



Trends in Agricultural Economics

ISSN 1994-7933

science
alert

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Research Article

Evaluating the Impact of Financial Inclusion on Income Optimization in Farm Enterprises

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Abstract

Background and Objective: There exists some unknown and yet unmeasured empirical endogenous financial inclusivity scoring boosters with unique peculiarities to specific sectoral or sub-sectoral applicants. This study hereby aimed at unraveling the extent and roles of financial inclusion in optimizing farm enterprise income levels and its deterministic variables. **Materials and Methods:** Analytical responses from a randomly selected 210 poultry farm holders were analyzed using mean, percentages and logit models alongside required econometric diagnostics. Data on socioeconomic, demographic and financial inclusion variables were randomly collected via questionnaire schedules in a multi-staged sampling procedure. **Results:** From the population, the financially excluded were outrightly more (82.38%) than the financially included (17.62%). Also, 56.76, 64.86 and 62.16% of the financially included access to electricity joined cooperatives and solely engaged in farming while it is 6.38, 38.30 and 40.43% for the excluded, respectively. Besides, financially included households had higher gross returns to factor, relative to the deprived by at least 57.4% more and significant at a 5% level. Deterministic analyses of financial inclusivity, while infrastructural access, increasing formal education, cooperative membership, farming experience, solely farmers and age significantly determined financial inclusivity, owing to some or all of the reasons hypothesized. **Conclusion:** Financial inclusion significantly optimized farm income earning to an appreciable extent, with its influencing factors among the farm enterprises as investigated by this study hence, a favorably enabling environment that further consolidates its sustainability should be fostered.

Key words: Financial inclusivity, income differentials, farm enterprise, South-West Nigeria, econometric analyses

Citation: Prince, P.D., 2025. Evaluating the impact of financial inclusion on income optimization in farm enterprises. Trends Agric. Econ., 18: 1-8.

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Competing Interest: The author has declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

The shooting up of nutritious food has imposed numerous constraints upon many vulnerable households in recent years, which was further exacerbated by the COVID-19 pandemic, while the same menace is currently aggravated by the Ukraine-Russia war, which is a key factor driving the skyrocketing prices of staple foods, especially imported grains upon which many livestock, humans and production units largely depend for their sustenance.

Additionally, concerning livestock, about 50% of the Global population keeps livestock¹, while more than 70% of Nigeria's population resides in rural areas. However, poultry production plays important livelihood functions among the rural communities of developing countries where many African nations belong, which also accounts for about 80% of the global poultry stockings among many developing countries².

Furthermore, with an appreciable quota of households primarily engaging in livestock production as their livelihood, while others resort to subsistence agriculture to augment their primary livelihood, given the existing level of technologies and infrastructure with its improvements, access to adequate financial capital via financial inclusion among the stakeholders at successive stages of the agricultural value chains can to a large extent induce increased productivity, promote higher financial returns on investment and consequently improve wellbeing, *Ceteris paribus*.

Within or without agriculture, there exists scanty literature that assessed financial inclusivity variables and regarding the few relevant existing literatures³ assessed the determinants of credit access and amount of credit by youth in Rachuonyo North Sub-County and found that education level, gender, enterprise volume, availability of collaterals, training and group membership positively influenced the decisions to access credit, while age, collateral and repayment duration positively influenced the amount acquired.

Besides, the determinants of credit access among smallholder farmers in North-East Benin found that access to credit is positively determined by formal education, cooperative membership, literacy and guarantor and negatively determined by collateral and interest rate⁴. Their study was limited to determinants of credit accessibility, devoid of socioeconomic features by credit accessibility and credit accessibility-wise income level differential analyses, as to be addressed in this research.

Notably, there exist shortages in literature that assessed and quantified financial inclusivity variables among farm enterprises, as some of the existing studies such as

Odhiambo *et al.*³ and Assogba *et al.*⁴, are canonical, while a few other studies of Anang and Kabore⁵ and Tura *et al.*⁶, focused on credit demand among poultry farmers and crop farmers, respectively^{7,8}, assessed determinants of credit demand, but this study will further seek to bridge the existing research gaps by assessing the credit inclusivity linked income level variabilities alongside the determinant factors.

'Financial inclusivity' and 'financial demand' are a function of needs or wants respectively, with the former being a critical strategy for poverty alleviation⁹. It can also promote development via empowerment in the agricultural sector and foster rapid achievement of SDGs. Also, high poverty levels and the cost of financial services limit credit accessibility in Sub-Saharan African Countries¹⁰⁻¹², while some credit seekers are 'credit-constrained'^{18,13} and regarded as 'denied borrowers', some others are regarded as 'discouraged borrowers'¹⁴. The objective of this study is to assess the impact of financial inclusion on income optimization in farm enterprises by analyzing access to financial services, credit utilization and their influence on farm profitability and productivity.

MATERIALS AND METHODS

Study area/data collection: This study lasted from August to January 2024, the population for this study is situated in Oyo State, South West Nigeria comprising 33 Local Government Areas (LGAs) with about 7.8 million inhabitants, while the edaphic structural outlay covers about 35,743 km² located between Latitude 2°N and 5°N and within Longitude 7°E and 9.3°E.

Data on socioeconomic, demographic and financial inclusion variables were randomly collected via questionnaire schedules in a multi-staged sampling procedure. The first stage involved a purposive selection of Oyo State from the existing six States in South West Zone for their prominence in poultry farming as favored by the prevailing climatic conditions that better homes poultry farming and followed by stratification into non-heterogeneous but non-overlapping categories of; less dense poultry producing area stratum and a dense poultry producing area stratum, based on the concentration of poultry farm enterprises, within which two Agricultural Zones (Oyo and Ibarapa/Ibadan, respectively) were selected randomly per stratum, from the four Agricultural Zones within the State, while the third sampling procedure was a random pick of three Local Government Areas (LGAs) per Ibarapa/Ibadan Zone (Ibadan South, Ibadan North and Ido) and Oyo Agricultural Zonings (Afijio, Oyo Central and Oyo West). The fourth stage was a random choice of 10 farm-based settlements/communities; one farm

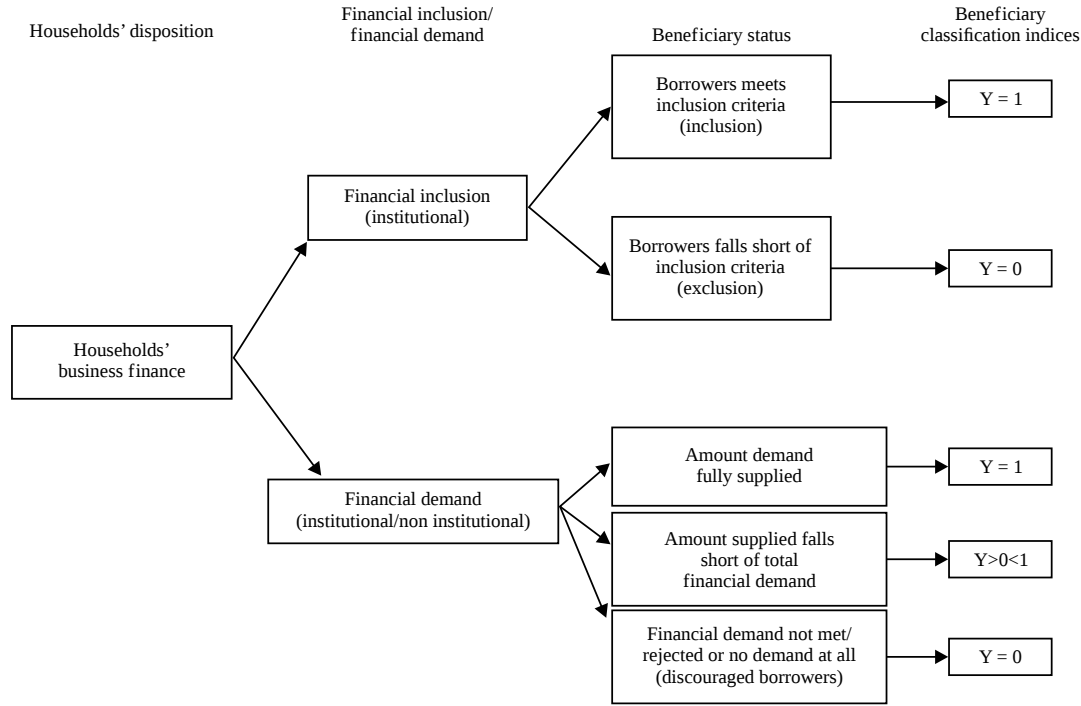


Fig. 1: Financial demand and financial inclusivity interactions

Source: Author's study conceptual framework

settlement within Ibadan North and Ibadan South LGAs with the other two from Ido LGA (due to relatively larger poultry farming activities occurring in Ido), while one farm settlement was chosen per Oyo West, Oyo Central and four other farm settlements from within Afijio LGA (with more poultry production enterprises in Afijio), wherein a total of 210 farm holders were covered in total, while 84 units were utilized due to analytical response characteristics vis-à-vis; 47 farm holders were excluded and 37 were included, respectively. Financial demand and financial inclusivity interactions are shown in Fig. 1.

Analytical framework

Farm enterprise income, amortization and financial inclusivity: There exists considerable background relevance of both the life cycle theoretical model and the permanent income hypothesis of Friedman¹⁵ and Modigliani¹⁶, to the theory of household debt and financial inclusivity. As quantitatively adapted for this study, poultry holder's financial utility maximization function is subjected to a recurring budget constraint as follows:

$$\text{Credit}_{\text{Max}} = \sum_{t=1}^T \left[(1+\alpha)^{-t} \times u(c_t) \right] \quad (1)$$

$$A_{t+1} = (1+r) (A_t + Y_t - C_t) \quad (2)$$

where, C is expenditure, Y is gross income, A is net assets, r is rate of return on assets and α is the discounting factor. The expenditure pattern, which is also vital to the lender, particularly on the repayment capacity of the borrower is subjected to a first-order condition of the standard Euler's equation:

$$E_t u'(C_{t+1}) = \frac{(1+a)}{(1+r)} u'(C_t) \quad (3)$$

The Euler equation provides for spreading the marginal utility of financial capital over its expected life cycle. It assumes that farming households can patronize financial service providers to finance immediate expenditures during periods of financial shortages or shocks, with its amortization.

Equation 2 and 3 also provide for a projected permissible minimum/ maximum expenditure beyond the present time that secures repayment capacity-effective amortization management and reduces the risk of defaulting hence, *Ceteris paribus*, households can smoothen their current and expected expenditures via favorable inclusive financing.

From this model, the current or projected expenditure is assumed to be independent of the current asset or current income level, while ' α ' and the source of ' C ', was assumed inert, for the excluded farm enterprises.

It can be further summarized that when:

- Equation 1 < 2 = Profitable
- Equation 2 < 1 = Nonprofitable

It is hence expected that under financial capital rationing, financial inclusion will favor households which maximizes Eq. 2 while Eq. 1 is at its least minimum as a measure of maximum marginal return to financial capital investment utility functionality.

Financial inclusion drivers: To quantify financial inclusivity, the logit model is prominent for its ability to adequately fit a dummy regress and in a dichotomous dependent variable regression model. To obtain the marginal propensity values (MPV), Eq. 4 was differentiated concerning X_i in the implicit financial inclusion model as follows¹⁷:

$$P_i = E(Y_i = 1 | X_i) \quad (4)$$

For the explicit model specification:

$$\Pr(Y_i) = \beta_0 + \beta_1 X_1 + \dots + \mu \quad (5)$$

$$P_i = E(Y_i = 1 | X_i) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 X_1 + \dots + \beta_n X_n)}} \quad (6)$$

But:

$$(Y_i = 0) = 1 - P_i \quad (7)$$

If otherwise (financial exclusion):

$$Y_i = \varphi \text{ if } y_i < \gamma = 0 \quad y_i' \text{ if } y_i > \gamma = 1 \quad (8)$$

Where:

$\beta_{(0,1,\dots,n)}$ = Parameter estimates of intercept and slopes, respectively

Y_i = Financial inclusivity (dummy; inclusion = 1; Otherwise = 0), $X_{1,\dots,n}$ = Explanatory variables $i = 1, 2, 3, \dots, 10$

X_1 = Access to infrastructure (dummy; Yes = 1; No = 0)

X_2 = Formal education in years

X_3 = Total monthly expenditure (NGN)

X_4 = Total per capita expenditure (NGN)

X_5 = Cooperative membership (dummy; Yes = 1; No = 0)

X_6 = Multidimensional well-being (dummy; Non poor = 1; Poor = 0)

X_7 = Farm income (NGN)

X_8 = Years of farming experience

X_9 = Primary occupation (dummy; Farming = 1; Otherwise = 0)

X_{10} = Age of household head in years

RESULTS AND DISCUSSION

Socioeconomic characteristics by financial inclusivity among poultry farm holders:

The problem of sample selection bias is common hence, to mitigate this, the sampled 210 poultry farm holders population was subjected to a normality test, but found skewed and significant at 1% level (adjusted and unadjusted) hence, data was further censored to 84 households to have a homogenous parabolic distribution, with a p-value of 3.401, indicating an unbiased-symmetrical sample and validated for a standard empirical policy analyses.

The descriptive analyses of the socioeconomic characteristics by financial inclusivity status were presented in Table 1, which showed that the financially excluded are overly more (82.38%) than the financially included (17.62%) for their farm production among the population. For the sample estimate; the mean age (52.5 years) of the financially included is higher than those deprived (47.4 years) and this difference is significant at 10%, while the modal age group for both categories is 41 to 50 years, simultaneously.

Furthermore, those financially included had higher years of farming experience with a mean of 15.5 years and a modal range of above 14 years, while it is 9.8 and 23 years respectively, for their excluded counterparts. These differences were found significant at a 5% probability level. Also, those financially included had higher years of formal education with a mean of 19.3 years and a modal range of above 16 years while it is 16.6 and 30 years, respectively, for their excluded counterparts. These differences were found significant at a 5% probability level.

Financial inclusivity-income differentials profile summary:

Financial capital helps expand the capital base of businesses such as via increased stockings, increased size and the number of pens, more feedstock capacity, increased technology/labour employment capacity and reduced average costs from the resulting economies of scale amongst others, by the amount invested without guarantying the actual or potential returns accruable from the business capital outlay. A categorical differential analysis was conducted to quantify the magnitudes of financial capital returns on financial inclusion-based investments and their significance, with the result presented in Table 2. The analysis of income

differentials based on financial inclusivity reveals a significant disparity in gross farm income. Financially included individuals report a mean income of 44.1k NGN (± 78.287), substantially higher than the 18.8k NGN (± 21.103) observed among financially excluded individuals. The pooled mean income stands at 29.9k NGN. The income differential of 25.33k NGN between the two groups is statistically significant ($p = 0.0365$), indicating that financial inclusion is associated with higher farm income levels. These findings suggest that financial inclusivity plays a crucial role in enhancing economic outcomes for farmers.

The differential significance analysis between the earnings of the financially included and excluded poultry firm revealed that farms with financial inclusion had higher gross returns on investment relative to those excluded by about 57.4% and this is significant at a 5% level, while it would require a financially excluded firm to increase her average monthly income by about 135% to bridge the existing financial inclusion gap as shown in Fig. 2. This can further pose a flourishing multiplier impact on successive productions from increasing return to factor owing to asset and income growth Teng *et al.*¹⁸.

Table 1: Cross-tabulated socioeconomic characteristics by financial inclusion status

Variables	Financially excluded	Financially included	Pooled	p-value
Population (skewness)	173 (82.38)	37 (17.62)	210	0.0000***
Sample (skewness)	47 (55.9)	37 (44.1)	84	0.3401
Infrastructural access				
No	44 (93.62)	16 (43.24)	60 (71.43)	
Yes	3 (6.38)	21 (56.76)	24 (28.57)	
Cooperative membership				
No	29 (61.70)	13 (35.14)	42 (50.00)	
Yes	18 (38.30)	24 (64.86)	42 (50.00)	
Sole farming				
No	28 (59.57)	14 (37.84)	42 (50.00)	
Yes	19 (40.43)	23 (62.16)	42 (50.00)	
Age group				
<31	4 (8.51)	1 (2.70)	5 (5.95)	
31-40	14 (29.79)	2 (5.41)	16 (19.05)	
41-50	12 (25.53)	17 (45.95)	29 (34.52)	
51-60	11 (23.40)	8 (21.62)	19 (22.62)	
>60	6 (12.77)	9 (24.32)	15 (17.86)	
Mean	47.42553	52.45946	49.6428	0.0740*
Formal education				
<1	5 (10.64)	0 (0.00)	5 (5.95)	
1-6	2 (4.26)	0 (0.00)	2 (2.38)	
10-12	2 (4.26)	1 (2.70)	3 (3.57)	
13-16	8 (17.02)	1 (2.70)	9 (10.71)	
>16	30 (63.83)	35 (94.59)	65 (77.38)	
Mean	16.57447	19.32432	17.785	0.0262**
Farming experience				
1-5 years	23 (48.94)	10 (27.03)	33 (39.29)	
6-15 years	16 (34.04)	13 (35.14)	29 (34.52)	
>15 years	8 (17.02)	14 (37.84)	22 (26.19)	
Mean	9.808511	15.54054	12.33	0.0419**
Farm size				
≤ 1000	22 (46.81)	15 (40.54)	37 (44.05)	
>1000-5000	22 (46.81)	18 (48.65)	40 (47.62)	
>5000	3 (6.38)	4 (10.81)	7 (8.33)	
Mean	1805.213	2887.568	2281.964	0.1966
Total	47 (55.9)	37 (44.1)	84 (100.00)	

Source: Field survey data analyses result, *if $p \leq 0.1$, **if $p \leq 0.05$, percentages parenthesized

Table 2: Financial inclusivity-wise income differential analysis

Gross farm income (NGN)	Financially excluded (NGN)	Financially included (NGN)	Pooled (NGN)
Minimum (1000.0)	1.5k	7.7k	1.5k
Maximum (1000.0)	80.0k	425.0k	425.0k
Mean (1000.0)	18.8k (21.103)	44.1k (78.287)	29.9k
Mean difference (1000.0)	25.33k		$p = 0.0365^{**}$

Source: Field survey data analyses result, *if $p \leq 0.1$, **if $p \leq 0.05$, standard deviation parenthesized

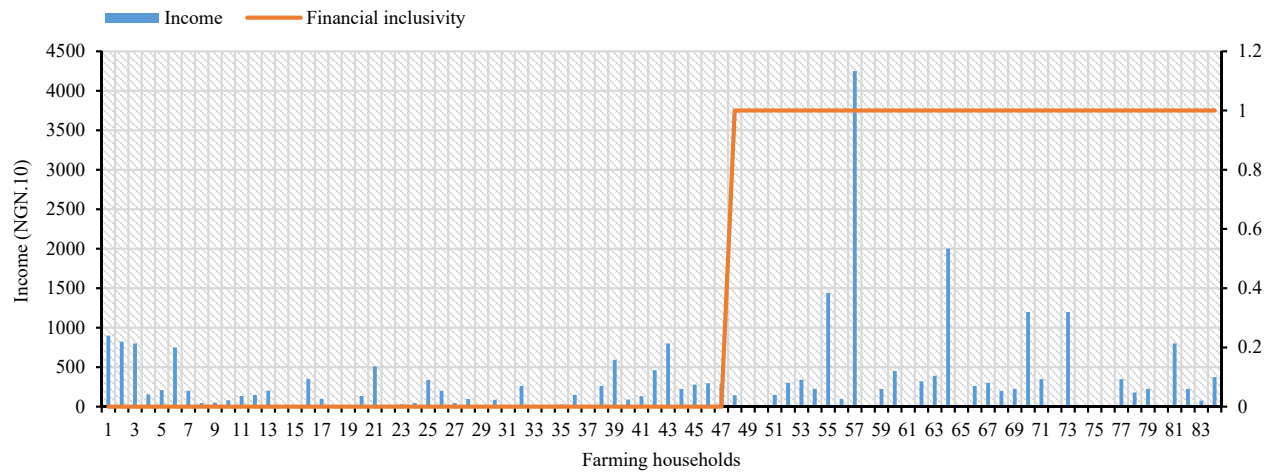


Fig. 2: Financial inclusivity and income

Area under orange coloured indicator superimposition of the origin mainly designates financial inclusion. Source: Field survey data analyses

Table 3: Logit-logarithmic likelihood estimate analyses of financial inclusivity determinants

Variables	Marginal functions	Standard error	Z-value
Access to infrastructure	0.2567936	0.0929997	2.76***
Formal education	0.0199156	0.0115222	1.73*
Total monthly expenditure	-2.04e-07	6.14e-07	-0.33
Total per capita expenditure	7.12e-07	7.71e-07	0.92
Cooperative membership	0.0555678	0.0244323	2.27**
Multidimensional poverty index	-0.0515022	0.2685457	-0.19
Ln-farm income	-0.0015372	0.034241	-0.04
Years of farming experience	0.0114468	0.003875	2.95***
Primary occupation	0.332017	0.1015408	2.95***
Age	0.0075619	0.0034052	2.22**

Diagnostics and post-estimations

Constant = -2.29	**VIF _{max} = 1.67
Probability > χ^2 = 0.0000	VIF _{min} = 1.15
Pseudo R ² = 0.5374	VIF _{mean} = 1.37
Area under ROC curve = 0.9374	

Source: Field survey data analyses result, *if $p \leq 0.1$, **if $p \leq 0.05$ and ***if $p \leq 0.01$

Reduced farm income has also been found to be significantly linked to increasing off-farm diversifications¹⁹, perhaps owing to capital resource shortages, which raises the need to expand the capital bases of farms via improved financial inclusion, given its empirical significance, with further analyses presented in Table 3.

Financial inclusivity determinant analyses: Financial inclusion is an important capital input in many businesses as it provides a probatory financial resource base that helps shoulder fixed and recurring expenditures in the production cycle. To know the factors that determine financial inclusivity, a binary logit regression analysis was conducted and the analysis showed that the model well explained the data with an adjusted coefficient of determination index of 53.7% which is significant at 1% level, with an area under curve (AUC) of at least 93.7% with no multicollinearity

problem from the Variance Inflation Factor (VIF) diagnostics as summarized in Table 3.

Out of the ten empirical variables that may determine financial inclusivity, only six variables were statistically significant and discussed. Infrastructure access positively influences credit access and is significant at a 1% probabilistic level. This may be due to the proximity of infrastructures to credit sources and vice versa, in addition to the need for large scale poultry production electrification to mitigate photoperiodicity-linked losses which in turn may serve as a credit worthiness criteria.

Furthermore, increasing formal education positively increases financial inclusivity and is found significant at a 10% level. Formal education provides a knowledge-based security for efficient production decision-making, which could have enhanced advantageous access to formal credit institutions that they have hitherto accessed, relative to their less

educated counterparts. This raises the need for the unskilled to possess or seek formal training in their line of enterprise for enhanced industrial relevance and better inclusion competitiveness in the contemporary. These attune to the findings of researchers^{3,4,8}.

In addition, cooperative membership positively determines financial inclusivity and is found significant at 5%. This is possibly due to the credit incentives associated with cooperatives, which also promote their creditworthiness relative to non-cooperators.

Also, years of farming experience positively increases financial inclusivity and is significant at 1%. More experienced farmers who have spent considerable years in production can make better decisions than less experienced ones hence, serving as an incentive to credit worthiness. Whether this could be empirically traded off for formal education despite its relatively higher variable-based statistical qualifier is not advisable due to the lower relative marginal response effect of the farming experience variable. These corroborate the findings of Odhiambo *et al.*³ and Assogba *et al.*⁴.

Also, primary occupation with farming as a reference unit positively determines financial inclusivity and was found significant at 1%. This may be due to similar reasons as in the case of years of farming experience. Also, individuals who majorly engage in farming as a primary occupation tend to dedicate ample time and good resources to it, being their primary means of livelihood hereby exposing them to input support. This relatively makes them perform better while reducing the risk of loss and under productivity when compared to their counterparts who primarily engage in activities other than farming.

Finally, age positively influences financial inclusivity and is significant at a 5% probability level. This might be due to the positive interactions of age timing with some credit-worthiness criteria such as formal education and years of farming experience, in addition to maturity which may position one to favorable credit input accessibility, relative to younger or less matured/ less experienced farm holders. This is related to the findings of Asiamah *et al.*⁸.

Research-based analytical findings recommended that, when access to infrastructure is enhanced via improved rural electrification, it will consequently increase output level and can also boost creditworthiness, while relevant formal education should be encouraged or provided to enhance production, managerial and financial literacy. Cooperative members should also be encouraged, to uphold their existing positive impact and further curb financial exclusion from the empirical monetary marginal returns to factors associated with

it as confirmed herewith. To these effects, the national monetary policy rates should be such that reduce inflationary tendencies while promoting market price stability for a sustainably efficient product market. Finally, the government can intensify efforts towards initiating efficiently successful financial inclusion projects/ programs for innovative financing mechanisms that build on the shortfalls and excesses of the moribund financial inclusion programs of the past administrations to correct and improve on them towards; Consolidating adequate financial capital availability for qualified applicants and compliant beneficiaries while Guaranteeing a better financial inclusion future that promotes full employment realization potentials, in the face of increasing uncertainties and towards addressing it.

CONCLUSION

It was deduced from the results obtained that the financially excluded are more than the financially included from the population but the mean age of the included is significantly higher than those deprived. Also, financially included farms were found to have higher gross returns on investment, relative to those without credit access by at least 57% more and significantly at 5% level, but it would require a financially excluded firm to increase her average monthly income by about 135% to bridge the existing financial inclusion gap while, access to infrastructure, increasing formal education, cooperative membership, years of farming experience, farming as primary occupation and farmer's age determined financial inclusivity and the null hypotheses were thereby rejected. Notwithstanding, this study further avails future studies unraveling of the actual profitability accrued to financial inclusion among Farm enterprises.

SIGNIFICANCE STATEMENT

The study highlights the critical role of financial inclusion in boosting agricultural productivity, particularly in the poultry sector, where financially included farms achieved at least 57% higher gross returns compared to non-included farms. Factors such as education, cooperative membership and infrastructure significantly influenced inclusion, while excluded farms would need a 135% income increase to bridge the gap. Financial inclusion enhanced returns to factors for participants and demonstrated its potential to address marginalization among prospective beneficiaries. These findings underscore the importance of accessible financial capital in agricultural development.

ACKNOWLEDGMENT

The authors appreciate the respondents, including farmers, sectoral experts and agents, with all group participants for their valuable responses towards this study.

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