ADOPTION OF SOLAR-POWERED BROODING SYSTEMS AMONG POULTRY FARMERS IN IKOM LOCAL GOVERNMENT AREA (LGA), CROSS RIVER STATE, NIGERIA

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Abstract
This cross-sectional study examined adoption of solar-powered brooding systems among poultry farmers in Ikom Local Government Area (LGA), Cross River State, Nigeria. Using a structured questionnaire administered to 120 purposively selected poultry farmers, the study measured adoption prevalence, farmer characteristics, information sources, perceived benefits and barriers, and factors associated with adoption. Descriptive statistics and binary logistic regression ($\alpha = 0.05$) were used for analysis. Findings show a 30% adoption rate (36/120). Key drivers of adoption were access to credit (OR = 3.5, p = 0.002) and higher education level (OR = 2.3, p = 0.03); major barriers were high upfront cost (70%) and limited technical know-how (50%). Recommendations include targeted financing schemes, farmer training and demonstration plots, and public–private partnerships to reduce equipment costs and increase adoption.

Introduction

Poultry production is an important livelihood activity in Cross River State. Successful brooding which is the provision of heat, ventilation and protection for day-old chicks, significantly influences chick survival and subsequent productivity (Okonkwo et al., 2022). Traditional fuel or electricity-based brooding which has been commonly used, can be unreliable and costly, especially in rural areas with irregular grid supply such as Ikom LGA (Odeh et al., 2021). Solar-powered brooding systems (SPBS) promise reliable, cleaner, and often lower long-term cost, heat and lighting for brooding houses (Uzodinma et al., 2020). However, despite the potential of solar-powered brooding to improve chick survival and reduce operational costs (Yerpes et al., 2020), anecdotal reports and preliminary field observations suggest low uptake among poultry farmers in Ikom LGA and low adoption may limit productivity gains, household incomes and resilience to energy shortages. SPBS ensures improved chick survival, stable heating during power outages, and lower running costs. Notwithstanding the numerous benefits of SPBS, the Nigeria Federal Ministry of Power (2024), reports that adoption of solar energy in many Nigerian LGAs remains limited due to financial, technical and informational barriers. This study therefore investigates the extent of SPBS adoption in Ikom LGA, factors associated with adoption, and barriers to uptake. Furthermore, empirical evidence on adoption levels, determinants and barriers in Ikom is scarce, limiting the ability of policymakers, extension agents and donors to design effective interventions. This study fills that gap by providing data-driven insights to inform targeted strategies to improve SPBS adoption.

Study Objectives

1. To estimate the prevalence of SPBS adoption in Ikom LGA
2. To identify the barriers to SPBS adoption in Ikon LGA
3. To determine the factors affecting the adoption of SPBS in Ikom LGA

Study Area

The study was conducted in Ikom LGA, Cross River State because of its active smallholder poultry sector and variation in energy access.

Sampling and Sample Size

A cross-sectional survey design was used. Using purposive selection of five communities that represent the LGA's poultry producing zones, 120 poultry farmers were interviewed. Within communities, poultry farmers were sampled using simple random selection from a sample frame of 172 provided by local extension officers.

Data Collection

A structured questionnaire was administered face-to-face by trained enumerators. Questionnaire modules covered demographics, farm characteristics, energy use for brooding, awareness and adoption of SPBS, sources of information, access to finance, perceived benefits and barriers. A small number (n=12) of key informant interviews with extension officers and equipment suppliers complemented quantitative data.

Method of Data Analysis

Data were entered into a spreadsheet and analyzed using descriptive statistics (frequencies, percentages, means) and binary logistic regression to identify factors associated with adoption. Statistical significance was set at $p < 0.05$.

Explicitly, the model is empirically estimated as:

$$Y = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + e \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (6)$$

where,

Y = Adoption (1 = adopters-farmer currently using an SPBS for brooding; 0 = non-adopters-not using)

X_1 = Educational level (number of years spent in school)

X_2 = Farm size (number of birds)

X_3 = access to credit (access=1, non-access=0)

X_4 = prior training in renewable energy (yes=1, no=0),

X_5 = perceived cost barrier (yes=1, no=0)

$\beta_1 – \beta_5$ = Regression coefficients

β_0 = Regression constant

e = error term.

Table 1: Socio-demographic and farm characteristics (n = 120)

Characteristic	Category	Frequency	Percent (%)
Gender	Male	78	65.0
	Female	42	35.0
Age group	< 30 years	18	15.0
	30–45 years	54	45.0
	> 45 years	48	40.0
Education	No formal	12	10.0
	Primary	30	25.0
	Secondary	54	45.0
	Tertiary	24	20.0
Farm size	Small (≤ 500 birds)	72	60.0
	Medium (501–2,000)	36	30.0
	Large (>2,000)	12	10.0
SPBS adoption	Adopters	36	30.0
	Non-adopters	84	70.0

Table 2: Barriers to SPBS adoption in Ikom LGA (multiple responses allowed)

Barrier	Frequency	Percent (%)
High upfront cost	84	70.0
Lack of technical know-how	60	50.0
Maintenance concerns	36	30.0
Limited access to credit	66	55.0

Results and Discussion

The 30% adoption rate indicates an early but meaningful level of uptake in Ikom LGA. Adoption concentrated among better-educated farmers and those with access to finance which is consistent with technology adoption theory where human capital and financial resources lower adoption barriers. The high proportion citing upfront cost (70%) and limited access to credit (55%) as barriers highlighting the importance of financing. Technical skills were also important: 50% reported low technical know-how as an impediment, which helps explain why prior training had a positive but not statistically significant effect on the sample ($p = 0.123$). however, sample size and uneven distribution of training may account for this.

Farm size showed a positive but marginal association with adoption ($p = 0.072$), suggesting economies of scale: medium and large farms can better amortize SPBS investments.

Reported benefits such as improved chick survival and stable heating are aligned with the expected performance advantages of solar brooding, indicating potential for productivity gains where adoption expands.

Factors affecting SPBS adoption in the study area

Table 3: Binary logistic regression predicting SPBS adoption (n = 120)

Variable	Coefficient	Std Error	p-value
Constant	-2.12	0.88	
Education level	2.30	0.38	0.030**
Farm size (medium/large vs small	1.90	0.35	0.072
Access to credit (yes vs no)	3.50	0.41	0.002**
Prior training (yes vs no)	1.80	0.39	0.123
Perceived high cost (yes vs no)	-0.40	0.36	0.010**

Interpretation: Farmers with at least secondary education were more than twice as likely to adopt SPBS. Access to credit was strongly associated with adoption (CO=3.5). Perceiving the cost as high reduced the odds of adoption (CO= -0.40).

Limitations: The cross-sectional design precludes causal inference; purposive community selection and modest sample size (n=120) limit generalizability beyond the sampled communities. Also, self-reported measures may involve recall or desirability biases.

Conclusion and Recommendations

Given that Ikom is a major poultry hub for poultry farmers in Cross River with over 20% of cross river's poultry products produced there, it is concerning that lack of electricity has become

a norm in Ikom LGA as residents claim to have not had electricity for over 10 years. Hence, the need for solar-powered brooding systems to provide a controlled environment for young chicks, promoting healthy growth and reducing reliance on traditional energy sources. Thus, this study estimated the prevalence of SPBS adoption in Ikom LGA as a 30% adoption rate which is quite poor as a result of upfront cost (70%), limited access to credit (55%) as lack of technical -know-how (50%). Furthermore, factors such as education, access to credit and perceived upfront cost were strongly associated with adoption of SPBS. Consequently, the following recommendations were put forward:

1. A targeted credit or leasing schemes (e.g., pay-as-you-go, equipment leasing) in partnership with microfinance institutions should be developed by the government to reduce upfront cost barriers.
2. Agricultural stakeholders such as the ministry of Agric should establish demonstration brooding units and hands-on training through extension services and NGOs to build technical capacity and confidence.
3. The government should explore public–private aggregation or bulk procurement to reduce unit prices; consider time-limited subsidies for smallholder farmers.

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