EGG PRODUCTION METRICS, PROFITABILITY AND MANAGEMENT PRACTICES IN LAYER FARMING IN SARPANG DISTRICT

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ABSTRACT: *This study examines the economic performance and management practices of layer poultry farming in Sarpang District, a region producing 22 million eggs annually. Using data from 30-layer farms, representing 30% of the district's poultry operations, the research analyses feed efficiency, production metrics, and profitability. Egg production averaged 668±394 eggs daily, with a mortality rate of 12.9% no significant relationship was found between stocking size and mortality rates (p = 0.412). The cost of production (CoP) per egg was Nu. 7.85, while the average selling price was Nu. 13.77±1.14, yielding a profit margin of 75.4%. Revenue among farms varied significantly, influenced by factors such as farm size, market access, and management practices, with monthly earnings ranging from Nu. 81,900 to Nu. 720,000. Training of poultry farmers emerged as a critical factor in improving production efficiency, as farmers with formal training reported more consistent outcomes. Despite its profitability, the sector faces challenges, including inadequate management practices and limited access to modern infrastructure. To overcome these, the study recommends targeted investments in farmer training programs, advanced feed technologies, and biosecurity measures. Additionally, promoting larger flock sizes and enhancing access to markets and financial resources are essential to ensuring long-term sustainability and growth.*

Keywords: Egg; Layer farming; Management practices; Profitability

1. INTRODUCTION

Livestock has been a key sector in improving livelihoods of rural people all over the world because it provides animal-origin food like protein for human consumption (Demircan et al. 2010). Livestock farming also assists to ensure daily food requiremets and nutritional security to households that helps in poverty allevation (Osti et al. 2016). The minimum recommended protein requiremnt in human diet from animal-origin food per day is 40 - 60% (Demircan et al. 2010). This daily protein requirement in human diet can be met through poultry eggs because it is the most popular source of animal protein, minerals and vitamins (Szollosi et al. 2019). Poultry farming is one of the most lucrative business and preferred over large ruminants because of short rearing period, which gives a quick economic returns (Maoba 2016; Noonari et al. 2015). Demand for eggs would continue to increase due to high nutritional demand and cheaper source of animal protein, increase in human population, and rising income and urbanization (Islam et al. 2013; Mottet and

Tempio 2017).For instance, eggs are used as food additive in various processed food products as a result of change in customer preference and food diversity (Yang et al. 2018). Intensification of layer farming would probably meet the demand for eggs and poultry products (Ami et al. 2020). The increasing demand for eggs has lead to continuous imporvement in layer farming practices (i.e. transition from subsistence to commercial farming) with proper design sheds, rearing prolific layers, installating biosecurity measures (e.g. foothbath, fencing) and automatic feeding technology (Yang 2021).

It has been reported that 9.5% of the Bhutanese population had experienced food insufficiency in 2022 (NSB 2023). One strategy to ensure food security is to encourage layer farming because it gives quick economic returns and create jobs opportunities (Noonari et al. 2015). In Bhutan, poultry development first started with the initiation of the first Five-Year Plan in 1961 (Gaylal and Dorjee 2024). It is estimated that about 25% of rural households rear small scale poultry farm for egg, meat, manure and income (Mutago 2022; NSB 2023). Over the year, improved chicken (i.e. layers) has become popular among the Bhutanese farmers, and they are reared under deep litter system fed with commercial feeds (Gaylal and Dorjee 2024). Some studies claim that larger layer flock size has more net return compared to smaller flock size (Bamiro 2008; Demircan et al. 2010; Osti et al. 2016), which possibly is associated with egg production and feed efficiency (Osti et al. 2016). A farm with large flock size have lower cost of production, thereby having high net return (Demircan et al. 2010). However, there was limited study conducted on egg production metrics, profitability, and management. Therefore, this study was aimed to evaluate the egg production metrics, profitability, and management practices in layer farming in Sarpang district.

2. MATERIALS AND METHODS

2.1 Study area

This study was carried out in Sarpang district from December, 2023 to January, 2024.The purposive sampling method was used to select the study site. Sarpang district was selected because it is one of the highest egg producers (22 million of eggs) in the country(NSB 2021). The district is located at south central part of Bhutan at elevation ranging from 200 - 3600 meter above sea level. In summer, the district experiences hot and wet weather condition while winter months are dry and cool. The district experience annual average rainfall of 5376.20 mm and average temperature of 29.65^{o}C (National Center for Hydrology and Meteorology [NCHM], 2023).

2.2 Data collection

A purposive sampling method was used to select the layer farmers based on whether farm is active or closed. According to NPDC (2022) 101 layers farms are recorded under Sarpang districts and accordingly 30% of the total population was taken as sample for this study (n=30 farms) (Memom et al. 2020). Data was collected through interview. The

information was gathered on general information, livestock information, management practices, animal health, animal production and revenue generation channel.

2.3 Data analysis

The collected data were entered into Microsoft excel version 2016 and then exported to R-programming software version 4.4.2, for statistical analysis. The data were checked for normality using Shapiro-Wilk test. The data on gender, educational background, farm size, egg production, management practices, egg price, mortality, animal health care, farmer training availed and marketing was analysed and reported. The study report is being analysed using descriptive statistics and inferential statistics with significance level of 0.05.

3. RESULTS AND DISCUSSION

3.1 Respondents characteristics

The table 1 shows respondents characteristics. The survey results reveal a significant gender imbalance, with 80.6% of respondents being male and only 19.4% female, which may reflect broader societal norms or structural barriers to female participation in surveys (United Nation [UN] 2023). In terms of education, 74.2% of respondents reported being literate, while 25.8% had no formal education, indicating disparities in educational access that could affect the representativeness of the data (United Nations Educational, Scientific and Cultural Organization [UNESCO] 2008). This gender and educational disparity may influence the survey findings, as underrepresentation of females and the less-educated farmers could result in skewed perspectives on the issues being studied. These results align with global patterns of gender and educational inequality, highlighting the importance of considering such factors when interpreting survey data (World Bank 2023).

Table1: Characteristics of respondents

Variable	Category	Respondent (%)
Gender	Male	80.6
	Female	19.4
Education	Literate	74.2
	No education	25.8

3.2 Farm structure and farming experience

Figure 1 shows relation between years of layer farming and layer stocking. The analysis of farm size and experience among layer farming operators reveals a mature industry, with participants having an average of 8.6±4.29 years of experience. While some experienced farmers operate larger farms, the scatter plot of farm size versus experience indicates no significant correlation between the two variables ($p=0.196$), suggesting that experience alone is not a determining factor for farm capacity. Instead, factors such as capital availability, management expertise, and access to resources are likely more influential in determining the operational scale (FAO 2013). This aligns with findings in agricultural economics, where farm size is often more closely linked to financial resources and managerial skills than to the length of experience (Ren et al. 2019).

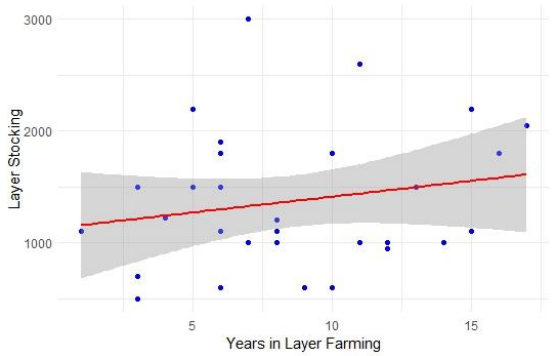

Figure 1: Graph showing layer stocking vs years of layer farming

3.3 Layer management practices

All the respondents reared layer under deep litter system. Some of the important healthcare services received by the farmers were vaccination, treatment, and minerals and vitamin supplementation. All respondents mentioned that they carry out vaccination of birds as per the schedule. This helps to boost immunity and reduce incidences of disease outbreak which is in line with finding of Islam et al. (2013) at 98.3%. All respondents mentioned that they experienced mortality for the last one year (current batches). An average mortality of layers was 171±180 (min., 15 birds; max., 700 birds). As per the respondents, pecking, cannibalism and unknown diseases were said to be the main causes of layer mortality. In addition respondents have stated high temperature and humidity in summer probably contributed to layer mortality because of heat stress similar to findings by Aduli et al. (2003). All respondents mentioned that mortality mostly occurs when layers were DoC or young age, and this was also mentioned in study by Shittu et al. (2014). The mortality of birds at young age could be probably because of stress coming into production phase and change in management practices (Jongman 2021). Although respondents (80.6%) maintained mortality record at early stage, later it was discontinued because of few cases of mortality.

Around 77.4% of respondent's practices biosecurity measures (changing cloths, boots, footbath, and visitor restrictions) while rest do not practice bio security measures. In addition, 25.8% of respondents have constructed boundary fence. Delpont et al. (2021) and Tilli et al. (2022) reported that bio-security measure helps to improve farm productivity because it helps to prevent diseases within farms and disease entry from external sources. Around 71% of respondents stated that they have constructed biological pit to dump death carcasses while 29% either fed to pigs or dig pits to bury the carcass.

Respondents (64.5%) stated they remove weak and sick layers from health flocks and keep in different shed. This helps to prevent cannibalism and reduce spread of diseases

among healthy layers. This is slightly lower than Risvansuna et al. (2021) finding of separating 82% sick layers to different shed for observation and treatments. The respondents (80.1%) stated that they consult with nearest Gewog Livestock Extension Supervisor when layers fall sick and/or when mortality occurs, while rest (12.9%) provides local medication by themselves. This is in disagreement to Afakye et al. (2020) where most of layer farmers do not relay on veterinarian but rather depends on peer and/or past experience to treat sick layers.

3.5 Production performance

Figure 2 shows the relation between mortality and stocking rate. The study reveals that daily egg production averages 668±394 eggs across the surveyed farms, indicating generally efficient production systems. However, there is significant variability in production efficiency, with trained farmers exhibiting notably better performance, suggesting that knowledge and skill play crucial roles in enhancing productivity (FAO 2020). The average mortality rate of 12.9% represents a significant operational challenge for the industry, highlighting the need for improved management practices to reduce losses (Mramba and Mwantambo 2024). The mortality analysis visualization indicates a relationship between farm size and mortality rates, implying that larger operations may encounter different challenges in managing bird health compared to smaller farms. Despite this trend, no significant relationship was found between stocking size and mortality rate (p=0.412), indicating that factors other than stocking density, such as farm management practices or biosecurity measures, may be affecting mortality outcomes (Mramba and Mwantambo 2024). These findings underscore the importance of training and proper management in reducing operational inefficiencies and health-related challenges in layer farming.

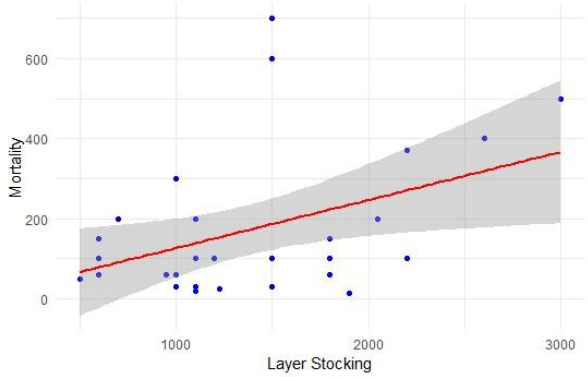

Figure 2: Graph showing mortality vs layer stocking

Figure 3 is a box plot showing the impact of training on poultry husbandry on daily egg production. The x-axis represents whether training on poultry husbandry was conducted ("No" or "Yes"), and the y-axis represents daily egg production. The "No" group has a wider range of egg production, with a higher median and greater variability compared to the "Yes" group. The "Yes" group shows a smaller range of production, with a lower median and one outlier above the upper whisker. This suggests that training on poultry husbandry may be associated with reduced variability and lower median egg production.

Education level of respondent have less effect on farm profitability despite education provides necessary skills and information for adoption of new technologies (Johnson et al. 2020; Mutago 2022). Farmer probably

have gained farming experience over time and advise from livestock officials (Johnson et al. 2020).

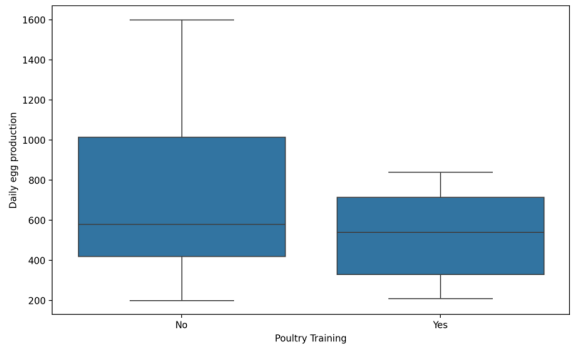

Figure 3: Graph showing egg production vs training on poultry husbandry

3.6 Economy and profit

Figure 4 reveals the monthly revenue trend. The monthly revenue data from 30 different layer farms reveal significant variability, with earnings ranging from 81,900 to 720,000, reflecting diverse farm sizes, operational efficiencies, and market conditions. Farms generating higher revenues, such as 507,000, 546,000, and 720,000, likely benefit from larger production capacities, better market access, or more efficient operations, which contribute to their higher profitability (Nalami and Olayiwola 2019). In contrast, farms with lower revenues, such as 81,900 and 94,500, may be constrained by factors such as smaller farm size, lower production capacity, or unfavourable market conditions, which can hinder their ability to generate higher earnings (Tey and Brindal 2015). The substantial variation in monthly revenue highlights the differences in profitability across farms, which are likely influenced by factors such as farm size, location, management practices, and local market dynamics (Tey and Brindal 2015).

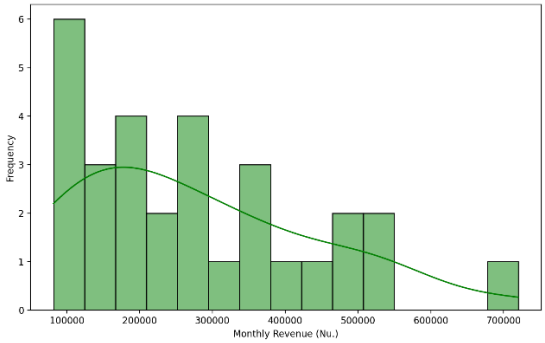

Figure 4: Graph showing monthly revenue generation from egg

Table 2: Table showing CoP, mean egg price and profit

Parameters	**Cost (Nu.)**
CoP for an egg	7.85
Average selling price per egg	13.77±1.14
Profit margin	7.85±1.14

The cost of production (CoP) per egg is Nu. 7.85, while the average selling price is Nu. 13.77±1.14 resulting in a profit margin of Nu. 7.85±1.14. This yields an impressive profit margin percentage of 75.4%, indicating a highly profitable operation where the selling price far exceeds the production cost (Suzan and Nabilah 2020). The notable difference between the CoP and the selling price not only highlights the potential for substantial earnings but also provides a healthy financial buffer that can absorb market fluctuations and cover operational expenses (Bhujel et al. 2019). Such a profit margin suggests that the farms are operating efficiently, with strong pricing strategies and cost management practices that enable them to remain competitive and

financially stable even in the face of potential market volatility (FAO 2011).

3.7 Marketing

Figure 5 illustrates the relationship between business distance from highway and monthly revenue generated. It reveals that businesses farther from the highway (>1 km) exhibit a wider range of revenues, with some reaching as high as ~ Nu. 700,000, while those located closer to the highway (0–100 m) show more consistent but lower revenues.

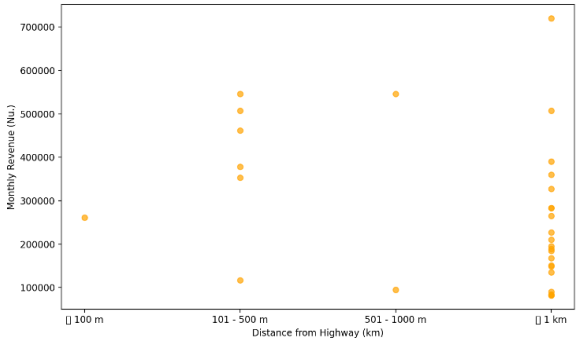

Figure 5: Graph showing farm distance from highway

Accordingly, FAO (2013) revealed that the road is an important factor in poultry farming. In layer poultry farming, the marketing analysis highlights a stable pricing environment, with an average selling price of Nu. 13.77 per egg (Table 2) and an average monthly revenue of Nu.278,240 per farm. The price distribution is relatively consistent, with most farms pricing their eggs between Nu. 13-15 as shown in Figure 6. However, revenue variation across farms is substantial, largely influenced by differences in farm size, production efficiency and market access. Farms closer to highways tend to generate higher revenues, underscoring the importance of market accessibility in revenue generation (FAO 2013; Ma et al. 2024).

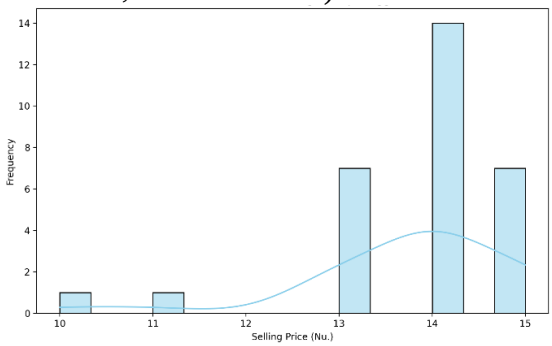

Figure 6: Graph showing egg price distribution

4. CONCLUSION AND RECOMMENDATION

Layer poultry farming in Bhutan holds substantial potential to improve livelihoods, enhance household nutritional security, and contribute to poverty alleviation. The study highlights its economic viability, with profitability linked to larger flock sizes, which result in better production efficiency and reduced production cost. Despite this potential, challenges persist including high feed costs, limited access to modern farming techniques and inadequate management practices which restrict optimal performance. To overcome these barriers, tailored training programs are essential to equip interested potential poultry farmers with skills in feeding practices, stocking density management, bio-security measures, waste management and other relevant areas on poultry husbandry. Additionally, investing in local feed mills with advanced technologies and efficient practices can reduce reliance on imported feed, significantly lowering production costs.

Encouraging private sector involvement in Day-Old Chick production would alleviate the strain on government facilities and ensure consistent supply. Furthermore, improving farmers' access to affordable resources, infrastructure, and financial support is crucial for enabling necessary investments in automated feeding systems, reliable water supply, and enhanced biosecurity measures. Finally, implementing policies that incentivize larger flock sizes and promote commercial-scale farming will not only improve productivity and profitability but also contribute to the long-term sustainability and socio-economic development.

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