Traits of Economic Importance in Duck Egg Production in the Philipines

Arnolfo M. Monleon

School of Agriculture Marinduque State College Torrijos Poctoy, Torrijos, Marinduque, Philippines
ammonleon@yahoo.com

Abstract

The success of duck egg production relies on several determinants and parameters affecting performance and profit. Profit depends on the compounded effect of intrinsic or inherent properties governed by both nature and nurture. This study evaluates the causal relationship of intrinsic properties with profit in duck egg production. Seventy ducks from a single population, reared singly in a cage from 16 to 40 week old were used. The individual records of egg production were collected daily. The records were evaluated and subjected to correlation and regression analyses. Of the 21 variables, the egg number and feed conversion were identified to directly affect profit on egg production. The very strong positive linear correlation (r = .937) indicates that the high profit is assured from increased number of eggs produced. The FCR has the highest negative impact to profit (β = –22.404) at $R^2 = 1.0$ indicating that all deviations in profit per egg are due to the feed function. The production protocol and support service that shall optimize output-input ratio are desired.

Keywords:

Anas platyrhynchos domesticus; Egg number; Egg production; Feed conversion; Philippine mallard

Introduction

The Philippine mallard is the popular egg-type breed of domestic duck (*Anas platyrhynchos domesticus* L) in the Philippines. The popularity of Philippine mallard is directly associated to "balut" (embryonated egg and hard-boiled before serving), a food delicacy that is unique in the Philippines. The consumption pattern of "balut" is unavailable but the duck egg production is traditionally known for "balut" processing. Several Filipino families are benefitting from the duck egg industry that has been thriving for more than a millennium and contributing to the gross value in agricultural production (BAS, 2014). The support services and associated industries like the feed milling, veterinary drug manufacturing, and the transport sector are likewise benefitting from the duck egg production.

The continued growth and sustainability of the duck egg industry are desired. A productivity analysis on duck egg production has provided substantial information and technical advises for its sustainability (Chang and Villano, 2008). However, the mass rearing technique being employed for the Philippine mallard is believed to affect productivity and profitability. It was hypothesized that profit in duck egg production is primarily due to the compounded effect of intrinsic or inherent properties governed by both nature and nurture. These intrinsic properties are expected to cause fixed or random effects in the overall egg production performance. Understanding their expression in the population is required in optimizing their potential impact thereby assuring better productivity and profitability.

In chicken egg production; the length of production cycle, egg sale price, laying percentage, price of pullet, feed price, cost of labor, cost of veterinary service and medicine, depreciation cost, cost of repair and maintenance, feed conversion ratio (FCR), and mortality rate are factors of production associated to profit. The feed price and egg

sale price posted the highest negative impact and highest positive impact on profit, respectively (Altahat et al, 2012). These factors, however, are random variables and highly dependent on market forces. This study, on the other hand, evaluates the causal relationship of intrinsic properties with profit in duck egg production.

Materials and Methods

The Data

The reference population was composed of 70 ducks that were reared singly in a cage and fed with balanced ration from 16 week to 40 week of age. The population originates from the National Swine and Poultry Research Development Center ($13^o57'13"$N, $121^o18'58"$E) of Bureau of Animal Industry of the Philippines Department of Agriculture and grown at the University Animal Farm of the University of the Philippines Los Baños ($14^o09'51.60"$N, $121^o14'49.22"$E).

The egg production parameters were age at sexual maturity, laying duration, egg number, individual laying rate, prime sequence length, sequence length or clutch size, number of sequences, pause length, number of pauses, and feed conversion ratio. The age at sexual maturity was determined by counting the number of days from day–old until lay of first egg. The laying duration, egg number, hen–day rate egg production, prime sequence length, sequence length or clutch size, number of sequences, pause length, number of pauses, and feed conversion ratio were determined from individual daily egg production records.

The individual laying rate was calculated by dividing the total number of eggs for each duck with the number of days from lay of first egg until 40 week of age. The sequence length was determined by counting the number of days by which an egg was laid before a non-laying or pause day. The mean sequence length was the average of all sequences while the prime sequence was the longest uninterrupted laying sequence.

The egg quality traits were egg weight, egg shell appearance (e.g. normal shelled eggs, soft shelled eggs, shell-less eggs), incidence of double-yolked eggs and egg shape index. Egg weights were recorded daily from lay of first egg until 24 week of age and once a week thereafter. The egg shape index was calculated as the proportion of egg width to egg length, expressed in percent. The relative profit over feed cost was computed following the farm-gate price of P5.30 for each egg.

Analyses of Data

The profit over feed cost as the dependent variable and the 21 explanatory variables were tested for equality of variance and normality distribution. After clearing the data for outliers, records from 69 ducks were considered to qualify for correlation and regression analyses. A statistical software (SPSS ver 11.5) was used in running the correlation and regression analyses. The multiple regression model is as follows: $Y = f(X_1, X_2, X_3, X_4 \ldots\ldots X_{21})$

where:
Y = Profit over feed cost, peso
X_1 = Age at first egg, d
X_2 = Body weight at first egg, g
X_3 = Laying duration, d
X_4 = Egg number from 1st egg until 40 week old, pc
X_5 = Individual laying rate, %
X_6 = Average sequence length, d
X_7 = Number of sequences, d
X_8 = Prime sequence length, d
X_9 = Pause length, d
X_{10} = Number of pauses, d
X_{11} = Longest pause length, d
X_{12} = Feed conversion ratio, kg feed / egg
X_{13} = Egg weight, g
X_{14} = First egg weight, g
X_{15} = Last egg weight, g
X_{16} = Percent normal shelled eggs
X_{17} = Percent soft-shelled eggs
X_{18} = Percent shell-less eggs
X_{19} = Percent double-yolked eggs
X_{20} = Body weight at 40 week old, g

X_{21} = Egg shape index

Results and Discussion

Profit Function

Profit, as described here, refers to the amount (in Philippines Peso) derived from the sale of egg after deducting the cost of feed to produce such egg. It is further referred to as profit per egg over feed cost. The profit was determined from each egg to consider the variation that exists due to individual effect. The marketing practice in selling and buying of egg particularly at the retail market is currently by count of pieces. Based on profit function model, a negative mean value (-1.12 pesos) was derived indicating failure to earn profit per egg over feed cost. The failure to earn, however, is a function of the egg sale price, feed cost, feed quantity to produce an egg, and other factors in the profit function regression model (Altahat et al., 2012). Among these factors, the feed quantity is dependent on inherent properties of individual in converting this production input into salable product, in this case egg. The feed cost was observed to have the highest negative impact (β = -3.01) in the profitability of chicken egg production (Altahat et al., 2012).The feed wastage particularly at the beginning of the laying curve also affects the efficiency in feed utilization (Basso et al., 2012). The feed cost, therefore, depends on the efficiency in feed utilization or feed conversion ratio.

Of the 21 explanatory factors or intrinsic factors, 10 factors were either positively or negatively correlated with profit (Table 1). The total number of eggs produced per duck from lay of 1st egg until 40 week old (r = .937), individual laying rate (r = .694), length of laying period from 1st egg until 280 day old (r = .474), prime sequence length (r = .408), and sequence length (r = .288) were positively correlated with profit. The negatively correlated intrinsic factors were body weight at 40 week old (r = -.383), age at first egg (r = -.474), pause length (r = -.648), longest pauses (r = -.662), and feed The equation shows that a duck with short pause length and producing relatively more

conversion ratio (r = -1.0). The very strong positive linear correlation (r = .937) indicates that high profit is assured from increase number of eggs produced. The feed conversion ratio (FCR) posted the perfect negative linear correlation (r = -1.0) with profit, indicating that a high profit is expected from low FCR while low profit results from high FCR.

In a profit function regression model, however, only the FCR was significantly associated with profit at R^2 = 1.0 indicating that all deviations in profit per egg are due to the feed conversion factor (Table 2). A regression equation model fitting FCR with profit is written as:

Y_1 = 5.299 – 22.404X_{12}; where:
Y_1 = Profit per egg over feed cost, Peso
X_{12} = Feed conversion ratio (FCR), kg feed per egg

The equation further shows that a peso increased/decreased in profit is linearly associated with a unit decreased/increased in FCR, respectively. This linear association of FCR to profit in egg production was similarly observed in chicken (Altahat et al, 2012).

Feed Function

The feed conversion ratio (FCR) refers to the quantity of feed utilized to produce a desired output, in this case egg. The FCR was found correlated with nine intrinsic factors, namely: longest pauses (r = .661), pause length (r = .649), age at first egg (r = .474), body weight at 40–week old (r = .383), sequence length (r = -.287), prime sequence length (r = -.408), laying duration (r = -.474), individual laying rate (r = -.694), and egg number (r = -.937) (Table 1).

Among these correlated intrinsic factors, the pause length and egg number were significantly associated with FCR at R^2 = .928 (Table 2). A regression model is written, as:
Y_2 = 0.602 + 0.005X_9 – 0.003X_4; where: Y_2 = Feed conversion ratio; X_9 = Pause length, d; X_4 = Egg number from 1st egg until 40 week old, pc
number of eggs was highly efficient in converting feeds into egg (Table 2). The

residual feed intake as a measure of feed efficiency was similarly positively correlated with reproductive traits (Basso et al., 2012). However, the feed wastage particularly at the beginning of laying curve was found to affect the efficiency in feed utilization (Basso et al., 2012). The nutrient composition in feed is another source of bias. The differences in egg production performance and profit over feed cost occur as a function of protein and metabolizable energy contents in feeds. Thus, the effect of feed factors should be minimized through appropriate husbandry practices such as three times feeding, use of single feed brand, and keeping free from wild birds and rodents.

Table 1. Correlation coefficient, *r*, of intrinsic factors affecting profit in egg production in Philippine mallard (*Anas platyrhynchos domesticus* L).

INTRINSIC FACTOR	CORRELATION COEFFICIENT, *r*		
	TEP, pc	FCR, kg feed/egg	Profit over feed cost, P/egg
Age at first egg, d	-.565[**]	.474[**]	-.474[**]
Laying duration from 1st egg until 40 wk/o, d	.565[**]	-.474[**]	.474[**]
Egg number from 1st egg until 40 wk/o, pc	1.000	-.937[**]	.937[**]
Individual laying rate, %	.703[**]	-.694[**]	.694[**]
Sequence length, d	.414[**]	-.287[*]	.288[*]
Number of sequences	-.240[*]	ns	ns
Prime sequence length, d	.513[**]	-.408[**]	.408[**]
Pause length, d	-.503[**]	.649[**]	-.648[**]
Number of pauses	-.260[*]	ns	ns
Longest pause length, d	-.555[**]	.661[**]	-.662[**]
Egg weight, g	-.245[*]	ns	ns
Feed conversion ratio (FCR), kg feed/egg	-.937[**]	1.000	-1.000[**]
Body weight at 40 week old, g	-.288[*]	.383[**]	-.383[**]

** - Correlation is significant at the 0.01 level
*   - Correlation is significant at the 0.05 level
ns - No significant correlation

Table 2. The estimated regression model.

Factors	β Value	Std. Error	R^2	F Value	Sig. F
Y_1: Constant	5.299	0.002	1.0	2.0E+07	.000
X_{12}	-22.404	0.005			
Y_2: Constant	0.602	0.018	.928	375.352	.000
X_9	0.005	0.001			
X_4	-0.003	0.000			
Y_3: Constant	148.822	2.566	.996	1324.002	.000
X_{12}	-34.146	7.115			
X_2	0.614	0.101			
X_4	-0.807	0.024			
X_5	-0.219	0.033			
X_6	1.084	0.033			
X_7	0.018	0.008			

Egg Number Function

The egg number (EN) refers to the total number of eggs produced from lay of 1st egg until 280 day old (40 week old from hatch) by a duck. Twelve intrinsic factors were either positively or negatively correlated with EN (Table 1). The positively correlated intrinsic factors were: individual laying rate (r = .703), laying duration (r = .565), prime sequence length (r = .513), and sequence length (r = .414). These positively correlated intrinsic factors were involved in increasing the total number of eggs. Among these 12 correlated intrinsic factors, five factors were significantly linearly associated with EN at R^2 = .996 (Table 2). A regression model is

written as: $Y_3 = 148.822 - 34.146X_{12} + 0.614X_9 - 0.807X_1 - 0.219X_{11} + 1.084X_5 + 0.018X_8$; where: Y_3 = Egg number, count; X_{12} = Feed conversion ratio, kg feed / egg; X_9 = Pause length, d; X_1 = Age at first egg, d; X_{11} = Longest pause length, d; X_5 = Individual laying rate, %; X_8 = Prime sequence length, d.

The regression equation shows that the feed conversion ratio (β = -34.146) had the highest impact on the total number of eggs produced and that any changes in the FCR value will surely affect EN.

Conclusion

The feed conversion ratio (FCR) and egg number (EN) were linearly correlated to profit in duck egg production in the Philippines. The very strong positive linear correlation (r = .937) indicates that the high profit is assured from increased number of eggs produced. On the other hand, the FCR posted the perfect negative linear correlation (r = -1.0) to profit indicating that profit is expected from low FCR while low profit results from high FCR. The FCR has the highest negative impact to profit (β = –22.404) at R^2 = 1.0 indicating that all deviations in profit per egg are due to the feed function. The production protocol that shall optimize output-input ratio are recommended as follows: 1. monitor the egg production performance to remove the unproductive or non-laying duck from the flock, 2. monitor the feed consumption and feed conversion, 3. avoid feed wastage, and 4. establish the optimum

population density per unit area. The nutrition requirement of the Philippine mallard must be reviewed to consider the cost of metabolic activity, cost of egg development and cost of egg laying intensity.

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