Assessing the Poultry Farmers' Intention to Adopt Insects as Alternative Chicken Feed

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Abstract

Due to the weakening of the Malaysian ringgit and the rise in global feed prices, the cost of poultry feed has recently risen dramatically in Malaysia. This study investigates the elements that influence farmers' intentions to replace soybeans and corn with insects. The questionnaire survey was completed by 52 poultry farmers using the snowball sampling approach. The Theory of Planned Behaviour and factor analysis were used in this study to examine the impact of farmers' attitudes, subjective norms, and perceived behavioural control on their intention to utilize insects as maize and soybean substitute feed. The component analysis revealed that farmers' views toward substitute feed, subjective standards, and perceived behavioural control are critical factors in explaining their intentions. This study suggested that farmers are eager to accept alternative feed for their farming if the insects used to replace conventional feed are ecologically benign, low-cost, safe, and sustainable.

Keywords: Insect, Poultry farmers, substitution, intention, theory of planned behaviour

Introduction

The second most common food in Malaysia, after rice, is poultry, which contributes significantly to the country's daily protein consumption. Malaysia's per capita chicken consumption increased from 2010 to 2020 (Figure 1). In 2020, Malaysians consumed 49.3 kg of poultry on average, and this suggested that the poultry industry must expand supply to meet demands for food security, particularly in the consumption of broilers since they account for 96% of chicken output.

Malaysia's agriculture sector has recently faced multiple issues that have echoed throughout. According to Dardak (2015), this situation has emerged because of an increase in input costs and capital investment in agricultural commodities. The poultry sector plays a critical and competitive part in the country's economy. The commencement of the COVID-19 pandemic in early 2020 triggered a confluence of circumstances that curtailed chicken supply, the most notable of which was an increase in demand, resulting in a sharp increase in poultry prices.

Furthermore, uncontrollable factors, most notably the global soybean and corn markets, have put financial hardship on small-scale chicken farmers. The rising cost of poultry feed has forced farmers to reduce production to avoid operational losses, inflicting a long-term burden on consumers through the constant rise in chicken prices (see Figure 2).

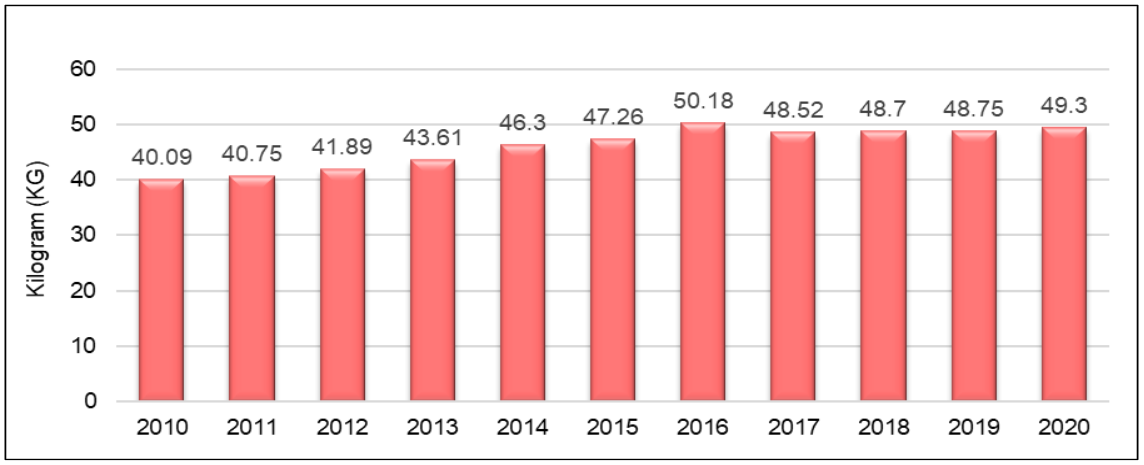

Figure 1. Malaysia Poultry Consumption per Capita, Kg (2010-2020)
Source: Department of Veterinary Services

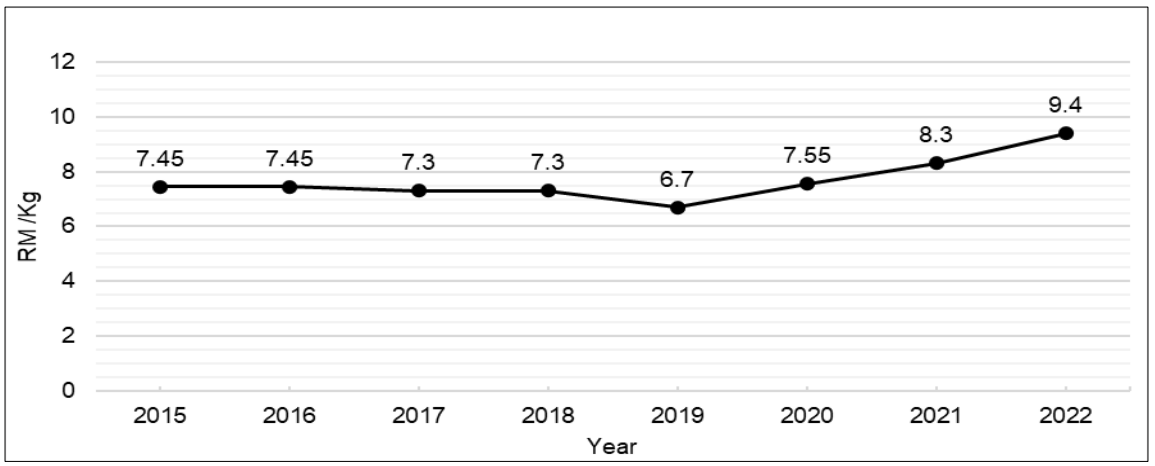

Figure 2. Chicken Price (2015-2022)
Source: Department of Veterinary Services

The main components of chicken feed, notably soybeans, and corn, are mostly obtained from the foreign market. The depreciation of Malaysia's currency, combined with the effects of the COVID-19 pandemic and the Russo-Ukrainian War, resulted in a significant spike in world soybean and maize prices, with each suffering a 60 per cent increase from 2020 to 2022. Figure 3 depicts this trend vividly, with corn prices rising from US$3.8544 per bushel in 2019 to US$7.0677 per bushel in March 2022. Given Ukraine's importance as the fifth largest grain exporter, the Russo-Ukrainian War significantly accelerated a significant fall in global corn production. Concurrently, bad weather in Brazil and Argentina drove up soybean prices from US$9.5344 per bushel in 2019 to US$15.934 per bushel in 2022. According to the Ministry of Agriculture and Food Industries (MAFI), Malaysia's annual import of animal feed totalled 4.3 million

tonnes at a cost of RM6.7 billion. The rise in corn and soybean prices has resulted in a significant increase in poultry production costs, spreading the financial burden to local poultry farmers. Feed costs in the poultry business are inextricably linked to the fluctuations in supply and demand for critical ingredients. Increased worldwide soybean and maize prices have a direct impact on production costs, as these feed materials account for 70% of total chicken production costs. As a result, Malaysia's government proactively enacted temporary legislation prohibiting chicken exports from May 2023 to July 2023, to avoid a potential market shortfall.

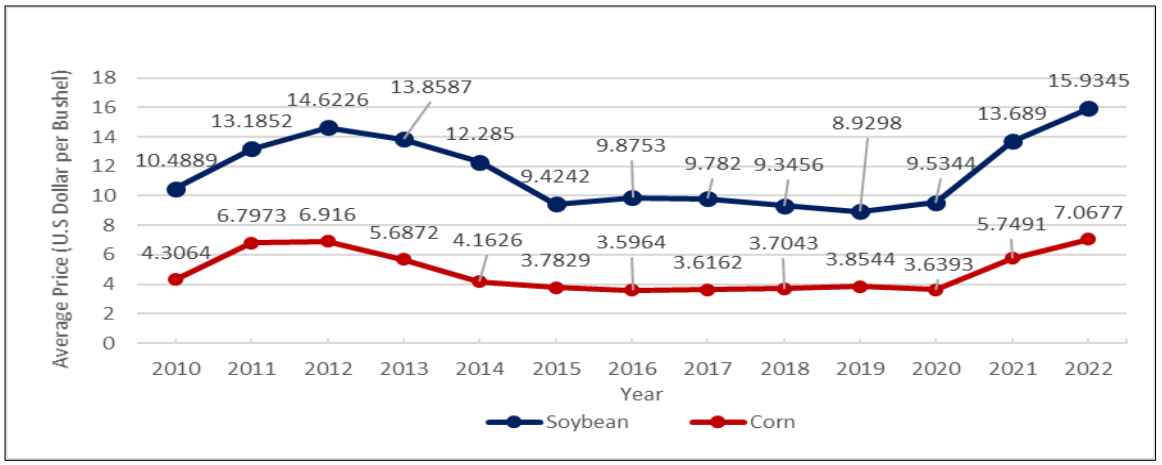

Figure 3. Soybean and Corn Price (2010-2022)
Source: US Department of Agriculture (USDA)

Due to the significant increase in feed costs, poultry farmers are now at a higher risk of experiencing losses. In Malaysia, the pricing of commercial chicken has been constrained by a ceiling policy, preventing producers from making proportionate price adjustments, even in the face of rising production costs. As a result, poultry farmers are forced to consider alternatives, such as feed substitution, as a strategic manoeuvre to reduce production costs and reduce their reliance on corn and soybeans. A considerable body of literature has dug into novel routes aiming at lowering production costs through substitutes of common feed elements.

Recently, there has been increased competition for scarce resources in the food, feed, and fuel sectors, which has been exacerbated by the impact of changing climatic conditions. This increased competition has not only impacted the availability of traditional feed ingredients like soybean, fish meal, and cereals, but it has also resulted in increased price volatility (Mugwanya *et al.*, 2022). As a result of these resource constraints and rising feed costs over the last decade, the poultry industry has begun a search for alternative protein sources. Insects have received special attention due to their exceptional nutritional value, potential environmental benefits, and cost-effectiveness of insect production (Huis *et al.*, 2022). Furthermore, Čičková *et al.* (2015) provide insights into a variety of insect species being studied for their suitability as protein sources in poultry nutrition, including common houseflies,

mealworms, black soldier flies, locusts, and silkworms, among others, with the goal of contributing to the ongoing exploration of alternative protein options. According to Sajid *et al.* (2023), insect meal emerges as a highly promising protein alternative, with long-term prospects for use in the poultry industry.

The quest for insect protein is a notable example in this regard, with the Black Soldier Fly (BSF) serving as a model. Incorporating BSF-derived protein into poultry feed can potentially reduce reliance on imported commodities such as soybeans and corn. BSF protein's nutritional values are like those of soybeans. This shift toward lower feed costs is expected to boost farm earnings, potentially leading to a drop in chicken prices. Furthermore, past studies have explored the inclusion of housefly larvae in chicken diets, indicating that a 25 per cent incorporation level has no negative influence on feed consumption, efficiency, or weight gain, as stated by Pretorius (2011). Despite these developments, certain modern farming segments are still unfamiliar with insect-based feeding strategies. As a result, the current study aims to close this cognitive gap by shedding information on the uptake and viability of insect-based alternatives in the context of poultry nutrition in Malaysia.

Materials and methods

Conceptual framework

In the context of this research, the Theory of Planned Behavior (TPB) has been adopted as the theoretical framework for analysing farmers' intention to substitute traditional feed with insect-based alternatives (depicted in Figure 4). The study explores the interaction of independent variables, specifically farmers' views on substituting insects for feed, subjective norms, and perceived behavioural control, in predicting their desire to engage in such replacement. According to Ajzen (1991), behavioural acts are dependent on intentions, which are predictably affected by factors such as attitude, subjective norms, and perceived behavioural control. As a result, the potency of an individual's desire to engage in an activity directly determines the chance of its actualization (Rowe *et al.*, 2015). Alavion *et al.* (2017), and Al-Ajam and Nor (2013) highlight the utility of TPB elements in determining behavioural intentions. The construct of intention is a critical focal point within the world of conduct, where attitudes, subjective norms, and perceived behavioural control all can have a positive impact on farmers' behavioural tendencies (Ali *et al.*, 2020). As a result, these behavioural variables may have a major impact on farmers' willingness to incorporate insect-based alternatives into chicken meals.

According to Kritikou *et al.* (2021), the idea of attitude acts as a yardstick for assessing an individual's proclivity toward a given behaviour, while also emerging as a significant aspect in decision-making processes surrounding the acceptance of innovations (Paul *et al.*, 2011). According to Hussien *et al.* (2017), a positive mindset leads to positive intents, with farmers' positive attitudes possibly arising from their conviction that insects provide a cheap, readily available, and nutritionally sound component for chicken feed (Sebatta *et al.*, 2018). As a result, Hypothesis H1 is proposed as follows:

H1: Farmers' attitudes on the use of insects as chicken feed substitutes influence their intention to embrace insects as an alternative feed source.

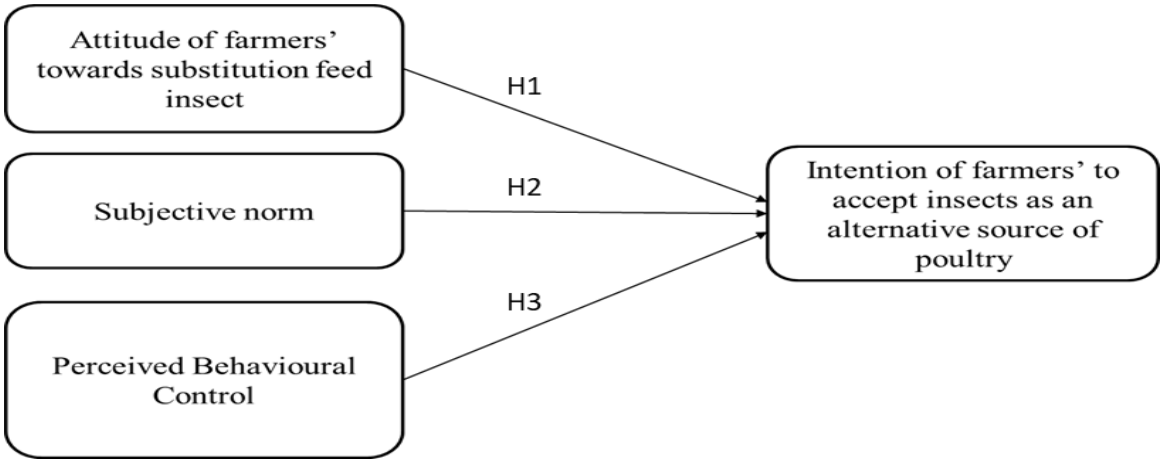

Figure 4. Conceptual Framework of the Impact of Attitude, Subjective Norms, and Perceived Behavioural Control towards Farmers' Intention Substitute Conventional Feed with Insects

The perceived societal influences that compel or prevent an individual from engaging in a particular conduct are referred to as subjective norms (Russel *et al.*, 2017). This construct defines the level of social impact an individual feels in relation to their participation or non-participation in each conduct (Ajzen, 1991). Examples include peer pressure from fellow farmers, advice from extension field personnel, advice from opinion leaders, and even familial expectations regarding the use of insects as feed alternatives (Ali *et al.*, 2020). According to the literature, subjective norms have the capacity to positively alter an individual's behavioural purpose within a specific environment (Li *et al.*, 2012). Therefore, Hypothesis H2 is proposed:

H2: The influence of subjective norms on feed choices appears positively, influencing farmers' intention to embrace insects as an alternative feed source.

Perceived Behavioral Control indicates the perceived level of complexity an individual relates to the execution of a goal behaviour (Ajzen, 1991), and serves as a barometer of one's self-perceived capacity and chances for behaviour enactment (Russel *et al.*, 2017). This concept contains individuals' expectations of their ability to engage in a specific behaviour, considering available resources and probable barriers (Ajzen, 2002). Farmers' intentions are more likely to be enhanced when they believe they have the self-efficacy and competence to implement feed substitution (Ali *et al.*, 2020). Hence, Hypothesis H3 is proposed:

H3: The extent of Perceived Behavioral Control bears a positive influence on the farmers' intention to accept insects as an alternative feed source.

Results

This study endeavours to discern the determinants that influence poultry farmers' proclivity to embrace insects as a viable substitute within the context of poultry production. Employing a factor analysis approach, the research aims to elucidate the intricate interplay of variables in this regard. The survey instrument administered to

participants comprises 18 questions employing a 5-point Likert Scale, encompassing domains such as farmers' attitudes, subjective norms, and perceived behavioural control. By conducting a Factor Analysis, the investigation seeks to unravel the underlying construct and structural relationships among the investigated variables.

The findings pertinent to the suitability of the dataset for Factor Analysis are presented in Table 1. This table encompasses the outcomes of two pivotal statistical assessments, the Kaiser-Meyer-Olkin (KMO) test for sampling adequacy and Barlett's Test of Sphericity, conducted on the collected survey data. These diagnostic tests are performed to validate the appropriateness of conducting a factor analysis on the dataset. The KMO metric evaluates the extent to which the partial correlation matrix conforms to an identity matrix, a deviation from which suggests unsuitability for the factor model. The prerequisite for commencing a reliable factor analysis entails a KMO value exceeding 0.5, and a p-value for Barlett's Test of Sphericity less than 0.05. A KMO value below 0.5 would imply potential inadequacy for conducting a factor analysis.

Table 1. KMO and Barlett's Test

KMO and Barlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.681
Barlett's Test of Sphericity	Approx. Chi-Square	992.731
	df	120
	Sig.	0.000

The outcomes, as depicted in Table 1, affirm that the sampled data meets the requisite criteria for robust factor analysis, as the KMO value falls within an acceptable range, a sentiment underscored by Hair *et al.* (1998). A discernibly reduced subset of variables demonstrates alignment with the foundational prerequisites for facilitating a rigorous factor analysis. Moreover, the statistical significance of $p<0.000$ in conjunction with the KMO and Barlett's test reaffirms the data's suitability, underscored by an achieved KMO value of at least 0.681.

The analysis revealed eigenvalues exceeding unity, thus yielding three distinct factors encompassing variables presented within the questionnaire. These factors originate from inquiries probing farmers' inclinations toward substituting conventional poultry feed with insects, the impact of subjective norms, and the perceived efficacy of behavioural control. As indicated by the outcomes emanating from the factor analysis, a triad of factors emerged from the factor solution, encompassing a total of 16 individual items, each factor comprising a range of 5 to 6 distinct elements. This outcome substantiates the statistical significance of these factors, rendering them amenable to substantive interpretation.

While executing the Factor Analysis, variables exhibiting factor loading values lower than 0.6 underwent exclusion, prompting iterative reiterations of the Factor Analysis procedure. This iterative process was iteratively pursued until all variables demonstrated factor loading values surpassing 0.6. Factor loadings embody the correlation coefficients quantifying the relationships between variables and the derived factors. This meticulous procedure aimed to distil the substantive underlying factors pertinent to poultry farmers' intentions to adopt insects as an alternative poultry feed source, ultimately culminating in the reduction of one statement through the application of factor analysis. The nomenclature assigned to each factor correspondingly aligns with the variables encapsulated within the factor, as elucidated in Table 2.

Table 2. Rotated Component Matrix

	Factor Loading		
	1	2	3
The attitude of farmers toward substitution feed insect			
Using insects as chicken feed can provide similar nutrition as conventional feeds.	0.977		
Using insects as chicken feed is more environmentally friendly.	0.963		
Insects are a sustainable feed for the chicken industry.	0.953		
Using insects can reduce the cost of production.	0.941		
I know how to substitute conventional feeds using insects.	0.930		
Subjective norm			
If the poultry industry-dominant firms such as QL Resources Berhad use insects to substitute conventional chicken feeds, I will follow to do so.		0.923	
If my competitor uses insects as chicken feed, I will follow and use insects to substitute the conventional feeds.		0.915	
I will try to use insects to substitute conventional feeds if more researchers suggest that.		0.900	
I intend to adopt insects to replace conventional feeds if the Federation of Livestock Farmers' Association of Malaysia (FLFAM) suggests it.		0.893	
If my competitor uses insects as chicken feed, I will follow and use insects to substitute the conventional feeds.		0.871	
Perceived behavioural control			
I am willing to join a training workshop and learn how to use insects for chicken feed.			0.878
I am willing to spend time exploring the information about using insects for chicken feeds from any social media such as the Internet and newspapers.			0.840
I would try to find the supply of insects for my farm's chicken feeds if I decided to use them.			0.817
I am willing to try insects for my farm's chicken feeds even though other competitors are not using them.			0.802
I am willing to pay the insects' price even though the price is higher than my expectation but lower than the imported feed price.			0.720
I will try to use insects for my farm's chicken feed even though this is something new to me.			0.668
Eigenvalue	5.434	4.206	2.979
Percentage of variance (%)	33.959%	26.289%	18.617%
Cumulative (%)	33.959%	60.24%	78.866%

Factor 1: Attitude of farmers towards substitution feed insect

The first factor is most correlated with "*Using insects as chicken feed can provide a similar nutrition as conventional feeds* (0.977)", "*Using insects as chicken feed is more environmentally friendly* (0.963)", "*Insects is a sustainable feed for chicken industry* (0.953)", "*Using insects can reduce the cost of production* (0.941)" and "*I know how to substitute the conventional feeds using insects* (0.930)".

Factor 2: Subjective norm

The second factor is most correlated with "*If the poultry industry dominant firms such as QL Resources Berhad using insects to substitute the conventional chicken feeds, I will follow to do so* (0.923)", "*If my competitor using insects as chicken feed, I will follow to use insects to substitute the conventional feeds* (0.915)", "*I will try to use insects to substitute the conventional feeds if more researchers suggest that* (0.900)", "*I intend to adopt insects to replace the conventional feeds if Federation of Livestock Farmers' Association of Malaysia (FLFAM) suggested it* (0.893)" and "*If my competitor using insects as chicken feed, I will follow to use insects to substitute the conventional feeds* (0.871)".

Factor 3: Perceived behavioural control

The second factor is most correlated with "*I am willing to join a training workshop and learn how to use insects for chicken feed* (0.878)", "*I am willing to spend time in exploring the information about using insects for chicken feeds from any social media such as Internet and newspaper* (0.840)", "*I will try to find the supply of insects for my farm's chicken feeds if I decided to use it* (0.817)", "*I am willing to try insects for my farm's chicken feeds even-though other competitors are not using it* (0.802)", "*I am willing to pay the insects' price even though the price is higher than my expectation but lower than the imported feed price* (0.720)" and "*I will try to use insects for my farm's chicken feed even-though this is something new to me* (0.668)".

The reliability test (Table 3) has also been used to assess the dependability of the variables chosen for inclusion in the factor analysis. The obtained values are in the range of 0.884 to 0.976. A Cronbach's Alpha coefficient greater than 0.6 indicates a respectable level of internal consistency within the theoretical framework, proving the acceptability and appropriateness of completing the subsequent factor analysis.

Table 3: Reliability Test

Factors	Items	Cronbach's Alpha
The attitude of farmers toward substitution feed insect	5	0.976
Subjective norm	5	0.945
Perceived Behavioural Control	6	0.884

Conclusion

Incorporating insects into poultry feed holds considerable promise for our poultry sector, as it has the potential to reduce production costs and, as a result, contribute to lower chicken pricing. This strategic integration is especially important given the ongoing rise in demand for chicken products. Exploration of insects as suitable chicken feed involves long-term and comprehensive research efforts, especially given the widespread lack of knowledge among

farmers. Furthermore, the concept of subjective norm, which encompasses the influence of social norms on individual conduct, is important in this context. Pressures can come from a variety of sources, including peer groups of fellow farmers, extension field employees, opinion leaders, and even familial circles. As a result, government assistance is critical in persuading and inspiring farmers to use insect-based poultry feed. It is the obligation of organizations and relevant authorities to raise farmers' awareness of the potential of insect-based feed replacements.

In line with this, policymakers, particularly governmental institutions, play a critical role in developing creative measures to encourage farmer participation in this paradigm change. This might include extensive advertisements, well-structured extension programs, and prudent subsidies, all aimed at easing the transition to insect-based poultry feed. The collaboration of these activities is critical to facilitating a significant shift in current practices and promoting wider adoption of this viable alternative.

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