Stage):

$$AA_i = \alpha_0 + \sum_{n=1}^{8} \alpha_k Z_k + \varepsilon_i \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

AA_i = Amount of Loan Demanded (Naira)

Z_1 = Value of Savings (Naira)

Z_2 = Level of Education (Years)

Z_3 = Income from Vegetable Production (Naira)

Z_4 = Cost of Borrowing (Naira)

Z_5 = Availability of Collateral (1, Yes; 0, Otherwise)

Z_6 = Experience in Credit Use (Years)

Z_7 = Distant to Financial Institutions (Kilometer)

Z_8 = Inverse Mill Ratio (Number)

α_0 = Constant Term

ε_i = Noise Term

2.2. Tobit Dichotomous Regression Model
The model follows Akudugu (2012), Kehinde and Bamire (2023) is stated explicitly as:

$$LS_i^* = \beta_0 + \beta_1 P_1 + \beta_2 P_2 + \beta_3 P_3 + \beta_4 P_4 + \beta_5 P_5 + \mu_i \ldots\ldots\ldots\ldots\ldots (4)$$

$$LS_i = \frac{\text{Amount of Credit Supplied to Vegetable Producers}}{\text{Amount of Credit Applied by Vegetable Producers}} \ldots\ldots\ldots\ldots (5)$$

$$LS_i^* = \begin{cases} 0, & if \ LS_i \le 0 \\ 1 = LS_i > 0 \end{cases}$$

Where,

LS_i^* = Latent or Unobserved Amount of Loan Supplied by Financial Institution (Naira)

β_0 = Constant Term

β_1 - β_6 = Regression Coefficients

P_1 = Experience in Lending (Years)

P_2 = Liquidity of the Lender (Naira)

P_3 = Interest Rate (%)

P_4 = Business Leverage of Credit Institutions (Naira)

P_5 = Type of Credit (1, Collaterals; 0, Otherwise)

μ_i = Noise Term

2.3. PCA (Principal Component Analysis)

The constraints faced by vegetable producers and financial institutions were submitted to PCA, the model will reduce many interrelated constraints to few unrelated ones. The principal Component Analysis is stated thus:

$$x = (x_1, x_2, x_3, \ldots, x_p) \quad (6)$$

$$\alpha_K = \left(\alpha_{1k}, \alpha_{2k}, \alpha_{3k}, \ldots \alpha_{pk}\right) \quad (7)$$

$$\alpha_k^T X = \sum_{j=1}^{p} \alpha_{kj} X_j \quad (8)$$

$$Var = \left[\alpha_k^T X\right] \text{ is Maximum} \quad (9)$$

Subject to:

$$\alpha_k \alpha_K = 1 \quad (10)$$

and

$$cov\left[\alpha_1^T X - \alpha_2^T X\right] = 0 \quad (11)$$

The variance of each of the principal components are:

$$Var\left[\alpha_k^T X\right] = \lambda_k \quad (12)$$

$$S = \frac{1}{n-1}(X - X)(X - \overline{X})^T \quad (13)$$

$$S = \frac{1}{n-1}\sum_{i=1}^{n}(X_i - \overline{X_i}(X_i - \overline{X_i})^T \quad (14)$$

Where,

X = Vector of p Random Variables

α_k = Vector p Components

λ_K = Eigen Value

T = Transpose

S = Covariance Matrix

3. Results and discussion

3.1. Summary Information of Factors of Interest

The summary figures of factors of interest is presented in Table 1. They include the units of measurement, mean and standard deviation of each of the variables of interest used in the estimation. Approximate 80% and 81% of samples vegetable producers were male and married respectively. The average age, years of vegetable farming experience, and educational level approximate 45 years, 8 years, and 11 years respectively. Similarly, the mean farm size, household size, amount of credit accessed approximate 1.29 ha, 5, 75, 741.67 Naira respectively. This communicate the fact that the vegetable producers were young, energetic, agile, and resourceful. This represent that the vegetable producers had formal education, and thus can read, write and under goes all administrative procedure requires for demanding and accessing finance from financial institutions. This research corresponds to the work of Kehinde and Bamire (2023) who obtained an average age of 41.64 years and 7.44 years of farming experience when determining demand and supply of micro-credit among catfish farmers in Osun State, Nigeria.

Table 1. Summary Figures of Variables of Interest.

Variables	Unit of Measurement	$\bar{X}_i$	SD
Age	Years	45	13.45
Male	1, Male; 0, Female	0.80	0.61
Married	1, Married; 0, Others	0.81	0.42
Household Size	Number	5.00	2.21
Years of Farming Experience	Years	8.43	4.25
Farm Size	Hectares	1.29	0.95
Amount of Credit Accessed	Naira	75, 741.67	37,021.06
Educational Level	Years	11.47	5.80

Source: Field Survey (2024)

3.2. The Factors Influencing the Demand of Formal Credit among Vegetable Producers, The Probit -Decision Stage of Heckman 2 Stage Model

The result of the 1st stage which if the decision stage of Heckman 2 stage model is presented in Table 2. The regression stimulus influencing the demand of formal credit among vegetable producer is considered. All the regression coefficients were positive except the cost of borrowing that has negative coefficient, and this is consensus with a priori expectation. The cost of borrowing, experience in credit use, and distant to financial institutions among vegetable producers were significantly different from zero at 1% probability level, respectively. The value of saving, and level of education, are significant different from zero at 5% probability level, respectively. Similarly, income from vegetable production is significantly different from zero at 10% probability level.

The coefficient of value of saving was estimated at 0.2245, the marginal value was evaluated at 0.0572. A 1% increase in the value of saving, while keeping all other factors fixed will give rise to 5.72% increase in the demand for formal credit among vegetable producers. This study is supported with the findings of Akudugu (2012) who obtained a significant relationship between savings and demand for credit among farmers in Ghana. Also, Akudugu *et al.* (2009b) and Akram et al. (2008) reported that savings form a basic requirement of accessing credit from formal financial institutions. A 1% increase in the level of education keeping all stimulus fixed will give rise to 14.16% increase in the demand of formal credit among vegetable producers. This finding is supported with findings of Oladeebo and Oladeebo (2008) who reported that highly educated household heads are more likely to have stable incomes and are better able to obtain finance from both formal and informal institutions making them more prone to take risks than less educated farmers. The coefficient of income from vegetable production was estimated at 0.1789, the marginal value was approximately 0.0464. A 1% increase in income of vegetable producers, while keeping all other predictors constant will give rise to 4.64% increase in the demand for formal credit. This finding is supported with Nwaru *et al.* (2011) and Chen and Chivaku (2008) who documented a positive a significant relationship between credit demand and farm income. Similarly, a 1% increase in the cost of borrowing, interest rate inclusive keeping all other stimulus fixed will give rise to 18.15% decrease in demand of formal credit among vegetable producers. The coefficient of experience in credit use was estimated at 0.1271, the marginal value was approximately 0.0329. A 1% increase in experience in credit use while keeping all other factors constant will give rise to 3.29% increase in demand for credit among vegetable producers. The distant to financial institutions conformed to the a priori expectations of negative (-0.0429) relationship with the probability of vegetable producers demanding formal credit from financial institutions. The negative relationship between the distance to the

financial institutions and the probability of demanding for formal credit from financial institutions by vegetable producers is supported with the findings of Fakayode and Rahji (2009) and Ayamga *et al.* (2006) who reported that the closer the source, the higher the probability of the decision to demand for formal credit and vice versa. The Pseudo R^2 of 0.6999 point to the fact that 69.99% of all stimulus included in the Heckman 1ˢᵗ stage model was able to estimate the likelihood of vegetable producers to demand for formal credit from financial institutions. The LLF (Log Likelihood Function) of-95.6954 is statistically different from zero at 1% level of significant. This is to confirmed the likelihood of

the stimulus included in the 1ˢᵗ stage of Heckman model jointly estimates the likelihood of the vegetable producers deciding to demand formal credit from financial institutions. This symbolize that the data and model is of good fit. This work is in accord with result of Ayamga *et al.* (2006) and Fakayode and Rahji (2009) who documented that the nearer the financial institutions to the vegetable producers the higher the likelihood to demand for formal credit and vice versa. This work is in consensus with the outcome of Akudugu (2012) who documented that savings, and distance are significant stimulus influencing the demand of credit among farmers in Ghana.

Table 2. Heckman Two Stage (The Decision Stage), The Probit Model

Variables	Coefficients	$\dfrac{\delta y}{\delta x}$	Standard Error	Z	$P > \lvert Z \rvert$
Value of Saving	0.2245***	0.0572	0.0742	3.03	0.003
Level of Education	0.5457**	0.1416	0.2431	2.25	0.026
Income from Vegetable Production	0.1789*	0.0464	0.0948	1.89	0.059
Cost of Borrowing	-0.6999***	-0.1815	0.2596	-2.69	0.007
Experience in Credit Use	0.1271***	0.0329	0.0309	4.12	0.000
Distant to Financial Institution	-0.0429***	-0.0111	0.0136	-3.16	0.002
Number of Observation	120				
Diagnostic Statistics					
LR_{χ^2} (6)	81.93				
Pseudo R^2	0.69998				
LLF (Log Likelihood Function)	-95.6954				
Prob $>_{\chi^2}$	0.00000				

Source: Field Survey (2024)

3.3. The Factors Influencing the Amount of Formal Credit Demanded among Vegetable Producers, The OLS -Outcome Stage of Heckman 2-Stage Model

The outcome stage of Heckman 2 stage model is presented in Table 3. The regression stimulus influencing the amount of credit demanded among vegetable producer is considered. All the stimulus included in the regression model has positive coefficients except the cost of borrowing that has negative coefficient, this is conformity with a priori expectation. The level of education, and cost of borrowing are significantly different from zero at 1% probability level. In addition, the income from vegetable production, availability of

collaterals, experience in credit use, and IMR (inverse mill ratio) are all different from zero at 5% level of probability. Similarly, the value of saving is different from zero at 10% probability level. The coefficient of value of savings was estimated at 0.053. A 1% increase in value of savings, while keeping all predictors fixed will give rise to 5.3% increase in amount of formal credit demanded by vegetable producers. This outcome is supported with the findings of Akudugu (2012) who obtained positive (3.2476) and significant relationship between value of savings and demand for credit among farmers in Ghana. Similarly, a 1% increase in level of education keeping all other stimulus fixed will

give rise to 36.4% increase in amount of formal credit demanded from financial institutions among vegetable producers. The income from vegetable production estimated at (0.052) and significantly different from zero at 5% probability level. This finding is supported with the result of Kehinde and Bamire (2023) who obtained positive and significant coefficient approximately 2.972 between farmers' income and demand for micro-credit among fish farmers in Osun state, Nigeria. This may be explained by the possibility of re-investing farm profits in commercial enterprise which increase credit demand. The vegetable producers with high incomes are also more likely to receive formal credit from lenders since they have a better probability to repay the loan. Also, a 1% decrease in cost of borrowing, interest rate inclusive while keeping all other regressors fixed will give rise to 17.32% increase in amount of formal credit demanded from formal institutions among vegetable producers. The coefficient of availability of collaterals approximately 0.1702 was significantly different from zero at 5% probability level in influencing the demand for formal credit among the vegetable producers. This work agrees with the work of Atieno (2001) and Hainz and Teksoz (2006) who reported that the positive influence of collaterals implies that the more collaterals a farmer possessed the more is his likelihood of demanding for formal credit. The coefficient of experience in credit use was estimated at 0.118. A 1% increase in experience

in credit use, while keeping all other factors constant will give rise to 11.8% increase in the demand for formal credit among vegetable producers. This finding is supported with the findings of Lemessa and Gemechu (2016) who obtained a positive and significant coefficient (1.618) between experience in credit use from the formal sources and access to formal credit farmers in Ethiopia. The coefficient of distant to financial institution (0.046) was significantly different from zero in influencing the demand for formal credit at 10% probability level. This finding is similar to Lemessa and Gemechu (2016) who obtained positive and significant coefficient (0.861) between physical distant of farmers from the lending institutions and access to formal credit among smallholder farmers in Ethiopia. The R square value is 0.8421 this indicate that all regressors included in the model jointly explain 84.21% of amount of formal credit demanded from financial institutions among vegetable producers. The F-value (89.78) is significantly different from zero at 1% probability level. This represent that the model is well fitted. This outcome is in consensus with Nwaru *at al.* (2011) who documented a significant and positive association between farm income and credit demanded among farmers. This outcome is also in accord with Kehinde and Bamiro (2023) who documented the significant and negative association between interest rate and amount of micro-credit demanded among fish farmers' in Osun State, Nigeria.

Table 3. Heckman Two Stage (The Outcome Stage), The OLS Model

Variables	Coefficient	Std Error	t-Value	P > |t|
Value of Savings	0.053*	0.032	1.646	0.101
Level of Education	0.364***	0.064	5.67	0.000
Income from Vegetable Production	0.052**	0.026	1.998	0.043
Cost of Borrowing	-0.1732***	0.029	-6.03	0.000
Availability of Collateral	0.1702**	0.067	2.54	0.030
Experience in Credit Use	0.118**	0.045	2.62	0.020
Distant to Financial Institutions	-0.046*	0.024	-1.92	0.090
Inverse Mill Ratio	0.012**	0.005	2.21	0.040
R Square	0.8421			
Adjusted R Square	0.8320			
F-Value	89.78			

Source: Field Survey (2024)

3.4. The Supply of Formal Credit to Vegetable Producers

The result of MLEs (Maximum Likelihood Estimates) for supply of formal credit to vegetable producers is presented in Table 4. The Tobit dichotomous regression model was employed in the estimation. All the regressors had positive and significant coefficients. The experience in lending and type of credit was significantly different from zero at 1% probability level. In addition, the liquidity of lender, interest rate, and business leverage were significantly different from zero at 5% probability level. The coefficient of experience in lending was positive and significant (0.4962). This suggests than a 1% increase in experience in lending while keeping all other factors fixed will give rise to 49.62 % increase in supply of credit by financial institutions. This finding is supported by findings of Nwaru *et al.* (2011) and Essien (2009) who reported that the length of time a lender has been active in lending may help the lender avoid or minimize problems that arise from lending. The length of time the financial institution has been actively involved in lending may be a sign of the practical experience he has gotten on how to effectively resolve lending related problems. Such practical experience would enable the financial institutions to handle loan applicants more efficiently, carefully, and evaluating them properly. According to Nwaru *et al.* (2011) who reported that this would lower the risk associated with his loan portfolio and enhance the amount of credit available. The interest rate has positive coefficient that point to the fact that it favour the financial institutions, a 1% increase in interest rate will give rise to 38.04% increase in supply of formal credit by financial institutions to vegetable producers. Similarly, a 1% increase in the level of liquidity of the lender will give rise to 25.83% increase in the amount of money supplied by the financial institutions. This work is in conformity with outcome of Nwaru *et al.* (2011) who documented that micro-credit lenders easily release credit to

potential borrowers established on the level of liquidity. According to Olweny and Chiluwe (2012), the liquidity ratio can be defined as the proportion of total deposit deposit that must be reserve in designated liquid assets so that the financial institutions must be able to maintain credibility and service cash withdrawal request. The coefficient of business leverage was positive (0.1713) and significantly different from zero in influencing the supply of credit among the financial institutions. This result is supported with findings of Kehinde and Bamire (2023) who reported that the current debt and owner equity make up the lenders business leverage. The coefficient of type of credit was positive (0.3210) and statistically different from zero in influencing the supply of credit among financial institutions. The outcome agrees with the results of Olaitan (2006) who noted that the financial institutions can only grant loan to farmers on the presentation of acceptable collaterals and other requirements.The Pseudu R square value is 0.8258, this denotes that 82.58% of amount of credit supply by financial institutions is explained by stimulus included in the model. The LLF (The Likelihood Function) (-132.36) is significantly different from zero at 1% probability level. This confirm that the model is of good fit. This outcome is in resemblance to result of Kehinde and Bamire (2023) who documented that the liquidity, experience in lending, and interest rate were significant stimulus influencing supply of credit to fish farmers in Osun State, Nigeria.

3.5. The Constraints Faced by Vegetable Producers

The constraints faced by vegetable producers was submitted to PCA (Principal Component Analysis) is presented in Table 5. Approximate 6 constraints facing the vegetable producers were reserved, that is those having Eigen values more than 1. Lack of collateral score 1st with Eigen value approximate 1.8316, and this represents 13.09% of all constraints kept in the model (no group lending, no credit scoring, no government

back-loan schemes). The insufficient loan approval with Eigen-value approximate 1.7212 score 2nd and this explain 14.22% of all constraints reserved in the model. The high interest rate with Eigen value approximate 1.3403 score 3rd and this explain 15.91% of all

constrained retained by the model. All the constrained kept by the model explained 71.94% of all the constraints identified by the vegetable producers. The chi square value (718.12) is significantly different from zero at 1% probability level.

Table 4. The MLEs (Maximum Likelihood Estimates) of the Tobit Dichotomous Regression Model

Variables	Parameters	Coefficient	Standard Error	t-Value	ME
Constant	β_0	0.8325***	0.2140	3.89	0.0625
Experience in Lending	β_1	0.4962***	0.1000	4.96	0.2701
Liquidity of Lender	β_2	0.2583**	0.0997	2.59	0.2901
Interest Rate	β_3	0.3804**	0.1440	2.64	0.3732
Business Leverage	β_4	0.1713**	0.0738	2.32	0.1219
Type of Credit	β_5	0.3210***	0.0668	4.80	0.2802
Diagnostic Statistics					
Sigma	0.18632				
LR$_{\chi^2}$ (5)	98.56***				
Pseudo R^2	0.8258				
LLF (Log Likelihood)	-132.56				
Prob $>_{\chi^2}$	0.00000***				

Source: Field Survey (2024), ME=Marginal Effect
*Significant at $(P < 0.10)$., **Significant at $(P < 0.05)$, ***Significant at $(P < 0.01)$.

Table 5. The Constraints Confronted by Vegetable Producers

Constraints	Eigen-Value	Difference	Proportion	Cumulative	Rank
Lack of Collaterals	1.8316	0.1104	0.1309	0.1309	1st
Insufficient Loan Approval	1.7212	0.3809	0.1422	0.2731	2nd
High Interest Rate	1.3403	0.0790	0.1591	0.4322	3rd
Cumbersome Administrative Procedures	1.2613	0.2201	0.1642	0.5964	4th
Untimely Delivery of Loan	1.0412	0.0307	0.1121	0.7085	5th
Long Distant to Financial Institution	1.0105	0.0852	0.0109	0.7194	6th
Bartlett Test of Sphericity					
χ^2	718.12***				
KMO	0.8116				
Rho	1.00000				

Source: Field Survey (2024), KMO – Kaiser-Meyer-Olken

3.6. The Constraints Faced by Financial Institutions

The constraints faced by financial institutions was submitted to PCA (Principal Component Analysis) is presented in Table 6. Approximate 6 constraints facing the financial institutions were retained, that is those having Eigen values more than 1. High rate of default on the part of customers score 1st with Eigen value approximate 4,7132, and this represents 36.18% of all constraints reserved in the model (crop failure, price volatility, or market instability are

significant factors). The lack of skilled personnel on the part financial institutions with Eigen-value approximate 4.0061 score 2nd and this explain 16.41% of all constraints kept in the model. The insufficient capital with Eigen value approximate 3.5703 score 3rd and this explain 06.95% of all constrained reserve by the model. All the constrained kept by the model explained 74.76% of all the constraints identified by the financial institutions. The chi square value (4258.35) is significantly different from zero at 1% probability level.

Table 6. The Constraints Faced by Financial Institutions

Constraints	Eigen-Value	Difference	Proportion	Cumulative	Rank
High Rate of Default	4.7132	0.7071	0.3618	0.3618	1st
Lack of Skilled Personnel	4.0061	0.4358	0.1641	0.5259	2nd
Insufficient Capital	3.5703	0.0651	0.0695	0.5954	3rd
Lack of Bank Branches	3.5052	0.5000	0.0523	0.6477	4th
Lack of Supervision	3.0052	0.1947	0.0507	0.6984	5th
High Level of Illiteracy of Farmers	2.8105	1.8510	0.0492	0.7476	6th
Bartlett Test of Sphericity					
χ^2	4258.35				
KMO	0.7586				
Rho	1.0000				

Source: Field Survey (2024)

4. Conclusion and Recommendations

This work investigated factors influencing demand and supply of formal credit among vegetable producers in North West, Nigeria. Primary data were used based on well-designed questionnaire administered to 120 vegetable producers and 30 financial institutions from each state. The financial institutions were purposively selected, while the vegetable producers were selected through multi-stage sampling design. The data were analyzed using descriptive statistics, Heckman selection model, Tobit dichotomous regression model, and principal component analysis. Based on the research questions, the following conclusions were suggested:

What is the socio-economic characteristics of vegetable producers?
About 80% of vegetable producers are male, while 81% of the respondents were married. The mean age of vegetable producers was 45years. Approximately the producers had an average of 8 years' experience in vegetable farming. The vegetable producers were literate with an average of 11 years in school education. This result agrees with Shettima *et al.* (2016) who obtained an average age of 37 years among vegetable producers in Borno State, Nigeria.

What are factors influencing the demand of formal credit among vegetable producers?
In the Heckman 1st stage model, the value of saving, level of education, income from vegetable production, cost of borrowing, experience in credit use, distant from financial institutions were significantly different from zero in influencing the demand for formal credit among vegetable producers. In the Heckman 2nd stage model, the value of savings, level of education, income from vegetable production, cost of borrowing, availability of collaterals, experience in credit use, and distant to financial institutions were statistically different from zero in influencing the amount of formal credit demanded by vegetable producers. This result is supported with the findings of Kehinde and Bamire (2023) who obtained that farmers' income, age of farmers, pond size, interest rate, and education were significant factors influencing the demand of micro-credit among fish farmers in Osun State, Nigeria.

What are factors influencing the supply of credit among the financial institutions?
The experience in lending, liquidity of lender, interest rate, business leverage, and type of credit were significantly different from zero in influencing the amount of formal credit supplied by the financial institutions to the vegetable producers. This result is supported with the

findings of Kehinde and Bamire (2023) who obtained that liquidity, experience in lending, interest rate, were significant factors influencing the supply of micro-credit among fish farmers in Osun State, Nigeria.

(iv) What are the major constraints faced by vegetable producers in the study area?

The three utmost constraints facing the vegetable producers were lack of collaterals (1st), insufficient loan approval (2nd), and high interest rate (3rd). The 3 utmost constraints facing the financial institutions were high rate of default (1st), lack of skilled personnel (2nd), and insufficient capital to meet the demand of customers (3rd).

Establishing on the outcome of this research findings, the following policy implications were suggested: Enough bank branches are needed in the rural areas for easy access of financial institutions by rural farmers; the financial institutions need more capital to meet up with the demand of farmers for credit; interest rate should be given reduced at single digit with less collateral requirement for farmers; the financial institutions should employ more skilled staff to meet up with the demand for credit by farmers; the cumbersome administrative bottleneck should be removed to enable farmers access credit; farm inputs such as improved seeds, fertilizers, chemicals, should be made available to farmers to increase productivity and efficiency, the role of financial literacy, financial education can help improve credit demand, repayment behavior and overall financial management, enhancing financial literacy could be a critical factor in improving credit access and repayment rates.

5. References

Agbugba, I.K., Nweze, N.J., Achike, A.I., Obi, A. (2013). 'Market Structure, Conduct, Channel & Margin of Dry Season Okra Vegetable in South-Eastern Nigeria', *Presented in Melaka, Malaysia and Published in the Proceedings, IPCBEE.*, Vol 55 pp. 73-78.

IACSIT Press, Singapore. https://doi.org/10.7763/IPCBEE.2013.v55.14

Ajayi, A. R., Nwalieji, A.H. (2010). 'Impact of the Anambra State Fadama Project Phase-1 on the Socio- Economic life of the rural farmers.', *Journal of Human Ecology,* 29 (2), pp. 129-139.

Aju, P.C., Popoola, L. (2010). 'The dietary role of traditional vegetables in the rural communities of Imo state Nigeria.', *Journal of Sustainable Development in Africa,* Volume 12 (7), pp.104-113.

Akram, Z., Ajmal, S., Munir, M. (2008). 'Estimation of Correlation Coefficient among Some Yield Parameters of Wheat under Rainfed Conditions.', *Pakistan Journal of Botany,* 40 (4), pp. 1777 – 1781.

Akudugu, M.A., Egyir, I.S., Mensah-Bonsu, A (2009b). 'Access to Rural Bank in Ghana: The Case of Women Farmers in the Upper East Region, Ghana.', *Journal of Development Studies,* 62, pp. 142 – 167.

Akudugu, M.A. (2012). 'Estimation of the Determinants of Credit Demand by Farmers and Supply by Rural Banks in Ghana's Upper East Region.', *Asian Journal of Agriculture and Rural Development,* 2 (2), pp. 189 – 200.

Alabi, O.O., Lawal, A.F., Chiogor, H.O. (2016). 'Access to Formal Credit Facilities among Small scale Crop Farmers in Gwagwalada Area Council, Abuja, Nigeria.', *Russian Journal of Agricultural and Socio-Economic Sciences,* 1 (49), pp. 57 – 66. https://doi.org/10.18551/rjoas.2016-01.07

Alulu, J., Otieno, D.J., Oluoch-Kosura, W., Ochieng, J. (2021). 'Comparison of Technical Efficiency and Technology Gaps between Contracted and Non-Contracted Vegetable Farmers in Western Kenya', *Cogent Food & Agriculture,* 7, 1, 1910156, https://doi.org/10.1080/23311932.2021.1910156

Atieno, R (2001). *'Formal and Informal Institutions',* Lending Policies and Access to

Credit by Small scale Enterprises in Kenya: An Empirical Assessment. AERC Research Paper III

Ayamga, A., Sarpong, D.B., Asuming-Brempong, S. (2006). 'Factors Influencing the Decision to Participate in Microcredit Programmes: An Illustration for Northern Ghana.', *Ghana Journal of Development Studies,* 32 (2), pp. 57 – 65.

Bashir, M.K., Mehmood, Y., Hassan, S. (2010). 'Impact of Agricultural Credit on Productivity of Wheat Crop: Evidence from Lahore, Punjab, Pakistan.', *Pakistan Journal of Agriculture Science,* 47 (4), pp. 405– 409

CBN (2012). *'Central Bank of Nigeria.',* Statistical Bulletin, 23.

Chen, K., Chivaku, M. (2008). *'What Drives Household Borrowing and Credit Constraints?',* Evidence from Bosnia and Herzegovina (IMF Working Paper WP/08/202), Washington, DC: International Monetary Fund, Pp. 2 – 34.

De la Rosa, L.A., Alvarez-Parrilla, E., Gonzalez-Aguilar, G.A. (2010). *'Fruits and Vegetable Phytochemical Chemistry',* Nutritional Value and Stability*,* Wiley-Blackwell, A John Wiley Andsons Inc., USA.

Diange, A., Zeller, M. (2001). *'Access to Credit and its Impact on Welfare',* Malawi: Research Report No 116, International Food Policy Research Institute, Pp. 153.

Essien, U.A (2009). *'Gender, Informal Credit Markets and Determinants of Credit Use by Food Crop Farmers in Akwa Ibom State of Nigeria.',* MSc Thesis, Micheal Okpara University of Agriculture, Umudike, Nigeria.

FAO (2024). *'Food and Agriculture Organization',* Data Base, Rome Italy.

Fakayode, S.B., Rahji, M.A.Y. (2009). 'A Multinomial Logit Analysis of Agricultural Credit Rationing by Commercial Banks in Nigeria.', *International Research Journal of Finance and Economics,* 24, pp. 94 – 100

Fischer, G., Patt, N., Ochieng, J., Mvungi, H. (2020). 'Participation in and Gains from Traditional Vegetable Value Chains: A Gendered Analysis of Perception of Labour, Income and Expenditure in Producers' and Traders Households.', *The European Journal of Development Research,* 3(2), pp. 1080 – 1104.

Hainz, C., Teksoz, U. (2006). *'Access to Finance: The Role Inside Versus Outside Collaterals in Transition Economies.*

Kehinde, A.D., Bamire, A.S. (2023). 'Determinants of demand and supply of microcredit among fish farmers in Osun State.', *J. Agribus. Rural Dev.,* 1(67), pp. 5– 18.

Lemessa, A., Gemechu, A (2016). 'Analysis of Factors Affecting Smallholder Farmers' Access Formal Credit in Jibat District, West Shoa Zone, Ethiopia.', *International Journal of African and Asian Studies,* 25, pp. 43 – 53.

Ogunleye, B. (2000). *'Innovation for Poverty Eradication: Country Women Association of Nigeria.',* A Paper Presented at Micro-Credits Seminar, Washington, USA.

Oladeebo, J.O., Oladeebo, O.E (2008). 'Determinants of Loan Repayment among Smallholder Farmers in Ogbomoso Agricultural Zone of Oyo State, Nigeria.', *J. Soc. Sci.,* 17(1), pp. 59 – 62.

Olaitan, A.S (2006). *'Formal-Informal Institutions Linkages in the Nigerian Agribusiness Sector and Implication for Pro-Poor Growth.',* IPPG Discussion Paper Series, 37. NISER Ibadan.

Olanrewaju, K.O., Akintunde, O.K., Adeoye, I.B., Bamiwuye, O.A. (2021). 'Gender Differential in Leafy Vegetable Production in Lagelu Local Government Area of Oyo State, Nigeria.', *Journal of Agriculture and Food Science,* 19 (1), pp. 120 – 133.

Olasunkanmi, J.B. (2012). *'Economic Analysis of Fish Farming in Osun State, South-Western, Nigeria.',* IIFET Proceedings, 56pp.

Olweny, T., Chiluwe, M. (2012). 'The Impact of Monetary Policy on Private Sector

Investment in Kenya.', *J. Appl. Fin. Bank,* 2 (2), pp. 239 – 287.

Orinda, M., Lagat, J., Mshenga, P. (2017). 'Analysis of the Determinants of Sweet Potato Value Addition by Smallholder Farmers in Kenya.', *Journal of Economics and Sustainable Development,* 8(8), pp. 1 – 11.

Otunnaiya, A.O., Ologbon, O.A.C., Akerele, E.O. (2014): Analysis of Agricultural Loan Use Decision among Poultry Farmers in Oyo State, Nigeria. International Journal of Poultry Sciences 13 (2): 108 – 113

Lemessa, A., Gemechu, A. (2016). 'Analysis of Factors Affecting Smallholder Farmers Access to Formal Credit in Jibat District, West Shoa Zone, Ethiopia. *International Journal of African and Asian Studies,* 25, pp. 43 – 53.

Mburu, S., Ackello-Ogutu, C., Mulwo, R. (2014). 'Analysis of Economic Efficiency and Farm Size: A Case Study of Wheat Farmers in Nakuru District, Kenya. *Economics Research International,* 1(4), pp. 40 – 50.

Nyoro, J. (2002). *'Agriculture and Rural Growth in Kenya',* Tegemeo Working Paper.

Nwaiwu, J.C., Esiobu, N.S., Onyeike, G.C.E., Ndinechi, P.C. (2022). 'Analysis of Vegetable Production among Rural Women Farmers in Imo State, Nigeria.', *International Journal of Agricultural & Research,* 5 (5), pp. 1 – 9.

Nwaru, J.C., Essien, U.A., Onuoha, R.E. (2011). 'Determinants of Informal Credit Demand and Supply among Food Crop Farmers in Akwa Ibom State, Nigeria.', *J. Rural Comm. Dev.,* 6 (1), pp. 129 – 139.

Saboor, A., Hussain, M., Munir, M. (2009). 'Impact of Micro-Credit in Allevating Poverty: An Insight from Rural Rawalpindi, Pakistan.', *Pakistan Journal of Life and Social Sciences,* 7(1), pp. 90 -97.

Saqib, S.E., Kuwornu, J.K.M., Panezia, S., Ali, U. (2018). 'Factors Determining Subsistence Farmers' Access to Agricultural Credit in Flood-Prone Areas of Pakistan.', *Kasetsart Journal of Social Sciences,* 39, pp. 262 – 268. https://doi.org/10.1016/j.kjss.2017.06.001

Shettima, B.G., Ibrahim, A., Mohammed, S.T., Zongoma, B.A. (2016). 'Economic Efficiency of Irrigated Vegetable Production in Borno State, Nigeria: A Stochastic Frontier Cost Function Approach.', *Asian Journal of Agricultural Extension, Economics & Sociology,* 12(4), pp. 1 – 14

Tinh, D., John, G., Mark, H. (2010). 'Impact of Household Credit on Education and Healthcare Spending by the Poor in Peri-Urban Areas, Vietnam.', *Journal of South East Asian Economie,* 31(24), pp. 103 – 119.

United State Agency for International Development (USAID) (2019). *'The Role of Women in the fruit and vegetable supply chain in Maharas intra and Tamil Nadu, India.',* The new and Expanded Social and Economic Opportunities for vulnerable Groups task order under the Women in Development 1QC Contract No GEW-1-00-02-00016- 00800; 2019.

Yamane, T. (1967). *Statistics: An Introductory Analysis',* 2nd Edition., New York: Harper and Row. Pp. 33-50.