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Preparing Pullets for the Future of the UK Egg Industry

Written by:

Charlotte Cole NSch

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A NUFFIELD FARMING SCHOLARSHIPS REPORT

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Date of report: June 2026

*"Leading positive change in agriculture.
Inspiring passion and potential in people."*

Title	Preparing Pullets for the Future of the UK Egg Industry
Scholar	Charlotte Cole
Sponsor	BEMB Trust
Objectives of Study Tour	1. To evaluate rearing strategies that improve disease resilience, laying persistency and eggshell quality in commercial laying hens. 2. To investigate the role of pullet rearing in preventing feather pecking and cannibalistic behaviours in laying hens. 3. To understand data sharing practices between rearing and laying farms
Countries Visited	UK, Ireland, Netherlands, Japan, Vietnam and Australia.
Messages	Pullet development continues until around 30 weeks of age, meaning responsibility for optimum development is shared between the rearing and laying farmer, therefore laying farmers should be provided with a comprehensive pre-delivery rearing summary to inform laying practices. Interventions and rearing environment within the first weeks of life play a critical role in the development of the gastrointestinal tract, immune system, microbiome and behaviour, with long-term consequences for disease resilience, performance and behavioural traits associated with feather pecking, fearfulness and ranging behaviour. Prioritise growth quality and flock evenness rather than transfer weight as conformation has a lasting impact on disease resilience, laying persistency and eggshell quality. Consider the use of key performance indicators and incentive schemes that recognise and reward high-quality pullet rearing.

EXECUTIVE SUMMARY

The global egg industry faces increasing pressure to improve productivity and welfare whilst reducing environmental and financial costs. In the UK there is ongoing pressure to ban enriched cages, despite currently producing ~83% of eggs in cage-free systems, which are more costly and complex to manage than caged systems, due to increased labour requirements, disease challenges and behavioural considerations. Pressure to eliminate enriched cages continues to grow, yet replacing this production would require more than three billion additional cage-free eggs annually. Whilst some demand can be met through housing conversion and building, improving flock performance will be essential to maintain supply efficiently. Significant performance differences exist between and within countries, with Germany producing 27% more eggs per bird than the UK in 2024 and UK free-range flocks averaging 378 eggs per bird, compared with over 570 in top-performing flocks. Improving persistency of lay, disease resilience and feather cover, presents an opportunity to increase egg output from existing housing capacity, whilst improving welfare and sustainability.

Pullet rearing accounts for approximately 20% of a laying hen's life and represents a critical period of skeletal, physiological, behavioural and immune development. However, pullet development should not be viewed as ending at transfer, as development continues until around 30 weeks of age, meaning responsibility for optimum development is shared between the rearing and laying farmer.

A consistent theme throughout this study was the importance of early-life development. Growth quality and flock evenness influence future productivity, health and longevity. The first weeks of life play a critical role in the developing gastrointestinal tract, immune system and microbiome, with long-term consequences for disease resilience and performance. Behavioural traits associated with feather pecking, fearfulness and ranging are also influenced by the rearing environment during the first 10 weeks of life.

The first 10 weeks, shapes the next 100

Five key recommendations emerged from this Nuffield Scholarship.

1. Prioritise growth quality and flock uniformity rather than transfer weight.
2. Maximise early feed intake, gut development and disease resilience.
3. Provide substrate and environmental complexity from day one to support behavioural, microbiome and skeletal development.
4. Optimise lighting, feeder and environmental management throughout rear.
5. Improve communication and transparency across the supply chain so pullet development is managed as a continuous process rather than separate production stages.

To produce longer-lived, more resilient laying hens capable of achieving high performance in cage-free systems, greater emphasis and subsequent reward must be placed on quality pullet development.

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CHAPTER 1: PERSONAL INTRODUCTION

I grew up on a smallholding, rearing poultry and later working in my parents' kennels and cattery business. Becoming a vet was not part of the plan; I wasn't naturally academic and didn't see university as an option until I found something I was passionate about. After being inspired, I took an unconventional route into university, where I discovered the poultry industry. I joined St David's Poultry Team after graduating in 2019 and moved to North Yorkshire with my husband, Sam. I work with laying hens, pullets, broilers and broiler breeders across the North of England.



Charlotte Cole NSch, the author

A desire to understand *why* has shaped my career, leading me to seek root causes rather than temporary fixes and to understand how management, environment and physiology influence health, behaviour and performance. My Christian faith has deepened this curiosity. As scientific discoveries reveal more about the complexity of living systems, I become increasingly convinced that our role is to understand and work with them as whilst intervention is sometimes necessary, human solutions can have unintended consequences.



CHAPTER 2: STUDY SUBJECT BACKGROUND

Globally, egg production is mostly cage-based, UK are ~83% cage-free, with the highest proportion of birds kept in free-range systems globally, at >75% (Ritchie, Pablo and Roser, 2023; British Egg Industry Council, 2025). Europe is moving to 100% cage-free, despite cage-free systems having higher environmental and financial cost. The UK would need to increase barn or free-range egg production capacity by >3 billion eggs annually. Alongside housing conversions, improving flock performance will be essential to meet this demand. Despite similar production systems, Germany produced 27% more eggs per bird (EPB) than the UK in 2024 (Ritchie, Rosado and Roser, 2024). Within the UK, free-range flock performance ranges from an average of 378 EPB to over 570 EPB in top-performing flocks. Closing this performance gap requires improved persistency of lay, disease resilience and feather cover, enabling hens to remain productive for longer.

Feather pecking and cannibalism are major health and welfare concerns within the global laying industry and contribute to high flock mortality, especially in cage-free systems. Globally, beak trimming is widely practiced, using infrared beak treatment in day-old chicks, which causes the tip of the beak tissue to slough off in the following weeks. Six countries in north-west Europe, including the Netherlands, have banned beak trimming and pressure is mounting for the UK to follow suit.

To achieve more sustainable, longer-lived flocks, in cage-free systems without beak trimming, the laying industry must work collaboratively, considering whole flock variables, including pullets.

Pullets are typically reared from day-old to approximately 16 weeks of age (WOA) before transfer to the laying farm. This period accounts for around 20% of the bird's life and has a significant influence on future health, welfare and productivity. As poultry are reared entirely in artificial environments without maternal contact, their development is heavily dependent on human management.

Whilst breeding stock and hatchery management influence laying hen development, they are outside the control of primary producers and are not considered in this report.



CHAPTER 3: ANALYSIS OF UK REARING DATA ON LAYING OUTCOMES

A flock-based dataset, kindly provided by UK pullet rearers, was collated (Appendix 1). From the data provided, 16 weeks was the most common age of transfer to the laying house and the average number of injectable vaccines received was 2.4 (1-5 range). The average 7-day mortality was 1.08% (0.2-5%) and cumulative mortality in rear was 2.37% (0.4-9.86%). Smothering in rear commonly occurred between 9-11 WOA, which coincides with the second moult. **There was no statistically significant correlation between any rearing mortality or smothers and end of lay KPIs; EPB, Egg Mass or laying mortality.**

Body weight (BW), compared to each breed standard, averaged 99-104% at 5, 12 and 16 WOA. Interestingly, **achieving higher BW at 12 WOA, compared to breed standard weights, was correlated with higher end of flock mortality and lower EPB, independent of 5-week BW.**

1% above BW target = -1.5 epb

1% above BW weight target = +0.2% cumulative mortality in lay

Average evenness from the dataset at 5-weeks was 69%, 12-weeks 80% and 16-weeks 84%. **Evenness at 12 weeks and 16 weeks showed association with EPB.**

1% increase in evenness at 12 weeks = +0.8 EPB

1% increase in evenness at 16 weeks = +0.65 EPB

Breed was significantly associated with laying outcomes, including EPB and mortality, accounting for up to 30% of variation in some models. The laying system had no impact on laying KPIs. Laying mortality had a statistically significant negative association with farm size, meaning larger laying farms had slightly lower mortality.



Impact on Lay

- Higher BW at 12 WOA → reduced laying flock performance and increased mortality
- Higher evenness at 12 WOA → increased laying performance
- Rearing mortality had no statistically significant impact on laying outcomes



Action Points

- Avoid excess body weight from 12 WOA
- Measure evenness weekly from 4 WOA



CHAPTER 4: PULLET DEVELOPMENT

Development continues beyond transfer, making a 0–30 week perspective more appropriate than a 0–16 week rearing period. Development stages include:

- **0-6 weeks:** Organ and initial microbiome development.
- **6-12 weeks:** Rapid daily growth, with development of feathers and musculoskeletal system.
- **12-18 weeks:** Slow daily growth, start of fat cell proliferation and reproductive development and completion of skeletal size by ~13 weeks.
- **18-24 weeks:** Fast weight gain, reproductive tract continues developing, alongside medullary bone and fat.
- **24-30 weeks:** Slow weight gain, before maintenance shortly after 30 weeks. Final development of reproductive tract, medullary bone and fat.

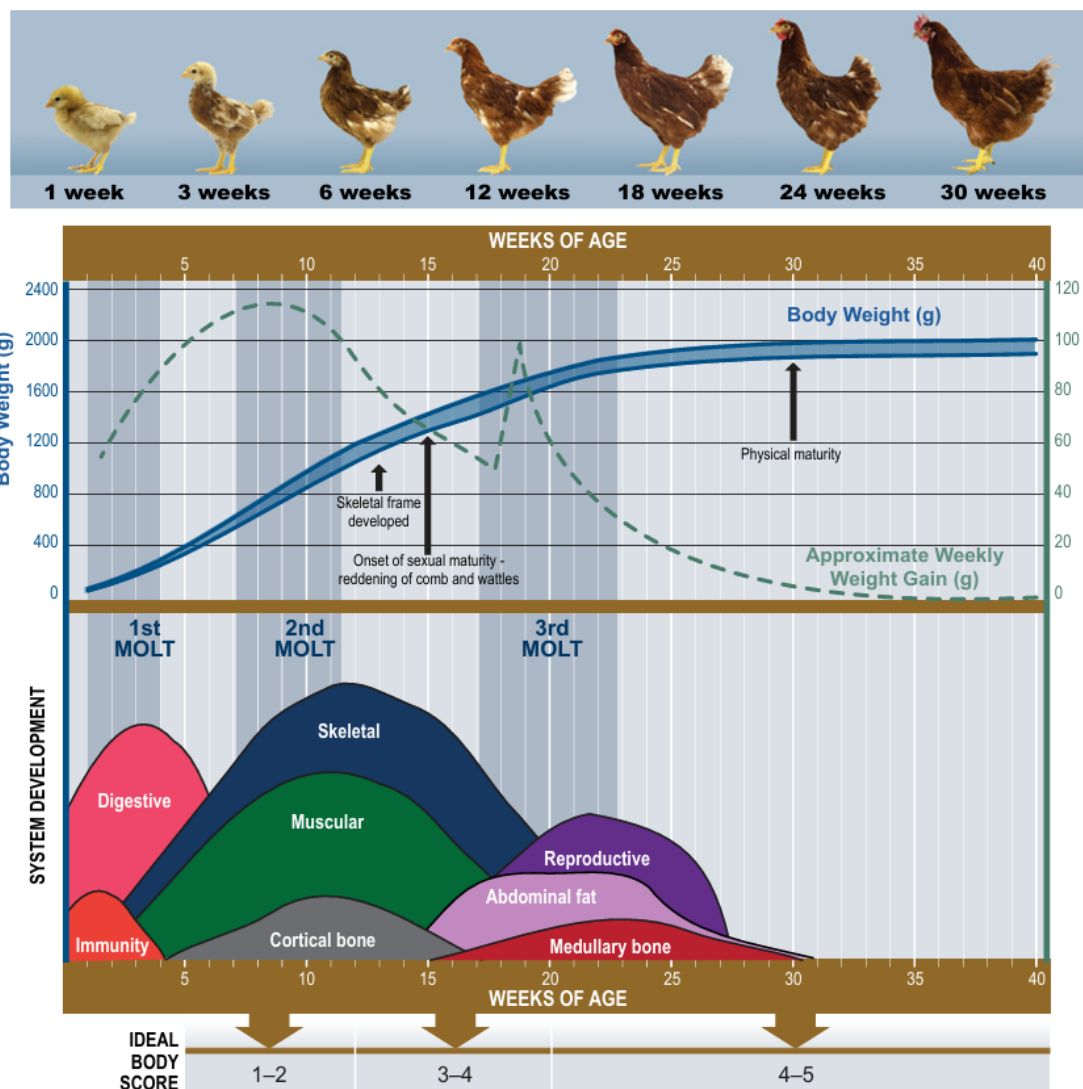


Figure 1: Hy-Line development graph (Hy-Line, 2021).



4.1 Organ Development

Adequate skeletal reserves are required to meet the exceptional metabolic demand of laying hens. Cortical bone provides structure, a holding zone, for the medullary bone which is used for reserves. The cortical bone frame is established by 12-13 weeks and mineral reserves for egg production is directly related to skeletal frame size (Hy-Line, 2016). Medullary bone forms ~14-30 weeks and accumulating enough medullary bone early in life is vital for maintenance of skeletal integrity and eggshell quality in older hens (Alfonso-Carrillo *et al.*, 2021).

Birds with shorter gastrointestinal tracts, often associated with lower BW at 0–6 WOA, typically show poorer nutrient utilisation and greater disease susceptibility as layers. Likewise, impaired liver development or function can reduce nutrient utilisation, disrupt metabolism, and increase disease susceptibility. The impact of organ development is relatively straightforward to understand, but recent research reveals a more complex interaction between organs, genetics, nutrition, immunity, and the recently recognised role of the microbiome.

Maturation of the chicken brain continues up to 10 WOA, suggesting the first 10 WOA are an important developmental window during which behavioural traits and microbiome-associated influences on the gut–brain axis may become established (Atkinson *et al.*, 2008).



Impact on Lay

- Small skeletal frame at ~13 weeks → poor eggshell quality in late lay, even if BW is 'caught up'.
- Low BW at 5-6 WOA → flock disease susceptibility and poor nutrient utilisation
- First 10 WOA impact behavioural traits in adult laying hens



Action Points

- Consider body weight and evenness at key ages; 5-6 and 12-13 WOA.

4.2 Microbiome Development

The microbiome is a community of microorganisms inhabiting a particular environment. Current research focuses on the gut microbiome, and finds microbial populations have a significant impact on most measurable outcomes. For example, microbiome transplants from healthy adult birds to chicks - mimicking natural consumption of mother hen faeces - promotes the development of immune organs, enhances immune response and reduces colonisation of *Salmonella Typhimurium* (Chu and Mazmanian, 2013; Meijerink *et al.*, 2020; Liu *et al.*, 2023; Song *et al.*, 2023). Early microbial colonisation has long lasting effects on most bodily functions in some way, for example:



- **Genetic-microbiome interactions:** gut microbiome can influence the expression of genes, and one study identified genes and microbes in the small intestine which act together to influence eggshell quality at 90 WOA (Jin *et al.*, 2024). Another found an increased ratio of certain bacteria, regulated liver gene expression, increasing fat deposition and improving eggshell quality (Bai *et al.*, 2025). Breed companies will increasingly be considering the microbiome impact on their genetics.
- **Nutrition-microbiome interactions:** gut microbiome influences nutrient utilisation, and differences in microbial composition have been associated with variation in amino acid metabolism and egg production between high and low-producing hens (Su *et al.*, 2026). Nutritionists will increasingly need to consider the microbiome in ration formulation, as testing becomes more commercial.
- **Gut-bone axis:** gut microbiome influences bone health, for example *Firmicutes* bacteria have been shown to stimulate pathways which increase bone formation (Zaiss *et al.*, 2019; Y.-N. Lu *et al.*, 2025).
- **Gut-liver axis:** gut dysbiosis or liver inflammation can lead to compromised immunity and reduced laying productivity (Amevor *et al.*, 2025).
- **Gut-brain axis:** there is bidirectional communication between the brain and intestines, which contributes to the presentation of abnormal behaviours across species. High feather pecking birds have a different population of gut microbiota, compared to low feather pecking birds, with low feather pecking birds also showing increased microbial diversity (Meyer, Zentek and Harlander-Matauschek, 2013; Birkel *et al.*, 2018). Furthermore, transferring gut microbes from calm, low-pecking chickens to newly hatched chicks reduced feather pecking and other harmful social behaviours, suggesting early-life caecal microbiota transplantation (CMT) can improve welfare in laying hens (Fu *et al.*, 2024). The gut microbiome in young animals has a role in programming the later responsivity of the stress system, thus development of abnormal behaviour (Dinan and Cryan, 2012; De Haas *et al.*, 2021).



Impact on Lay

- The gut microbiome influences all laying outcomes, including persistency of lay, disease resilience and injurious feather pecking.



Action Points

- Nutritionists, genetics companies and vets will need to consider the flock level microbiome once testing becomes commercially viable.
- For now, pullet rearers should work with vets to ensure early-life management practices facilitate the development of a diverse microbiome.



CHAPTER 5: MEASURING PULLET DEVELOPMENT

5.1 Bodyweight and Evenness

Accurately tracking BW and evenness allows farmers and nutritionists to respond to the bird's growth curve. BW measurements throughout rear are vital, a study found birds 25% behind BW at 6 weeks old, had statistically significant poorer performance in lay up to 72 weeks, compared to birds at target weight (J. Lu *et al.*, 2025). Furthermore, BW 6% lower than breed standard at 18 weeks, sustained a longer laying cycle when compared to birds 5% higher BW, which matches earlier data analysis, suggesting higher BW are not always better (Muir *et al.*, 2023). Plotting weights on visual graphs rather than recording numbers alone, helps identify patterns.

Globally, there are variations in measurements taken; BW is commonly measured but not evenness, despite breed management guides outlining the importance of flock evenness, from 4 weeks old (Hy-Line, 2016; Lohmann GB Limited, 2019; H&N GB, 2022). The UK appear to be most consistent in monitoring evenness. Hendrix Genetics specify the most important factor in judging the quality of a flock is the evenness, with a batch being even at >80% (Hendrix Genetics, 2025).

Most pullet rearers globally are manually weighing, usually weekly, providing the farmer with details on average BW, range and evenness. Automatic weighers offer the ability to continuously monitor, assess more birds and offer insights into weight variation across houses. The development of technology and artificial intelligence will enable more insightful measurements to be undertaken.



Impact on Lay

- Low BW (25% less) at 6 WOA → poor persistency of lay
- BW slightly (5%) exceeding 18 WOA target → poor persistency of lay



Action Points

- Avoid exceeding breed target body weight from 12 weeks
- Visualise data: graph weights alongside breed standard
- Measure evenness weekly from 4 weeks old
- Consider installing automatic weighing scales



5.2 Body Conformation

BW is easy to measure, but offers minimal insight as standalone figures, as two birds could have the same BW, but vastly different conformation. Tracking weekly growth rate, compared to target, provides feedback on developing body confirmation. Figure 2 shows good flock trajectory (black) compared to a poor flock trajectory (red), yet both achieve the same BW at 16 weeks.

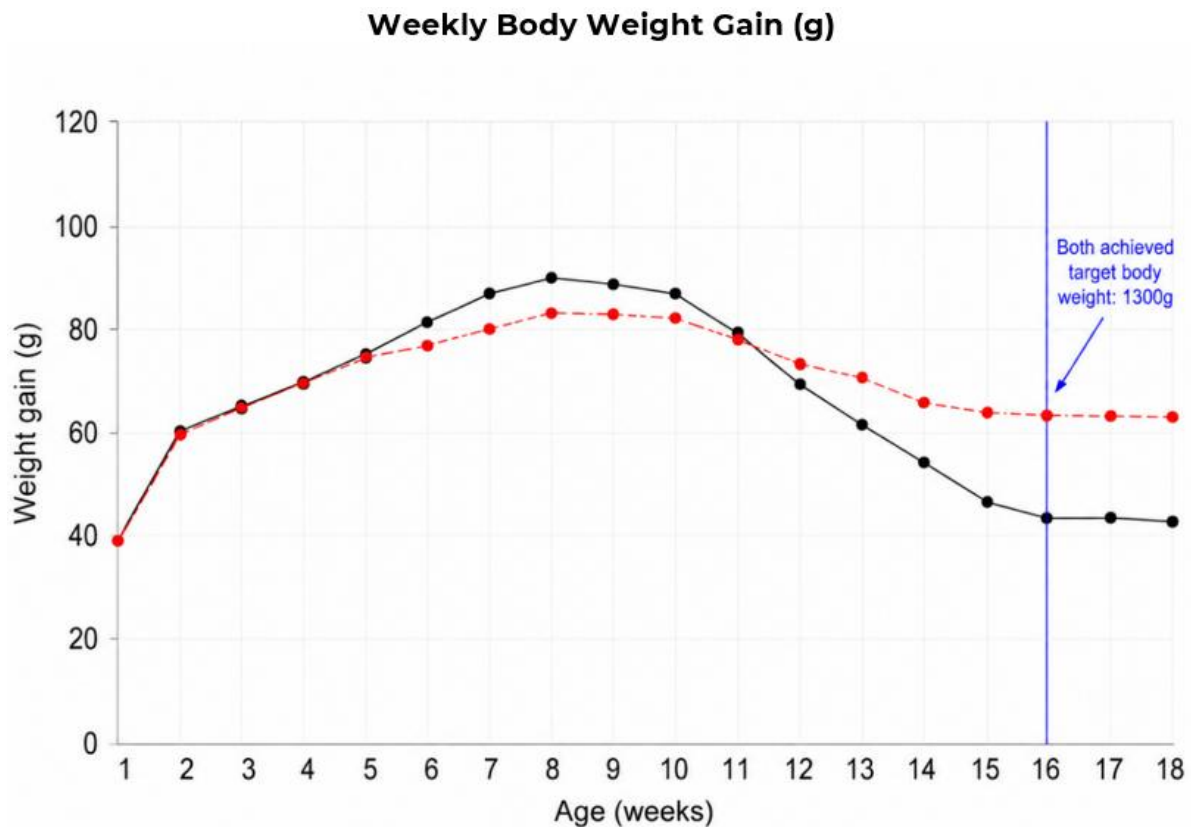


Figure 2: Example of weekly body weight gain of two flocks, which achieve the same target body weight at 16 WOA yet will have different body conformation and therefore outcomes in lay.

Due to slowed weekly growth during 6-10 WOA, the red flock is likely to have a smaller skeletal frame, resulting in poor medullary reserves and poor persistency of lay (J. Lu *et al.*, 2025). The accelerated growth of the red flock at the end (>12 weeks) increases the risk of rapid fat deposition and metabolic disease, prolapses and behavioural disorder such as injurious pecking.

Trouw Nutrition uses Bioelectrical Impedance Analysis (BIA) to measure live pullet body composition, including water, protein, fat, and ash. Their research found correlations between body composition at 5 WOA and performance at 100 WOA, with ash percentage at 16 weeks showing the strongest correlation with egg production, highlighting the importance of skeletal development. BIA may be available for on-farm use in future.



Impact on Lay

- Reduced growth during skeletal formation → poor persistency of lay
- Rapid growth from 12 weeks → increased disease, feather pecking, mortality and lower EPB.



Action Points

- Visualise weekly growth rate data to understand body conformation

5.3 Skeletal Frame Assessments

Skeletal frame assessments are used in research, but not routinely in the laying industry. As shank length correlates with BW and persistency of lay, regular BW monitoring and interpretation, is likely to provide sufficient insight into skeletal frame (Debes *et al.*, 2015; Aviagen, 2023).

5.4 Breast Muscle Assessment

Breast muscle condition is an indicator of the nutritional and health status of a bird. Hy-Line developed a body scoring chart, including both breast muscle condition and abdominal fat pad, they recommend achieving score 1-2 at 5-12 weeks, 3-4 at 12-20 weeks and 4-5 >20 weeks (Hy-Line, 2021).

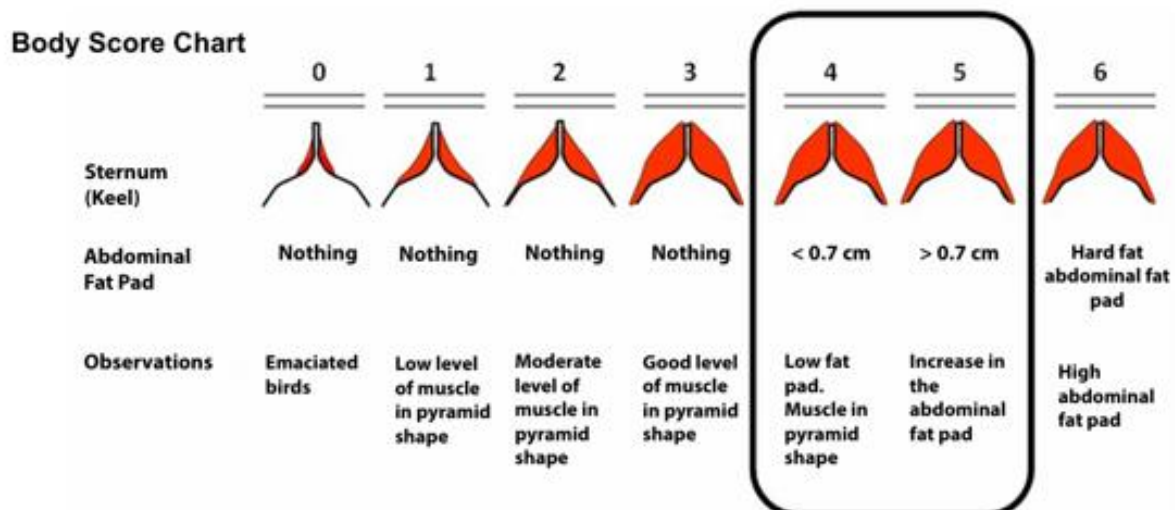


Figure 3: Body condition score chart (Hy-Line, 2021).



5.5 Abdominal Fat Pad Assessment

The abdominal fat pad (AFP) is a useful indicator of body fat and nutritional status. Excess fat is associated with cloacal prolapse, reduced feed efficiency, poor egg production and persistency, increased disease risk and injurious pecking.

AFP can be assessed postmortem or, more recently, using non-invasive technologies such as Cargill's Reveal, a non-invasive technology utilising Near InfraRed light to measure fat pads.

Regular BW monitoring, alongside integrated knowledge of bird development for interpretation, ideally using automatic scales, also remains a practical method of assessing energy balance and body conformation. Monitoring should focus from 12 WOA onwards, and any diagnosis of fatty liver disease should prompt a review of nutrition, growth rates and energy balance from rear through to 30 weeks.



Impact on Lay

- Excess abdominal fat → cloacal prolapses, reduced feed efficiency, reduced egg production and persistency of lay, increased disease and injurious pecking.



Action Points

- Measure abdominal fat pad or track BW from 12 weeks of age
- Retrospectively investigate any diagnosis of fatty liver disease

5.6 Microbiome Assessment

The microbiome is made up of different microbes and research is currently focused on bacterial populations. Common assessment methods within research settings include 16S rRNA gene sequencing, shotgun metagenomic sequencing and metabolomics which provides information on microbial composition. Commercial tools are now emerging which combine microbiome testing with farm data and artificial intelligence to provide practical recommendations. Cargill have developed Galleon, which uses Microarrays to detect genes which represent ~86% of bacterial abundance. HorAlzon uses artificial intelligence to compare faeces to previous sequencing results and DSM-firmenich have SciTell which utilises a sequencing tool.

Flock specific, ongoing, microbiome assessments will expand significantly within the next decade, which will give farms the opportunity to improve their understanding of inputs as well as improve outputs.



CHAPTER 6: REARING INTERVENTIONS AND THE IMPACT ON LAYING HENS

6.1 Impact of Rearing Systems

Globally, most rearing, is conducted in cages to match the predominant housing type. Europe has more variability, including systems shown in table 1.

Table 1: Rearing systems for Barn, Free-Range and Organic laying systems.	
Rearing System Options	Description
Floor	Raised in a barn, on the floor, with litter.
Floor with multi-tier platforms (F+MT)	As above, but platforms and perches are added to encourage roosting.
Jumpstart	Start on a raised slatted floor (no litter) in large groups, then sides are dropped and birds access the floor with litter. Perches and platforms area available for roosting.
Aviary	Start in cages (no litter access) in small groups (+/- perches or platforms), then doors are opened and birds access perches, platforms and litter.

Note: the categorisation of systems (e.g. Aviary vs jump-start vs F+MT) varies from person to person, for the purposes of this report, I am referring to the categories outlined in this table.

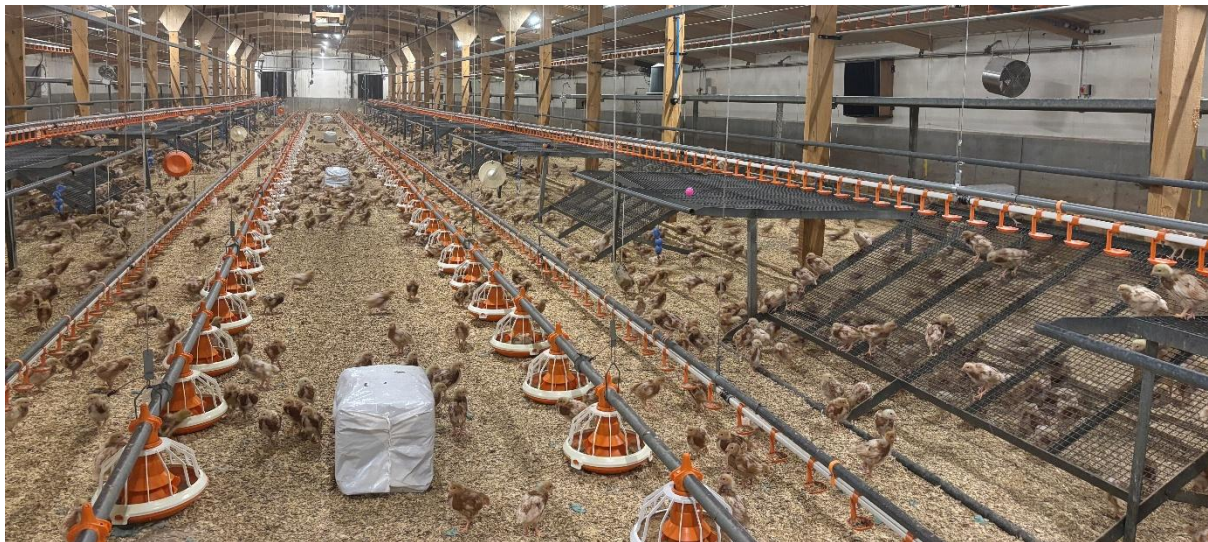


Image 1: Floor with multi-tier platforms



Image 2: Jumpstart



Image 3: Aviary at 2 weeks old



Image 4: Aviary at 12 weeks old



Laying farmers report improvements in transition to multi-tier laying houses from birds reared in aviary systems. Research shows this is also true for floor with multi-tier platforms and jumpstart systems (Pullin *et al.*, 2024).

Birds should be provided with opportunities to forage within the first four weeks of life to reduce fearfulness and feather pecking. Litter access from day one promotes natural foraging and significantly reduces the development of feather pecking and fearfulness in laying hens (Huber-Eicher and Sebö, 2001; Brantsæter *et al.*, 2017a). Birds reared in enriched conditions, including litter, have improved immune competence, likely due to improved microbiome development, and benefits result from exposure at week 0 onwards (Campbell, De Haas and Lee, 2019).

Aviary systems can limit early foraging opportunities because chicks are typically confined to cages for up to 6 weeks. Although feed is initially scattered on chick paper, the substrate often deteriorates within 1–2 weeks. Providing paper substrate with continued top-up feeding in aviary systems until 5 weeks reduced feather pecking at 30 weeks (Tahamtani *et al.*, 2016). Similarly, the absence of enrichment such as pecking blocks and stones from 0-4 weeks within aviary systems, increased subsequent pecking behaviour (Schwarzer *et al.*, 2022).



Image 5: Enrichment in early aviary rearing, image from Schreiter *et al.*, 2019



Let down age also impacts bird development, with earlier aviary let down (14 days, opposed to 28 days) associated with higher relative gizzard weight (Schröder *et al.*, 2025). Higher stocking density within the first 4 weeks, such in cases of delayed let down, is associated with feather damage during the rearing (Bestman, Koene and Wagenaar, 2009). Furthermore, birds reared in barren environments (e.g. cages) have poorer spatial cognition and working memory and show more fearfulness on moving to laying environments (Tahamtani *et al.*, 2015; Brantsæter *et al.*, 2016, 2017b). Most aviary systems, without alterations, are suitable for a let-down age of ~5 weeks, with earlier let-down associated with significant necrotic enteritis mortality and weight loss because of resource deprivation. The following measures are recommended to facilitate earlier let down:

- **Nipple drinker lines** available on the floor, in each corridor, for a few weeks after let-down.
- **Ramp design** impacts ease of bird movement. Wide short ramps that allow multiple birds to pass freely perform better than narrow ramps, where dominant birds may restrict access to resources.
- **Walking birds at night** for 10 days following let down was recommended by Ter Heerdt, who utilised a system with narrow ramps.

Jumpstart or F+MT provide early structurally complex environment, which increases time in active locomotion including wing-assisted running, improving bone development (Pufall *et al.*, 2021). Compared with cages, pullets reared in jumpstart systems had greater bone density, bone mineral content, bone strength and muscle development at 16 WOA (Casey-Trott *et al.*, 2017). Maximising exercise opportunities throughout rear improves bone characteristics to the end-of-lay.

Dark brooding mimics maternal care by providing a dark, warm place to retreat while allowing movement to light areas to find resources. It can be utilised in floor or F+MT systems, as shown in image 6. Research agrees with experiences of Performance Pullets, suggesting dark brooding reduces fearfulness, injurious pecking and mortality in lay (Sirovnik and Riber, 2022).

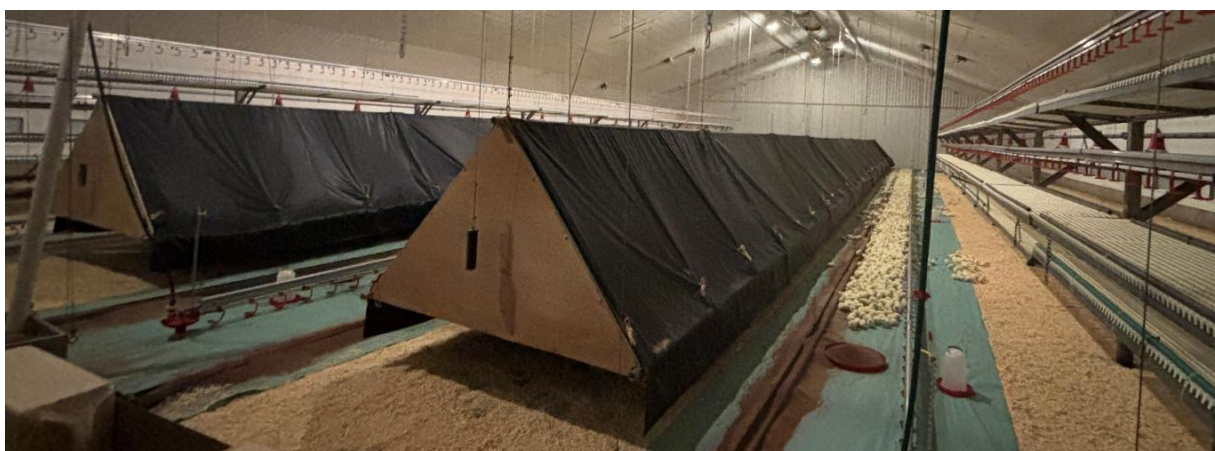


Image 6: Dark brooding in floor with multi-tier platform systems (immediately after chick placement)



Impact on Lay

- Foraging opportunities <4 WOA → less fearfulness and feather pecking
- Early litter access → reduced feather pecking and fearfulness
- Complex environment in first 10 weeks → improved bone characteristics for longevity of lay
- Dark brooding → reduce fearfulness, pecking and mortality in lay



Action Points

- Give ample opportunity to run and jump from an early age
- Maintain chick paper in aviary cages as long as possible, continue top up feeding and add enrichment (pecking blocks and stones).
- Consider adapting aviary design by adding wide ramps and drinker lines on the floor to facilitate early 'let-down'
- Walk birds every night for 10 days, following 'let-down' from aviary system

6.2 Impact of Enrichment

The benefits of litter access, perching and multi-tier systems are discussed in section 6.1. Early access to litter promotes dust bathing, foraging behaviour and immunocompetence and enrichment provided during the first 4 WOA can have lasting effects on laying hens, supporting the recommendation to provide enrichment in aviary cages (Campbell, De Haas and Lee, 2019). Beyond the early rearing period, research into additional enrichment shows mixed results. Birds reared with novelty enrichments (e.g. balls changed weekly) showed little effect on pullet behaviour and reduced range use during lay compared with structural enrichments like perches (Campbell *et al.*, 2020, 2025). During the study tour, cage free systems, commonly provided destructible enrichment such as lucerne, ropes and pecking blocks from mid-rear. Research suggests these are beneficial in less complex environments, such as cage rearing or aviary systems (before let-down), however benefits were less pronounced where birds had access to litter from placement (Schreiter, Damme, von Borell, *et al.*, 2019).



Impact on Lay

- Access to litter or foraging materials from placement → less injurious pecking and increased disease resilience
- Structural enrichment (perches and platforms) → increased ranging

Action Points

- All chicks from day old should have access to either litter or materials which encourage foraging
- All rearing systems should have perches and platforms to encourage ranging

6.3 Impact of Chick Start

Early feed and water consumption enhances intestinal, immune and microbiome development and ensures yolk sac utilisation (Rubio, 2019; Liu, Jia and Wong, 2020; Proszkowiec-Weglarz *et al.*, 2020).



Image 7: Crop palpation in a chick, image from (Ross, 2025)

The crop can be palpated in day old chicks to assess effectiveness of the brooding set up, by showing how quickly birds found feed and water. Most pullet-rearing guidelines recommend measuring crop fill at 24 hours post-placement. However, assessing crop fill at 6 hours allows issues to be identified and corrected while there is still time to influence outcomes. At 6 hours, >75% of chicks should have a soft, pliable, blueberry-sized crop, with 100% crop fill the ultimate target. Results below 75% should be investigated. Most aspects of brooding management will influence chick start, as will chick health. Examples of key variables are shown in figure 4.



Pre-heat time	Pre-heat temperature	Sensor locations and calibration	Stocking density	Temperature profile	Ventilation settings
Humidity profile	Drafts	Heater distribution	Heater run times	Alternative noises	Chick paper distribution
Chick paper type	Drinker heights	Drinker pressures	Light intensity	Light distribution	Amount of feed on chick paper
Feeder depth	Feeder heights	Chick tipping process	Litter type	Litter depth	Frequency of shed walks

Figure 4: Key variables influencing 6-hour crop fill

Rondeel, in the Netherlands, is now undertaking on-farm hatching, reducing the time chicks are without feed and water and enhancing early microbiome seeding. This is possible due to in-ovo sexing and vaccination alongside the removal of day-old beak treatments.

Another option for further research is hatchery feeding, which is conducted in some broiler hatcheries.



Image 8: Daniel van der Brink, Rondeel with the author



Impact on Lay

- Early feed and water consumption → improved organ, immune and microbiome development



Action Points

- Measure 6-hour crop fill and react to poor results



6.4 Impact of Water Hygiene

Water is a vital nutrient, and housed birds are reliant on our provisions. Water contaminated with high populations of pathogenic bacteria, results in higher mortality, slower growth, increased need for antibiotics, significantly altering the establishing microbiome. Testing water within the first 1-2 days of chick placement, provides confidence in terminal hygiene protocols. Repeated testing is advisable to ensure water remains clean throughout the rear.



Impact on Lay

- Presence of high levels of pathogenic bacteria within drinker lines → altered developing microbiome, slowed growth, disease, potential antibiotic use → impaired laying performance and disease resilience



Action Points

- Test water hygiene within the brooding period as a minimum

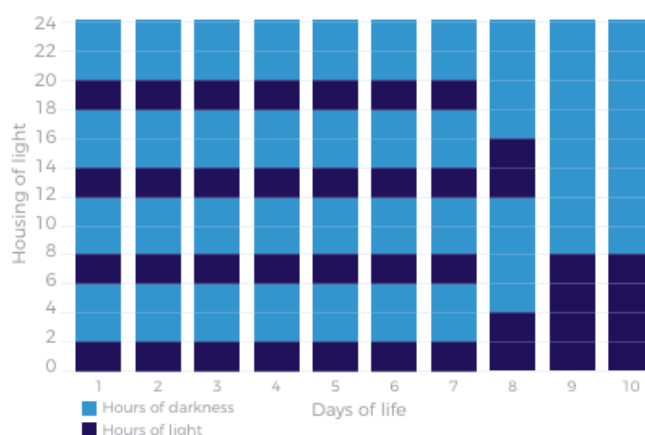
6.5 Impact of Lighting

6.5.1 Lighting Programme: The First Two Weeks

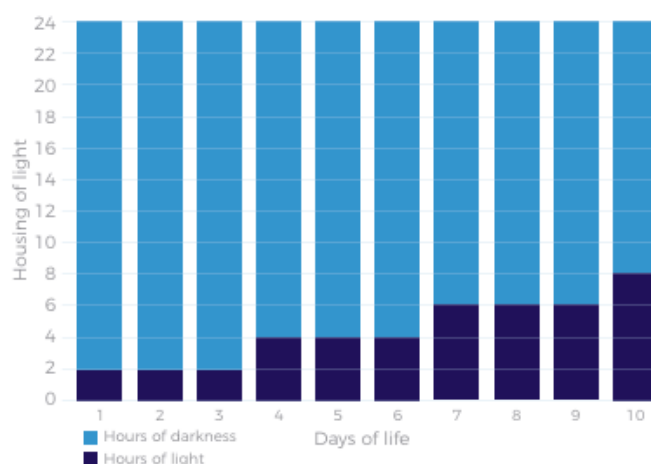
Intermittent lighting programme (ILP) is recommended, benefits include;

- Improved flock evenness
- Improved 7-day mortality
- Weak chicks are stimulated by stronger ones to eat and drink
- Chicks were more relaxed and able to express normal behaviour

Typically, ILP is recommended for the first 7-10 days, utilising a 24-hour cycle of 4 hours light, 2 hours darkness (Hy-Line, 2016; Lohmann GB Limited, 2019; H&N GB, 2022). After 7-10 days, lighting can be switched to the non-intermittent lighting programme recommended by the breed company.



A) Example of an intermittent program for 7 days followed by a transition day to the standard lighting program.



B) Example of a non-intermittent program. Note that every day there is a period of darkness.

Figure 5: Two graphs comparing difference visually, between ILP and a standard, non-intermittent programme, commonly utilised in the UK. Graphs from (H&N International, 2021).

ILP is common in Europe, but not the UK, likely due to interpretation of welfare guidance, legislation and assurance schemes which favour a continuous light cycle. However, ILP, like dark brooding, more closely mimics maternal care by providing periods of dark (under mother hen) and periods of light, when chicks would venture to find resources for the first 1-2 weeks. It is likely ILP would bring similar benefits to dark brooding, including reduced fearfulness, injurious pecking and mortality in lay (Sirovnik and Riber, 2022).

6.5.2 Lighting Programme: After Two Weeks

Pullets utilise a step-down programme, where in the first few weeks they 'step down' to a consistent light period, typically 9 hours, before 'stepping up' light hours to trigger sexual maturation and onset of lay, once in lay, light hours are kept consistent, typically 15-16 hours.

6.5.3 Light Intensity

Light intensity globally is managed as a blanket rule (<5 lux too low, >50 lux linked to abnormal behaviour), regardless of lighting type. However, this ignores spectrum, and since natural daylight can exceed 100,000 lux while supporting welfare, intensity alone is unlikely to determine health, performance, or welfare.



6.5.4 Light Spectrum (Colour)

Most farms use LED lights, often with limited understanding of the bulb spectrum or Kelvin, however Andrew Maines and Once by Signify, explained chickens perceive a broader light spectrum than humans and different wavelengths influence behaviour, skeletal development and reproductive performance (Hy-Line, 2017; England and Ruhnke, 2020).

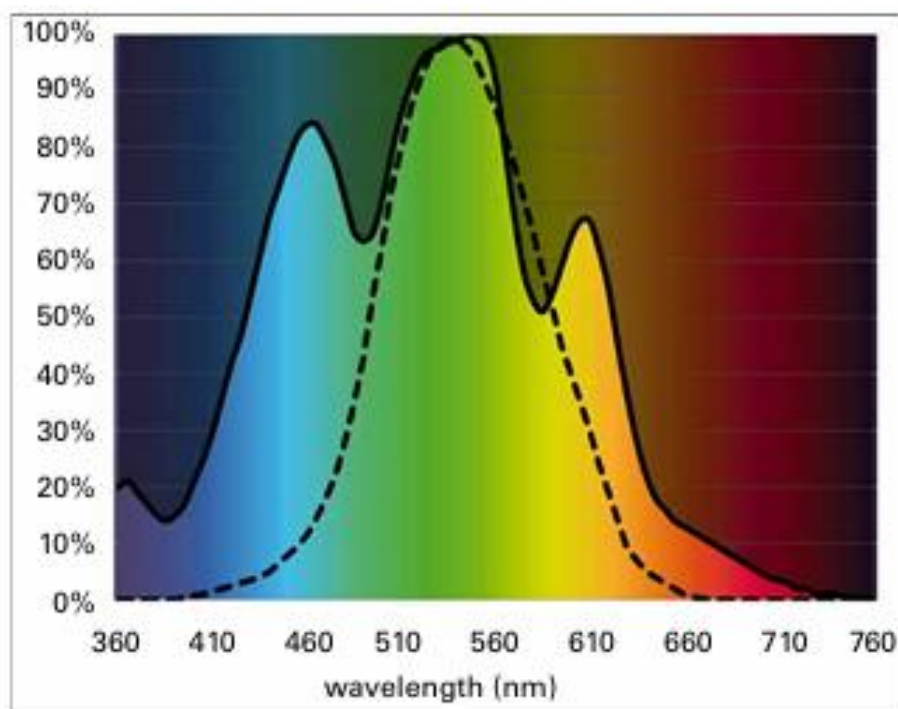


Figure 6: Photopic spectral response of chickens (wide coloured area), compared to humans (dashed line). Graph from (Hy-Line, 2017).

Research highlights the benefits of individual light spectrums. Under blue and white light, pullets spent more time, preferred to eat and drink and had early growth benefits, however yellow/orange (e.g. warm, 2700k LED) resulted in improved bone mineral density (Rozenboim *et al.*, 2004; Li *et al.*, 2019, 2020; Wei *et al.*, 2020, 2022). Pullets reared under red, orange or yellow produced more eggs and had greater reproductive development than birds under blue or green (Hassan *et al.*, 2013; England and Ruhnke, 2020; Wei *et al.*, 2020). Furthermore, longer-wavelength light can penetrate the skull to stimulate extra photoreceptors, with red light (650nm) able to reduce aggressiveness and have accelerating effect on sexual development via the specific wavelength, not just light intensity (Huber-Eicher, Suter and Spring-Stähli, 2013).



UV-A lighting has been associated with reduced fear and stress responses in laying hens, although some studies report increased injurious pecking (Sobotik, Nelson and Archer, 2020; Rana and Campbell, 2021). UV-B can improve skeletal health and eggshell quality in late lay (Rana and Campbell, 2021). Studies investigating mixed-spectrum lighting with UV have produced inconsistent results (Rana *et al.*, 2021, 2024; Wichman *et al.*, 2021).

Different wavelengths influence bird development in different ways, this finding in conjunction with blanket application of light intensity, yet significant variation in responses, suggests providing a single light spectrum is overly simplistic. Since natural daylight contains the full light spectrum, with more longer wavelengths at dawn and dusk and shorter wavelengths at midday, commercial lighting programmes should aim to reflect these patterns, utilising the benefits of multiple wavelengths and avoid prolonged exposure to a single spectrum.



Image 9: Aviary rearing system, with windows for natural daylight.
Pictured: Frank Jansen, the author and Gert Van Drie.

6.5.5 Daylight

Natural daylight via windows is promoted as a welfare tool in pullet and laying houses, with Dutch producers reporting calmer flocks when managed correctly. However, most window materials transmit little UV light, suggesting any benefits arise from natural variation in visible wavelengths rather than UV exposure. Lohmann notes that artificial lighting only partially replicates the spectrum visible to birds, and pullets reared without daylight may experience greater stress when transferred to free-range systems (Thiele, 2009). Whilst daylight provision appears beneficial, research has not consistently demonstrated improvements in welfare or feather cover, with management factors such as litter access, genotype and ventilation often having a greater influence (Bestman, Koene and Wagenaar, 2009; Bestman *et al.*, 2019).



Impact on Lay

- Intermittent Lighting Programme → improved performance and reduced injurious pecking in lay
- Longer-wavelength light (red/orange/yellow) → improved egg production
- Shorter-wavelength light (blue / green) → improved rearing activity and weight gain, but reduced egg production
- Yellow/orange light (warm LEDs) → improved bone mineral density, thus longevity of lay
- Red light (~650nm) → reduced aggression and accelerated sexual development
- Daylight provision via windows may ease transition to free-range systems



Action Points

- Industry should review legislation and assurance scheme requirements to allow full utilisation of Intermittent Lighting Programme in the UK.
- Understand lighting currently present in rearing and laying houses (use a spectrometer or manufacturers details on light spectrum and kelvin)
- Remove any cool white (>4000k) LEDs from rearing and laying houses and replace with warm white (<3000k) LEDs, ideally with the ability to add more red tones in laying houses as required.
- Progressive approach would be to work with lighting specialist to utilise a 24-hour lighting wavelength which mimics natural daylight spectrum, utilising benefits of multiple wavelengths.

6.6 Impact of Pullet Nutrition and Feed Management

Farmers can feel investing in pullet nutrition is “wasted” because birds are not yet producing eggs. However, pullets form the foundation of the laying hen, and early nutrition strongly influences later egg production and shell quality. Early deficiencies in calcium, vitamin D3, and trace elements can cause lasting reductions in shell strength, even after correction, likely due to impaired development of intestinal absorption pathways (Bar, 2008; Sinclair-Black, Garcia and Ellestad, 2023).

Even nutritionally complete rations can result in deficiencies if feed form and feeder management lead to uneven intake or poor nutrient distribution. Feed should therefore be routinely assessed using a sieve to evaluate mash particle size and checked at both ends of the feeder line to identify variation in presentation and access. Feed samples (Ca, P, protein) can also be collected across the shed to assess consistency and distribution.



The following feed management strategies were discussed during this study;

0-5 WOA: Feed as much as possible, maintain fast weekly BW gain.

- Ter Heerdt and Hendrix recommend top up feeding until 4 weeks in aviary systems, scattering the ration on chick cardboard, alongside utilising ILP.
- Avoid overcrowding, a common problem in aviary systems with delayed 'let down'.



Image 10: Nick van Bentem and the author, visiting Ter Heerdt aviary rearing system.

5-16 WOA: Condition pullets to eat enough to develop appetite, crop and gizzard function

- Gizzard development is required to optimise digestibility of nutrients throughout life, gizzard muscle tone can be developed by coarse, insoluble grit. Starting from ~5 WOA, it can be scattered on the floor (Lohmann GB Limited, 2019; Hendrix Genetics, 2025)
- Implement empty feeder technique (EFT) or clearing the tracks from 5 WOA to encourage consumption of micro-nutrients. It should be done mid-day, avoiding morning (prevent disrupting natural feed intake) and late afternoon (avoid impacting shell quality in lay) (Novogen Layers, 2024). Mien from Vepymo, explained each site should first determine how long it takes birds to empty feeders, as this varies by house.
- Before introducing the EFT daily, feeders should be cleared once a week from the start, to prevent build-up of fine particles.



- From ~10 WOA, include coarse particles (>1.0 mm), higher fibre and transition off high-energy grower diets by 12 WOA to support feed intake and prevent excess weight gain.
- If stocking rates get high, particularly towards the end of rear, block feeding (two feed runs, shortly after each other) can improve evenness (Ito, 2022).

16-30 WOA: Transition into lay

- Communicate feeder management practices, including EFT, with the laying farmer.



Impact on Lay

- Early nutritional deficiencies → impaired absorption pathway and long-term shell quality issues
- Management of feeders in rear contribute to long-term shell quality
- Poor early uptake (<5 WOA) → poor organ development



Action Points

- Seek expert nutrition advice and communicate long-term goals
- Feed and faeces sampling can inform feeder management techniques
- Top up feed on chick cardboard for the first 4 weeks in aviary systems
- Implement empty feeder technique / clearing the tracks from ~5 WOA
- Provide coarse, insoluble grit, on the floor or in trays, from ~ 5 WOA
- Monitor stocking density, consider block feeding if competition is high
- Rearing farm to share feeder management practices with laying farm

6.7 Impact of Disease Challenges

The following diseases were identified as having the greatest long-term impact on laying performance, mainly affecting growth, flock uniformity, and resilience rather than mortality, consistent with earlier analysis showing no correlation between mortality in rear and mortality in lay.

Intestinal diseases in rear (e.g. **coccidiosis**, **necrotic enteritis**), can reduce growth and evenness. If these occur during vital growth phases (<7 WOA), may reduce disease resilience and persistency of lay.

Infectious Bursal Disease (Gumboro) affects chicks <6 weeks of age, causing long-term immunosuppression. Laying flocks infected in rear would show persistent infections, poor serology, high mortality and increased injurious pecking.



Fatty liver disease is a metabolic disease characterised by excessive fat accumulation in the liver and abdomen. It can cause sudden death and decreased egg production, although subclinical cases impair liver function, persistency of lay, and resilience, and increase injurious pecking. Excess BW gain in late rear (~13 WOA onwards) increases risk.



Impact on Lay

- Intestinal disease → impaired growth and poor evenness → poor disease resilience and persistency of lay
- Gumboro disease → immunosuppression, recurrent infection, high mortality, increased injurious pecking
- Fatty liver disease → impaired liver function, reducing persistency of lay, reduced disease resilience and increased injurious pecking



Action Points

- Analyse previous flock data with a poultry vet to identify issues early
- Avoid exceeding target weight at the end of rear (13-25 WOA)

6.8 Impact of Veterinary Interventions

Effective vaccination planning, tailored to farm-specific disease risks, helps establish robust immunity before the onset of lay, while routine serological monitoring confirms vaccine uptake and flock protection. Dave Hodson from Rosehill Poultry highlighted the importance of vaccine application testing, including drinker line recovery, stock solution assessments and tongue staining for live vaccines, with a target of >90% tongue staining. Audits of injectable vaccine administration are valuable as application accuracy can vary (30-100% accuracy).

Vaccination programmes are well implemented globally, although approaches differ between countries. Unlike common UK practice of administering inactivated vaccines at transfer, Dutch farms avoid injectable vaccination at transfer to support successful transition into the laying house.

Antibiotics are used prudently across Europe, commonly in response to early chick infections or necrotic enteritis. However, antibiotic use in the first 14 days of life reduces microbial diversity, leading to a less stable microbiome, increased disease susceptibility, reduced antibody responses, slower recovery from disease and a greater abundance of opportunistic pathogenic bacteria (Simon *et al.*, 2016; Liang *et al.*, 2023).



Bacteriophages could make great alternatives; they target specific pathogens, while preserving the microbiome. Chris Stanford and his team at Aparon have developed bacteriophages targeting *C. perfringens* and are investigating applications against other poultry pathogens. Despite being discovered before antibiotics, bacteriophages were largely overshadowed by the broad-spectrum efficacy and convenience of antibiotic treatments. Advances in diagnostics and microbiome research support the use of bacteriophages, although regulatory barriers continue to limit commercial adoption.

Veterinary support should extend beyond disease treatment, with health, welfare and performance discussed routinely to enable a holistic, preventative approach to flock management.



Image 11: Visiting Aparon, pictured Joe Edwards, Chris Stanford, Joe Brown and the author.



Impact on Lay

- Poor vaccination update (via application or poor immunity) → disease susceptibility
- Early antibiotic use → increased disease susceptibility, reduced antibody responses, slower disease recovery and a greater abundance of pathogenic bacteria



Action Points

- Routinely monitor live vaccination application and audit injectable vaccine administration
- Avoid early antibiotic use, especially in the first 14 days where possible
- Utilise routine discussions with your vet and stakeholders to ensure holistic approach to bird development

6.9 Impact of Transition to the Laying Farm

Mixed Flocks

Ideally, rearing flocks should be transferred intact. Mixing birds can disrupt social hierarchies, reduce evenness and increase behavioural and health challenges during lay.

Environment

In free-range and barn laying systems, pullets are transferred from a relatively high stocking density rearing environment into a more spacious laying house. The resulting reduction in shared body heat can increase susceptibility to cold stress. Effective or "felt" temperature is determined by ambient temperature as well as air speed (draughts), and relative humidity. Cold stress reduces bird comfort, increases feed intake, reduces BW gain and evenness and contributes to smothering and feather pecking behaviours.

Paula Baker of the Laying Hen Welfare Forum recommends matching the laying environment to the rearing environment as closely as possible, including effective temperature, litter quality, enrichment provision, and lighting programmes.

Egg Size

Managing egg size in early lay is key to flock longevity, persistency, and profitability. Calcium requirement per eggshell is similar regardless of egg size, and egg size is difficult to change later, so overstimulation should be avoided. Larger eggs increase physiological strain and mortality. Charles Macleod estimates maintaining 60g eggs rather than 63g can improve profitability over a 72-week cycle.



Table 2: Financial example for managing egg size over 72-week cycle.

Egg Size	Revenue
60g	+ £21,622
63g	Standard weight
66g	-£35,639

Targets should align with breed, frame (12-week BW) and age. Egg weights should be measured at least twice weekly to allow timely nutritional intervention, as waiting for grading results and feed changes allows egg size to exceed targets before corrective action can be taken.



Impact on Lay

- Mixing birds from different rearing flocks → increased risk injurious pecking, poor evenness and increased disease challenges
- Change in “felt” temperature → increased risk injurious pecking, smothering, weight loss and poor evenness
- Large egg in early lay → reduced longevity, increased mortality



Action Points

- Avoid mixing rearing flocks within laying houses
- Match rearing and laying farm conditions
- Weigh eggs on farm frequently to allow timely intervention



CHAPTER 7: COMMUNICATION BETWEEN REARING AND LAYING FARMS

Communication between rearing and laying farms is critical to flock success. Some Dutch rearers provide laying farmers with full access to rearing data, although interpretation still requires collaboration between stakeholders. It is recommended laying farmers receive a pre-delivery summary covering vaccination, lighting, feeding, enrichment, litter conditions and bodyweight development chart to support continuity of management during lay. The pullet flock review sheets by the Laying Hen Welfare Forum provide a practical framework.

Hendrix breeder hatchery requires farmers to complete a feedback form after the first week, to inform hatchery practices. This concept could be extended into a pullet feedback system, with the inclusion of 30-week key performance indicators. Recognising good pullet quality also helps reinforce motivation within rearing systems.

Contracted broiler breeder rearing farms in Ireland are paid bonuses based on flock evenness; a similar structure could align incentives in pullet rearing, since laying farmers ultimately benefit from high-quality, even pullets. Advancements in on-farm measurement tools for body conformation and microbiome development could be integrated into this bonus model in future.



Impact on Lay

- Rearing transparency → informed laying management and improved outcomes



Action Points

- All laying farms should receive a pre-delivery rearing summary
- Rearers should consider requiring laying farmers to provide structured feedback at 30 WOA
- Consider introducing a bonus payment for rearing farms meeting KPIs
- Recognise good pullet quality to reinforce motivation



CHAPTER 8: CONCLUSION

This scholarship report demonstrates pullet rearing has a profound and lasting influence on laying hen outcomes.

BW alone is an insufficient measure of pullet quality. While achieving target weights remains important, flock evenness, skeletal development, body composition, behavioural development, gut health and early-life environmental experiences all contribute significantly to lifetime performance. In particular, the first 10 weeks of life represent a critical developmental window during which nutrition, lighting, environmental complexity, microbiome establishment and stockmanship shape laying outcomes. Furthermore, birds that fail to achieve appropriate growth and skeletal development early in life cannot fully recover through later weight gain. Compensatory growth after 12 weeks, even exceeding target body weight by a few percent, negatively impacts persistency of lay and mortality.

The relationship between rearing and laying performance should be viewed as a continuous process, especially from 0-30 weeks while the bird is still developing. Improved communication between rearers, laying farms, vets, nutritionists and breed representatives is essential if the full value of high-quality pullet rearing is to be realised. As industry understanding of flock microbiomes, nutrition and behavioural development continues to advance, successful producers will increasingly be those who adopt a holistic approach to bird development rather than focusing solely on short-term growth targets.



CHAPTER 9: RECOMMENDATIONS

1. Prioritise growth quality rather than body weight alone

- Measure BW and flock evenness weekly from 4 weeks, consider automatic weighing scales for increased readings and accuracy.
- Visualise growth data against breed standards and monitor growth rates, not just absolute weights.
- Notable KPIs for laying flock longevity:
 - Achieve or exceed target BW and evenness at 5–6 weeks.
 - Achieve target evenness at 12 weeks (1% increase = +0.8 epb).
 - Avoid exceeding BW targets from 12 weeks (1% increase = -1.5 epb).
- Avoid compensatory growth and excessive daily weight gain from 12 weeks onwards.

2. Maximise early feed intake, bird development and disease resilience

- Ensure rapid feed and water consumption after placement through effective brooding management, assessed using crop fill.
- Review legislation and assurance scheme requirements to allow utilisation of Intermittent Lighting Programme in the UK, to improve flock evenness and reduce fearfulness.
- Early antibiotic use can have lasting effects on gut microbiome development, disease resilience and antibody responses. Avoid antibiotic use within the first two weeks of life, where possible.
- Pullet rearers and advisers should prioritise management practices that support early microbiome development and be prepared to incorporate flock-level microbiome assessments as testing becomes commercially available.

3. Provide substrate and environmental complexity from day one

- Litter access and foraging opportunities in the first 4 weeks of life reduce fearfulness and feather pecking via both behavioural and microbiome development, so either provide litter or in aviary systems, cardboard with top-up feeding for at least 4 weeks.
- Ensure all birds have access to structural enrichment such as perches and platforms to promote exercise, skeletal development and ranging behaviour.



4. Optimise lighting, feeder and environmental management

- Recognise shorter-wavelength (blue/green) lights can improve rearing activity, longer-wavelength (yellow/red) improves longevity of lay. Rearing environments should favour warm-spectrum lighting (yellow).
- Future lighting patterns could follow 24-hour spectrum changes representative of the natural environment, utilising benefits of all spectrums.
- Implement empty feeder technique from 5 weeks of age.
- If aviary let-down is being delayed to prevent mortality, consider adapting aviary design by adding wide ramps and drinker lines on the floor.

5. Improve communication and transparency across the supply chain

- Pullet development should be viewed as a continuous process from hatch to 30 weeks, with rearing and laying farmers sharing responsibility for supporting flock development.
- Provide laying farms with a comprehensive pre-delivery rearing summary, including growth and evenness data, health and vaccination records, and key management information regarding lighting, feeders, temperature, litter and enrichment provisions.
- Encourage structured feedback from laying farms to rearers to identify links between rearing practices and laying outcomes.
- Consider the use of key performance indicators and incentive schemes that recognise and reward high-quality pullet rearing.



CHAPTER 10: ACKNOWLEDGEMENT AND THANKS

This study would not have been possible without the generosity, encouragement and support of many individuals and organisations. Firstly, I would like to express my sincere gratitude to the BEMB Trust and the Nuffield Farming Scholarships Trust for giving me the opportunity to explore a subject I am deeply passionate about. The scholarship has broadened my knowledge, challenged my thinking and enabled me to learn from exceptional people around the world, building friendships that will have a lasting impact on both my career and personal development.

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Finally, thank you to everyone who welcomed me into their homes, businesses, farms and research facilities during my travels. Your openness and generosity in sharing your knowledge have shaped this study and enriched my understanding far beyond what could have been achieved through the literature alone.

Country visited	Who	Why
UK 2 weeks February 2025 to May 2026	Alister McBain; Duncan Farms	Pullet Rearing
	John Mackay; Rettenmaier UK	Microbiome Interventions
	Pam Rimmer and Emily Brass; Performance Pullets	Pullet Rearing
	Lesley Allick and Robert Parsons; Melkinthorpe Farm	Pullet Rearing
	David Hodson; Rosehill Poultry	Vaccine Specialist
	Paul Wigley; University of Bristol	Microbiome Research
	Luke Barnard and Jean De Oliveira; Cargill	Microbiome Interventions
	Ben Hartley; Country Fresh Pullets	Pullet Rearing
	Karen Campbell; Glenrath Farm	Pullet Rearing
	Mike Tresise; Scottish Sea Farms	Salmon Hatchery
	Jonty Hay; Pathway Farming	Calf Rearing for Beef Production
	Paula Baker; Laying Hen Welfare Forum	Pullet Research
	Chris Stanford; Aparon	Microbiome Interventions
	Clara Alfonso Carrillo; Trouw Nutrition	Pullet Body Conformation



	Charles Macleod; St Davids Poultry Team	Pullet Rearing
	Andrew Maines; PW Maines	Poultry Equipment
	BFREPA Conference	Free Range Layer Conference
Australia 2 weeks March 2025	Mini Singh; Australian Eggs	Research & Development
	Abby Northrup and Dwayne; Baiada Poultry	Breeder Management
	Ivor Schutte; The Cordina Group	Broiler Management
Netherlands 2 weeks June 2025	European Poultry Nutrition Conference	Nutrition and Microbiome
	Sarah Andrews & Tom Hepburn; Elanco	Microbiome Interventions
	Erica Bongers; Once by Signify	Poultry Lighting
	Estella Leentfaar; Hendrix Genetics	Pullet Nutrition
	Mien Van Olmen; Hendrix Genetics	Rearing Management
	Bert Peters; Hendrix Genetics	Parent Stock Layer Hatchery
	Gert Van Drie; Pluriton	Rearing Farm
	Alrik Visscher; Visscher Farm	Laying Farm
	Christian Bressers; Pluriton	Settery, MRI Sexing Technology
	Frank Jansen; Jade Rearing Partnership	Pullet Rearing
	Robert Nijkamp; Nijkamp Founder of Farmersnet.org	Broiler and Dairy Farm, Data
	Evgeni Levin; HorAlzon	Artificial Intelligence
	Nick van Bentem; Lohmann Breeders	Layer Management
	Remco Huizing, Mts. Huizing-Tonkens, Bio Aufzuchtbetrieb Kof-Pohlmeyer; Ter Heerdt	Pullet Rearing
	Bert Jansen; Egelwaay Ter Heerdt	Poultry Vet
	Daniel van der Brink; Rondeel	Laying Farm
Vietnam 1 week October 2025	Matthew Albon-Crouch & Hang Trinh; British Embassy	Trade Discussions
	Hoà Phát Group	Laying Farm
	Gerry Oude Elfering; De Heus Dong Nai	Poultry Feed
	Vietstock Show	Livestock Exhibition
	Bing Yan and Tom Millman; Cherry Valley	Duck Industry
	Loc Tran, Hein Pyae, Yun Min Thant; ShrimpVet	Shrimp Farm and Research
	Sanjeev Kumar; JAPFA	Broiler Production
	Ms Chu Thi Hong Thuy; TAFA Group	Laying Farm
	Jonathan Cade; Hy-line	International Laying Sales
	Nguyen Manh Ho and Duangcheewan Jaikla; Hy-line	Layer Breed Representatives
	Sanja Horvat; Huvepharma	Poultry Health
Japan 1 week October 2025	Naoki Kinoshita; Gunma Noukyou Chicken Foods	Broiler Production
	Kazunori Sakagami and Kanuro Shimazaki; Tomaru	Integrated Egg Production
	Kyota Yoshikawa;	Laying Farm
	Miyu Sakamoto; Sakamoto Egg Farm	Laying Farm
	Hideki Obata and Yuriko Katada; Norinchukin Research Institute	Research
Ireland 1 week February 2026	Liam Walsh; St Davids Poultry Team Ireland	Broiler Breeder Health
	James Greaves; Shannon Vale Foods	Broiler Hatchery
	Paul Cotter; Teagasc Food Research Centre	Microbiome Research
	Aoife Corrigan and Fergal McAdam; Alltech	Microbiome Interventions



APPENDIX 1

Variables examined from UK pullet rearers outlined in table 4, those with enough data were examined using statistical analysis software (Jamovi).

Table 4: Flock data gathered		
	Questions	Enough data to run statistics
Flock	Breed	Yes
Rearing	7-day mortality	Yes
	Cumulative mortality in rear	Yes
	Age mortality spikes occurred after 7 days	Yes
	Rearing System	No: not enough data
	5-, 12-and 16-week body weight and evenness	Yes
	Aggression or cannibalism observed in rear	No: neither observed
	Necrotic enteritis diagnosis	No: not enough data
	Antibiotic use	No: not enough data
	Lucerne use	No: not enough data
	Number of injectable vaccines	Yes
	Age at transfer	No: all moved at 16 weeks
Laying	Laying flock size	Yes
	Laying system	Yes
	Lucerne use	No: not enough data
	25-week body weight and evenness	No: not enough data
	Feather cover score (%) at 30, 50, 65 weeks and depletion	No: not enough data
	Aggression or cannibalism observed in lay	No: neither observed
	Antibiotic use in lay	No: not enough data
	Depletion age	Yes
	Cumulative mortality in lay	Yes
	Eggs per bird	Yes
	Egg mass (kg)	Yes

- 1% above body weight target = -1.5 epb ($\beta=-150$, $SE=43.2$, $p<0.001$, $R^2=0.104$)
- 1% above body weight target = +0.2% cumulative mortality in lay ($\beta=20.8$, $SE=10.5$, $p=0.051$, $R^2=0.038$)
- Evenness at 12 weeks ($\beta=76.7$, $SE=20.6$, $p<0.001$, $R^2=0.122$) and 16 weeks ($\beta=64.9$, $SE=25.0$, $p<0.011$, $R^2=0.0632$) showed association with EPB.
- Laying mortality had a statistically significant negative association with farm size, meaning larger laying farms had slightly lower mortality ($\beta=-570$, $p=0.037$, $R^2=0.043$).



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