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Households Access to Agricultural Credit and Agricultural Production in Nigeria: A PSM Model[1]

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Abstract

Background: Agricultural production is low in Nigeria as a result of low utilisation of farm inputs facilitated by farmers' inability to save and invest. Therefore, credit is needed by farmers to enhance their productive capacity and efficiency in agriculture.

Aim: Given the importance of credit to farmers, this study examined the nexus between households' access to credit and agricultural production in Nigeria.

Setting: The study made use of data from the Living Standard Measurement Study-Integrated Survey on Agriculture (LSMS-ISA) consisting 4210 households across the 36 States in Nigeria as well as the Federal Capital Territory (FCT), Abuja.

Method: The study employs Propensity Score Matching (PSM) technique

Result: The main result from the study suggests that households who had access to agricultural credit facilities had yields that are thrice-folds more than their counterparts who did not benefit from such facilities. In the event of a shock, the farmers who did not have the source of credit are often forced to adopt measures such as lowering consumption, selling assets, which in the long-run worsen their poverty levels.

Conclusion: The study recommends that policymakers should address underlying factors that prevent inclusion in access to credit for agricultural production, which is capable of raising the productive capacities farmers.

Key Words*:* Access to Credit; Agriculture; Household; Production; PSM
JEL Classification: I30, J43, Q10

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1. Introduction

In developing countries, about 1.5 billion households live in extreme poverty (Food and Agricultural Organisation- FAO, 2016). Approximately 75% of these individuals who live on less than 1.25USD reside in rural areas of many sub-Saharan African (SSA) countries, where they depend mainly on agriculture for survival (Osabohien, Osabuohien and Urhie, 2018; FAO, 2016). It has been noted that for the past two decades, credit policies have expanded rapidly in most of the developing countries, as 2.1 billion people benefited from social protection policies including social assistance, social insurance and labour market interventions (Croppenstedt, Knowles and Lowder, 2017).

Consequently, the little income generated by rural farmers from agriculture is frequently insufficient and vulnerable to shocks; such as drought, pests and diseases outbreak, weather variations and death. Without adequate credit assistance, farmers will no doubt suffer hardship and long-term deficiency; because, access to credit provide household with emergency relief, such as the purchase of seeds, fertilizers and livestock among others; therefore, in the absence of this, farmers are liable to hardship (Rehman, Chandio, Hussain and Jingdong, 2017; Croppenstedt et al., 2017). It has also been observed that the insufficient telecommunication base alongside weak agricultural investment and human capital development has increased the vulnerability of farmers and contributed to low production (Ejemeyovwi, Osabuohien, and Osabohien, 2018; Osuma, Ikpefan, Osabohien, Ndigwe and Nkwodimmah, 2018).

In most cases, these poor farmers in rural communities often choose livelihood strategies that forego income to ensure survival, so that when shocks occur, they are often forced to cope in ways that increase their vulnerability or undermine their future income generation capacity (Dercon, 2011). It has been observed that 40% of rural farmers in SSA rely predominantly on agriculture as an occupation for their livelihoods; well-structured local institutions and credit facilities are needed for production enhancement (Osabohien, Afolabi and Godwin, 2018; Osabuohien, Okorie and Osabohien, 2018; World Bank, 2008).

Generally, agricultural credit facilities can be in the form of a loan, overdraft, among others that are made available for farmers to help boost their productive capacity which will increase their earnings through which socio-economic risks, vulnerability, poverty and deprivation reduces (Croppenstedt et al., 2017). Credit facilities can be in the form of smallholder

agricultural policies, which focus on improving crop production, fisheries, forestry and livestock and improving access to markets (Osabohien, Matthew, Aderounmu and Olawande, 2019; World Bank, 2008). Credit policies are required in reducing the incidence of rural poverty through the sale of farm yields. However, farmers have been largely neglected with access to credit facilities, in the majority of developing countries, especially in Nigeria where the emphasis has been placed instead upon the primacy of economic growth rather than the agricultural sector which employs more than 75% of the total labour force in the country (United Nations Conference on Trade and Development-UNCTAD, 2016; World Bank, 2007).

Saqib et al., (2018); Adjognon et al., (2017); Suri, Tschirley, Irungu, Gitau and Kariuki (2009) are among the few studies that addressed agricultural credit policies in SSA and provides the framework for agricultural interventions and the livelihood of rural farmers in Kenya and in Nigeria. These studies described the agricultural intervention as providing income through direct seed and cash transfers in order to reduce hunger and poverty, but whether the credit policies were successful or not remains an issue for discourse. However, in the case of Nigeria, there is a dearth of literature that addresses the issues of access to agricultural credit for the rural farmer, which forms the motivation for this study.

2. Insights from the Literature

Ewetan, Fakile, Urhie and Oduntan, (2017) examined the effect of government expenditure on agricultural production in Nigeria. The study noted that, whether the effect is being looked at from the macroeconomic or microeconomic level, most of the existing literature assumes that government expenditure (credit facilities) has a significant impact on agricultural production. The direction of the impact differs from one study to another, with a greater positive effect on average in developing countries. Adjognon et al., (2017) used two-stage sampling techniques with data from the Living standard measurement integrated survey on agriculture (LSMS-ISA) for two panel waves: wave 1 (2010/2011) and wave 2 (2012/2013) covering 3000 farming households validated the findings of Suri et al., (2009) noting that farmers in SSA often experienced low yields as a result of limited access to agricultural credit facilities.

Furthermore, Tirivayi et al., (2016) examined the interaction between credit policies and agriculture using a quantitative study and found that little attention has been paid to the interaction between credit access and agricultural production in rural communities, and how they influence the design and the implementation of credit policies to achieve sustainable agriculture outcomes. In line with that, controlling for seed, Njine (2006) compared actual maize and cassava yields from the trial station in Kenyan using different fertilizer combinations with yields obtained by farmers on site with characteristics similar to trial stations. The study estimated technical inefficiency of the farmers at 60%, suggesting that effective credit towards agriculture is needed for sustainable agricultural production.

Barrett, Marenya, McPeak, Minten, Murithi, Oluoch-Kosura and Wangila(2006) offered supporting evidence of the potential of credit policies in Madagascar. Barrett et al. (2006) also reported the current spending on agricultural research to enhance the production of crop production in Madagascar is about 2.5% of the total annual value of crop production. Validating the impact of credit facility on agricultural production, Chandio, Jiang, Gessesse, and Dunya, (2017) in their study, examined the impact of agricultural credit on production in Pakistan using a cross-sectional random sampling technique of 180 rice producers in Sindh area of Pakistan. The study employed the maximum likelihood estimate (MLE) and the result showed that households access to credit enables to increase their farm size which significantly impacts the productive capacity of farmers in Sindh area of Pakistan. The study concluded that households access to credit and farm size are the two main factors in improving the level of agricultural production in as well as the technical efficiency of small-scale farmers in Pakistan.

These findings from the empirical literature signal the importance of households' access to credit towards increasing agricultural production in Nigeria. Despite the findings of the effect of access to credit on agricultural productivity across various countries, the adoption of an effective credit policy towards the agricultural sector remains relatively low in Nigeria. At one level, this situation reflects the lack of adequate public funding devoted to agricultural research and its dissemination, especially in the area of crop production. To make a case for public funding towards agricultural credit,

In the light of the foregoing issues reviewed in the literature, it becomes obvious that households access to credit will invariably improve agricultural production, thereby reduce

the rate of poverty among rural dwellers who solely engage in agriculture. Thus, the present study different from other empirical study in the field added to the literature by probing into the hypothesis of whether household access to credit has any significant impact on agricultural production in Nigeria using Propensity Score Matching (PSM) on household data Sourced from the Living Standard Measurement Study-Integrated Survey on Agriculture (LSMS-ISA) wave 2 (2012/2010, which to the best of knowledge is novel in the study of credit assistance and agricultural production of farmers in rural communities in Nigeria.

3. Theoretical Framework

Some theories have emerged on the analysis of poverty and government intervention in form credit facilities, but few theories have been confined to the understanding of households' access to credit and agricultural production; especially, when it has to do with rural farmers. However, this study has examined in summary; the credit channel theory; the classical and the neo-classical views, the Keynesian and Marxian views, including the Social Exclusion theory leading to the Livelihood Portfolio theory proposed by de Neubourg (2009) and the Cobb-Douglas production function.

However, under the neoclassical expression, poverty is more of economic and deprivation occasioned by market imperfections that exclude the poor from credit and lack of a fair share in the distribution of factors or economic resources (Bradshaw, 2007). On the other hand, the Keynesians are of the opinion that poverty in a society is driven by the lack of public goods and inequality in the distribution of available resources. To this end, a credit facility should be controlled by the state and the distribution should be even, irrespective of social stratification (Bradshaw, 2007). For instance, human capital development such as education and health provisions should be the obligation of government and individuals should be guaranteed the opportunity to harness such rights in equal proportion.

Far from this, the neo-Keynesians also argued that there should be an overall growth in human development to uplift the individual from Poverty (De Haas, 2010). This can only be achieved through government intervention to reduce the negative influence of macroeconomic factors such as inflation, exchange rate and unemployment on the economic well-being of the populace (Osabuohien, Obiekwe, Urhie and Osabohien, 2018).

A more radical dimension was taken by the Marxian economists espousing that economic growth alone may not possibly lift the poor especially peasant farmers out of poverty, because of class struggle in the capitalist system where the factors of production are controlled by the rich (Shildrick and Rucell, 2015). They would rather prefer mainstream economic stability, which includes both economic and environmental improvements, because the poor are most vulnerable to environmental disasters, especially in farming. The social exclusion theorists were the most fundamental in the recognition of structural changes in society. The inadequacy of credit capital was understandably the challenge of this school of thought. Nevertheless, they streamlined the definition of poverty to those unable to receive credit benefits (Shildrick and Rucell, 2015; De Haas, 2010; Bradshaw, 2007).

In addition, Sen and Dreze (1989) suggested that more attention should be directed to wage and labour market outcome in the distribution of economic resources and political considerations should be channelled into an institutional framework for the provision of welfare. As a result, definitions of poverty sprang up from multilateral institutions such as the World Bank (2008), the inadequate physical security and lack of political voice; United Nation Programme (2016) lack of participation in decision making and in civil, social and cultural life. This broad concept of poverty encapsulates all the social and economic dimensions of deprivation, for both individual and group significance.

However, the development of the social exclusion theory leads to what de Neubourg (2009) referred to as the livelihood portfolio theory, where institutions - family, markets, social networks, member institutions and public authorities are believed to be the core driving force of credit policy for the household. Under the livelihood portfolio theory, de Neubourg (2009) using the welfare pentagon expressed the interaction between credit agents in the determination of household welfare, given certain basic assumptions of utility maximisation and income constraints, occasioned by consumption risks. These consumption risks are mitigated by public authorities through social security benefits and agricultural subsidies for farming communities or individuals relying on family or communal support to compensate for a shock.

4. Methodology
4.1 Data

Table 1: Description of Variables

Variable	Description
Outcome Variable	
Agricultural Production	=1 if household harvested crop in the 12 months preceding the LSMS-ISA post-harvest interview, =0 otherwise
Control variable/Household characteristics	
Access to credit	=1 if a household has access to credit, =0 otherwise
Education	=1 if a household is able to read and write, =0 otherwise
Household head	=1 if household head is male, =0 otherwise
Capital	=1 if household own farming equipment, =0 otherwise
Labour	=1 if household hire labourers, =0 otherwise
Land	=1 if household own a land, =0 otherwise
Health	=1 if household consult health practitioners since the last survey, =0 otherwise
Information	=1 if household have access to information, eg radio or television, =0 otherwise

Source: Authors using LSMS-ISA Wave 2 Data

4.2 Outcome variable

To determine the outcome variable, households were interviewed about their farm harvest in Wave 2 (2012/2013) post-harvest agriculture season in the LSMS-ISA data. Questions regarding the land area of crop harvested, name of crops planted, unit of crops harvested and how much unit of crops sold since the last interview. Households who harvested crops are represented with 1, while household who did not harvest were presented with 0. Reasons for not harvesting were ascertained in the survey; such reasons include: lost crop due to drought, lost crop due to flood, lost crop due to pest, lost crop due to violence, lost crop due to theft, disagreement on land ownership, unable to work due to sickness, no available labour and delayed or deferred harvest. Other control variables were considered as important factors that affect production including the key variable (access to credit), health, education, labour, capital, land, and information, which are presented in the next subsection

4.3 Control Variables

The control variable which is included in the study are:

Health: Households' health was considered as an important factor for production in the study. The health condition of households was ascertained by asking if the household has visited or consulted a health practitioner during the past four weeks prior to the survey. A household who has consulted health practitioners were represented with 1, while households

who have not consulted were represented with 0. Households' reasons for consulting health practitioners include: checkup or other preventive care, prenatal checkup, follow up appointment, new or acute illness, new injury etc. Health practitioners consulted include traditional healers, doctors, dentist, nurse, medical assistance, midwife, pharmacist, chemist, TBA (traditional birth assistant, spiritualist, patent medical vendor (PMV), others

Education: information about education include household who can read and write in English language and if the household has attended any school; household who can read and write were represented with 1, while those cannot read and write were represented with 0

Labour: information about farm labour was collected. Households who hire labourers to work in their fields were represented with 1, and 0 if otherwise. The number of hours worked per week for hired labourers and how much was their payment (naira) was factored in and if they receive any in-kind payment/allowance for this work

Capital: information about capital was based on if the housed owned or rented the farm equipment used such as tractors. Households who own farm implement were represented with 1, and 0 if otherwise

Information: During the survey, households were interviewed if they have access to information, eg if they have access to a radio or television. Households could have access to radio either own, through family member/friend/neighbour, umbrella centre, workplace, mobile phone, others. A household who have access to information is represented with 1, and 0 if otherwise

4.4 Model Specification

Computing the change in the outcome of interest mathematically is depicted as $Y_i^{T=1}$ for the outcome of the households who had access to credit and $Y_i^{T=0}$ for the counterfactual (households who did not have access to credit)). Therefore, the change in the outcome that is attributed to participating in social protection policies is computed as:

$$\Delta Y = Y_i^{T=1} - Y_i^{T=0} \quad (1)$$

The average treatment effect therefore will be:

$$agrout = E(\Delta Y \mid T = 1) = E(Y_i^{T=1} \mid T = 1) - E(Y_i^{T=0} \mid T = 0) \quad (2)$$

Where: $E(.)$ is the mean (or the expected value). This equation attempts to capture the outcome of agricultural production of the households or farmers with agricultural credit compared to what the households would have experienced without agricultural credit (that is, what their production would have been without agricultural credit).

$$i.e\ Y^{o}_{i} \perp p_i \mid X \quad (3)$$

After an adjustment has been made for noticeable variations, it can be inferred that the mean of the outcome variable is the same for both households with and without agricultural credit. This condition helped in matching the households without agricultural credit as a control group when measuring the effect of agricultural credit on household production. Thus, equation (4) above may be depicted as follows:

$$((Y^{l}i \mid P = 1, X) = (\text{?}_i^0 p = 0, X)) \quad (4)$$

This study used the Kernel Matching (KMA) algorithms, as they are found to be suitable for this study majorly because it avoids random pruning

The Kernel Matching Algorithm (KMA) was found to give more effectual outcome and is more appropriate for handling large, asymmetrically distributed datasets (Baser, 2006). The KMA is designed in a way that each household with agriculture credit with *"i"* is matched with other control observations that have weights that are inversely proportional to the households without. The weight is computed as:

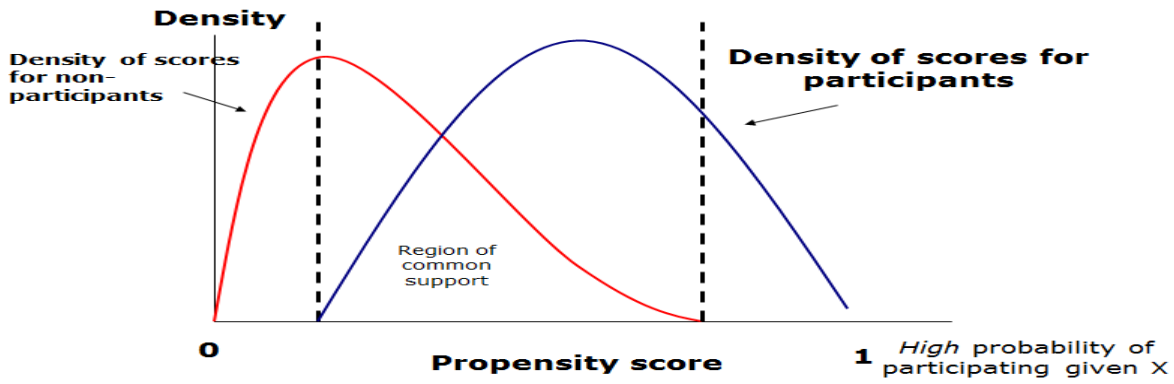

Figure 1: Graphical representation of PSM.

Source: Authors' adopted from
cega.berkeley.edu/assets/cega_events/31/Matching_Methods.ppt

Figure 1 is a graphical representation of the propensity score matching (PSM). The right-hand side is the participant or the treatment side, while the left-hand side is the non-treatment or non-participant side. The participants are the households who benefited from the programmes (social protection policies), while the non-participant is households that did not benefit from social protection policies.

5. Results and Discussion

Figure 1 showed that across the six zones in Nigeria; households who lack access to credit are far more than households who have access to credit. Yes in the figure represent households who have access to credit and No represent those whose no access to credit, In North-Central (Yes = 135, No = 662); this implies that, out of the 979 farming households, 135 households had access to credit represent 13.79%, while a larger number of households (662 representing 67.62%) had no access to credit, thus affirmed the reason behind low yields.

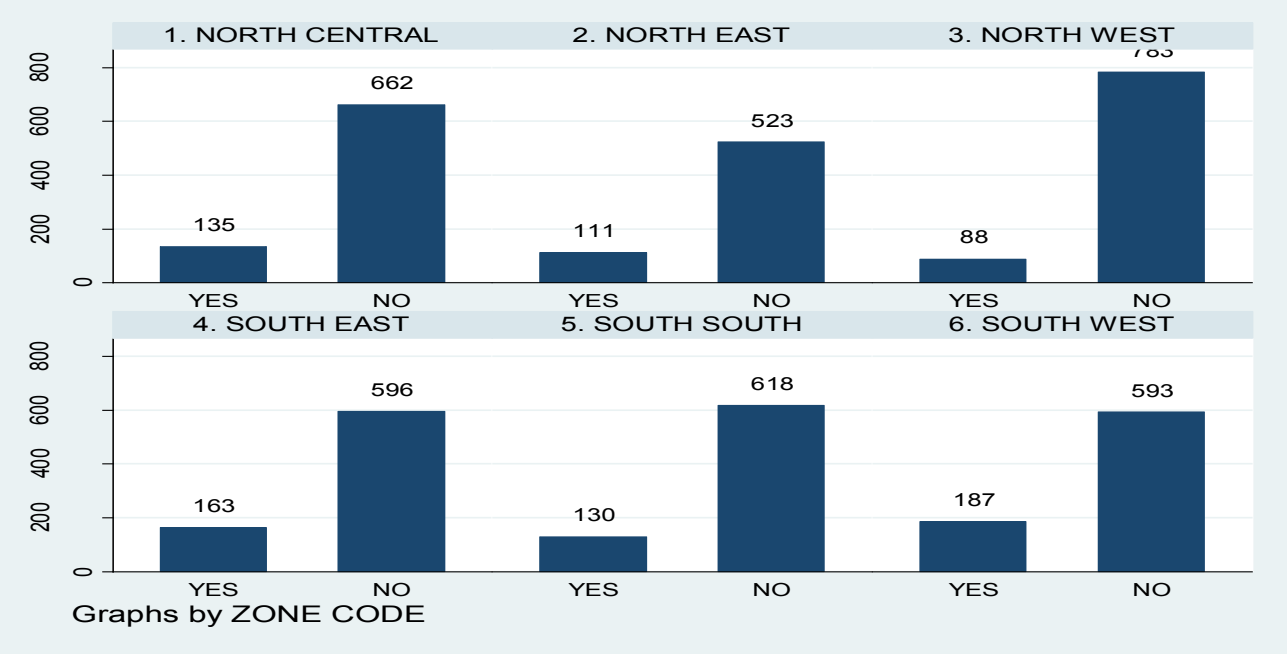

Figure 2: Households Access to Credit by Zones in Nigeria.
Source: The Authors' using data from LSMS-ISA, Wave 2

In the North- Central, 111 households had access to credit representing 17.50%, while 523 had no access to credit representing 82.49%. North-East is not different as 88 (10.10%) of the households lack access to credit as compared 783 (89.90%) of the households who had no access to credit. Similarly, in South- East geopolitical zone; 163 (27.35%) of households had

access to credit while 579 (72.65%) lack access to credit. In South-South and South-West, 130 (24.06%) and 187 (23.97%) of households had access to credit while 618(82.62%) and 187 (76.03%) of households lack access to credit, thus, this result signals the importance of credit to farming households to enhance production.

5.1 Result from Kernel Density Plot

The Kernel Density Plot approximated the density function of the outcome (agricultural production) variable and compared its trend as shown in Figure 3. The kernel density plot of households' agricultural labour allocation is shown in Figure 3. The results depicted households with agricultural credit being more productive than households without agricultural credit (households without social protection policies).

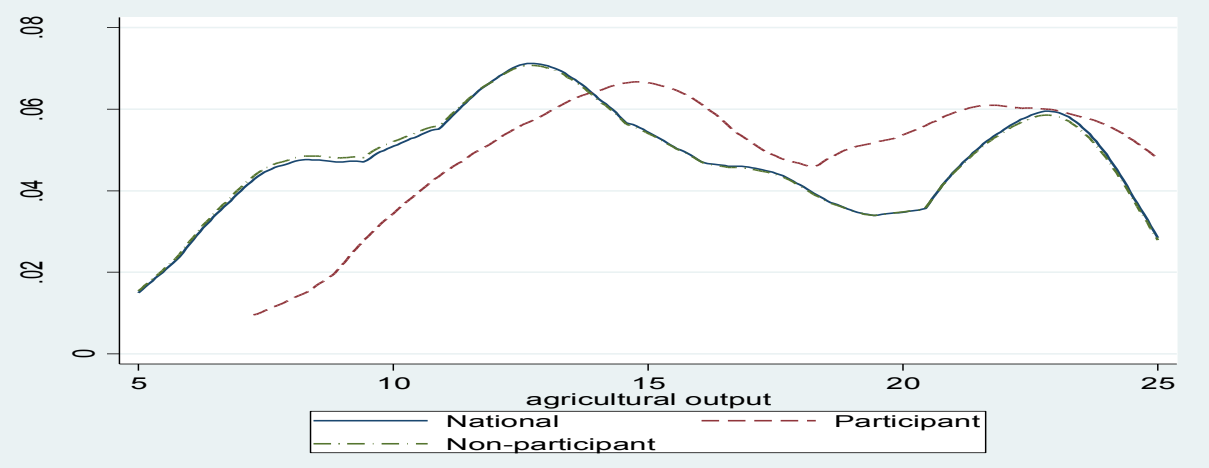

Figure 3: Kernel Density Plot of Agricultural Credit. **Source:** Authors' computation using STATA software version 13, 2019.

5.2 Household Characteristics of Propensity Score Matching

The household characteristics of interest as mentioned above include; size, average age, educational attainment, credit access and land ownership. The descriptive statistics are presented in Table 2, which compares the sample characteristics of households with and without agricultural credit. The aforementioned household characteristics are important as they determine how effective households become in terms of productivity.

Table 2: Comparing Household Characteristics of Propensity Score Match (Outcome variable: agricultural production)

	Households with agricultural credit		*Households without agricultural credit*		
agricultural credit(with=1, without = 0)	Mean	SD	Mean	SD	t-stat
Health status	1.8075	0.6140	1.7892	0.4310	-4.31*
Information	0.5472	0.2944	0.5574	0.2180	4.80*
Capital	1.9872	0.0734	1.9765	0.1221	-0.99
Land	0.0100	0.0672	0.0046	0.0370	-1.82***
Labour	1.8212	2.2317	1.1750	1.9819	-3.62**

Source: Authors' computation using STATA software version 13, 2019.
Note: *, and **,* ** indicate levels of significance at 1%, 5% and 10%, respectively.

5.3 The Probit Model for Propensity Score Matching

Table 3: Probit Model for Computing the Propensity Score

Household characteristic	*Outcome*
Information	0.0917**
	(0.046)
Household capital	0.74170
	(0.153)
Health status	-0.4005
	(0.131)
Household land	0.6040
	(0.565)
Household labour	0.0446**
	(0.018)
Constant	-2.7876**
	(0.010)
Pseudo R2	0.014
Pro value	0.002
Log. Likelihood	-437.1680

Source: Authors' computation using STATA software version 13, 2019.

Figure 4 presents the result of the balancing quality checks and the histograms of the predicted propensity scores for both the treated and control groups.

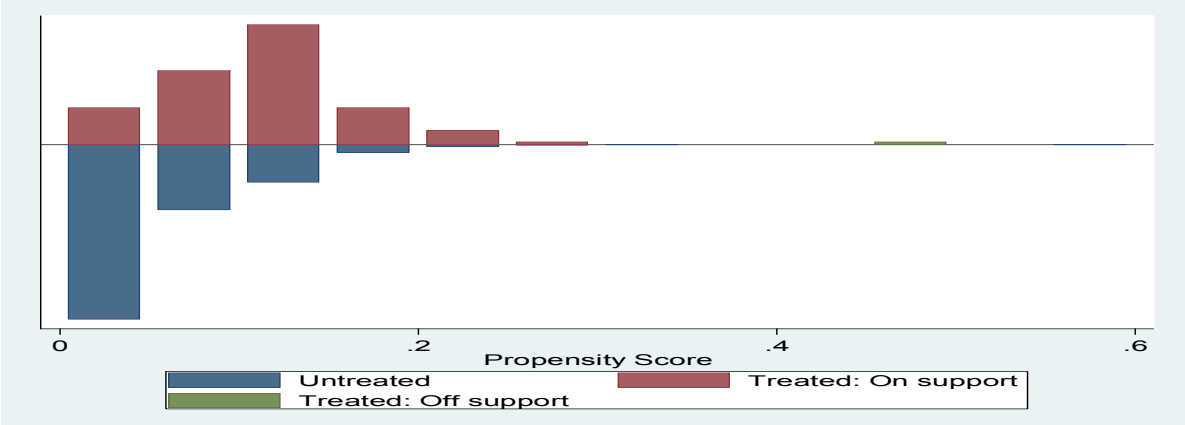

Figure 4: Propensity Score Distribution.
Source: Authors' computation using STATA software version 13, 2019.

5.4 Discussion and Implication of Findings

The study found that households access to credit had a positive impact on agricultural production, this indicates that a unit increase in the effectiveness of access to credit facilities will lead to a more than a unit increase in agricultural production. Similarly, health status and agricultural production showed a positive relationship which implies that an increase in health status leads to an increase in agricultural production. Labour and agricultural production also showed a positive relationship which means an increased supply of labour increased the level of agricultural production. The Propensity Score Matching (PSM) and the Kernel Density plot indicated that households who had access to agricultural credit had yields thrice more than their counterparts who did not benefit from such credit. This validated the need for households' effective access to credit in order to increase agricultural production. On the other hand, households who did not benefit from credit facilities are compelled to meet the shortfall in their production and living standard by selling their assets.

From the results in Table 2, we observed that health status, quality of information obtained, availability of land and labour are factors that significantly account for the differences between households with agricultural credit and households without agricultural credit. However, this distinction only drew from the sample characteristics, with less emphasis on the outcome of the experiment. However, the results in Table 3 revealed that information and household labour significantly determined whether the household received any form of agricultural credit or not.

Information asymmetry is an issue of concern, because of the lack of database; information flow is inadequate, so only the privileged in the society would have access to government credit policies. On the other hand, more labour will be put to work if there is a significant incentive for return on labour productivity. In a similar study for Tanzania, Hermann et al., (2018) found that for all households; information, health status, property and labour, whether or not a household owned and cultivated farm plots are found to be significantly associated with agricultural credit. It is obvious that agricultural credit will improve household health and labour productivity because with extra funds they can purchase better farming tools and good nutrition for an improved standard of living.

The findings of this study are in tandem with the results of Adjognon et al., (2017) on the impact of credit on agricultural production in SSA. The study of Adjognon et al., (2017) examined the impact of agricultural input credit on agricultural production in SSA. The study engaged four SSA countries (Mali, Nigeria and Tanzania and Uganda) with 3219 (Mali), 3000 (Nigeria), 3047 (Tanzania) and Uganda (2910) farm households using the LSMS-ISA using two-sample technique the study found that in Mali 60% of households have access to fertiliser subsidy policy, unlike Nigeria where only 5% of the fertiliser used by households were subsidised, thus limiting farm yields. However, findings in this study disagreed with Ewetan et al., (2017) that pointed out that agricultural production is the major driver of economic growth using the co-integration approach to examine the long run relationship between agricultural production and economic growth in Nigeria. Nevertheless, the non-conformity with Ewetan et al., (2017) relates to the relationship between agricultural production, economic growth, and development.

In the case of Ewetan et al., (2017), the study was taken at the aggregate level without considering how the production capacity of rural farmers could be enhanced. To this end, the aggregate agricultural production which is a requisite in spurring economic growth and development without the inclusion of farmers in rural communities tend to be increasingly ineffectual. This study also agreed with Osabuohien et al., (2019) on the female labour outcome and large-scale agricultural investment in Tanzania, using PSM method and the findings revealed that female with investment credit tends to be more productive than female without investment credit. The PSM technique tends to be a more realistic measure of the changes in the behaviour of subjects in a treatment design, where pre-treatment and post-treatment analysis is of the essence.

6. Summary and Conclusion

This study examined the relationship between households' access to agricultural credits and agricultural production in Nigeria with a view to providing new insights on how the provision of agricultural credit can contribute to increasing agricultural production. The variables include the number of crops produced by household members (farmers in rural communities where the survey was conducted) measured in percentiles as the outcome variable which captures agricultural production, the major dependent variable is agricultural credit, while other control variables included are agricultural inputs were captured by labour and capital. Labour measures the number of hours' farmers work on their farmlands, while capital measures the number of hours/weeks machines were put to work on the farmlands. Similarly, in relation to health as revealed by literature, healthy farmers are no doubt more productive than farmers who are health challenged. Therefore, households' access to agricultural credit or subsidy improves the productive capacity of farmers and those who have no access to credit facilities fell back on the conversion of existing assets to improve their livelihood thereby deepening their poverty

In conclusion, it is widely believed that agriculture holds the future of Nigerian economy because it generates employment and income for rural dwellers. The agricultural sector cannot operate in isolation but will perform more efficiently when appropriate credit policies are geared towards empowering those who engage in it. In the light of the above, the study recommended that: agricultural sector should be made more attractive through the implementation and execution of effective credit policies that can help pull labour out from other sectors (labour pouching) as this will enhance the productive capacity of the sector.

As revealed in the study by the PSM method, households who benefited from agricultural credits had yields thrice more than households who did not have access to credit, this scenario calls for government and donor agencies to effectively implement credit policies in the agricultural sector which will improve the living standards of farmers in rural communities. Therefore, this study has contributed to knowledge by evaluating the impact of households' access to credit facilities on agricultural production in Nigeria using the Propensity Score Matching (PSM), which to the authors' best of knowledge has not been examined in the Nigerian context.

Further studies in this area could be channelled to ascertain the performance of the agricultural sector with respect to human capital development; this is because as households begin to receive improved health care facilities and education in new farming techniques and subsidies from the government, there is the tendency that agricultural production will increase. However, a drawback for the implementation of credit policies in a developing country like Nigeria is the lack of adequate database (identification) for the purpose of disbursement of credit incentives.

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