

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, the 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 the acceptability of BSF as a protein source for poultry feed among farmers in the Oyo State, Nigeria. A two-stage technique was used to select 120 medium- and large-scale poultry farmers, and data were collected using structured questionnaires. A short, structured video on BSF was used to control for knowledge. Data were analyzed using descriptive statistics and multiple linear regression ($\alpha_{0.05}$). The level of perceived benefits was high and included increase in profit margin and reduced transportation cost of waste management. The knowledge level of BSF was high among the majority, just like acceptability (67.2%). Most perceived constraints included the unavailability of land/space and irregular larva production. The 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.

Keywords: black soldier fly; acceptability; protein source; social acceptance



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1. Introduction

The 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 effort 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]. The substantial increase in the market price of both soymeal and fishmeal in the last decade may help make this protein source economically viable for animal feeding. However, despite the high potential this insect portends, there is a generally low level of adoption in Nigeria. One of the key variables for 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 as an indicator of its prospect for acceptance and adoption among poultry actors. 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 the acceptance of BSF in the study area.

2. Materials and Methods

A two-stage sampling procedure was employed for this study. The 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 were the 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 were obtained using a structured questionnaire administered through an interview schedule. The 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. The 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 larva 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 the perceived benefits, constraints, knowledge and acceptability, a score was obtained and used in subsequent analysis, such as categorization (as in the case of knowledge and acceptance) and multiple linear regression, for all variables. Scores were also obtained of the 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 descriptive statistics such as frequency counts and mean values, while the hypothesis was tested using multiple linear regression at the 5% level of significance.

3. Results and Discussion

3.1. Socio-Economic Characteristics of Poultry Farmers

The socio-economic characteristics of the respondents show that almost half (44.2%) of the respondents were between 31 and 40 years of age, while 22.5% were between the ages of 41 and 50 years. This implies that the majority of the respondents are active economically. This suggests that most youths in this category have more aspiration for farming than the younger ones. This finding agrees with the findings of Ref [6] that reported a mean age of 44 years for poultry farmers in Nigeria. Additionally, the majority (61.7%) were married, while 10% were single. The result agrees with that of Ref [7], which reported 86% being 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 against 38.3% without formal education. The 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

The result as shown in Table 1 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 the 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 an increase in income, reduction in transportation cost of waste and an increase in job opportunities with increased number of BSF farmers. This is in agreement with Ref [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 \pm SD	Rank
Loans and credits are easily accessed when the number of BSF users and farmers increases	1.15 \pm 0.38	9th
Increase in accessibility to protein source in formation of feed	1.17 \pm 0.44	8th
Low cost of feed	1.33 \pm 0.61	7th
Increased egg production	1.40 \pm 0.67	6th
Increase in profit margin	1.48 \pm 0.77	1st
Reduction in transportation cost of waste	1.42 \pm 0.74	2nd
Improved farmer and household wellbeing	1.40 \pm 0.69	4th
Rescue for the poultry industry due to the hike in feed and feed materials	1.37 \pm 0.69	5th
Job opportunities increase	1.38 \pm 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 \pm 1.54), irregular larvae production (1.98 \pm 1.55) and little product quality control (1.91 \pm 1.45). This result is in agreement with the report of Ref [9] 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 \pm SD	Rank
Lack of technical know-how in handling BSF production	1.30 \pm 0.56	10th
Unavailability of labor	1.54 \pm 0.58	8th
Legal limitations regarding the use of certain substrates for the larvae and trade restrictions	1.55 \pm 0.63	7th
Low degree of efficiency or even risk of system failure due to unskilled personnel	1.45 \pm 0.59	9th
Difficulty in credit and loan procurement processes	1.58 \pm 0.30	6th
Unavailability of land/space	1.99 \pm 1.54	1st
Irregular larvae production	1.98 \pm 1.55	2nd
Little product quality control	1.90 \pm 1.45	3rd
Little control over hygiene standards	1.81 \pm 1.57	5th
Inadequate marketing	1.86 \pm 1.99	4th

Source: Field survey, 2021.

3.5. Acceptance of Black Soldier Fly as a Protein Source in Poultry Feed

Table 4 reveals that the 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 a lack of social and cultural restraints to the adoption of BSF in the poultry industry in Nigeria. This suggests that under an enabling policy environment, BSF will be widely adopted among poultry farmers in the study area and in Nigeria.

Table 4. Distribution of respondents' acceptance (willingness to adopt) of 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 the determinants of adoption of BSF is presented in Table 5. Family size ($\beta = 0.188$), income from poultry ($\beta = 0.423$), number of birds ($\beta = 0.172$), perceived economic viability of BSF ($\beta = 0.499$) and perceived environmental friendliness ($\beta = 0.291$) contributed positively and significantly to poultry farmers' acceptance of BSF. This is in line with Refs. [10,11] and [12], which identified education and both off-farm and on-farm income as an important factor for adoption.

Table 5. Table determinants of acceptability of BSF among poultry farmers.

Model	Standardized Coefficient (β)	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
Poultry farming experience (Year)	−0.321	−3.768	0.000	Significant
Christian	0.040	0.601	0.549	Not Significant
Married	−0.111	−1.726	0.087	Not Significant

Table 5. Cont.

Model	Standardized Coefficient (β)	t-Value	p-Value	Decision
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. Conclusions

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 favorable 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 favorable 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 organizations to strengthen the know-how capacity of poultry farmers by providing relevant information and skills in such manner so as to allay their fears and pessimisms about the prospects of black soldier fly in the poultry industry in Nigeria.

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