EMPIRICAL ANALYSIS OF THE EFFECT OF INCENTIVES ON SUSTAINABILITY OF INTERVENTION PROJECT IN SMALLHOLDER CHICKEN EGG PRODUCTION IN SOUTHWEST NIGERIA

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https://dx.doi.org/10.4314/gjansci.v15i1.10

ABSTRACT
Justification of sustained investment on technology development and dissemination is predicated on proven impact on agricultural production systems. Providing empirical evidence of ex-post impact of intervention on productivity and income of farmers has been a major challenge in execution of special intervention project in Nigeria. This study examined the effect of the intervention on increased productivity, income and growth of smallholder chicken egg farmers in Southwest Nigeria. Using data generated from the records of farmer participants of an intervention project sponsored by the Korea-Africa Food and Agriculture Cooperation Initiative (KAFACI), this study showed increase in managerial capabilities of farmers over the three years of the project through reduction in mortality rate from baseline of 37.8% to 12.6%, increase in egg production per bird from 122 to 348 eggs and income per farm of ₦418,288.54, ₦819,912.00 and ₦1,000,792.30 for 2017, 2018 and 2019 production cycles respectively. The farmers also responded positively to the intervention with increase in stock size (461.3%) pointing to growth potential attributable to the intervention. The intervention project through capacity building, technical backstopping and monitoring improved the management capabilities of the farmers translating to improved productivity, enhanced income generation and increased stock size.

Keywords: *Smallholder farmers, chicken egg production, sustainability, productivity, Nigeria*

INTRODUCTION

The egg production sub-sector of the Nigerian poultry industry has for years being a pivot point for growth of the poultry industry in enhancing food security through the supply of quality animal protein across seasons. The industry is however dominated by smallholder farmers who are characterised by limited capital, low adoption of productivity-enhancing practices and technologies and poor access to market among other constraints (Apantaku, 2006; Akanni, 2007; Olaniyi *et al*., 2008; Adeyemo and Onikoyi, 2012). These categories of farms include those established as backyard poultry farms, neighbourhood farms in urban and peri-urban communities particularly in the Southern part of the country. The significant role played by this segment of the farming population in accounting for a significant proportion of poultry production notwithstanding, the growth of the smallholder segment of the poultry value chain has been seriously undermined by limited access to credit, market and other production incentives (Sonaiya, 2007; Thieme *et al.,* 2014; Wong *et al.,* 2017).

Such incentives, when provided in the appropriate quantity, quality and time improves the technical capabilities of these categories of farmers to adopt improved technologies and management practices for increased productivity through greater efficiency. In most instances, it has been recommended that incentives for improved productivity among these categories of farmers should include capacity building through entrepreneurship training and other customised intervention initiatives (Dumas, 2016; Thakur *et al.*, 2016; Mathiu *et al*., 2021). Institutional factors such as access to credit, input subsidies, training, group participation and extension activities have been noted to have positive impact on adoption of new technologies among smallholder farmers (Ceteni *et al*., 2014; Mwangi and Kariuki, 2015). It is believed that access to credit promotes the adoption of risky technologies through relaxation of the liquidity constraint as well as through the boosting of household's risk-bearing ability (Simtowe and Zeller, 2006). Hence, enhancing the capacity of smallholder farmers for appropriate poultry production technologies and proper husbandry practices is expected to improve the managerial capabilities for better productivity and income.

One of such initiatives targeted at the promotion of good management practices for small scale chicken egg farmers in Southwest Nigeria under the 'Development and Application of Management Techniques for non-ruminant Livestock' project was sponsored by the Korea-Africa Food & Agriculture Cooperation Initiative (KAFACI). The project provided capacity building, chicken stock, feed, drugs, medications and other technical supports for farmers in six states of Southwest Nigeria from 2017 to 2019. Sustainability of such projects has been predicated mainly on the ownership of the interventions through adoption of participatory approach and counterpart investment from inception. Farmers under the project were responsible for the housing, cages, complementary feeding and management of the birds.

The intervention period involved the supply of farmers with 100 Point of Lay (POL) pullets, feed, drugs and technical support services to ensure compliance with good agricultural practices in layer chicken rearing. Prior to supply of input to the selected farmers, they were engaged in training/workshops on application of good management techniques/practices in layer chicken production. A training manual was developed and deployed for the training and were also given to the farmers as guide and this was supported with routine monitoring visits for data collection. During the third year, no additional input was given to selected farmers from the previous years asides provision of technical backstopping and monitoring.

The sustainability of the project is assessed in this study by the comparison of the performance of the farmers as regards egg production, income generation and the post project initiatives taken by the farmers to build on existing literature on implementation of intervention project in the poultry sub-sector of the Nigerian livestock industry. This study therefore examines the effect of the intervention comprising training and provided incentives as a composite package on increased productivity, income and growth of smallholder chicken egg farmers in Southwest Nigeria.

MATERIALS AND METHODS

Southwest Nigeria represents a land mass spreading between latitude 6^{o}N and 4^{0}S and longitude 4^{o}W and 6^{o}E and comprises of Osun, Oyo, Ekiti, Ondo, Lagos and Ogun States. This region is bounded in the east by Edo and Delta States, in the north by Kwara and Kogi States, in the west by the Republic of Benin and in the south by the Gulf of Guinea (Faleyimu *et al.*, 2013). The climate is typically equatorial, with an average annual rainfall between 150mm and 1480mm and temperature range of 18^{o}C to 35^{o}C. The zone is the central hub of poultry industry in Nigeria with a large concentration of small scale and commercial poultry farms, feed mills and hatcheries.

The study used panel data collected weekly from the records of KAFACI project farmers in six state of Southwest Nigeria (Ekiti, Lagos, Ondo,

Osun and Oyo) who participated in the intervention project as a way of measuring the effect of the provided incentives and compliance with recommended management practices on productivity of the participants over the project life span. Participants were selected from two zones prominent for poultry (chicken) production in each of the 6 states with the support of the Extension and Livestock Department of Agricultural Development Programmes (ADPs) of the respective states. Data on management practices, input and egg production over a span of four years including three years of support to the farmers and the post-intervention period of one year were collected. The study adopted egg laying cycle of 15 months for the assessment of the farmers' performance.

Isa brown breeds of commercial layer chickens were supplied across the three years at point of cage birds (14weeks) and feed (Topfeeds) was supplied and recommended to the selected farmers all through the project life span. Each farmer was supplied with a copy of production guide as template for management operations with all inputs promptly (May/June) supplied in each year with all the farm locations geo-referenced using the geographic positioning system (GPS). The distribution of the farmers selected for intervention phase of the project is as shown in Fig. 1.

Data on mortality, hen day production, income generation and saved fund were collected from the poultry farms of the participants on weekly basis. The data were subjected to descriptive statistical and farm budget analyses to estimate the cost of production, revenue and gross margin from egg production activities of the farmers. The gross margin (GM) was estimated as:

$$GM_{it} = \sum_{i-1}^{n} GR_{it} - \sum_{i=1}^{n} VC_{it} \quad , \quad (i = 1,2,3, \ldots\ldots\ldots, n) \qquad (1)$$

Where;

$$\sum_{i=1}^{n} GR = \sum_{i=1}^{n} Q_{ijt} P_{ijt} \sum_{i=1}^{n} Q_{ikt} P_{ikt} \quad (i = 1,2,3, \ldots\ldots\ldots, n) \qquad (2)$$

$$\sum_{i=1}^{n} VC_{it} = \sum_{i=1}^{m} X_{ijt} P_{ijt}, \; (i = 1, 2, 3, \ldots n, \; j = 1, 2, 3, and \; t = 1,2,3.) \qquad (3)$$

GM_{it} = *Gross margin*
GR_{it} = *Gross income*
VC_{jt} = *Total variable cost*
Q_{ijt} = *Quantity of egg produced*
P_{ijt} = *Price per egg for farmer*
Q_{ikt} = *Quantity of culled old stock*
P_{ikt} = *Price per unit of culled old stock*
X_{ijt} = *Quantity of input used for production*
P_{ijt} = *Price per unit for input*
i = *farmer i (i = 1, 2, ……., n)*
j = *Input j (j=1, 2, 3, 4)*
t = *Production cycle (t = 1, 2, 3)*

RESULTS AND DISCUSSION

The evaluation of the performance of the farmers across production cycle was done in consideration of the project's aim of improving managerial capabilities of the smallholder farmers for increased productivity through better adoption of improved production practices, low disease incidence, reduced mortality and higher egg production.

The results in Table 1 shows a significant reduction in mortality rate from the baseline findings of 37.8% (Saka *et al.,* 2017) and at the project inception phase of 49.87% in 2017 to 13.96% and 12.6% in 2018 and 2019 respectively. This signifies an improved adherence to the management procedures and capacity enhancement being introduced to the participants (Adesehinwa *et al*., 2019) Similarly, egg production per farm increased significantly from 13,308 in 2017 to 26,701 and 34,803 eggs in 2018 and 2019 production cycle respectively. Average egg production per bird was also significantly higher in 2019 (348 eggs) than 122 and 316 eggs in 2017 and 2018 production cycles respectively.

These results point to significant increase in productivity of the chicken egg farms through reduction in mortality and increased egg production attesting to improvement in managerial capabilities of the farmers as they spent more years in the project. This is similar to what was obtained by Dumas *et al.* (2016) in a study where smallholder farmers provided technological sup-

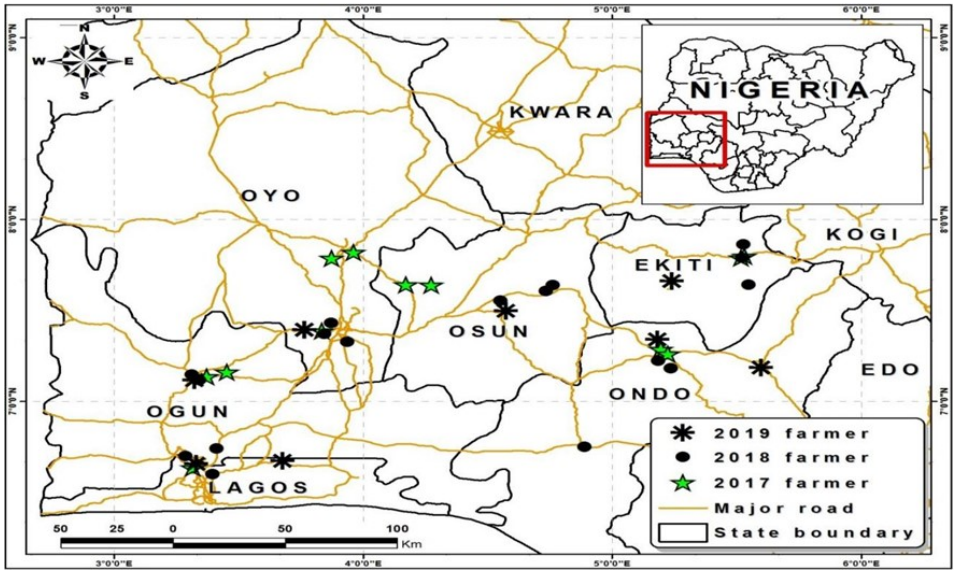

Fig 1: Distribution of Beneficiaries across States (2017 – 2019)

port experienced decreased mortality rate and increased egg production. The high mortality rate recorded in the first year of this study was attributed to lack of sufficient layer chicken management skills by the farmers. However, the quality of training improved in subsequent years after taken into consideration some of the gaps and lessons learnt in the previous year with technical backstopping intensified thereby resulting in reduced mortality and increased egg lay per bird for 2018 and 2019 production cycles respectively.

However, the performance of the farmers selected in 2019 can primarily be attributed to improved monitoring activities from the technical team, having learnt from the shortcomings of the previous years since this category of farmers had only spent one year on the project. In addition, the experience of the existing farmers shared with the 2019 farmers prior to their empowerment provided platforms to learn from the mistakes of the past in addition to improving the enthusiasm of the new entrants towards the project. These support the claims that the need for frequent training and interaction of farmers with specialists as well as among the farmers themselves improves productivity (Dumas *et al.,* 2016; Mathiu, 2021).

Cost and Returns to Chicken Egg Production

The results of the farm budget analysis in Table 3 show that income generation from chicken egg production in Nigeria is not limited to sales of egg alone. The average income from egg sales were ₦349,434.69, ₦717,874.00 and ₦857,482.30 in 2017, 2018 and 2019 respectively. The results however fell below the findings of Akinyemi *et al.,* (2019) and above the findings of (Akanbi *et al.,* 2020 and Latu *et al., 2018)* in their separate findings. In addition, income from sales of culled birds at the end of the production cycle increased significantly from ₦68,853.85 in 2017 to ₦102,038.00 and ₦143,310.00 per farm in 2018 and 2019 respectively which falls below the findings of Akinyemi *et al.,* (2019). Consequently, the average total income per farm was ₦418, 288.54, ₦819,912.00 and ₦1,000,792.30 in 2017, 2018 and 2019 production cycles respectively. However, share of egg in the total income were significantly higher for 2018

(87.04%) than in 2017 (72.23%) and 2019 (84.90%) cycle respectively.

The cost component analyses in Table 3 show that cost of production per farm was significantly higher in 2019 production cycle (₦714,449.50) than 2017 (₦514,141.08) and 2018 (₦609, 836.92) production cycles respectively with cost of feed accounting for 62.90%, 68.27% and 67.40% for 2017, 2018 and 2019 cycles respectively as reported by (Akinyemi *et al.,* 2019*,* Akanbi *et al.,* 2020 *and* Latu *et al.,* 2018). The Gross margin per farm from chicken egg production was also significantly higher in 2019 (₦286,343.00) than ₦95,852.54 and ₦210, 075.08 recorded for 2017 and 2018 cycle respectively. The results however corroborate the findings of Latu *et al.,* (2019) that found out that gross margin of egg production for Plateau State was about N162,024.56.

The loss incurred in 2017 is however attributable to the high mortality rate recorded in 2017 which in turn limited the productivity of the farms during the year. This, however, points to the significance of biosecurity and compliance with other health management techniques and routines which had earlier been introduced to the beneficiaries as a prerequisite for profitability and growth of poultry enterprises. Also, another source of growth for poultry enterprise is the ability of farmers to generate re-investible income for expansion from returns to management. The results in Table 3 show that farmers' savings from generated income ranged from 4.9% in 2017 to 18.64% and 19.1% in 2018 and 2019 cycles respectively (Table 3).

CONCLUSION

Improved productivity among small holder farmers in the study was a pointer to the improved

Table 1: Average farmer's performance by year

	2017 Production Cycle	2018 Production Cycle	2019 Production Cycle	F-Statistics
Number of farmers selected for participation in the year	13	18	10	
Total initial stock of birds supplied to farmers	1400	2082	1000	
Total closing stock of birds at the end of production cycle	679	1,726	972	
Average opening stock of birds	108 (9.71)	83 (25.50)	100 (0.00)	7.60***
Average closing stock of birds	52 (22.21)	69 (27.21)	97(3.04)	10.90***
Average stock of spent layer culled for sale	50 (15.53)	71 (23.1)	97 (3.04)	17.55***
Mortality rate (%)	49.87 (17.51)	13.96 (8.84)	12.6 (3.81)%	49.45***

Table 2: Productivity of Chicken Egg Farms across Production Years

Item	2017 (₦)	2018 (₦)	2019 (₦)	F-Stat
Hen-day egg production (%)	74%	85%	86 %	
Egg production per farm	13,307.5 (7,373.26)	26,700.8 (10,425.17)	34,803 (13,053.36)	13.18***
Egg production per bird	122.38 (64.41)	316.44 (59.82)	348.1 (130.46))	31.02***

Table 3: Cost and Returns to Management in Chicken Egg Production

Item	2017 (₦)	2018 (₦)	2019 (₦)	F-Stats
Cost of birds per farm	145,384.62 (13,104.79)	124,920.00 (38,256.18)	140,000 (0.01)	2.48
Cost of feed per farm	328,807.38 (101,246.96)	421,028.28 (136,039.96)	482,154.10 (41,424.29)	5.43**
Cost of medication per farm	12,283.54 (5,454.15)	16,950.6 (6,682.38)	18,597.1 (809.96)	3.45**
Cost of labour per farm	27,125.69 (10,981.77)	46,938.12 (10,690.489)	73,698.40 (4,148.33)	63.50***
Average variable cost	514,141.08 (119,571.58)	609,836.92 (180,315.3)	714,449.50 (45888.40)	5.28**
Egg sales per farm	349,434.69 (191,987.23)	717,874.00 (296,630.4)	857,482.30 (283,713.41)	11.80***
Culled bird income per farm	68,853.85 (23,469.67)	102,038.00 (34264.82)	143,310.00 (12,312.46)	19.51***
Total income per farm	418,288.54 (209,987.24)	819,912.00 (327,936.16)	1,000,792.30 (286,163.99)	12.76***
Gross margin per farm	-95,852.54 (120,669.02)	210,075.08 (172,519.58)	286,343.00 (278,995.03)	15.00**
Egg share of income (%)	72.23 (29.76)	87.04 (2.67)	84.90 (3.14)	4.02**
Average saved fund	24,974.15 (24,994.69)	165,937.16 (111,320.93)	195,742.20 (91,260.47)	12.92***
Save fund percentage	4.90 (4.63)	18.64 (7.60)	19.10 (6.10)	20.70***

Table 4: Stock Size Before and After Intervention

YEAR	2017	2018	2019	Average
No. of farmers	8	17	10	11.7(12)
Average pre-project stock size per farm	76.63	65.12	62.3	63.66
Average current stock size per farm	702.87	329.53	161.5	366.86
Growth in average stock size (%)	818.8	406.1	159.2	461.3
t-stat	2.31	2.36	2.35	

managerial capabilities of the farmers which helped to minimise losses arising from disease incidence, mortality and wastage of resources. This therefore showed that the training workshops provided during the project impacted on the farmers. Likewise, the improved monitoring and technical backstopping ensured timely conduct of biosafety activities by the farmers, as some of the farms now had provision for foot dips with disinfectant at the entrance(s) to their farms as well as, greater restriction of movement by visitors. However, high cost of feed has remained a major limiting constraint in poultry production and this pointed to the appropriateness of any incentive-oriented intervention in this regard. Similarly, access to certified layer stocks is crucial to their productivity and growth of the chicken egg enterprises. This therefore

calls for adequate monitoring of activities of the commercial hatcheries and operators along the chicken egg value chain. Regular training of farmers on improved techniques of brooding day -old chicks of egg type birds will also assist farmers in reducing losses of the pullets for greater profitability. These results however underscores the importance of institutional supports as incentives for adoption of improved technologies and greater productivity in the poultry sector of the Nigerian livestock industry.

ACKNOWLEDGEMENT

The authors wish to specially thank the Korea Africa Food and Agriculture Cooperation Initiative (KAFACI) for funding this study through the project on "Development and Application of Management Techniques for Non-Ruminant Livestocks. The management of Institute of Agricultural Research and Training are also appreciated for providing the man-power used in the project. The Agricultural Development Programme (ADP) of Ekiti, Lagos, Ogun, Ondo, Osun, and Oyo States are acknowledged for releasing their staffs to participate in this project.

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