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# Overcoming Social Barrier to Adoption of Black Soldier Fly (*Hermetia illucens*) as a Protein Source for Poultry: How Tall is the order?

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**Abstract:** The demand-supply gap for protein has continued to widen globally. Unfortunately, costs of conventional feed resources are assuming an alarmingly increasing trend in Nigeria, with continued decline being projected for the near future for poultry. Black Soldier Fly (BSF) is being promoted as a more sustainable alternative due to high protein contents and environmental sustainability prospects. The study examined acceptability of BSF as a protein source for poultry feed among farmers in Oyo State, Nigeria. A two-stage technique was used to select 120 medium and largescale poultry farmers and data were collected using structured questionnaires. Short structured video on BSF was used to control for knowledge. Data were analyzed using descriptive statistics and multiple linear regression ( $\alpha_{0.05}$ ). Level of perceived benefits was high and included increase in profit margin and reduced transportation cost on waste management. Knowledge level of BSF was high among majority just like acceptability (67.2%). Most perceived constraints include unavailability of land/space and irregular larvae production. Average income from poultry, farm size, perceived economic viability, environmental friendliness, total income from other sources, years of experience and perceived constraints were predictors of acceptability of BSF. Therefore, the prospect for social acceptance of BSF in Oyo state is high, devoid of any form of socio-cultural barriers.

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**Keywords:** Black soldier fly; acceptability; protein source; social acceptance.

## 1. Introduction

Poultry industry is one of the most important and most prosperous sub-sectors of the livestock industry in Africa. According to FAOSTAT (2018), the Nigerian poultry industry comprises about 180 million birds, the second largest chicken population in Africa after South Africa – producing 650 000 tonnes of eggs and 300 000 tonnes of poultry meat in 2013 [1], [2]. Therefore, the poultry industry, if properly harnessed, can also serve as a source of foreign earnings complementing crude oil which at present constitutes the main source of foreign earnings in Nigeria. The most immediate efforts needed is the need to at least match the growing rate of the chicken meat production with the growth rate of the human population to provide sufficient dietary protein for as many people as possible. Thus, alternative protein sources for animal feed are required to achieve this balance. Insect protein has recently been acknowledged as a potential protein source and

feed ingredient for animal production systems, and black soldier fly (BSF) has been promoted globally and has gained global prominence as a profitable and sustainable protein source alternative.

The BSF is an extremely resistant specie capable of dealing with demanding environmental conditions, such as drought, food shortage or oxygen deficiency [3]. One major advantage of *BSF* over other insect species used for biomass production is that the adult does not feed and therefore does not require particular care and is not a potential carrier of diseases. The larvae are sold for pets and fish bait, and they can be easily dried for longer storage [4], substantial increase in the market price of both soymeal and fishmeal in the last decade may help to make this protein source economically viable for animal feeding. However, despite the high potential this insect portends, there is generally low level of adoption in Nigeria. One of the key variables to adoption of technologies in the agricultural sector is how such technologies resonate with the people. It is important therefore to investigate and isolate the potential social barriers to its adoption and infer for prospect for acceptance and adoption. To this end, the study ascertained farmers' knowledge of BSF larvae as a protein source for poultry; investigated the perceived benefits of BSF; ascertained the perceived constraints to acceptance/adoption of BSF; assessed the acceptability of BSF larvae as a protein source for poultry feed and investigated the collective and individual effects of these variables on acceptance of BSF in the study area.

## 2. Materials and Methods

A two-stage sampling procedure was employed for this study. First stage involved a purposive selection of three poultry association zones out of the five in Oyo State due to the high concentration of poultry farmers and prominence of poultry production in Nigeria [5]. These zones are: Ibadan 1, Oyo and Ogbomoso zone. A list of registered poultry farmers was then obtained from the selected zones. A simple random sampling technique was used to select 50% of the respondents from the zone to make a total of 120 respondents for this study. Data was obtained using structured questionnaire administered through interview schedule. Perceived benefits and constraints were each measured using a three-point scale reflecting a continuum of importance for benefits (2 = "high", 1 = "low" and 0 = "not a benefit") and severity (2 = "severe", 1 = "mild" and 0 = "not a constraint") for constraints. Weighted mean, in each case was computed for items and used to rank them in order of importance and severity for the two respective variables. Knowledge was assessed by presenting respondents with a list of question items representative of the general concept of and technicality around BSF larvae production. Options of "yes", "no" and "I don't know" were presented and correct answers were assigned 1 ("yes" or "no") and incorrect answers ("yes", "no" or "I don't know") were assigned 0. Social acceptance was measured by percentage inclusion in poultry feed for protein. For each of perceived benefits, constraints, knowledge and acceptability, a score was obtained and used in subsequent analysis such as categorization (as in case of knowledge and acceptance) and multiple linear regression for all variables. Scores were also obtained of perceived relative advantage (social acceptance, economic viability, environmental friendliness and cultural compatibility), also measured on a three-point scale. These variables were input into the multiple regression model alongside other variables to estimate the collective and individual contributions of these variables to acceptance of BSF among respondents. Data were presented in simple descriptive and hypothesis was tested using multiple linear regression at 5% significant level.

## 3. Results and discussion

### 3.1 Socio-economic characteristics of poultry farmers

Socio-economic characteristics of respondents shows that almost half (44.2%) of the respondents were between 31- 40 years while 22.5% were between ages of 41-50 years. This implies that majority of the respondents are active economically. This suggests that most youth in this category have more aspiration for farming than the younger ones. This finding agrees with the findings of [6] who reported a mean age of 44 years for poultry farmers in Nigeria. Also, majority (61.7%) were married while 10% were single. The result agrees with that of [7], who reported 86% married and 14% unmarried among poultry farmers. This implies that the

married household tends to be more involved in poultry production because they have more responsibilities and usually a sizable number of the households tends to render assistance on the farm. About 62% had formal education as against 38.3% without formal education. Result of their primary livelihood activities shows that 56.7% were poultry farmers, 20.8% were civil servants and 17.5% were traders/artisans.

### 3.2 Distribution of respondents by level of overall knowledge of BSF as a protein source

Result as shown in table 2 shows that while 79.17% had good knowledge on the general concept of BSF, exactly half (50%) had good knowledge of the technicality involved. Overall, 75.0% had good knowledge of BSF. It is expected that the good knowledge will engender an informed consent (Olutegbe and Ogungbaro, 2020) on acceptance or otherwise of BSF as an alternative protein source among poultry farmers in the study area.

**Table 1: Respondents knowledge of BSF (technicality and benefits)**

Level of knowledge of BSF (%)	Overall F (%)	General F (%)	Technical F (%)
Good (>66%)	90 (75%)	95 (79.17%)	60 (50%)
Fair (34% - 66%)	17 (14.17%)	20 (16.67%)	25 (20.83%)
Poor (< 34%)	13 (10.83%)	15 (12.5%)	35 (29.17%)

### 3.3 Distribution of respondents on the perceived benefits of BSF as a protein source

Table 2 below shows the perceived benefits of BSF as a source of protein for poultry feed among farmers. The most highly perceived benefits include increase in income, reduction in transportation cost for waste and increase in job opportunities with increased number of BSF farmers. This is in agreement with [8] which maintained that BSF larvae offers new opportunities concerning ecological intensification in rural aqua cultural ecosystems.

**Table 2: Distribution of respondents on perceived benefits of BSF as a protein source for poultry feed in Oyo State**

Variables	Mean±SD	Rank
Loans and credits are easily accessed when the number of BSF users and farmers increases.	1.15±0.38	9th
Increase in accessibility to protein source in formation of feed	1.17±0.44	8th
Low cost of feed	1.33±0.61	7th
Increases egg production.	1.40±0.67	6th
Increase in profit margin	1.48±0.77	1 <sup>st</sup>
Reduction in transportation cost for waste	1.42±0.74	2nd
Improved farmers and household wellbeing.	1.40±0.69	4th
Rescue for the poultry industry due to the hike in feed and feed materials	1.37±0.69	5th
Job opportunities increases	1.38±0.72	3rd

**Source: Field survey, 2021.**

### 3.4. Perceived constraints of BSF as a protein source for poultry feed

This result (Table 3) shows the perceived constraints of BSF as a source of protein for poultry feed among farmers. The most perceived constraints include unavailability of land/space (1.99±1.54), irregular larvae production (1.98±1.55) and little product

quality control ( $1.91 \pm 1.45$ ). This result is in agreement with the report of [9]Lähteenmäki-Uutela (2007) that there is unclear regulation and legislation on farming and selling insects for human consumption.

**Table 3: Distribution of respondents on the perceived constraints of BSF as a protein source for poultry feed among farmers in Oyo State**

Variables	Mean±SD	Rank
Lack of technical know-how in handling BSF production	1.30±0.56	10 <sup>th</sup>
Unavailability of labour	1.54±0.58	8 <sup>th</sup>
Legal limitations regarding the use of certain substrates for the larvae and trade restrictions	1.55±0.63	7 <sup>th</sup>
Low degree of efficiency or even risk of system failure due to unskilled personnel	1.45±0.59	9 <sup>th</sup>
Difficulty in credit and loan procurement processes	1.58±01.30	6 <sup>th</sup>
Unavailability of land/space	1.99±1.54	1 <sup>st</sup>
Irregular larvae production	1.98±1.55	2 <sup>nd</sup>
Little product quality control	1.90±1.45	3 <sup>rd</sup>
Little control over hygiene standards	1.81±1.57	5 <sup>th</sup>
Inadequate marketing	1.86±1.99	4 <sup>th</sup>

**Source: Field survey, 2021.**

### 3.5. Acceptance of black soldier fly as a protein source in poultry feed

Table 4 reveals that majority of respondents highly accept i.e. are highly willing to accept BSF as an alternative protein source in poultry. This is an indication of lack of social and cultural restraints to the adoption of BSF in the poultry industry in Nigeria, and this suggests that under an enabling policy environment, will enjoy a high level of adoption among poultry farmers in the study area and in Nigeria.

**Table 4: Distribution of respondents' acceptance (willingness to adopt) BSF as a source of protein for poultry feed among farmers.**

Level of acceptance	Frequency	Percentage
Not accepted	22	15.5
Low (33% inclusion or below)	10	7.0
Moderate (34.0% – 66.0%)	21	14.8
High (> 66% inclusion)	89	62.7

**Source: Field survey, 2021.**

### 3.6. Determinants of social acceptance of BSF

Linear Regression analysis showing determinants of adoption of BSF is presented in Table 5. Family size ( $\beta = 0.188$ ), income from poultry ( $\beta = 0.423$ ), farm size in number birds ( $\beta = 0.172$ ), perceived economic viability of BSF ( $\beta = 0.499$ ) and perceived environmental friendliness ( $\beta = 0.291$ ) contributed positively and significantly to farmer's acceptability to BSF. This is in line with [10],[11] and [12] who identified education and both off-farm and on-farm income as an important factor to adoption.

**Table 6: Table Determinants of acceptability of BSF among poultry farmers**

Model	Standardized Coefficient( $\beta$ )	t-value	p-value	Decision
Constant		9.266	0.000	
Age	0.129	1.517	0.132	Not Significant
Family Size	0.188	2.732	0.007	Significant
Income from poultry average monthly	0.423	4.298	0.000	Significant
Total income from other sources	-0.293	-3.732	0.000	Significant
Year of farm experience	-0.321	-3768	0.000	Significant
Christian	0.040	0.601	0.549	Not Significant
Married	-0.111	-1.726	0.087	Not Significant
Educated	-0.084	-1.389	0.168	Not Significant
Farm size	0.172	2.116	0.037	Significant
Perceived benefits	-0.041	-0.596	0.553	Not Significant
Constraints	-0.232	-2.794	0.006	Significant
Perceived social acceptability	-0.054	-0.483	0.630	Not Significant
Perceived economic viability	0.499	4.326	0.000	Significant
Perceived cultural compatibility	0.039	0.411	0.682	Not Significant
Perceived environmental friendliness	0.291	2.228	0.028	Significant
Knowledge scores-general	0.080	0.819	0.414	Not Significant
Knowledge scores-technical	0.107	1.035	0.303	Not Significant

Source: Field survey, 2021.

#### 4. Conclusion

Based on the findings, the study concludes that the use of black soldier fly, just like in other countries holds so much promise for the poultry industry in Nigeria if accorded favourable policy consideration. This conclusion is premised on the fact that from the study, the main actors in the poultry value chain, i.e. the producers display favourable inclination to its adoption, an indication that other actors including feed mills and consumers are equally positively disposed to its consideration and inclusion as a protein source in feed formulation. However, there is the need for the agricultural extension and other agro-service organisations to strengthen the know how capacity of poultry farmers by providing relevant information and skills in such manners as allay their fears and pessimisms about the prospects of black soldier fly in the poultry industry in Nigeria.

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