Evaluating the Growth and Production Performance of Indian River Layer Parent Stock Across Key Life Phases

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Abstract

This study evaluates the production performance of Indian River layer parent stock across brooder (0-6 weeks), grower (7-15 weeks), and layer (35-61 weeks) stages under Sri Lankan farm conditions. Key parameter - body weight (BW), weight gain (WG), feed intake (FI), feed conversion ratio (FCR), and mortality-were monitored. Results indicated significant sexual dimorphism, with males achieving higher BW at all stages, while females exhibited higher FI during lay. FCR increased with age, reflecting greater maintenance and reproductive demands. A critical finding was the strong negative correlation between the Temperature-Humidity Index (THI) and performance metrics (BW, WG, FI, FCR), while THI was positively correlated with mortality. Furthermore, early-life performance profoundly influenced later productivity; higher WG and FI during the brooder stage were negatively correlated with subsequent egg production and egg weight, whereas a better brooder-stage FCR was positively correlated. The study concludes that optimizing early-growth management and mitigating heat stress are essential for maximizing the reproductive performance and sustainability of Indian River parent stock in tropical climates.

Keywords: Brooder, Grower, Growth performance, Indian River parent stock, Layer, Temperature-Humidity Index

I. INTRODUCTION

Poultry is one of the most progressive livestock sub-sectors in Sri Lanka, having shown remarkable growth over the past thirty years. The poultry sector in Sri Lanka has recently gained prominence due to its significant contribution to the national gross domestic product (GDP). In 2023, the poultry sector contributed Rs. 21.9 bn (1.1% of GDP), accounting for 79% of the total livestock GDP (DAPH, 2024). The poultry industry in Sri Lanka plays an important role in the nation's protein supply, thereby helping to address malnutrition among vulnerable populations (Nisamiya et al., 2023).

The Indian River offers a high-performance line of poultry breeds to meet the modern demands of commercial poultry production. Known for its efficiency, adaptability, and strong health profile (Aviagen, 2024). Body weight management during the growing phase is a crucial factor in successful parent stock production, influencing sexual maturity, reproductive efficiency and subsequent performance of progeny (Rahman et al., 2015). Growth performance in poultry is routinely assessed using body weight (BW), weight gain (WG), feed intake (FI) and feed conversion ratio (FCR) (Leeson and Summers, 2005; Quintana-Ospina et al., 2023). These parameters are influenced by bird sex and genetics (England et al., 2023), as well as feeding management and diet composition, which determine feed intake and nutrient availability, and environmental conditions such as ambient temperature and humidity (Quintana-Ospina et al., 2023). The FCR is a key indicator of feed efficiency; a lower FCR value indicates that birds require less feed to produce a unit of body mass or output, reflecting greater efficiency (Quintana-Ospina et al., 2023).

The environment in poultry production refers to the external physical and climatic conditions in which birds are reared. Key environmental parameters include temperature, relative humidity, ventilation, air quality, lighting, and stocking density. Environmental conditions also influence production performance, animal welfare, and the yield of parent stock (Bist et al., 2024). Ambient temperature and humidity are

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often expressed as the temperature-humidity index (THI). High THI can have adverse effects, including reduced feed intake, slower growth rate, and decreased feed efficiency, while also increasing mortality (Ferreira et al., 2024). Additionally, the performance of commercial chicks mainly depends on the quality of chicks obtained from parent stocks (Rahman et al., 2015). Selecting high-quality day-old chicks from a broiler breeder can help enhance the flock performance, underlining the importance of early-stage management for future production outcomes (Siagian and Nugraheni, 2021).

Considering the importance of optimised production performance for the sustainability of the poultry industry, it is vital to evaluate how Indian River parent stock performs across its different life stages. While existing studies emphasise factors such as feed efficiency, weight gain, and environmental conditions in poultry production, a gap remains in comprehensive data tracking performance from brooding to the laying period under Sri Lankan conditions. Moreover, the link between early chick performance and later reproductive outcomes in parent stock is not fully explored. The present study addresses this gap by assessing growth and production performance at the brooder, grower, and layer stages, examining the impact of temperature-humidity index on productivity, and clarifying how early-life performance shapes egg production and egg quality. The findings underscore the significance of optimising brooder management and mitigating heat stress to improve long-term reproductive efficiency and sustainability in Indian River parent stock.

II. MATERIALS AND METHODS

The study was conducted at a commercial poultry breeder farm located in the Western Province of Sri Lanka, which lies in the wet zone and is characterised by a tropical monsoonal climate with high relative humidity. The farm operates under an open-sided housing system and follows standard commercial management practices for broiler parent stock (Aviagen, 2024).

A. Experimental design and Birds

This study was conducted in an open-sided poultry house across three growing stages: brooder (0-6 weeks), grower (7-15 weeks), and layer (35, 42, 56, and 61 weeks). Table 01 presents the experimental layout. The male-to-female ratio was adopted in accordance with the standard farm practice where the study was conducted. This ratio reflects the farm's established management protocol for broiler parent stock, specifically for monitoring body weight, allocating feed, and evaluating performance. Data were collected separately for males and females, although birds were housed together under uniform management conditions. These ages were selected to represent critical growth and production milestones. The brooder stage encompasses early growth and immune development, while the grower stage ensures proper pre-pubertal growth and body weight management. The selected layer weeks correspond to key points in the reproductive cycle, including peak and late production, allowing for the assessment of growth, reproductive performance, and environmental effects.

Table 01. Layout of the experiment

Stages	Age (week)	No. of birds	
		Male	Female
Brooder	0 - 6	50	100
Grower	7 - 15	50	100
Layer	35	25	50
	42	25	50
	56	25	50
	61	25	50

The equipment and poultry house were thoroughly cleaned and disinfected before the placement of chicks. Fresh wood shavings were used as litter material. A 100 W bulb was used as a light source in combination with three heating coils, which provided the main source of heat during brooding. The temperature is adjusted according to the chick's behaviour. Standardised feeding practices were followed across all stages. Birds were provided with commercial diets formulated for each stage (brooder, grower, and layer) according to the nutrient requirements of Indian River parent stock. Although water consumption was not measured quantitatively, birds had continuous access to clean drinking water throughout the trial, ensuring no limitation to feed intake or feed conversion. Environmental conditions were

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regularly monitored to ensure consistency across all experimental units.

During the first two weeks, feed was provided ad libitum. After two weeks, quantitative feed restriction was implemented to meet body weight targets. Adjustments were made by increasing the feed allocation by 1 g for every 50 g of underweight compared to the target standard. During the grower stage, feed adjustments ensured uniform body weight (±10% of the standard). Layer birds were supplied with breeder layer feed using an automatic chain feeder system, with allocations adjusted weekly based on body weight. Feed intake was recorded daily, and weekly averages were calculated.

The environmental temperature and relative humidity inside the poultry house were measured daily in each cage using a wet-dry bulb thermometer. The temperature-humidity index (THI) (Marai et al., 2001; Thom, 1959) was calculated as:

$$THI=0.85\times T+0.15\times RH-0.15$$

where T= ambient temperature (^{0}C), RH = relative humidity

Body weight (BW), weight gain (WG), feed intake, feed conversion ratio (FCR), egg production (hen-housed percentage), and mortality were recorded throughout the study. BW was measured using a UWE HS Series digital hanging scale. In the first week, chicks were weighed in groups of five; from the second week onward, individual birds were weighed.

$$Weight\ Gain = Final\ Body\ Weight - Initial\ Body\ Weight$$

The FCR was calculated weekly as the ratio of feed intake to body weight gain, providing a measure of feed efficiency (Martinez et al., 2022).

$$FCR= \frac{Total\ Feed\ Intake\ (kg)}{Total\ Body\ Weight\ Gain\ (kg)}$$

B. *Statistical Analysis*

Microsoft Excel and SPSS (Statistical Package for the Social Sciences) version 26.0 were used to analyse the data. Descriptive statistics were applied to summarise performance parameters. Correlation analyses were performed to assess the relationship between production performance and the Temperature-Humidity Index (THI) at four specific layer production ages: 35, 42, 56, and 61 weeks. Statistical significance was considered at $p < 0.05$.

III. RESULTS AND DISCUSSIONS

A. Growth Performance

The growth and feed utilisation performance of Indian River broiler parent stock were monitored across the brooder, grower, and layer stages. Key parameters assessed included BW, WG, FI, and FCR. Separate evaluations for male and female birds are summarised in Table 02, which highlights the differences between sexes and growth stages. Male birds consistently exhibited higher BW than females. At the brooder stage, males had an average BW of 517 g, while females averaged 331 g. During the grower stage, the average BW of males was 1931 g, while that of females was 1324 g. By the layer stage, males and females reached an average BW of 4806 g and 4195 g, respectively. These findings align with England et al. (2023), who attributed sex differences in body weight to competition for feed, social dominance, hormonal differences, and metabolic demands. The findings indicate that males consistently outperform females in terms of growth at every stage of production. Weight gain peaked during the brooder stage. Female chicks gained 95 g, while males gained 183 g. Weight gain patterns stabilised during the grower and layer stages, with males continuing to gain more than females. This reflects the rapid early growth phase in poultry, as noted by Siagian and Nugraheni (2021).

Feed intake increased with age for both males and females. During the brooder and growth stages, males consumed more feed than females. However, females consumed more feed (1127 g) than males (975 g) during the layer stage, due to the additional energy demand for egg formation. These changes highlight the evolving dietary needs associated with female reproduction. The FCR was lowest during the brooder stage (1.2 in males and 0.8 in females), indicating the highest feed efficiency at early growth. As birds grow, FCR increased substantially, reaching 5.0 for

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males and 5.7 for females at lay. A Higher FCR in later stages reflects the increased nutritional

Table 02: Body weight, weight gain, feed intake, and feed conversion ratio of Indian River parent stock across brooder, grower, and layer stages

Performance of broiler parent stock	Gender	Age (Stage)		
		Brooder	Grower	Layer
Body weight (g/bird)	Male	517.19±329.74	1931.19±307.78	4806.41±494.05
	Female	330.82±173.08	1324.42±328.74	4194.89±569.84
Weight Gain (g/bird)	Male	183.45±158.74	121.43±39.74	193.74±9.12
	Female	94.62±100.50	122.37±37.16	193.47±17.87
Feed Consumption (g)	Male	389.31±172.45	567.86±15.62	975.30±24.57
	Female	263.78±93.63	469.62±59.16	1126.79±25.84
Feed Conversion Ratio	Male	1.2±1.17	5.2±1.89	5.0±0.27
	Female	0.8±1.86	4.2±1.66	5.7±0.82
Mortality (%)	Male	2.57%±1.90%	0.67%±1.00%	2.50%±2.97%
	Female	2.57%±1.51%	1.44%2±1.13%	3.00%±2.13%

requirements to support their maintenance and reproduction. Furthermore, both genetic and environmental factors contribute to the increase in FCR (Quintana-Ospina et al., 2023). Mortality rates remained within acceptable commercial limits across all stages (<3.5%). Rates were slightly higher in females during the layer stages, possibly due to reproductive stress.

B. Effect of Temperature-Humidity Index (THI)

The correlation analysis revealed a significant negative relationship between THI and BW (r = -0.62), WG (r = -0.65), FI (r = - 0.61), and FCR (r = - 0.56), all p<0.001 (Table 03). Higher THI adversely affect birds' growth performance and feed efficiency. Vandana et al. (2021) also reported that heat stress increases maintenance energy requirements and compromises productivity. In contrast, THI was positively correlated with mortality rate (r = 0.44, p<0.01). Given that the death rate rises in tandem with THI, this implies that rising temperatures and humidity levels have a negative impact on bird survival (Kang et al., 2020).

C. Brooder Performance on Layer Productivity

Tables 04 and 05 present the results of correlation analysis, illustrating the relationships between brooder stage growth performance and its impact on subsequent egg production and egg weight.

Table 03: Relationship between THI levels and key performance parameters

	BW	WG	FI	FCR	THI
BW	1				
WG	0.53**	1			
FI	0.94**	0.55**	1		
FCR	0.55**	0.33*	0.55**	1	-
THI	-0.62**	-0.65**	-0.61**	-0.56**	1
M	-	-	-	-	0.44

BW = Body weight, WG= Weight gain, FI= Feed intake, FCR= Feed conversion ratio, THI= Temperature humidity index, M=Mortality

** Correlation is significant at the 0.05 level (2-tailed).*

*** Correlation is significant at the 0.01 level (2-tailed).*

Table 04: Correlation of brooder growth performance with egg production

Growth Parameters	35th Week	42nd Week	56th Week	61st Week
BW	-0.18*	-0.25*	-0.32**	-0.28*
WG	-0.68**	-0.75**	-0.78**	-0.72**
FC	-0.79**	-0.82**	-0.85**	-0.79**
FCR	0.54**	0.62**	0.63**	0.58**

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BW = Body weight, WG= Weight gain, FC= Feed consumption, FCR= Feed conversion ratio, EP = Egg production, EW= Egg weight
* Correlation is significant at the 0.05 level,
** Correlation is significant at the 0.01 level

The BW at the brooder stage was negatively associated with egg weight (r = -0.23 to -0.26) and egg production (r = -0.18 to -0.32) at $p<0.05$. indicating that rapid development during the brooder phase was linked to adverse effects on subsequent production performance. WG and FI during the brooder phase also showed strong negative correlations with egg production and egg weight at 35, 42, 56, and 61 weeks. These results suggested that rapid early growth and overfeeding may compromise production performance, aligning with findings of Rahman et al. (2015). Confirming the relationship between increased early feed consumption and decreased reproductive performance, similar adverse patterns were observed at 42, 56, and 61 weeks of age.

Table 05: Correlation of brooder growth performance with egg weight

Growth Parameters	35th Week	42nd Week	56th Week	61st Week
BW	-0.25*	-0.25*	-0.26*	-0.23*
WG	-0.88**	-0.89**	-0.89**	-0.89**
FC	-0.99**	-0.99**	-0.99**	-0.99**
FCR	0.70**	0.72**	0.73**	0.73**

BW = Body weight, WG= Weight gain, FC= Feed consumption, FCR= Feed conversion ratio, EP = Egg production, EW= Egg weight

* Correlation is significant at the 0.05 level,
** Correlation is significant at the 0.01 level

A positive correlation was found between brooder FCR and both egg production (r = 0.54) and egg weight (r = 0.70), suggesting that more efficient feed utilisation supports sustained production performance. Confirming the association between improved FCR and enhanced reproductive outcomes, similar positive trends were identified at 42, 56, and 61 weeks.

IV. CONCLUSION

The present study demonstrated that the growth and production performance of the Indian River parent stock improved as the birds advanced through the production stages, from the brooder to the grower and layer stages. Males consistently showed higher growth compared to females across all stages. Females, however, achieved relatively better feed efficiency during the early stages and higher feed intake during the laying period due to reproductive demands. The THI had a negative influence on growth performance and feed efficiency, while being positively associated with mortality. Providing us with confirmation of the adverse role of heat stress on breeder productivity. Importantly, early-stage performance was strongly correlated with reproductive outcomes. Excessive early growth and feed intake are negatively impacting egg production and egg weight. Optimising early-life management and minimising environmental stress are critical for sustaining the productivity and profitability of Indian river parent stock.

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