

Research Article

Commercial Agriculture and Youth Poultry Egg Farmers' Efficiency in Nigeria

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Abstract

Low egg production is one of the many factors that challenge the growth of the Nigerian poultry industry and particular attention has not been paid to youth involvement in commercial poultry egg production. Using data from 181 sampled farmers, this study used Propensity Score Matching (PSM) to investigate whether the impact of the concluded Commercial Agriculture Development Project was sustainable, even three years after its closure in Nigeria. Farmers who participated in the project recorded 7.6%-21.0% increases in profit and a slight (0.1%-0.7%) decrease in technical efficiency. Comparing determinants of profitability between youth and non-youth farmers, show that price per crate and egg production quantity recorded more positive effects on the profitability of youth farmers while feed price had a more negative effect on the profitability of non-youth farmers. On the determinants of Technical Efficiency (TE) between youth and non-youth farmers, although years of education decreased the TE of both groups, the effect was greater among youth farmers, while egg production was significant and positive for both groups, the effect was greater for non-youth farmers. Also, the number of birds, feed quantity, and price per crate had negative effects on TE for youth farmers only, while years of experience although negative was significant for only the non-youth group. Overall, youth farmers recorded more significant positive effects on profit than non-youth farmers and less significant positive effects on TE. Overall, our results suggest scaling-up or expanding commercial agriculture interventions to farmers, especially youth. Our finding further highlights the need for training/capacity-building and extension services for youth farmers as this will bridge the gaps of inexperience that are contributory to TE of non-youth farmers.

Keywords

Commercial Agriculture, Efficiency, Poultry Egg, Profitability, Youth Farmers

1. Introduction

Commercialization in agriculture is a process by which farms increase their engagement with input and output markets as they move away from integrated or subsistence farming systems to specialized crop production [1]. In developing countries like Nigeria, agriculture plays a key role in employment, livelihoods, income growth, food security, poverty alleviation, socio-economic development and environmental

sustainability [2, 3]. Agriculture is one of the major sources of youth employment and is a sustainable source of food for the growing population. However, the Nigerian agricultural sector in recent times has been affected by sporadic flooding, conflicts between farmers and herdsman as well as Boko Haram insurgencies that have disrupted food production [4].

The National Youth Policy [5] categorizes Nigerian citi-

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zens between 18 and 35 years old youth as [6] and youth aged 18-35 years were 52.2 million in 2012 [5]. Youth unemployment rate grew to 53.40% in 2020 [8] and has become a threat to the country's social, economic, and political stability.

Nigeria is the most populated African country with a population of over 214 million [7] and is projected at 300 million by 2050 with 280 million people estimated to live in cities, significantly increasing the demand for poultry products [8]. Due to the high population growth in Africa and growing income, the demand for eggs and poultry meat has significantly increased in recent years across large parts of the continent [9]. Food production growth in Nigeria is low, as between 2016 and 2019 the cumulative agricultural import value was about \$10.2 million while agricultural export value was about \$2.5 million [10].

Poultry is a very important sub-sector of the livestock industry, and has the ability to promote economic growth in the industry as egg and poultry have been found to be one of the highest contributors to output in the livestock sector after meat [11]. Furthermore, the Nigerian poultry sub-sector is chiefly important in the provision of meat and egg as well as the provision of employment either directly or indirectly. Nigeria's poultry industry provides about 15%-18% of employment opportunities to the populace [12]. This is ascribed to the fact that the production cost per unit of poultry keeping is low relative to other types of livestock and returns to investment are high. Thus, producers need a small amount of capital to start up poultry production. Among poultry products, poultry egg is considered to be more pleasant because it is low in cholesterol and high in protein [13]. Of all animal sources of protein, poultry egg is one of the most nutritious and complete foods known to man, and it provides the means by which rapid transformation of animal protein intake can be achieved [14]. The poultry sub-sector is the most commercialized of all Nigeria's agricultural sub-sectors with a net-worth of \$4.4 billion [8].

In Nigeria, the gross production value of poultry eggs between 2014 and 2016 was about \$796 million [15], while egg production increased from 120,000 tonnes in 1971 to 646,667 tonnes in 2020 growing at an average annual rate of 3.93%. Despite this growth in the egg production industry, local demand has not matched local supply as there is a huge demand/supply gap, thus hindering the 'one egg per day' advocacy process. The total poultry production amount however became 454 billion tonnes of meat and 3.8 million eggs per year, with a standing population of 180 million birds in Nigeria [16]. Tijjani *et al.* [17] noted that despite the growth in the country's egg production industry since the year 2000, domestic egg production is yet to meet demand. Moreover, meeting the challenge of improving rural incomes in Africa will require some form of transformation out of the subsistence, low-input, and low-productivity farming systems that currently characterize much of rural Africa [18].

In response however, to solve this demand-supply gap;

poultry production must be technically efficient and profitable [19]. Farmers can improve their technical efficiency through the production of higher value-added and higher yield commodities [20, 21]. Bamiro *et al* [22] defined technical efficiency as the achievement of maximum potential output from a given quantity of input, taking into account the physical production relationship. Moreover, Rahji *et al* [23] opined that the economic efficiency of chicken meat and egg production depends on the growth rate of birds as well as the feeding cost and finishing time.

Assessing the profitability and efficiency of commercialized poultry egg farms as well as its determinants has become necessary. Specifically for farmers that participated in the Commercial Agriculture Development Project (CADP) poultry eggs' value chain and those who did not participate – particularly, youth farmers and then comparing outcomes with non-youth farmers. In terms of relevance to designing youth-oriented policy, this study will serve as an indicator on whether or not to consolidate on the gains of commercialized agriculture or eliminate some or all its components. In addition, studies on youth agricultural commercialization, profitability and technical efficiency are important. However, limited studies have been conducted in this regard. Rarely did any of the notable studies [24-29] focus on youth farmers or compare outcomes with non-youth farmers nor pay specific attention to the effect of commercialized agriculture on youth production. Thus, this study provides insight into the profitability and technical efficiency of farmers, specifically comparing youth with non-youth farmers. This way, this study makes a unique contribution to available youth development literature in Nigeria as this contribution is important to evaluating impact literature conducted without using comparison groups [30]. The objectives of the study are to investigate the impact on poultry egg farmers' profitability and technical efficiency; as well as examine the determinants of profitability and technical efficiency between youth and non-youth farmers.

The remainder of the paper is organized as follows: section two presents the materials and methods used in the study, including the analytical framework and estimation techniques. The results and main findings of the study are presented and discussed in section three. Lastly, section four focuses on discussing the conclusions and recommendations.

2. Materials and Methods

2.1. The Study Area

The study was conducted in Nigeria. Cross-River, Enugu, and Lagos States. Cross River State is in the South-South geo-political zone, lying between latitude 4°15' North and 7°00' North and longitude 7°15' East and 9°30' East. As of 2016, the estimated population was over 3.8 million and the total land area is 106.586km² [31]. The second State - Enugu is in the South-East geo-political Zone, is located at 6°30'

North of Equator, and 7°30' East of Latitude, and covers an area of 7,161km². The third State, Lagos, is the most urbanized city in Nigeria, and one of the world's fastest-growing urban centers [32]. The State is geographically located in the South-western zone and lies between latitudes 6°22' - 6°42' North and longitude 2°45' - 4°20' East [33]. It occupies about

3,577 km² land area, approximately 0.4% of Nigeria's land-mass [34]. The city is estimated to have approximately 22 million populace [35].

The data was collected from a cross-sectional survey in Cross River, Enugu and Lagos States in Nigeria from poultry egg farmers using well-structured questionnaires.

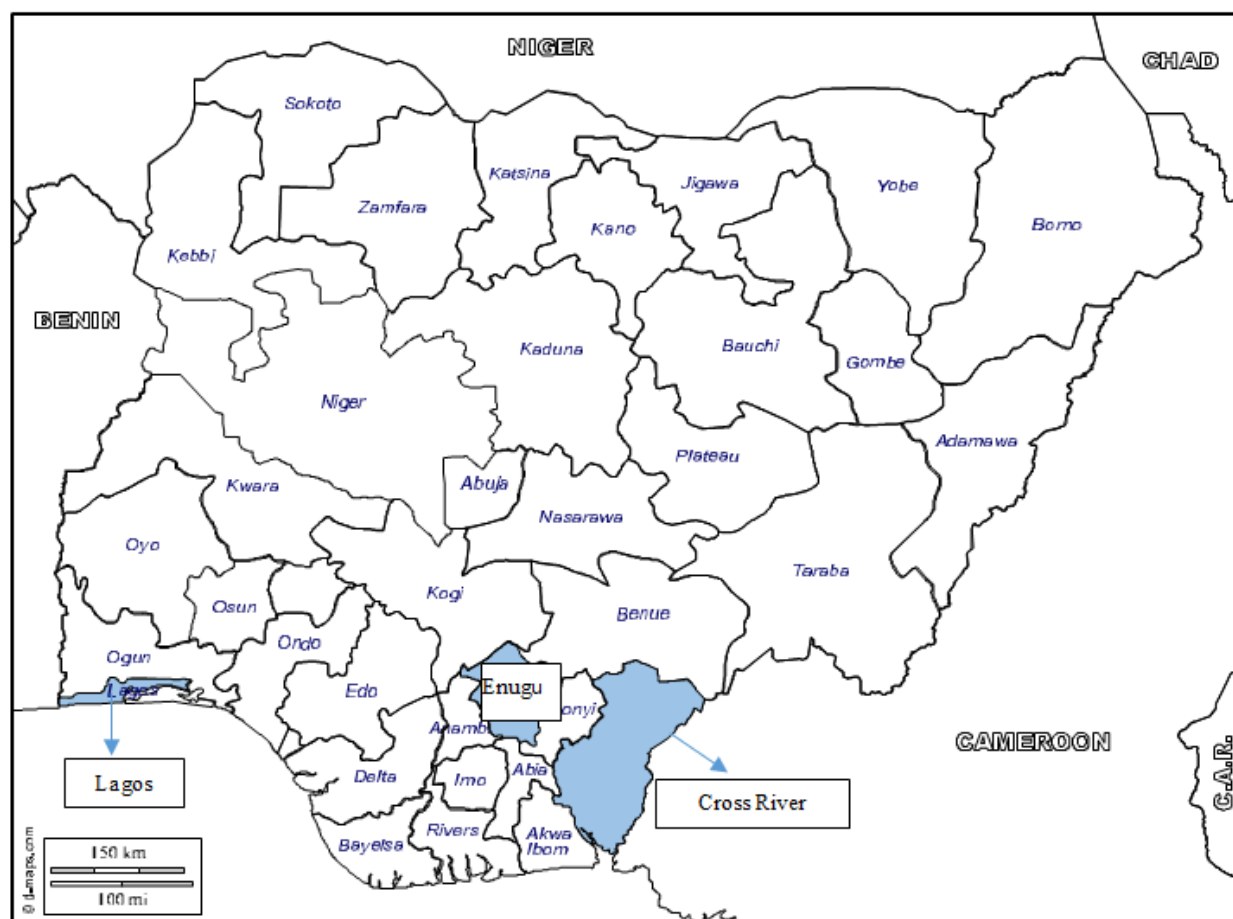


Figure 1. Map of Nigeria, highlighting the study area.

2.2. Sampling Procedure

Two-stage sampling technique was adopted for this study in the selection of respondents. The first stage is the purposive selection of Cross River, Enugu and Lagos States being states that participated in CADP. The second stage is the random selection of poultry egg farmers from the States. Using Cochran's [36] formula to calculate sample size for infinite population (n_0), and $n_0 = \frac{z^2 pq}{e^2}$ where z is the selected critical value of desired confidence level, p is the estimated proportion of an attribute that is present in the population, $q = 1 - p$ and e is the desired level of precision. Thus at $p = 0.5$, 80% confidence level ($z = 1.28$)

with 5% precision, $n_0 = 41$. Therefore, the least sample size for the field survey is 51 in each respective state. The respondents were reached through the Agro-Processing, Productivity Enhancement and Livelihood Improvement Support (APPEALS) Project. A total of 253 well-structured questionnaires were administered, and 181 were valid for further analysis after matching. The survey questionnaire was designed to gather detailed information on socio-economic characteristics of poultry egg farmers, costs and revenue from production and agricultural commercialization.

Table 1 presents the distribution of farmers, 55.96% were youth while 44.05% were non-youth.

Table 1. Distribution of Farmers according to State.

| State | Non-participation | | Participation | | Total |
|-------------|-------------------|------------------|---------------|------------------|-----------------|
| | Youth (N=51) | Non-Youth (N=49) | Youth (N=43) | Non-Youth (N=25) | |
| Lagos | 23 (12.72) | 19 (10.51) | 15 (8.30) | 11 (6.08) | 68 (37.57) |
| Cross River | 18 (9.95) | 16 (8.85) | 11 (6.08) | 8 (4.42) | 53 (29.28) |
| Enugu | 14 (7.75) | 17 (9.40) | 19 (10.51) | 10 (5.53) | 60 (33.15) |
| Total | 55 (30.42) | 52 (28.76) | 45 (24.89) | 27 (16.04) | 181 (100.00) |

*Percentages are presented in parenthesis Field Survey, 2019

2.3. Theoretical Framework and Estimation Strategies

2.3.1. T - Tests Statistics

T-test were used to examine significance of mean difference between populations, i.e. youth and non-youth. According to Walpole *et al.* [37], if the populations are normal, the statistic $t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$; has an approximate t-distribution with approximate degrees of freedom.

$$v = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{\left(\frac{s_1^2}{n_1}\right)^2}{n_1 - 1} + \frac{\left(\frac{s_2^2}{n_2}\right)^2}{n_2 - 1}}$$

Where, \bar{X}_1, \bar{X}_2 are the sample mean; s_1 and s_2 are corresponding standard deviations and n_1 and n_2 are sample sizes. As a result, the test procedure is to not reject the null hypothesis (H_0) when

$$-t_{\alpha/2, v} < t' < t_{\alpha/2, v}$$

2.3.2. Profitability Analysis

Gross margin (GM) is the difference between the total revenue (TR) and the total variable cost (TVC) and is given as $GM(\pi) = \sum(TR - TVC)$. Total revenue (TR) is the total revenue from poultry egg production and is a product of price per crate and number of crates produced weekly in dollar (NGN360.06 was equivalent to USD1 at the time of field survey), while TVC is the sum of the weekly equivalents of unit price of point of lay bird, cost of feed consumed,

wage/labour, veterinary costs, building/rent, water and other costs (mortality, transportation, sanitation, electricity etc.). Studies that have used this method include Tijjani *et al* [18], Folorunso *et al* [38] etc.

2.3.3. Stochastic Frontier Production Function for Estimating Technical Efficiencies

The stochastic frontier production function model is specified as follows:

$$\ln Y_i = \ln \beta_0 + \sum \beta_j \ln X_{ij} + v_i - u_i$$

Where:

Y –the output of the poultry egg farmer,

X_j – the input vector;

B_j – is the vector of production function parameters.

The frontier production function $F(X_j B_j)$ is a measure of maximum potential output for any particular input vector X_j . v_i and u_i cause actual production to deviate from the frontier.

v_i captures the random variation in output which is due to factors beyond the control of the farmer (e.g. natural hazards, temperature, extremes, moisture etc.) and is assumed to be independently and identically distributed with zero mean and constant variance $(0, \sigma_v^2)$, and independent of u_i . u_i is a non-negative term representing the deviations from the frontier production, which is attributed to controllable factors (technical inefficiency). It is half normal, identically and independently distributed with zero mean and constant variance: $N(0, \sigma_u^2)$. The stochastic frontier production function model is established using the Maximum Likelihood Estimation (MLE) procedure [39]. The technical efficiency is empirically measured by decomposing the deviation into a random component (U).

According to Ojo [40], the technical efficiency of an individual farm is defined as the ratio of observed output (Y_i) to the corresponding frontier output (Y_i^*) for the available technology, that is:

$$TE = \frac{Y_i}{Y_i^*}$$

$$\frac{\ln \beta_0 + \sum \beta_j \ln x_{ij} + v_i - u_i}{\ln \beta_0 + \sum \beta_j \ln x_{ij} + v_i}$$

So that $0 \leq TE \leq 1$

The technology employed in poultry egg production was assumed to be specified by the Cobb–Douglas frontier production function [41] and is defined as:

$$\ln \pi_i = \ln \beta_0 + \beta_1 \ln X_{1i} + \beta_2 \ln X_{2i} + \beta_3 \ln X_{3i} + \beta_4 \ln X_{4i} + \dots + \beta_7 \ln X_{7i} + v_i - u_i$$

Where

π –Revenue (output) from egg production (\$)

X_1 – Number of birds

X_2 – Feed cost (\$)

X_3 – Poultry Capacity (number)

X_4 –Wage/labour (\$)

X_5 –Water costs (\$)

X_6 – Veterinary Costs (\$)

X_7 – Other costs (\$)

v_i – random errors

u_i – technical inefficiency defined as

$$u_i = \delta_0 + \delta_1 Z_{1i} + \delta_2 Z_{2i} + \delta_3 Z_{3i} + \delta_4 Z_{4i}$$

Where:

Z_1 – sex of farmer (male=1, female = 0)

Z_2 – age (years)

Z_3 – poultry egg production experience (years)

Z_4 – cumulative years of schooling (years)

These are included in the model to indicate their possible effect on the technical efficiencies of poultry egg production. β and δ are scalar parameters to be estimated. The variances of random errors (σ_v^2), the variance of the technical inefficiency effect (σ_u^2) and the overall variance of the model (σ^2) are related as $\sigma^2 = \sigma_v^2 + \sigma_u^2$. The ratio $\sigma^2 = \frac{\sigma_u^2}{\sigma^2}$ measures the total variation of output from the frontier which can be attributed to technical inefficiency [42]. The estimates for all the parameters of the stochastic frontier production and the inefficiency model are simultaneously obtained.

2.3.4. Propensity Score Matching (PSM)

To assess CADP impact on profitability and technical efficiency (TE), PSM was used to address the evaluation problem [43–45]. The data collected was matched to find the comparison group from a sample of non-participants that is closest to the sample of participants so as to get project im-

pact on profitability and TE.

Since the match was of good quality, the Average Treatment Effect on the Treated (ATT) was computed to determine impact. This is defined by Rosenbaum and Rubin [46] as follows:

$$E(Y_1 - Y_0/D = 1) = E(Y_1/D = 1) - E(Y_0/D = 1)$$

Where $E(Y_1/D = 1)$ is the observed outcome of the treated, that is, the expected outcome (profit/TE) earned by participants and $E(Y_0/D = 1)$ is the counterfactual outcome - the expected outcome they would have received if they had they not participated in CADP. The counterfactual outcome represents outcome of the non-participants since they have similar characteristics with participants. In addition to estimating the propensity score equation and then using the different matching methods (nearest neighbor, stratification, radius and kernel wherein standard errors were computed using bootstrapping method) to compare the results, the findings were consistent, thus, the direct nearest neighbor matching with one match per treatment was applied to check for robustness and the findings were reliable.

2.3.5. Ordinary Least-Squares (OLS) Regression

To assess the determinants of profitability and technical efficiency among youth and non-youth groups, OLS regression was used. It is represented mathematically using the straight line equation ' $Y = \alpha + \beta x + \varepsilon_i$ ' [47].

To obtain the estimated regression equation $\hat{Y} = \hat{\alpha} + \hat{\beta}X$

OLS is a technique that is used to obtain and. The OLS procedure minimizes

$$\sum_{i=1}^n e_i^2 = \sum_{i=1}^n (Y_i - \hat{Y}_i)^2 = \sum_{i=1}^n (Y_i - \hat{\beta}_0 - \hat{\beta}_1 X_i)^2$$

with respect to $\hat{\beta}_0$ and $\hat{\beta}_1$. Solving the minimization problem results in the following expressions:

$$\hat{\beta}_1 = \frac{\sum_{i=1}^n (X_i - \bar{X})(Y_i - \bar{Y})}{\sum_{i=1}^n (X_i - \bar{X})^2} = \frac{\sum_{i=1}^n X_i Y_i - n\bar{X}\bar{Y}}{\sum_{i=1}^n X_i^2 - n\bar{X}^2}$$

$$\hat{\beta}_0 = \bar{Y} - \hat{\beta}_1 \bar{X}$$

The explanatory variables are

X_1 =Years of Education (years)

X_2 =Poultry Capacity (number)

X_3 = Feed price (kg)

X_4 =Farm experience (years)

X_5 =Price per crate (\$)

X_6 =Rent (\$)

X_7 =Wage (\$)

X_8 = Number of birds

X_9 = Feed price (\$)

X_{10} = Egg production (Crate)

3. Results and Discussion

The section is divided into three (3) sub-sections – socio-economic characteristics of farmers; profit analysis (profitability, impact on profit; determinants of profit) and technical efficiency (TE) analysis (TE investigation, impact on TE; and determinants of TE).

3.1. Socio-Economic Characteristics of the Respondents

Majority (61.90%) of the farmers were male while 38.10% were female. Table 2 presents the socio-economic characteristics of the farmers. The mean age was 37.63 ± 8.26 years indicating that these farmers are in their active ages. This agrees with previous studies where an average age of 42 years was recorded for poultry egg producers and this implies a productive, young and active stage in which farmers are able to contribute meaningful labour input into all the stages of production for efficient output realization which in turn results in consumption and income opportunities with

proportional household welfare [48]. The mean cumulative years of education (15.29 ± 1.76 years) aligns with previous findings [38, 49] where many poultry egg farmers have years of formal education. This improves their ability to adopt new technology which can translate to increased poultry egg production [50]. Also, farm experience of 7.74 ± 4.69 years agrees with the findings of Ashagidigbi *et al.* [51] and Folorunso *et al.* [38], which opine that farming experience enhances efficient allocation and utilization of resources thus increasing productivity. TE value of 0.861 ± 0.106 indicating 13.9% chances for increasing egg production in the short run. This is similar to the findings of Osinowo and Tolorunju [52] who reported a mean TE value of 0.856 and 14.4% chances of increasing egg production in the short run.

Comparing only youth farmers, across those who participated and those who did not, the significant differences were the number of birds (19.11%), crates produced per week (13.76%), access to credit (76.5%), total revenue (25.47%) and total costs (18.41%). Participating youth farmers reported higher significant values.

Table 2. Mean and Mean Differences of Key Variables.

| Variable | Mean | Project Participant | | | |
|--|--------|---------------------|-----------|-----------|---------------|
| | | Youth | Non-Youth | Mean Diff | Mean Diff (%) |
| Age | 37.63 | 32.09 | 43.88 | 11.79*** | 36.74 |
| Cumulative years of education (Years) | 15.29 | 15.72 | 15.280 | 0.44 | 2.80 |
| Household size (Number) | 4.49 | 4.12 | 3.72 | 0.396 | 9.61 |
| Farm experience (years) | 7.94 | 6.93 | 7.120 | 0.190 | 2.74 |
| Poultry Capacity (number of birds) | 2444 | 2587 | 3288 | 701*** | 27.08 |
| Price per crate (\$) | 4.61 | 4.64 | 4.67 | 0.03 | 0.74 |
| Crates Produced/week | 42.00 | 43.00 | 56.00 | 13.00*** | 28.70 |
| Credit access (Yes=1, No otherwise) | 0.435 | 1.000 | 0.400 | 0.600 | 60.00 |
| Group membership (Yes=1, No otherwise) | 0.893 | 0.651 | 0.800 | 0.149* | 22.89 |
| Land owned (Yes=1, No otherwise) | 0.464 | 0.42 | 0.280 | 0.139 | 33.10 |
| Total Variable Cost (\$) | 81.73 | 89.66 | 116.69 | 27.03*** | 30.15 |
| Total Revenue (\$) | 173.58 | 181 | 235.50 | 54.50*** | 30.11 |
| Profit (\$) | 91.99 | 91.21 | 118.64 | 27.43 | 30.07 |
| Technical efficiency | 0.861 | 0.85 | 0.87 | 0.02 | 2.35 |

| Variable | Mean | Project Non- participant | | | |
|----------|-------|--------------------------|-----------|-----------|---------------|
| | | Youth | Non-Youth | Mean Diff | Mean Diff (%) |
| Age | 37.63 | 31.667 | 45.490 | 13.823*** | 43.65 |

| Variable | Mean | Project Non- participant | | | |
|--|--------|--------------------------|-----------|-----------|---------------|
| | | Youth | Non-Youth | Mean Diff | Mean Diff (%) |
| Cumulative years of education (Years) | 15.29 | 15.451 | 14.735 | 0.968 | 6.27 |
| Household size (Number) | 4.49 | 4.765 | 4.939 | 0.174 | 3.65 |
| Farm experience (years) | 7.94 | 6.705 | 10.531 | 3.825*** | 57.05 |
| Poultry Capacity (number of birds) | 2444 | 2093 | 2251 | 158 | 7.57 |
| Price per crate (\$) | 4.61 | 4.52 | 4.65 | 0.13 | 2.68 |
| Crates Produced/week | 42.00 | 37.00 | 40.00 | 3.00 | 6.37 |
| Credit access (Yes=1, No otherwise) | 0.435 | 0.235 | 0.163 | 0.072 | 30.64 |
| Group membership (Yes=1, No otherwise) | 0.893 | 0.549 | 0.510 | 0.388 | 70.67 |
| Land owned (Yes=1, No otherwise) | 0.464 | 0.419 | 0.280 | 0.069 | 16.47 |
| Total Variable Cost (\$) | 81.73 | 66.92 | 72.56 | 5.64 | 8.42 |
| Total Revenue (\$) | 173.58 | 147.68 | 163.31 | 15.63 | 10.58 |
| Profit (\$) | 91.99 | 80.76 | 90.75 | 9.99 | 12.37 |
| Technical efficiency | 0.861 | 0.725 | 0.703 | 0.022 | 3.03 |

| Variable | Mean | ALL Youth | | | |
|--|--------|-------------------|------------------------|------------|---------------|
| | | Participant Youth | Non- Participant Youth | Mean Diff. | Mean Diff (%) |
| Age | 37.63 | 32.093 | 31.667 | 0.426 | 1.33 |
| Cumulative years of education (Years) | 15.29 | 15.721 | 15.451 | 0.270 | 1.72 |
| Household size (Number) | 4.49 | 4.116 | 4.765 | 0.648 | 15.74 |
| Farm experience (years) | 7.94 | 6.930 | 6.706 | 0.224 | 3.23 |
| Poultry Capacity (number of birds) | 2444 | 2587 | 2093 | 494*** | 19.11 |
| Price per crate (\$) | 4.61 | 4.63 | 4.52 | 0.11 | 2.50 |
| Crates Produced/week | 42.00 | 43.00 | 37.00 | 6.00** | 13.76 |
| Credit access (Yes=1, No otherwise) | 0.435 | 1.00 | 0.235 | 0.765*** | 76.5 |
| Group membership (Yes=1, No otherwise) | 0.893 | 0.698 | 0.726 | 0.028 | 4.01 |
| Land owned (Yes=1, No otherwise) | 0.464 | 0.419 | 0.549 | 0.130 | 31.03 |
| Total Variable Cost (\$) | 81.73 | 89.80 | 66.92 | 22.88*** | 25.47 |
| Total Revenue (\$) | 173.58 | 181.00 | 147.68 | 33.32*** | 18.41 |
| Profit (\$) | 91.99 | 91.21 | 80.76 | 10.45 | 11.46 |
| Technical efficiency | 0.861 | 0.849 | 0.853 | 0.0037 | 0.44 |

*** Significance at 1%, **at 5%, * at 10% Field Survey, 2019

3.2. Profitability Analysis of Poultry Egg Farmers

Profitability analysis

Farm profit from poultry egg production is estimated as the difference between the total revenue (TR) and total variable cost (TVC). The mean profits were recorded as \$91.98±36.78 accounting for 53% of the total revenue. This supports the findings of Umar [53] and Folorunso *et al.* [38] who showed that poultry egg production is profitable and that profitability level is according to scale of production. Of the total cost, feed costs accounted for 55.49% agreeing with previous studies [51, 54, 55] where feed costs accounted for as high as 70% of the production costs. Also, cost of chicks was 38.03%, and labour costs was 2.76%. Furthermore, other

costs were building/rent (0.26%), water (0.62%), vaccination (2.02%) and miscellaneous (0.82%). These findings follow Aminu and Hermans [20] 38.3%, 1.2% and 1.0% were feed cost, vaccination/medication and miscellaneous respectively in layer production.

Table 3 presents the profiling of youth and non-youth farmers according to profit. Low, medium and high profit values were constructed as less than one-third, one-third to less than two-third and two-third and above. More of the youth farmers than the non-youth farmers recorded profits in the low and medium categories while more non-youth recorded high profits. This support previous findings [39, 56, 57] which posited that profits depend on the scale of production, which may be attributable to years of experience.

Table 3. Profiling of Youth and Non-Youth Poultry Egg Farmers by profit.

| Age category | low (<\$60.68) | Medium (\$60.68 - 121.35) | High (>\$121.35-182.03) | Total |
|-----------------------|-------------------|------------------------------|----------------------------|---------------|
| Youth (18-35 years) | 22 (13.10) | 57 (33.93) | 15 (8.93) | 94 (55.95) |
| Non-Youth (≥35 years) | 14 (8.33) | 38 (22.62) | 22 (13.10) | 74 (44.05) |
| Total | 36 (21.43) | 95 (56.55) | 37 (22.02) | 168 (100) |

Percentages are presented in parenthesis Source: Field Survey, 2019

Project Impact on Profit

Propensity score matching estimates using the different matching methods as well the direct nearest-neighbor matching for robustness of the average treatment effect were used. This is presented in Tables 4 and 5, Figure 2 also presents the common support graph of matched covariates. The average treatment effect of the project on profit was consistent from the matching methods, showing between 7.6% - 21.0% significant (at 5%) increases in profit for farmers who benefitted from the project. This finding supports the report of Bako *et al* [29] where Project participation had a significant impact on dairy farmers' income.

Table 4. Project Impact on Profit.

| Matching Method | Average treatment effect (ATE) | Hidden bias (e^r) |
|-------------------|--------------------------------|-----------------------|
| Nearest Neighbour | 0.079 (1.25) | 1.4 |
| Stratification | 0.081 (2.02) | 1.4 |
| Radius (0.001) | 0.210 (1.89) | 1.4 |
| Kernel | 0.076 (1.60) | 1.4 |

Figures in parenthesis are t-test values Source: Field Survey

The result obtained was consistent with the estimate of the direct near neighbor (Table 5), a 14.5% positive impact of participation on profit is seen and was significant at 5%. This implies sustainability, in that having participated in the project which ended three years ago significantly increases profit by 14.5%.

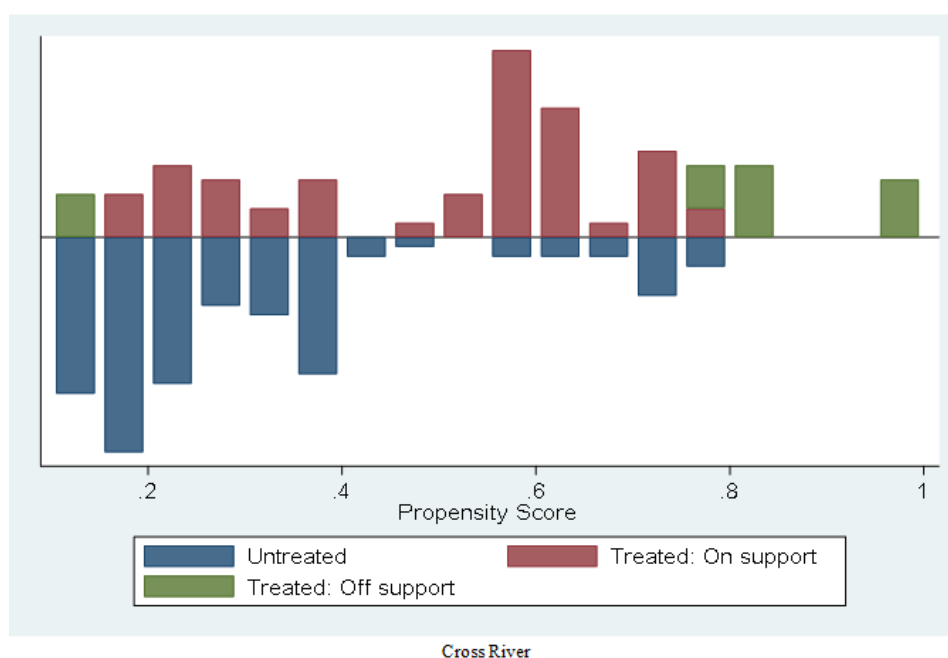


Figure 2. Common Support Graph of Matched Covariates.

Table 5. Direct neighbor matching estimate of project impact on profit.

| Profit | ATE | Std.Err. | Z | P>z | [95%Conf. Interval] |
|---|-------|----------|-------|-------|---------------------|
| Sample Average Treatment effect on the Treated (SATT) | 0.145 | 0.054 | 2.660 | 0.008 | 0.038 0.252 |

Source: Field Survey, 2019

Determinants of Profitability between Youth and non-youth Farmers

Table 6 compares the determinants of profitability for youth and non-youth farmers. For the youth group, significant variables were poultry capacity, number of birds, price per crate, feed price and egg production, while significant variables to profitability for the non-youth group were number of birds, price per crate, feed price and egg production.

Poultry capacity i.e. the number of birds that can be stocked in a unit was significant only in the youth group, and it reduced profit by 0.6%; this is tenable because youth are relatively inexperienced in poultry egg production unlike the non-youth group, who can stock their farms in ways that maximize profit. This findings contrasts the report of Aminu and Hermans [20], where farmer's age positively influenced profitability of layer production but had a negative effect for broiler production.

The negative and significant effect of number of birds on profitability was similar in both categories. This finding dis-

agrees with previous findings that flock size positively determine profit [12, 46, 47]. Although, price per crate and number of crates produced increased profit for both groups, the effect was greater for youths, this could be because non-youth farmers who are experienced spend less time on the effective supervision of their farms due to involvement in other societal activities [40]. Furthermore, Emokaro and Eweka [58] reported that many poultry farmers were within their active years of 30's and can make meaningful contributions to production.

Feed price reduced profit of both groups - youth farms (3.3%) and non-youth farms (3.6%) agreeing with studies [51, 54, 55] that feed costs reduce profit. Previous studies [59, 60] have reported that high cost of feeds is occasioned by the ban on feed importation, in the face of low production from local manufacturers. However, the negative effect of feed price on profitability was more pronounced among non-youth farmers and this is tenable because youth farmers with high levels of education are usually eager in the adoption of improved

farming technologies and this affect innovation, technological inputs, better techniques and skills invested in farming operations [61].

Table 6. Determinants of Profitability.

| Youth | | | Non-Youth | | |
|-------------------|-----------------------------|------------|--------------------|-----------------------------|------------|
| Profit | Coefficient | Std. Error | Profit | Coefficient | Std. Error |
| Years of Educ. | -3.000×10^{-3} | 0.004 | Years of Education | -7.000×10^{-3} | 0.007 |
| Poultry Capacity | $-6.00 \times 10^{-3} **$ | 0.003 | Poultry Capacity | 5.000×10^{-3} | 0.006 |
| Number of birds | $3.747 \times 10^{-4} ***$ | 0.000 | Number of birds | $-3.352 \times 10^{-4} ***$ | 0.000 |
| Farm experience | 2.837×10^{-4} | 0.002 | Farm experience | -6.070×10^{-5} | 0.003 |
| Price per crate | $7.740 \times 10^{-5} ***$ | 0.000 | Price per crate | $5.930 \times 10^{-5} ***$ | 0.000 |
| Rent | -3.240×10^{-5} | 0.000 | Rent | 3.200×10^{-5} | 0.000 |
| Wage | 1.26×10^{-5} | 0.000 | Wage | 1.910×10^{-5} | 0.000 |
| Feed price | $-3.300 \times 10^{-2} ***$ | 0.005 | Feed price | $-3.600 \times 10^{-2} ***$ | 0.009 |
| Egg prod. (Crate) | $3.000 \times 10^{-2} ***$ | 0.002 | Egg prod.(Crate) | $2.100 \times 10^{-2} ***$ | 0.004 |
| Constant | $3.983 ***$ | 0.099 | Constant | $4.017 ***$ | 0.196 |
| R-squared | 0.940 | | R-squared | 0.880 | |

*** $p < .01$, ** $p < .05$, * $p < .1$ Source: Field Survey, 2019

3.3. Technical Efficiency Analysis

Technical Efficiency

Table 7 presents the coefficients of the production frontier and their corresponding levels of statistical significance. The number of birds and feed price were positive and significant at 1% while water costs was negative and significant at 5%. The number of birds being significant at 1%, imply that an increase in number of birds increased output by 37.8%. This finding follows past studies [56, 62] where farm size had a positive and significant effect on poultry egg output. Also, the feed quantity was positive and significant at 1%, implying that feed quantity increased output by 34.2%, and that the more the birds consumed feed, the more technically efficient the farms are. The positive relationship between feed and

output is similar to previous findings [50, 63, 64], where increase in poultry production is increased by increase in feed (quality and quantity), than by increase in any other factor of production. Furthermore, water costs was negative and significant at 5% reducing output by 1.6%, implying that the more the water cost, the less the efficiency, thus farmers need know the limits for which water cost should be incurred.

The estimated model is derived as:

$$\log \pi_i = 7.44 + 0.378X_1 + 0.342X_2 + 0.001X_3 - 0.016X_4 + 0.023X_5 - 0.005X_6$$

However, the insignificance of the inefficiency parameters, indicate that these parameters do not determine TE.

Table 7. Maximum Likelihood Estimate of the Stochastic Frontier Production Function.

| Variable | Parameter | Maximum Likelihood Estimate |
|-----------------|-----------|-----------------------------|
| Constant | β_0 | 7.44*** (0.3888) |
| Number of birds | β_1 | 0.378*** (0.064) |

| Variable | Parameter | Maximum Likelihood Estimate |
|--|----------------|-----------------------------|
| feed quantity (kg) | B ₂ | 0.342*** (0.065) |
| Wage (Naira) | B ₃ | 0.001 0.006 |
| Water costs (\$) | B ₄ | -0.016* (0.009) |
| Veterinary Costs (\$) | B ₅ | 0.023 (0.025) |
| Other costs (\$) | B ₆ | -0.005 (0.015) |
| Inefficiency model | | |
| Constant | δ_0 | -12.356 (56.251) |
| Sex | δ_1 | 0.365 (2.109) |
| Age (years) | δ_2 | -0.085 0.358 |
| Farm Experience (years) | δ_3 | 0.125 (0.550) |
| Cumulative years of schooling | δ_4 | 0.595 (2.590) |
| Log likelihood | | 61.255 |
| Sigma squared ($\sigma^2 = \sigma v^2 + \sigma u^2$) | σ^2 | 0.850 |
| Gamma | γ | 0.989 |

***significant at 1%, **at 5%, * at 10%

Figures in parentheses are standard errors

Table 8 profiles youth and non-youth farmers according to TE. Low, medium and high TE values were constructed as < 0.3329, 0.333-0.665 and >0.665 respectively. While, none of the farmers recorded low TE, about half (51.19%) of the farmers are youth and recorded high TE (> 0.666). For both medium and high categories, youth farmers outnumber non-youth farmers. This implies that, farmers who are older and have more experience are inefficient technically com-

pared with youth farmers ones. This may be due to the fact that the more experienced farmers tend to rely on their technical know-how and thereby, tend to shun any innovative idea being brought forward. This finding is in accordance with those of (Begum *et al* [65], Onumah, and Acquah [66], and but contrasts those of Rahman [67], Sharma *et al.* [68] and Ashagidigbi *et al.* [51] who opine that the more experienced the poultry egg farmer is, the more efficient the producer becomes.

Table 8. Profiling of Youth and Non-Youth Poultry Egg Farmers by TE levels.

| Age category | Medium (0.33-0.66) | High (>0.66) | Total |
|---------------------|--------------------|--------------|------------|
| Youth (18-35 years) | 8 (4.76) | 86 (51.19) | 94 (55.95) |

| Age category | Medium (0.33-0.66) | High (>0.66) | Total |
|------------------------------|--------------------|--------------|------------|
| Non-Youth (≥ 35 years) | 6 (3.57) | 68 (40.48) | 74 (44.05) |
| Total | 14 (8.33) | 154 (91.67) | 168 (100) |

Percentages are presented in parenthesis Source: Field Survey, 2019

Project Impact on Technical Efficiency

P propensity score matching estimates using the different matching methods as well the direct nearest-neighbor matching for robustness of the average treatment effect were used. The average treatment effect was consistent from the matching methods, showing between 0.1% to 0.7% decreases in TE for participants as shown in Table 9. A hidden bias (e^r) = 1.4 indicate farmers differ in their odds of participation by a factor of 1.4.

Table 9. Regression results of project impact on TE.

| Matching Method | Average treatment effect (ATE) on profit | Hidden bias (e^r) |
|-------------------|--|-----------------------|
| Nearest neighbour | -0.006 (-0.985) | 1.4 |
| Kernel | -0.002 (-0.386) | 1.4 |
| Stratification | -0.001 (-0.100) | 1.4 |
| Radius (0.001) | -0.007 (-0.445) | 1.4 |

Figures in parenthesis are t-test values Source: Field Survey, 2019

The result obtained was consistent with the estimate of the direct near neighbor (Table 10), a 0.1% negative impact on TE was observed. This finding contrasts previous studies [28, 29] where CADP had a significant and positive impact on the outcomes.

Table 10. Direct neighbor matching estimate of project impact on TE.

| Technical Efficiency | ATE | Standard Error | Z | P>z | [95%Conf. Interval] |
|----------------------|--------|----------------|--------|-------|---------------------|
| SATT | -0.001 | 0.003 | -0.240 | 0.814 | -0.005 0.004 |

Source: Field Survey, 2019

Determinants of Technical Efficiency between Youth and Non-Youth

Table 11 compares the determinants of TE between the groups using the ordinary least squares regression. Years of education plunged the TE of youth farmers twice that of non-youth farmers. This is tenable because the more the years of education and invariably the experience farmers acquire on best management practices of poultry egg production, the higher the technical efficiency in commercial poultry egg production. However, this contrasts the work of Oji and Chukwumah [62]. The number of birds was significant and negatively affected TE of youth farmers only. This may be so because poultry egg farmers with more years of experience (non-youth) tend to be more efficient in poultry egg produc-

tion. However, number of birds reduced TE by 0.04% suggesting that farms can increase their egg production by decreasing their stock. This finding contrasts the report of Ajiboye *et al.* [69] where farms could still increase their egg production substantially by increasing their stock. Farm experience was significant only for the non-youth group, but decreased TE by 0.002, this contrasts the report of Hassan [70], which implies that a unit increase in the experience of the poultry egg farmers will increase their technical efficiency in commercial poultry egg production. Price per crate was also significant for youth farmers only and reduced the TE. This may result from inexperience of youth farmers who unlike non-youth farmers have continuously practiced poultry egg production which presumably makes them resource effi-

cient. Feed quantity was significant for only youth farmers and this was negative, this may be because non-youth farmers are experienced in the composition and/or combination of feed. Feed quantity negatively affecting TE by 2.0% imply that the more the feed intake, the less the TE and this finding contrasts previous findings of [67, 69] but supports Ajiboye *et al.* [69]. Egg production was significant and positive for both groups, but egg production for non-youth farmers was twice positively significant to TE than that of non-youth farmers, this may be due to experience of non-youth farmers. These

findings follow previous studies [50-51, 67] but contrasts Begum [65] and imply that, non-youth poultry farmers are less efficient when compared to their youth counterparts and this may be due to the fact that the more experienced producers are, the more they tend to rely on their technical know-how and thereby, shun any innovative ideas being brought forward. The young ones may tend to learn more and thereby, look forward to embracing the new technologies and ideas; hence, become more efficient than the older farmers.

Table 11. Determinants of Technical Efficiency.

| Youth (Mean= 0.851 ±0.103) | | | Non-Youth (Mean=0.987 ±0.03) | | |
|----------------------------|-----------------------------|-----------|------------------------------|-----------------------------|----------------|
| Technical Efficiency | Coefficient | Std Error | Technical Efficiency | Coefficient | Standard Error |
| Years of Edu. | -8.000 x10 ^{-3***} | 0.003 | Years of Edu. | -4.000x10 ^{-3**} | 0.002 |
| Poultry Capacity | 2.000x10 ⁻³ | 0.002 | Poultry Capacity | -2.000x10 ⁻⁵ | 0.002 |
| Number of birds | -3.965 x10 ^{-4***} | 0.000 | Number of birds | -1.230 x10 ⁻⁵ | 0.000 |
| Farm experience | -1.000x10 ⁻³ | 0.001 | Farm experience | -2.000 x10 ^{-3***} | 0.001 |
| Price per crate | 5.800 x10 ^{-5***} | 0.000 | Price per crate | 1.800x10 ⁻⁶ | 0.000 |
| Rent | -6.22 x10 ⁻⁶ | 0.000 | Rent | -9.890x10 ⁻⁶ | 0.000 |
| Wage | 1.230x10 ⁻⁵ | 0.000 | Wage | 4.930x10 ⁻⁶ | 0.000 |
| Feed quantity | -2.000 x10 ^{-2***} | 0.004 | Feed quantity | 2.000x10 ⁻³ | 0.002 |
| Feed price | 2.080x10 ⁻⁵ | 0.000 | Feed price | 1.12 x10 ⁻⁵ | 0.000 |
| Egg prod.(Crate) | 1.500x10 ^{-3***} | 0.002 | Egg prod.(Crate) | 3.000x10 ^{-3**} | 0.001 |
| Constant | 7.800x10 ^{-1***} | 0.078 | Constant | 1.044*** | 0.047 |
| R-squared | | 0.845 | R-squared | | |

*** p<.01, ** p<.05, * p<.1 Source: Field Survey, 2019

4. Conclusion

This study considered poultry, one of the selected value chains in CADP, particularly egg production and comparing outcomes for farmers who participated with those who did not participate across youth and non-youth groups. The methods of data analysis were Gross Margin analysis, Stochastic Frontier, Ordinary Least Squares Regression and Propensity Score Matching.

Majority of the farmers were male (61.90%), while the mean age, cumulative years of formal education and poultry experience were 37.63±8.26 years, 15.29±1.76 years and 7.74±4.69 years respectively. A mean profit value of \$91.99±36.78 and mean TE value of 0.861±0.106 was recorded among the farmers. Also, significant increases in profit of about 7.6%-21.0% were reported for farmers who partici-

pated, despite the CADP having ended in 2016; this indicates sustainability of project gains. Also, more youth farmers recorded low and medium profits than non-youth farmers, while more non-youth than youth farmers recorded high profit, invariably, and over time, these youth farmers will gradually transition into the high profit category. Moreover, given that youth farmers' inexperience negatively affected profitability, youth farmers should be exposed to extension and trainings that will bridge the gap that result from inexperience.

Parameters significant to TE were the number of birds, feed quantity and water costs. The positive effect of number of birds and feed quantity on TE suggest interventions that will provide and/or subsidize inputs. Specifically, policies that will stimulate local production of feed ingredients should be pursued. However, water costs having a negative effect of TE necessitate farmers' knowledge on the need to know the limits for which water cost should be incurred. The project impact is 0.1% to 0.7% decreases in TE. Com-

paring the determinants of TE between the groups highlighted the role of poultry production experience which is lacking in younger farmers, this can however be bridged through adequate extension services and farmer training. Our empirical findings revealed significant gain from project participation. This study affirms the profitability and efficiency impact of commercial agriculture; therefore, we recommend scaling up of existing projects, particularly focusing on youth farmers and providing continuous training and capacity building programmes that will bridge the gap of inexperience. Furthermore, youth poultry-egg farmers should be provided with inputs like birds, feeds, veterinary supplies etc.

Our study which was based on cross-sectional data from three of the thirty-six states in Nigeria, is limited in scope. We, therefore, recommend expanded research targeted at youth in all parts of the country.

Abbreviations

| | |
|------|--|
| ATT | Average Treatment Effect on the Treated |
| CADP | Commercial Agriculture Development Project |
| GM | Gross Margin |
| MLE | Maximum Likelihood Estimation |
| OLS | Ordinary Least Squares |
| PSM | Propensity Score Matching |
| SATT | Sample Average Treatment Effect on the Treated |
| TE | Technical Efficiency |
| TR | Total Revenue |
| TVC | Total Variable Cost |

Conflicts of Interest

The authors declare no conflicts of interest.

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