

ASSESSMENT OF THE PRODUCTION SYSTEM AND MANAGEMENT PRACTICES IN SELECTED LAYER CHICKEN FARMS IN BATANGAS, PHILIPPINES

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ABSTRACT

Poultry farming, particularly layer chicken production, plays a significant role in food security and the agricultural economy. Understanding layer chicken farms' production systems and management practices is essential for improving productivity while ensuring sustainability. Despite the critical role of layer chicken farming in local economies, there is a need to assess current practices and management systems employed by farmers to identify areas for improvement. This study aims to fill the gap in knowledge by assessing the management practices and production systems of 100 commercial layer farms in Batangas. Farmers were randomly selected and interviewed using structured questionnaires. Results showed that 87% of farmers' rearing and housing systems were intensive/complete confinement and open-sided, while slatted was the common type of flooring used during the brood-grow period. Dekalb and Lohmann were the common chicken layer strains reared by farmers. Practices on feeding, water management, record keeping, and marketing of eggs conformed with the provisions of PNS/BAFS:184:2016 and PNS/BAFS 209:2017. Applying new technologies and husbandry practices through training and demonstrations could be implemented to improve layer chicken raising in the province. This research provides valuable insights for farmers, policymakers, and researchers to enhance the sustainability and biosecurity of layer chicken farming in Batangas.

Keywords: layer chicken farms, marketing, production system, marketing

INTRODUCTION

Chicken layer farming is an important economic venture in Batangas for its notable contribution to the country's egg output, which provides greater returns than other livestock industries (FAO, 2003). The success and failure of chicken layer farming depend on the adapted management practices, choice of chicken layer strains, health, and disease management. However, no information on the production performance of layer chickens in Philippine conditions; therefore, identification and a better understanding of management practices on production are important to minimize the spread and reemergence of diseases and to cope with the future challenges encountered in the farm.

Batangas province is considered the egg-basket capital of the country, with 12%

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production from San Jose, Batangas, and 50% total egg output of the province or 40% of the egg production of CALABARZON, wherein the egg production of CALABARZON reached 179, 127 metric tons from January-October 2022 (PSA, 2022). Luzon dominates the 80% supply of commercial layers and table eggs, wherein CALABARZON is the country's key producer of eggs which is led by San Jose, Batangas with a 35.7% share and Central Luzon with a 20.2% share. Therefore, Batangas Province plays a significant role in the country's egg industry (DA-BAR, 2022).

Adedeji *et al.* (2014) mentioned that capital, strain, source of labor, and birds are the important production factors and are aligned with the work of Byarugaba *et al.* (2002). In addition, Maoba (2016) mentioned that traits such as feed consumption, laying period, age of starting laying, age of peak lay, percentage of egg production per hen-housed, health, environment, and farm management practices are factors that affect egg production, so any alteration in the above traits will lead to inconsistent results. Thus, special care and attention must be taken and implemented to ensure better productivity (Ali *et al.*, 2003).

Despite the rapid growth in layer chicken farming in Batangas, details pertaining to practices on production and compliance of commercial layer farms to PNS/BAFS 184:2016, PNS/BAFS 209:2017, and ASEAN GAHP for Layers and Broilers are lacking in the literature, especially in Philippine conditions. This study aims to identify the farmers' practices on production while presenting the farms conformed with the mentioned Philippine National Standard (PNS) and GAHP.

MATERIALS AND METHODS

Study Area

This study was conducted from April to August 2022 in 10 municipalities of Batangas province, namely San Jose, Rosario, Padre Garcia, Lipa, Santo Tomas, Ibaan, Agoncillo, Alitagtag, Dumucay, and Tuy. These municipalities have the highest inventory of layer chickens based on the records of the DA Region IV-A, wherein 100 commercial farms were interviewed, which represented 53% of the total (190) registered farms in Batangas province.

Survey Design and Data Collection

This survey study used a purposive sampling method in which respondents should be registered with the Department of Agriculture (DA) Region IV-A, operating commercial layer chicken farms, and raising 500 to >5,000 layers in their farms. A structured questionnaire was developed and used to identify and describe the socio-demographic profile of the layer chicken farmers and their practices on production. Random selection of layer chicken farms was then conducted using the data/information generated from the records of DA Region IV-A. The selected farms were contacted through phone messages and calls, and consent for a farm visit and a formal interview were requested. Before visiting the selected farm, coordination with the Municipal's Agriculturist Office, DA Livestock Inspector, Poultry Associations, Barangay Captains, and Barangay Health Workers was done to easily reach the selected layer chicken farms.

Data collected were analyzed for descriptive statistics, means, standard deviation, frequency counts, percentages, and correlation using SAS on Demand for Academic.

RESULTS

Socio-demographic profile of the farm owners

The findings revealed that both genders represented almost the same proportion of layer chicken farmers (Table 1). The majority of the layer farmers were married and finished college, although the majority of their education was not related to agriculture. The observed average age is 48.55 ± 12.71 , with 4.5 ± 1.8 mean household size. Members of the poultry association dominated almost the same proportion of layer farmers. The majority of the farmers owned the land where their layer farms were located and managed their farms full-time. Moreover, layer chicken farmers engaged in the industry for 12.5 years, ranging from 1 year up to 40 years. Poultry raising was the primary source of income for 69% of farmers, while 31% of them had other sources of income gained from their piggery business, owned feed mills, as an employee, and other businesses, with an average gross household monthly income of $109,349.74 \pm 209,558.08$.

Table 1. Socio-demographic profile of the respondents in selected layer chicken farms in Batangas, Philippines.

Variable	Classification	No. of respondents (n=100)	Percentage (%)
Gender	Male	57	57
	Female	43	43
Marital Status	Married	78	78.79
	Single	17	17.17
	Widow	4	4.04
Highest education attainment	College graduate	91	91.92
	College undergraduate	1	1.01
	Vocational graduate	2	2.02
	Highschool graduate	5	5.05
Education related to Agriculture	No	79	79.80
	Yes	17	17.17
	Not applicable	3	3.03
Member of Poultry Association	Yes	52	56.52
	No	40	43.48
Land Ownership	Owned	97	97.00
	Rented	3	3.00
Owner's Involvement in the Farm	Full time	80	80.00
	Part time	20	20.00
Primary source of income (Poultry Raising)	Yes	69	69.00
	No	31	31.00

Table 1 continued . . .

Variable	Average ($\pm$ SD)	Minimum	Maximum
Age, years	48.55 $\pm$ 12.71	23.00	83.00
Household size, heads	4.5 $\pm$ 1.8	1.00	10.00
Gross monthly income, Php	109,349.74 $\pm$ 209,558.08	10,000.00	1,200,000.00
Length of engagement in layer farming, years	12.5 $\pm$ 8.8	1.00	40.00

Table 2. Production system for commercial layer chicken in selected farms in Batangas, Philippines.

Variable	Classification	No. of respondents (n=100)	Percentage (%)
Farm type	Commercial ($>5,000$ heads)	65	65.00
	Semi-commercial (251-5,000 heads)	35	35.00
Rearing system*	Complete confinement	87	87.00
	Semi-confinement	8	8.00
	Free-range	5	5.00
Housing system	Open-sided	98	93.33
	Tunnel-ventilated	3	2.86
	Combination	4	3.81
Type of flooring during the brood-grow periods*	Slatted	90	90.00
	Litter	2	2.00
	Combination	8	8.00
Variable	Average ($\pm$ SD)	Minimum	Maximum
Farm size, hectares	1.87 $\pm$ 1.60	0.500	8.00
Depth of litter materials, cm	9.50 $\pm$ 8.78	5.00	20.00
Flock size, heads	30297 $\pm$ 58670	6000	450000
Number of laborers	19 $\pm$ 100	1.00	1000
Laborer to bird ratio	1:1700	1:450	1:7000

*=Multiple responses

Production system of commercial layer chicken farms

On average, layer chicken farmers had a farm size of 1.87 $\pm$ 1.60 hectares (Table 2). The mean number of laborers hired on the farm was 19 $\pm$ 100, wherein 1 laborer was hired per 1,700 birds reared on the farm. Out of 100 commercial layer farms, 65% were

classified as commercial (>5000 heads) and 35% as semi-commercial (251-5000 heads), and this result was associated with the number of pullets, $30,297.33 \pm 58670.06$, reared by the farmers. Intensive/Complete Confinement and open-sided are the common rearing and housing systems practiced by the chicken layer farmers in Batangas. Slatted was the most common type of flooring used during the brood-grow period; however, some farmers used rice hulls, old newspapers, apog/limestone, coconut husk, and sawdust as flooring during brood-grow periods with an average depth of 9.50 ± 8.78 cm.

Common chicken layer strains and their production performance

Dekalb White Layers and Lohmann were the most common chicken layer strains reared by the majority of farmers, while some of them reared different strains on the farm (Table 3). In this survey, the average age of 1st lay of pullets is 19.40 ± 1.65 weeks and reared up to 109.96 ± 19.97 weeks. The average egg production (HH/month) is 79.89 ± 6.37 percent. Results further revealed that the observed average mortality is 3.1 ± 0.7 , wherein the major cause of the mortality was due to climatic conditions (heat stress).

On the other hand, a Pearson correlation analysis between layer chicken strain and egg production revealed a weak and statistically non-significant negative association ($r = -0.075$, $p > 0.05$). These results imply that the strain is not a reliable predictor of egg production performance.

Table 3. Common chicken layer strains and their production performance in selected farms in Batangas, Philippines.

Variable	Classification	No. of respondents (n=100)	Percentage (%)
Chicken layer strains*	Dekalb White Layers	68	40.24
	Lohmann	44	26.04
	Shaver White	22	13.02
	Hi-sex	18	10.65
	Heritage Layer Chickens	10	5.92
	Babcock White Layers	4	2.37
	H&N	2	1.18
	Dominant CZ	1	0.59
Causes of mortality*	Climatic Condition	79	41.36
	Disease Outbreak	33	17.28
	Predator	21	10.99
	Feather Pecking & Cannibalism	19	9.95
	Prolapse	18	9.42
	Old & Thin layers	11	5.76
	Others	10	5.24

Table 3 continued . . .

Variable	Average ($\pm$ SD)	Minimum	Maximum
Age at first lay, weeks	19.40 $\pm$ 1.65	16.00	25.00
Production cycle, weeks	109.96 $\pm$ 19.97	90.00	124.00
Egg production per HH/ month, %	79.89 $\pm$ 6.37	60.00	96.00
Monthly mortality, %	3.1 $\pm$ 0.7	1.00	10.00
Variable	N	Correlation (r)	p>value
Strain vs. Egg Production	170	-0.075	0.332

*=Multiple responses

Feeding management and water treatment practices

The majority of the layer farmers purchased commercial mash feeds and offered to pullets twice a day, wherein the average feed intake of layers is 111g/head/day $\pm$ 5.74 (Table 4). The layer chicken farmers commonly used linear feeders. On the other hand, nipple and linear drinkers are commonly used by the farmers; however, few farmers use pan-type feeders and bell-automatic and pan and jar drinkers, which are widely used in rearing young chicks during brood-grow periods. Most of the farmers did water treatment every month to reduce coliform count and manganese content in water and prevent water-related problems such as clogging and greasy pipes of waterlines.

Disease management practices

Infectious coryza was the prevalent disease encountered in surveyed layer chicken farms (Table 5). Most farms have no occurrences of Coccidiosis, Newcastle disease, Gumburo, Avian influenza, Fowl cholera, and Salmonellosis. Maintaining cleanliness is the major practice of the 100-layer chicken farmers to prevent the occurrences and spread of the above diseases. Other practices are the isolation of sick birds into a separate cage, regular vaccination, good management practices, and strict implementation of biosecurity protocol to prevent the occurrences and spread of diseases in their farms. Most farmers practice disinfection, inspection of farm premises, and train their egg handlers for sanitation and hygiene practices to prevent *Salmonella spp.* contamination in eggs.

Marketing practices

Eggs are the top product generated in 100-surveyed farms and followed by culled layer chickens (28%), emptied feed sacks (25%), and manure (16%) (Table 6). The frequent egg sizes produced in the farm are small (3.60 $\pm$ 0.65), medium (3.89 $\pm$ 0.34), large (3.78 $\pm$ 0.56), and extra-large (3.46 $\pm$ 0.77). Farmers sell eggs directly to wholesalers, retailers, wet markets, bakery owners, and sari-sari stores to minimize transportation costs. About 27% of farmers sold eggs to their store and egg depot, while only 10% sold eggs door to door. Ventilated vehicles were commonly used by the majority of farmers to transport eggs to their customers. Plastic was the commonly used tray by farmers during egg collection and marketing. The majority of the farmers do not dispose of the carton trays; instead, these were used as filler during the marketing of eggs, while plastic trays were reused and sanitized.

Record keeping practices

The traditional method of recording used by most farmers was by manual means, while 34 farms were practicing both manual and computerized recording systems (Table 7). The majority of layer farmers claimed a good status of their farm records; however, one farmer reported that their records were poor since they are not committed to record keeping. Farmers frequently record the inventory of feeds, daily production, mortality, medication, vaccination, and profit. Cause of death and history of occurrence and spread of diseases on the farm were rarely recorded by the farmers. None of the farmers recorded the type of feeds, feed ingredients, or feed analysis since this was usually done by the feed millers, but some farmers who formulated their own feed and who owned feed mills recorded the above records. Other records kept are feed consumption, losses, additional Calcium, and limestone in the layer's diet.

Table 4. Feeding management and water treatment practices in selected chicken layer farms in Batangas, Philippines.

Variable	Classification	No. of respondents (n=100)	Percentage (%)
Feed type	Commercial	80	80.00
	Own mixed	20	20.00
Feed Form*	Mash	88	88.35
	Crumble	8	7.77
	Pellet	4	3.88
Frequency of feeding	2x a day	72	72.00
	3x a day	25	25.00
	Adlibitum	3	3.00
Type of Feeder*	Linear	72	65.45
	Automatic	23	20.91
	Semi-automatic	14	12.73
	Pan	1	0.91
Type of drinker*	Nipple	60	49.18
	Linear	41	33.61
	Cup	19	15.57
	Others	2	1.64
Frequency of Water Treatment	Once a month	42	42.00
	Every 3 months	24	24.00
	Not applicable	12	12.00
	Others	22	22.00
Variable	Classification	Average ($\pm$ SD)	Mode
Water related problems	Pipe clogging	1.99 $\pm$ 0.93	Seldom
	Greasy pipe of waterlines	1.80 $\pm$ 0.63	Seldom
	Insufficient water supply	1.14 $\pm$ 0.47	Never

*=Multiple responses; 1-1.75=Never; 1.85-2.50=Seldom; 2.60-3.25=Sometimes; 3.35-4.00=Often

Table 5. Disease management practices in selected chicken layer farms in Batangas, Philippines.

Variable	Classification	Average ($\pm$ SD) ¹	Mode
Diseases*	Coccidiosis	1.47 $\pm$ 0.85	Never
	Newcastle disease	1.24 $\pm$ 0.73	Never
	Gumboro disease	1.07 $\pm$ 0.35	Never
	Avian Influenza	1.04 $\pm$ 0.31	Never
	Fowl cholera	1.05 $\pm$ 0.26	Never
	Salmonellosis	1.60 $\pm$ 0.98	Never
	Infectious coryza	4.0	Often
Practices to prevent/ control occurrence and spread of diseases in the farm	Maintaining cleanliness	4.0	Often
	Isolation of sick birds	3.79 $\pm$ 0.67	Often
	Vaccination	3.96 $\pm$ 0.24	Often
	GMP	3.71 $\pm$ 0.10	Often
	Biosecurity protocol	3.95 $\pm$ 0.33	Often
	Veterinarian visit	3.00 $\pm$ 0.97	Sometimes
Practices to prevent <i>Salmonella spp.</i> contamination of eggs	Wiping of eggs with clean, dry, cloth	1.78 $\pm$ 1.21	Never
	Refrigeration of eggs	1.36 $\pm$ 0.83	Never
	Washing of eggs	1.43 $\pm$ 0.84	Never
	Pasteurization	1.00	Never
	Hot water treatment	1.06 $\pm$ 0.42	Never
	Hot air treatment	1.00	Never
	Irradiation of eggs	1.00	Never
	Coating of eggs with chitosan	1.02 $\pm$ 0.20	Never
	Training for food handler	2.62 $\pm$ 1.24	Sometimes
	Inspection of premises	3.94 $\pm$ 0.34	Often
	Disinfection	3.89 $\pm$ 0.53	Often

*=Multiple responses; ¹1-1.75=Never; ^{1.85}1.85-2.50=Seldom; ^{2.60}2.60-3.25=Sometimes; ^{3.35}3.35-4.00=Often

Table 6. Marketing practices of selected chicken layer farms in Batangas, Philippines.

Variable	Classification	No. of respondents (n=100)	Percentage (%)
Farm products*	Eggs	100	30.00
	Culled layer chickens	93	28.00
	Emptied feed sacks	83	25.00
	Manure	55	16.00
	Others	4	1.00

Table 6 continued . . .

Variable	Classification	No. of respondents (n=100)	Percentage (%)
Buyers*	Wholesalers	75	32.00
	Middleman (biyahero)	56	24.00
	Retailer	53	22.00
	Wet market	21	9.00
	Bakery owners	15	6.00
	Others	18	7.00
Method of Selling eggs*	Direct Selling	97	63.00
	Producers Market	37	27.00
	Door-to-Door Sales	12	10.00
Type of vehicle used to transport eggs to consumers*	Ventilated	79	63.00
	Insulated	34	27.00
	Not Applicable	13	10.00
Type of trays used*	Plastic	96	60.00
	Carton	59	36.88
	Crates	4	2.50
	Basket	1	0.62
Reused & Sanitized (PT)	Yes	94	94.00
	No	6	6.00
Disposed (CT)	No	77	77.00
	Yes	23	23.00
Variable	Classification	Average ($\pm$ SD)	Mode
Size of eggs frequently produced in the farm	a. Jumbo	3.13 $\pm$ 0.88	Sometimes
	b. Extra Large	3.46 $\pm$ 0.77	Often
	c. Large	3.78 $\pm$ 0.56	Often
	d. Medium	3.89 $\pm$ 0.34	Often
	e. Small	3.60 $\pm$ 0.65	Often
	f. Peewee	2.57 $\pm$ 0.89	Seldom

*=Multiple responses; 1-1.75=Never; 1.85-2.50=Seldom; 2.60-3.25=Sometimes; 3.35-4.00=Often; PT=Plastic tray; CT=Carton tray

Table 7. Record keeping practices of selected chicken layer farms in Batangas, Philippines.

Variable	Classification	No. of respondents (n=100)	Percentage (%)
Record keeping system	Manual	66	66.00
	Manual and Computerized Recording	34	34.00
Status of farm records	Good	74	74.00
	Excellent	21	21.00
	Not Good	4	4.00
	Very poor	1	1.00
Variable	Classification	Average ($\pm$ SD)	Mode
Records kept in the farm	Feed Inventory	3.53 $\pm$ 1.01	Often
	Daily Production	3.92 $\pm$ 0.46	Often
	Mortality	3.60 $\pm$ 0.98	Often
	Medication & Vaccination	4.00	Often
	Profit	4.00	Often
	Type of Supplements	3.14 $\pm$ 1.14	Sometimes
	Delivery Date	3.15 $\pm$ 1.17	Sometimes
	Batch Number	2.67 $\pm$ 1.23	Sometimes
	Water Treatment	2.88 $\pm$ 1.17	Sometimes
	History of Disease Occurrence/Spread	2.51 $\pm$ 1.21	Seldom
	Cause of Death	2.44 $\pm$ 1.19	Seldom
	Type of Feeds	1.72 $\pm$ 1.25	Never
	Feed Ingredients	1.49 $\pm$ 1.08	Never
	Feed Analysis	1.35 $\pm$ 0.92	Never

1-1.75 = *Never*; 1.85-2.50 = *Seldom*; 2.60-3.25 = *Sometimes*; 3.35-4.00 = *Often*

DISCUSSION

Socio-demographic profile of farm owners

The knowledge of farmers in layer chicken farming was not acquired through their education; instead, their knowledge was acquired from being a member of a poultry association. The farmers are still in their productive years, relatively mature, and have a high willingness to adapt and innovate (Irmasusanti *et al.*, 2013; Khan *et al.*, 2022). Layer chicken farmers who are not members of the poultry association are often limited to access and acquiring new information, practices, and technology (Okantah *et al.*, 2003). The socio-demographic information of the layer chicken farmers can be associated with their practices on production, feeding, health and disease management, biosecurity, and marketing (Mariene 1995; Devonish *et al.*, 2002). Therefore, identification of the farmer's socio-demographic profile is significant in improving the farm's operations, farmers' knowledge and skills, and

communication with the industry.

Production system of commercial layer chicken farms

The results indicated that commercial-scale operations dominated the egg industry in Batangas, which gives the farmers a better gross household monthly income. Layer chickens are usually reared in cage/elevated type of housing wherein waste management and control of parasites are easier (Sonaiya, 1990; Rocha *et al.*, 2008; Abah *et al.*, 2019; Damaziak *et al.*, 2021). Rearing, housing systems, and type of flooring employed by the farmers conformed with the PAES 403:2001 (PAES, 2001). Hence, the type of housing system used by the farmers was associated with the identified major cause of mortality in the area. The results of this study are linked with the fact that battery cages are commonly used in raising layer chickens in the area, and litter materials were commonly used by farmers practicing a semi-intensive and free-range system.

Common chicken layer strains and production performance

Dekalb White Layers and Lohmann were the most common chicken layer strains reared by the majority of farmers, while some of them reared different strains on their farms. The results were similar to the report of Poultrymanual (2018) wherein most strains reared by the farmers are Dekalb White Layers, Lohmann, and Babcock White Layers. On the other hand, results showed that the fewest farmers reared Babcock White Layers. The preference of most farmers for raising Dekalb White Layers over Lohmann may be due to reported cases of prolapse in Lohmann birds, which often result in mortality. Ibrahim *et al.* (2018) revealed that Lohmann Brown (LB) and Lohmann-Dual (LD) have higher average egg production than Koekoek (KK), Dominant Sussex (DS), and Dominant Red Barred (DR). In addition, the five parent stocks, during 17-60 weeks of laying, had significantly different average weekly egg production. Therefore, LD and LB had better egg production performance than other parent stocks, but the irregular and lower production was attributed to DS and DR. The differences in the results on each of the parent stocks depend on the breeder company and the interaction of genotype and environment. However, no investigations were recorded in the management of imported and local strains' performance, despite the interests of the farmers in enhancing chicken productivity, especially in the Commercial Parent Stock introduction. Moreover, the strain raised by the farmers was not associated with their egg production, aligning with the findings of Habig *et al.* (2012), Hassan *et al.* (2018), and Lohmann GB Limited (2023); instead, these studies found that egg weight was influenced by the strain of layer chickens.

The farmers practicing an intensive system usually reared commercial layer strains, while Heritage layer chickens were usually reared by the farmers practicing semi-intensive and free-range systems. On the other hand, Australian layer farmers commonly reared ISA brown, Hy-line, Leghorn, Hi-sex, and Heritage chicken layer strains (Scott *et al.*, 2017). Moreover, brown-shelled eggs were the predominant production in Indonesia, wherein farmers reared layer chicken strains such as ISA, Hy-line, Lohmann Brown Layers, Hi-sex, and Novogen (Tangendjaja, 2019); therefore, the strains commonly reared by the layer farmers in Batangas predominantly produce white-shelled eggs, which are common for the daily consumption of the Filipinos. Therefore, the farmer's choice of chicken layer strains was associated with the type of rearing system employed in the farm.

The observed average egg production (HH/month) is considered a good laying

performance (Jacob *et al.*, 2014), but some farmers reported 60-75% egg production (HH/month). The low egg production gained by some farmers can be associated with the old layers, layer strains, housing system, feeding management, culling, vaccination, disease, management practices, and an average monthly mortality rate of 3.1 ± 0.7 percent. Mortality rate in a cage system (5.4%) was lower compared to layers reared in a free-range system (9.5%) (Weeks *et al.*, 2012). However, there is no generally acceptable level of mortality rate in laying hens (Samkange *et al.*, 2020), but these mortalities will affect egg production and the profit of the farmers. The major cause of mortality can be associated with the type of rearing and housing system employed on the farm. Therefore, reduced mortalities and better laying performance will be achieved if strict biosecurity is implemented and the welfare of layers will be improved (Samkange *et al.*, 2020).

Feeding management and water treatment practices

Most farmers who purchase commercial feeds are members of feed miller's corporations, benefiting from shared resources, training, and technology that supports both smallholder and commercial farmers (Adedeji *et al.*, 2014; BAFS, 2016). Feeding practices, including offering mash, are effective for egg production, but *ad libitum* or restricted feeding can impact production (Renema *et al.*, 2008). Farmers use linear feeders and water systems designed for easy management with regular water treatment through chlorination and acidifiers to reduce *E. coli* and Salmonellosis, particularly based on water analysis and health concerns (PCAARRD, 2008; BAFS, 2017; ASEAN, 2021). The type of feeding system is associated with the rearing system practice by the farmers (Scott *et al.*, 2017). Therefore, farmers were looking for drinking systems that are designed to minimize clogging and water wastage.

Disease management practices

Like other livestock sectors, layer chicken farms encountered several diseases associated with their egg production. The identified prevalent disease (Infectious coryza) encountered in most farms can be related to the few reports of low egg production, which could cause economic losses in the poultry industry (Han *et al.*, 2016). Low cases of *E. coli* and *Salmonella* are associated with the practice of farmers with regular water treatment on the farm. Meanwhile, visits of veterinarians to the farms were not frequent due to the strict implementation of biosecurity protocols in the area (Abah *et al.*, 2019). Dead birds underwent necropsy to identify the cause of the bird's death and execute immediate action when disease is detected to prevent the spread of diseases (ASEAN, 2021). Nevertheless, the practices of the farmers in the water, disease management of the birds, and their biosecurity protocols in the farms are effective, so cases nowadays are minimal. However, egg handlers should be trained to minimize the contamination of eggs (BAFS, 2017), for the reason that few-layer farmers refrigerate cracked eggs, but this practice allows the possible entry and growth of microorganisms inside the eggs, especially causing spoilage and possible spread of *Salmonella* contamination of eggs (Arvanitoyannis, 2009); thus, refrigeration of cracked eggs is not recommended. The reduction in the risk of *Salmonella* contamination of eggs depends on the effective biosecurity practices implemented in the farms (Trampel *et al.*, 2014). It implies that the practices of the farmers on the washing of eggs and disinfection of trays could be associated with the reported *Salmonella* cases on the farm. Therefore, the practices of the farmers should follow the guidelines stated in PNS/BAFS 209:2017

(Code of Hygienic Practice for Table Eggs) and should ensure the implementation of good management practices, disease management, and biosecurity protocol in their farms to prevent *Salmonella spp.* contamination in eggs and minimize the spread of emerging poultry diseases

Marketing practices

The sole purpose of layer chicken farming was for egg production. The size of eggs collected on the farm will vary with the chicken layer strain and age of layers reared on the farm (Oladeebo and Ojo, 2012). Table eggs are sold to wholesalers and retailers, while the middleman (biyaheros) can distribute and sell eggs to wet markets, hotels, and restaurants if they have already applied to DA for a transport carrier license (DA-BAR, 2022). However, selling eggs through middlemen indicates that the marketing system of farmers in the area is lacking (Nikita, 2021); it implies that higher income will go to middlemen, thus low returns are gained by the farmers while customers will pay for the higher price of eggs. For the farmers to sell table eggs to supermarkets, they need to make sure that the eggs are free from *Salmonella spp.* (FAO, 2020). Therefore, special caution on washing eggs is recommended (BAFS, 2017) to prevent *Salmonella* contamination in eggs. In addition, farmers sold assorted/unclassified eggs while the grading of eggs was done by the buyers. Thus, the reported low farm-gate prices of eggs were associated with the type of buyers, the farmers' practice on selling eggs, and the problems that arise during marketing of eggs (Olegario and Matawaran, 2011). Proper grading of eggs attracts all types of buyers; therefore, the farmers should be trained and educated on the importance of grading eggs to gain a better selling price of eggs (PCAARRD, 2008). Buyers usually pick up eggs from the farms; therefore, delivery and transporting of eggs was not practiced by 10% of farmers. It implies that the practices of farmers in transporting eggs to the customers conformed to PNS/BAFS 184:2016. Plastic trays are reusable and cost-effective and can be used for a longer time than using carton trays; this is associated with the findings that most farmers disinfect and reuse plastic trays. On the other hand, some farmers used both plastic and carton trays, wherein plastic trays were only used in production while carton trays were used for marketing eggs; this practice is to prevent the occurrence of disease in the farm. Therefore, layer chicken farmers should implement good hygienic practices such as systematic disinfection and sanitation of trays before use for food safety and minimizing the occurrence of disease in the farm.

Record keeping practices

Daily production was recorded manually by the farm workers, and those records will be further encoded electronically. In addition, profit and chicken layer strains are usually encoded electronically. The majority of the layer chicken farmers collected farm records daily (Okantah *et al.*, 2003) and weekly (Devonish *et al.*, 2002). Hence, daily collection of farm records could not influence the farmer's decision-making promptly, but higher income was gained as the farmers kept farm records.

The farmer who was not committed to record keeping should be supervised with a simple and understandable way of recording since layer chicken farmers can achieve success through accurate and good keeping of farm records (Muhammad *et al.*, 2004). However, some layer farmers consider this practice to be a difficult task (Poggio, 2006), despite the significance of this practice to their farm operations, and this resulted in the farmers' poor decision-making as they were guided by vague understandings and estimation of their farm

records (Johl and Kapur, 2007), since records can be useful if maintained and categorized accurately. It implies that continuous practice of both manual and computerized systems is advisable for the efficient recording and good status of farm records, since the good keeping of farm records helps to assist farm's performance, early identification of problems in the farm, so it will prevent further losses and it can assist farmers in appropriate decision-making, although keeping of farm records will not guarantee the efficiency and profitability in layer chicken farming, but success is improbable without this practice (Praharee, 2023).

Type of feeds, feed ingredients, and feed analysis are important records to be kept (BAFS, 2016; 2017). Hence, important types of records (PCAARRD, 2008) were kept by the majority of layer farmers in Batangas. Therefore, the record-keeping practices of the farmers were in accordance with PNS/BAFS 184:2016 and PNS/BAFS 209:2017. Moreover, farm owners and laborers should be educated and trained on the new database to improve the traceability of possible causes of encountered diseases, challenges, and losses in the farm.

CONCLUSION

The study assessed 100-layer chicken farmers in Batangas to identify effective production and management practices to enhance productivity and market potential. None of the commercial farms were GAHP-certified, indicating areas for improvement in adopting best practices to be qualified as exporters of eggs. Farmers' knowledge, largely acquired through poultry associations and feed miller corporations rather than formal education, influenced their management strategies; thus, the study recommended encouraging non-member farmers to join poultry associations for knowledge and support. Battery cages are commonly used in raising layer chickens in the area, while litter materials are used by farmers practicing a semi-intensive and free-range system. The selection of layer chicken strains by farmers was related to the rearing system employed on the farm, but showed no association with egg production. Proper vaccination programs and strict biosecurity measures, particularly in cleaning soiled eggs, are essential to protect bird health and prevent disease outbreaks. Thus, implementation of strict biosecurity on the farm is the frontline in preventing the occurrence and spread of diseases in layer chickens; however, biosecurity is still poorly applied by some farmers.

BEPCO developed liquid and frozen eggs to address the problem of the oversupply of eggs in the province; thus, additional revenue was gained for farmers and laborers while sustaining food security in the country. Consequently, formulation of marketing policies (*i.e.*, price standardization) and incentive provision to farmers for innovative value-adding such as producing liquid, frozen, and egg powder are suggested to minimize imports from other countries, while sustaining food security in the country.

Moreover, the application of new technologies and husbandry practices through the conduct of trainings and actual demonstration could be implemented to improve the overall knowledge and skills of layer chicken farmers in the overall production and thus uplift the lives and profit margin of the layer farmers in Batangas.

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