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Layer Poultry Farming and Egg Production Profitability Model:Basis of Layer Harvesting

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ABSTRACT—The study aimed to forecast the period to harvest layers in a poultry farm. The basis of forecasting was the daily egg production data together with the Hen-Day Egg Production (HDEP) Index. The poultry farm involved in the study was a small-scale and family-owned farm intended for egg production. The farm had 1,168 Dekalb White Layers at the start of the study. All farm practices were religiously made consistent. Data on daily egg production was regularly recorded. Around 6 to 8 weeks after egg production begins, egg production is expected to reach a peak of about 90%, then gradually declines to about 65% after 12 months of lay. The poultry rule of thumb for egg production, from the highest peak to a downward trend, the 50% production rate using the HDEP index indicates the break-even point wherein the feed cost is equal to the market price of the eggs. Going below this index suggests culling the layers. On average 72 – 78 weeks, hens stopped laying eggs. The actual data on egg production together with the time-series analysis of the daily HDEP index, the period to cull layers was determined. The result shows that in the 102nd week, egg production reached 50% of the HDEP index. This indicates that layers can still optimally lay eggs beyond 78 weeks, giving 24 more weeks of egg production.

Keywords— chicken layer, egg production, forecasting, layer poultry farming, time series analysis

I. INTRODUCTION

The interest in layer poultry farming has grown in different parts of the world. Layer poultry farming refers to raising egg-laying poultry birds for commercial egg production. These layer chickens are special species of hens that start laying eggs commercially from 18-19 weeks of age. They remain to lay eggs continuously until they are 72-78 weeks of age. They can produce about one kg of eggs by consuming about 2.25 kg of food during their egg-laying period (Growel Agrovet Private Limited, 2015) [1].

There are various types of highly egg-productive layer breeds. Generally, layer hens are of two types according to the nature and color of the egg. The white egg-laying hens are comparatively smaller in size, relatively eat less food, and the color of the eggshell is white. Popular white egg-laying hens include Isa White, Lehman White, Nikchik, Bab Cock BV-300, Havard White, Hi Sex White, Sever White, Hi-line White, and Bovanch White (Growel Agrovet Private Limited, 2015) [1].

The brown egg-laying hens, on the other hand, are relatively larger, eat more foods, compared to white egg layers, and lay bigger eggs than other laying breeds. The eggshell is brown colored. There are many types of brown layer available which include Isa Brown, Hi Sex Brown, Sever 579, Lehman Brown, Hi Line Brown, Bab Cock BV-380, Gold Line, Bablona Tetro, Bablona Harko, and Havard Brown (Growel Agrovet Private Limited, 2015) [1].

In the Philippines, some of the most commonly raised breeds include Lohmann Layers, Dekalb White Layers, and Babcock White Layers (Poultry Manual, 2021) [2].

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Global egg production continues to see substantial growth. According to the data from the Food and Agriculture Organization of the United Nations (FAO), the total egg production has grown 50% from 51.1 million tons in 2000 to 76.7 million tons in 2018. The latest figures suggest a 24% increase in ten years (McDougal, 2020) [3].

Since the egg production industry is growing, according to Ahmad (2011) [4]., several mathematical or statistical, and artificial intelligence models were developed to compare egg production forecasts in commercial layers. However, these models are considered complex. A separate study conducted by Ahmad & Mariano (2006) [5], indicates that egg price forecasting of shelled eggs is a complex problem. Additionally, apart from creating models, it is also important that egg producers know and record the number of eggs produced wherein a production curve is plotted and monitored to detect problems in the production curve indicating a possible disease, or any other issues (Long & Wilcox, 2011) [6]. Furthermore, Lokhorst & Lamaker (1996) [7] reported an expert system for monitoring the daily production process in aviary systems for laying hens, however, no information has been found regarding the early detection of problems using farm data which are normally recorded in poultry production.

In the Philippines, the total chicken egg production is continuously growing. The chicken egg production was estimated at 605.79 thousand metric tons which was 3.9% higher compared with the previous year having 583.23 thousand metric tons (Philippine Statistics Authority, 2021) [8].

In terms of production by provinces, Batangas was the top producer of chicken eggs in 2020 with 151.88 thousand metric tons. This was followed by Pampanga and Cebu with 69.72 thousand metric tons and 45.99 thousand metric tons, respectively. Although the Cagayan Valley Region (Region 2) is not included in the top ten producers of chicken eggs in the Philippines, egg production in the region has been growing. Data from Philippine Statistics Authority in 2020 reveal that the Cagayan Valley Region has produced around 14.20 metric tons with Isabela leading the production in this region with 8.09 metric tons.

According to Jacob, Wilson, Miles, Butcher, & Mather (2014) [9], chicken flock production rises sharply and reaches a peak of about 90% around 6 to 8 weeks after egg production begins. Production then gradually declines to about 65% after 12 months of lay. Furthermore, Bernardo (2014) added that the post-peak production of eggs continually decreases to approximately 50% around 60 to 70 weeks of age. However, various factors may affect egg production wherein age is only one of these factors. Other factors would include breed, mortality rate, body weight, laying house, lighting schedule, feed, culling, climate, management factors, vaccination and disease control, and collection of eggs. Therefore, the production cycle must be managed effectively and efficiently to provide maximum output and profitability (Food and Agriculture Organization of the United Nations (2003) [10].

Bernardo (2014) [11] further added that the 50% production rate is near the "break-even" point for egg producers wherein the feed cost is equal to the market price of the eggs. At this point, the chicken layers have already a deteriorated production of eggs and would incur a cost as the chickens still eat feed whether or not they are laying. Thus, it is economically advisable that the chicken layers should undergo the culling process for profitability when the 50% production rate is reached.

This study was crafted to forecast the period when the egg production rate in a family-owned poultry farm in Isabela reaches 50%. This study would guide the owner in making an informed economic decision in managing his layer poultry farm business. Consequently, this will also serve as a basis for other layer poultry farm owners to understand better their chicken egg production to assist them in making sound decisions in their business.

II. METHODOLOGY

The study conducted employed a descriptive type of research with data exploration using a time series model. This study enabled the researcher to describe, analyze, and forecast the egg production rate in a small-scale family-owned poultry farm business in Isabela.

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The study was conducted during the second semester of the school year 2020-2021 at Nueva Vizcaya State University – Bayombong Campus. The daily egg production rate from the third week of March 2020 to the last week of April 2021 was the subject of the study in forecasting the period when the egg production rate reaches 50%.

The breed of chickens that are raised in this particular poultry farm to produce eggs are Dekalb White Layers. There were 1,168 chicken layers that were recorded during the start of data gathering. Other factors that may affect the egg production rate were held constant including the poultry housing, space, ventilation, lighting, vaccination and disease control, and feeding management. The design of the poultry housing involves the battery cage system of housing with a triple deck stair step. This is a type of intensive poultry housing system in which chicken layers are kept in compartment units (Chibuzor, 2021) [12]. To keep the space controlled, only three chicken layers were housed in each compartment unit. When it comes to airflow, the housing was designed to ensure that the housing was well-ventilated. Furthermore, the lighting's intensity and duration were strictly monitored as egg production will decrease at light intensities lower than five lux (Food and Agriculture Organization of the United Nations, 2003) [10]. The vaccination and disease control are overseen by a professional veterinarian regularly to ensure that the chicken layers are in full potential in producing eggs. Lastly, the chicken layers are fed with commercially prepared pellet layer poultry feed in the same commercial brand throughout the study. The schedule of feeding the chicken layers as well as the quantity and the condition of the plastic feeders are strictly monitored.

The researcher also sought the expertise of one of the veterinarians in the province of Isabela in the conduct of the study. He served as a consultant by offering advice and expertise in the field as he also owns and manages a large poultry farm in the region.

The egg production rate was assessed using the Hen-Day Egg Production (HDEP) Index (Tamil Nadu Agricultural University, n.d.) [13] which can be calculated for a particular day using the below formula in Equation (1) below:

$$HDEP = \frac{Total\ number\ of\ eggs\ produced\ on\ a\ day}{Total\ number\ of\ hens\ present\ on\ that\ day}\ x\ 100 \qquad (1)$$

In the data treatment, the researcher used the Microsoft Excel forecasting tool (Time–Series analysis) in determining the trends in the egg production rate.

III. RESULTS

A. *Weekly Egg Production Rate*

Fig. 1 shows the weekly egg production rate from March 2020 to April 2021.

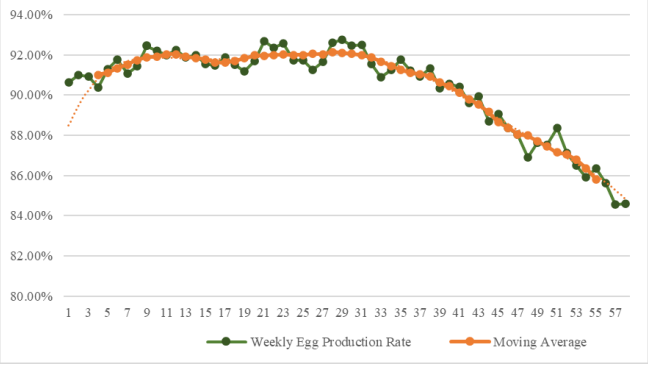

Fig. 1. Weekly Egg Production Rate and Moving Averages

It can be observed that the egg production rate curve generally decreases over time. Moving averages for the weekly egg production are included in Fig. 1.

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B. *The Forecasted Weekly Hen-Day Egg Production (HDEP) Rate*

Fig. 2 shows the actual weekly Hen-Day Egg Production (HDEP) rate from March 24, 2020 to April 27, 2021, as well as the forecasted weekly HDEP rate beyond May 4, 2021.

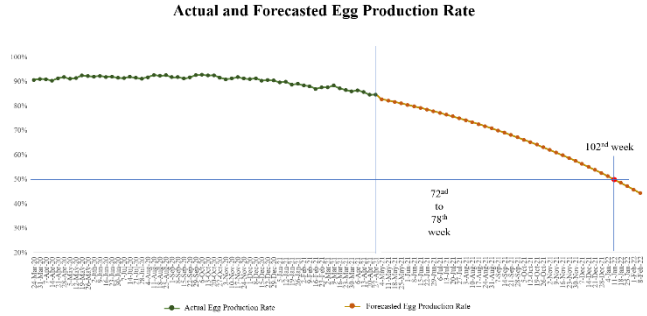

Fig. 2. Actual and Forecasted HDEP Rate

It can be gleaned from Figure 2 that the HDEP rate decreases over time. Keeping all poultry practices, the forecasted weekly HDEP rate was determined and it was made possible using Time–Series Modeling.

IV. DISCUSSION

It could be inferred from the data that chicken layers' potential to produce eggs is affected by their age. This finding was supported by the Food and Agriculture Organization of the United Nations (2003) [10] when it was mentioned that egg production rises rapidly and then starts to fall after 31 weeks of age. Furthermore, at about 71 weeks of age, less than 65% of the chicken layers will only be laying eggs. This was also affirmed by Jacob, Wilson, Miles, Butcher, & Mather (2014) [9] that chicken flock production rises sharply and reaches a peak of about 90% around 6 to 8 weeks after egg production begins. Production then gradually declines to about 65% after 12 months of lay.

Using Time–Series Modeling, it was forecasted that a 50% break-even point will happen on the second week of January 2022. On this date, the HDEP rate will be at 50% which according to Bernardo (2014) [11] that the business owner would encounter neither a profit nor a loss in his business since the feed cost is relatively equal to the market price of the eggs. In addition, during this period, the business owner needs to make an economic decision of having the chicken layers undergo the culling process.

According to Growel Agrovet Private Limited (2015) [1], hens usually stop laying eggs within the 72nd to 78th week. Thus, for small-scale poultry farms, knowing the optimum number of weeks in addition to the 78th week before the hens stop laying eggs would be advantageous to farm owners. They can maximize the period of hens laying eggs above the break-even points, which then could result in additional income or profit. In this study, the break-even point of egg production was predicted to happen on the second week of January 2022; this will happen on the 102nd week of egg production. Thus, it gives additional 24 more weeks to harvest eggs, which is an increase in profit which resulted from a longer period of egg harvesting before culling the hens.

In addition, based on the farm owner's past experiences, it would be even more profitable for poultry farm owners to have their chicken layers produce eggs when the chicken layers are older since the sizes of the eggs would be bigger and would have a higher value and demand in the market.

V. CONCLUSION

The study revealed the farm owner can maximize the profitability of the hens by knowing the period when the egg production rate reaches the 50% break-even point through the use of mathematical modeling techniques, in this study the use of Time-Series analysis.

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The study revealed that farm owners could still hold 24 more weeks in addition to the 78 weeks of the egg production period.

Furthermore, business owners could delay the culling period of the hens and giving them more time to prepare and create a business continuity plan before the forecasted period detailing the business' system of procedures to restore the business functions and operations once the chicken layers need to undergo the culling process.

The use of mathematical modeling adopted to poultry and egg production is effective. Hence, it is recommended for the farm owner especially those with small–scale poultry to use a mathematical modeling approach to guide them in their decision-making in culling hens, as well as in making business continuity plans.

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