



Sleeping, resting & other behaviors of broiler breeders – a comparison between the slatted and littered area

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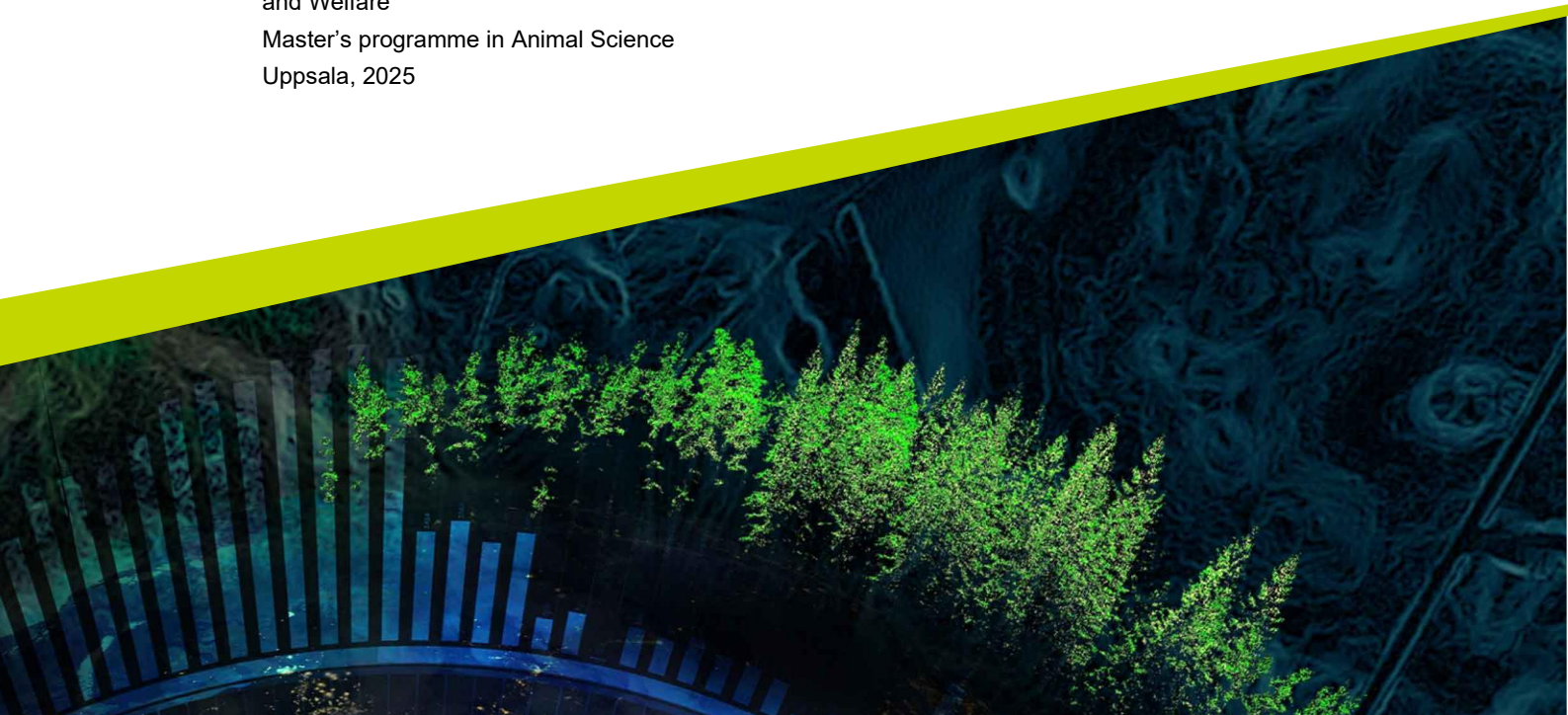
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Sleeping, resting & other behaviours of broiler breeders – a comparison between slatted and littered area

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Keywords: Broiler breeders, Comfort behaviour, Slatted floor, Litter floor, Environmental enrichment, Animal welfare, Sustainable poultry production.

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Abstract

The chicken meat production sector is expanding at a significantly faster rate compared to other meat sectors and is now producing over 72 billion chickens annually for meat, driven by rising consumer demand for affordable protein sources with lower fat content. This makes chicken meat a crucial and sustainable food source for vulnerable populations. Intensive poultry farming is also expanding quickly on a global scale. Sustainable broiler production involves not only maximizing productivity but also ensuring the welfare of both the birds and humans, as well as safeguarding the environment.

Enhancing poultry housing with environmental enrichment can lead to long-term improvements in animal welfare. This research was an observational study aimed to examine the relative preference and resting and other comfort behaviours such as sleeping, preening, mating, and dustbathing of male and female broiler breeders on slats, as well as on the litter area, during the critical laying period of 27 to 29 weeks of age. The study was conducted using behavioural video data collected between March and April 2025, corresponding to the birds' 27th, 28th, and 29th weeks of age. The findings highlight that the floor type plays a significant role in shaping comfort behaviour, with slatted areas generally supporting more resting, preening and some range in sleeping while higher mating and dustbathing occurred almost exclusively on litter, but observations were limited to narrow birds aged 27 to 29 weeks, which may not be sufficient to get a clear result. Sleeping behaviour was observed more frequently and higher proportion on slats than on litter, and in fact leaving no spare space on the slats. The variations in results of the sleeping behaviour may be influenced by the availability of limited slat space. There were some sex-related behavioural variations in some behaviours, though these could have been caused by either behavioural element being performed to a different level or due to the lower number of males, or the findings are limited by the short observation period. The findings indicate that housing design has a direct significant impact on the birds' ability to express their natural behaviours, especially the proportion of slatted to litter areas. And suggest that providing more slatted area space may not only support comfort behaviours like sleeping, resting and preening but also lower welfare concerns associated with overcrowding, factors that significantly impact broiler breeder management efficiency. Further research is needed to improve housing systems that effectively support broiler breeders' biological needs to express their natural behaviours while also meeting practical realities of commercial farming. Understanding and enhancing these behavioural needs by providing appropriate slats with spaces is essential not only for improving animal welfare but also for promoting sustainable poultry production.

Keywords: Broiler breeders, Comfort behaviour, Slatted floor, Litter floor, Environmental enrichment, Animal welfare, Sustainable poultry production.

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Abbreviations

Abbreviation	Description
BORIS	Behavioural Observation Research Interactive Software
BW	Body Weight
EFSA	European Food Safety Authority
F	Female
H/L ratio	Heterophil to Lymphocyte ratio
M	Male
SDG	Sustainable Development Goal
SLU	Swedish University of Agricultural Sciences
SPSS	Statistical Package for the Social Sciences
WWF	Worldwide Fund for Nature

1. Introduction

1.1 Livestock production

Global consumption of animal products increased by approximately 58% over 20 years until 2018, and a similar growth rate is expected to persist (Whitnall & Pitts 2019). The livestock sector is under growing pressure to meet the increasing demand for high-value animal protein. This rapid expansion is driven by population growth, rising incomes, and urbanization (Henchion et al. 2017). Urbanization plays a significant role in shaping the global demand for livestock products, as changing lifestyles and dietary preferences in urban areas drive increased consumption of animal-based protein (Speedy 2003).

The consumption of meat, fish, milk, eggs, and other protein sources plays a crucial role in meeting human amino acid requirements (Sheffield et al. 2024). Livestock contributes approximately 25% of the protein and 15% of the energy consumed in human diets, while also having detrimental environmental impacts (Smith et al. 2013). Livestock production has notable environmental impacts, such as greenhouse gas emissions, deforestation, biodiversity loss, and water pollution, all of which pose direct challenges to environmental sustainability (Espinosa-Marrón et al. 2022).

Livestock production also plays a significant role in socio-economic stability (Espinosa-Marrón et al. 2022). As livestock farming provides numerous benefits, including employment, financial stability, cultural significance, and in some cases, biodiversity conservation. The impact of livestock systems varies widely depending on the context, from intensive landless poultry production in high-income countries that ensures affordable meat supply, to small-scale farming in low-income regions, which supports nutrition, income generation, and agricultural sustainability refers to maintaining productivity while preserving resources and supporting rural livelihoods (Espinosa-Marrón et al. 2022).

1.2 Poultry production

The chicken meat production sector is expanding at a significantly faster rate compared to other meat sectors and is now producing over 72 billion chickens annually for meat, driven by rising consumer demand for affordable protein sources with lower fat content (Wahyono & Utami 2018). Over the past decades, poultry production has grown rapidly and surpassed the consumption of other meat types in many industrialized countries (Castro et al. 2023).

The EU is one of the world's largest poultry meat producers, with approximately 6 billion broiler chickens raised annually, producing around 13.3 million tonnes of

meat (Nielsen et al. 2023). Broiler farming in the EU is highly intensive, with most birds kept indoors at high stocking densities. They are bred for rapid muscle growth and typically slaughtered between 28 and 42 days of age (Nielsen et al. 2023).

Poultry meat and egg products are well-suited to meet the growing global demand for animal protein due to their rich nutrient profile and relatively low caloric content (Mottet & Tempio 2017). Broiler chickens are primarily raised for meat production because of their tender texture, low fat content, and short production cycle. As a result, they contribute significantly to global food security, protein supply, and employment generation (Mottet & Tempio 2017). And chicken meat is rich in highly bioavailable nutrients, including essential fatty acids, folic acid, iodine, vitamin A, and zinc. It is also the only natural dietary source of vitamins B12 and D, providing all essential amino acids in the ideal ratios required by the human body (Smith et al. 2013). This makes chicken meat a crucial and sustainable food source for vulnerable populations, such as children, adolescents, pregnant and reproductive-age women, and the elderly (Smith et al. 2013).

1.2.1 Development and Sustainability of Broiler Breeding and Production

Development of Broiler Production

Evidence suggests that chickens were domesticated from the Red Jungle Fowl (*Gallus gallus*) (Demree & Jensen 2024). Since the early days of domestication, humans have selectively bred farm animals for desirable traits such as meat production and surveillance (Nicol, 2017). Breeding chickens has a long history, as broiler breeder birds are positioned at the beginning of the supply chain. Some specialized genetic lines exist only in intensive production systems (Nicol, 2017).

Broiler breeder birds have been selectively bred mainly for rapid growth, high meat yield, and improved feed efficiency over several decades (Decuypere et al. 2010). More recently, selection programs have also focused on improving fertility, leg health, and overall welfare (de Jong & van Emous 2017).

Globally, intensive poultry farming is expanding quickly (Gržinić et al. 2023). Broiler meat production has experienced rapid growth to meet global demand and drive business profits. Key factors such as low production costs and swift economic progress have been essential in fuelling this rapid expansion (Gržinić et al. 2023).

Sustainability in broiler breeding and production

Poultry breeding is important for global food security and helps to achieve the Sustainable Development Goal of Zero Hunger (de Jong et al. 2022). Keeping high biosecurity, spreading breeding programs across different locations, and maintaining a variety of poultry lines help to ensure a steady supply of chickens, even during unexpected challenges (de Jong et al. 2022). By improving these areas

through balanced breeding, the industry can meet the demand for safe and healthy chicken meat while also improving animal welfare and reducing environmental impact (de Jong et al. 2022). Sustainable broiler production involves not only maximizing productivity but also ensuring the welfare of both the birds and humans, as well as safeguarding the environment (Gržinić et al. 2023).

Public Perception of broiler breeding and production

As societies become wealthier and fewer people engage in farming, the gap between food producers and consumers continues to widen. Consumers generally only see the broiler meat, and the public never encounters or even knows the parents exist (Burnside & Neeteson 2025).

Intensive indoor systems, which focus on high production, have drawbacks like animal welfare problems, including diseases and behavioural issues. These concerns have led to the public worry about poultry farming, especially about chickens' ability to show natural behaviours and live naturally (Bessei 2006). Many consumers view intensive farming negatively and are willing to pay more for food produced with higher animal welfare standards. These issues could potentially be improved by providing appropriate housing and management strategies (Lagerkvist & Hess 2011).

1.2.2 Overview of Housing and management and related broiler breeder welfare

Housing and management of broiler breeders

Broiler breeders are typically kept in environmentally controlled facilities with litter flooring during the rearing phase and partially slatted flooring during the production phase (De Jong & Swalander 2012). During the rearing period, males and females are raised separately and are later transferred to the production house, where they are housed together for reproduction (De Jong & Swalander 2012). Apart from the litter floor and the slatted area, where food and water lines are provided, the housing also provide nest boxes. Broiler breeders are typically transferred to production houses as young adults at 18–20 weeks of age, begin laying eggs at around 24–26 weeks, and remain in production until approximately 60–65 weeks of age (van der Klein et al. 2018).

The barns for the adult birds typically include nest boxes, an elevated slatted area, and a litter area, where feeders can be placed on both the slats and the litter (Chen et al. 2020). Slatted areas typically cover 30–50% of the barn floor, help reduce litter contamination and encourage movement and activity and are a common feature of European broiler breeder farms (Sonnabend et al. 2022). In contrast, the litter area, located on the floor, is where birds engage in natural

behaviours such as foraging, scratching, and social interactions (Sonnabend et al. 2022).

Ventilation is typically adapted to let in large amounts of fresh air, especially during the summer. After the laying period is over the barn is completely depopulated and thoroughly cleaned before the next batch of birds arrive (Chen et al. 2020).

Broiler breeder welfare and welfare challenges related to housing and management

Animal welfare is a broad concept, the minimum requirement for farm animals encompasses good health, positive emotions, and fulfilling the behavioural needs of animals (Newberry et al. 2001). Sustainable poultry production should, from an ethical perspective, ensure adequate welfare for birds at all stages of the value chain, including breeding stock (Webster 2016).

Housing for broiler breeders remains a relatively under-studied area. However, significant welfare issues, including aggressive mating behaviour, impaired locomotion, ill-health, feed restriction, and behavioural restriction have been identified in the broiler breeder industry. These issues could potentially be improved by providing appropriate housing and management (De Jong & Guémené 2011).

The use of feed restriction in broiler breeder management raises welfare concerns due to signs of hunger, lack of satiety, and frustration caused by unmet feeding motivation. But allowing unrestricted feeding intake can also result in health problems associated with rapid growth and obesity, which are also considered welfare concerns (Decuyper et al. 2010).

Significant research has been directed toward developing alternative feeding strategies to reduce the feeding motivation of feed-restricted conventional broiler breeders. These strategies focus on mitigating welfare issues associated with hunger and behavioural frustration while maintaining production efficiency (De Jong et al. 2003).

The importance of housing characteristics on the welfare has gained more attention in recent years (Dawkins & Layton 2012). Environmental enrichment involves modifying the surroundings of captive animals to expand their behavioural opportunities, ultimately enhancing their biological functions. Such enriched environments can provide a broader range of behavioural options (van de Weerd & Day 2009) and enhancing poultry housing with environmental enrichment can lead to long-term improvements in animal welfare (Riber et al. 2018). Raised slatted areas have the potential to improve health and welfare, and their effectiveness depends on factors such as design, space, and proper management (van den Oever et al. 2021a).

Legislation related to housing & management

In Switzerland, all pullets, layers, and breeding stock, including broiler breeders, must have access to perches (Norrington et al. 2016). However, apart from Switzerland, there is currently no national requirement for perches for broilers or broiler breeders in Europe (Norrington et al. 2016). The EU Council Directive 2007/43/EC sets minimum standards for the protection of broiler chickens kept for meat production. It regulates key aspects such as stocking density, lighting, housing conditions, and daily inspections (Bracke et al. 2020). The directive requires littered flooring, proper ventilation, and a minimum of six hours of darkness per day. It also mandates the use of animal-based indicators like footpad dermatitis and mortality to assess welfare. However, this directive does not apply to broiler breeders, hatcheries, or farms with fewer than 500 chickens (Bracke et al. 2020).

Although initial EU recommendations also included broiler breeders; no harmonized legislation exists either at the EU level or across member states. For example, in the federal state of Lower Saxony in Germany, regulations require that perches be provided for at least half of the birds in a broiler breeder flock. Each of those birds must have access to a minimum of 20 cm of perch space, in addition to access to a raised nesting platform (Baxter & O'Connell 2025a). Overall, regulations regarding perches for broiler breeders are limited and vary between countries, with some regions adopting independent rules (Rodenburg et al. 2008).

In Sweden, where animal welfare levels are often higher than in the rest of the EU, broiler breeders must be reared in a system preparing them for the production housing system, broiler breeder pullets must have access to perches, the adult birds must have access to either perches or elevated places to rest allowing space for all birds and they must have access to litter for pecking, scratching and dustbathing (SJVFS 2024:8).

Due to limited research, the European Food Safety Authority (EFSA) recently refrained from recommending specific materials, shapes, or diameters for broiler breeder perches. Determining bird preferences based on perch height, material, and shape can be challenging (Mens & van Emous 2022a).

1.3 Broiler behaviour

1.3.1 Expression of Ancestral Behaviours in Modern Production Systems

Although broiler breeders have been highly selected for production traits, they remain influenced by millions of years of evolution (De Jong & Guémené 2011). Despite intense selection for production traits, modern chickens still express natural behaviours inherited from wild ancestors like perching on an elevated place,

resting, dustbathing, nesting etc (Appleby et al. 1993). As an example, in natural conditions, hens seek quite scheduled locations to lay their eggs. In modern production systems, hens are encouraged to lay in designated nest boxes. Nest laying is a strong behavioural motivation, but when suitable nest spaces are unavailable, hens may still revert to floor laying (Appleby et al. 1993).

1.3.2 Sleeping and resting behaviour

Sleeping behaviour

Sleep is a complex phenomenon that is undoubtedly important for most animal species, likely serving multiple functions, although its full role is not yet completely understood (Krueger et al. 2019). Assefa et al. (2015), proposed functions of sleep include tissue restoration and growth, energy conservation, support of neurobehavioral and neurocognitive performance, memory consolidation and learning, as well as enhanced waste clearance in the brain. Sleep is a highly motivated behaviour, and disruptions to this behaviour may cause frustration and heightened stress (Fraser et al. 2013).

The wild ancestors of modern commercial chicken breeds naturally sleep in trees at night, using branches as elevated perching sites (Blokhuys 1984). Chickens tend to choose the highest available roosting spots at night, likely because greater elevation provides better protection from predators (Gebhardt-Henrich et al. 2018).

Resting behaviour

Rest can be defined as a prolonged period of inactivity that is clearly distinguishable from other maintenance behaviours. Based on physiological and ethological criteria, rest in poultry is divided into several sub-states, such as alert-rest, drowsiness rest, and paradoxical rest, as observed in electrophysiological studies (Rattenborg et al. 2017).

All individuals of the species *Gallus gallus*, including broiler breeders, have a preference for resting on elevated areas; however, only a few studies have focused on the resting behaviour of broiler breeders (Brandes et al. 2020).

Broiler breeders prefer elevated structures over low structures (Brendler et al. 2014). Resting in locations with a high risk of predation, affects the quality of rest in mallards (*Anas platyrhynchos*) and possibly in birds in general (Rattenborg et al. 2017). Broilers probably are less stressed if they can rest in an elevated location (Yngvesson et al. 2017). It is reasonable to hypothesize that broiler breeders share this preference and could gain welfare advantages from similar environmental enrichments (Riber et al. 2017a).

1.3.3 Perching behaviour

Perching is a widely recognized behavioural need in chickens (Olsson & Keeling 2000). The ancestors of modern domestic chickens (*Gallus gallus domesticus*), the red jungle fowl (*Gallus gallus*), and laying hens are highly motivated to perch when resting (Arshad et al. 2009). Perching on a higher perch may provide a greater sense of safety compared to lower ones (Brendler et al. 2014), because the risk of being captured by a ground predator is decreased by an elevated location (Newberry et al. 2001). Chickens perch primarily for these reasons: to roost at night, to access resources, to evade unwanted attention or threats (Brendler et al. 2014), and to preen (i.e. keep the plumage clean and in good condition (Nicol 2015)). Night-time roosting on elevated perch-like structures can be seen in feral domesticated hens, as well as in modern commercial hybrids of laying hens in aviary systems (Chen et al. 2014).

Broiler breeders, broilers and layers are different strains of chickens; they have been selected for different purposes but may have the same innate motivation despite very different physical appearances (Gebhardt-Henrich et al. 2018). So, it's unknown if research on laying hens or layer breeders could be directly applied to broiler breeders, due to significant differences in growth patterns and body composition (Gebhardt-Henrich et al. 2018). Perching motivation has not been extensively studied in broiler breeders, but broilers, like layers, are highly motivated to perch (Bokkers & Koene 2003).

Perching behaviour in broilers

Perches can improve welfare in commercial fast-growing broilers (Baillie et al. 2018), for example, by reducing the heterophil/lymphocyte (H/L) ratio, which indicates reduced stress (Campo et al., 2005; Ohara et al., 2015). Broiler chicks provided with perches or platforms of varying designs use them to a low extent (Kiyama et al. 2016). This limited use is likely due to their rapid growth and associated physical limitations (Havenstein et al. 2003), such as impaired mobility (A et al. 2003), and body weight (Bokkers & Koene 2003). Nevertheless, research suggests that even limited interaction with perches or elevated structures, they can provide welfare benefits particularly when these structures are accessible or offered during early life stages (Norrington et al. 2016), and feed restricted hence lighter broilers exhibit better physical abilities to perch (Bokkers & Koene 2003).

Perching behaviour in broiler breeders

Perches can contribute to better physical development in broiler breeders (Kaukonen et al. 2017). When elevated perches are available and used, they encourage jumping and flying behaviours. This increased activity may affect body composition, metabolism, and even stress levels, particularly if birds are unable to perch as desired (Kaukonen et al. 2017). When birds are offered attractive perches

that lead to increased perching behaviour, it is important to assess the potential impact on keel bone condition. Access to perches is associated with a significantly increased occurrence of keel bone deviations and fractures in broiler breeders (Gebhardt-Henrich et al. 2016). In addition, several studies have documented a high prevalence of footpad dermatitis (FPD) in broiler breeders associated with perch use (Vasdal et al. 2022a). However, broiler breeders are often kept without perches, and hatch egg producers claim that these animals do not use perches but instead sit on the slats above the manure pit, even when perches are offered (Mens & van Emous 2022b).

If commercial broiler breeder farmers are to incorporate perches or slats structures into their housing systems, the design and placement of these elevated structures must be guided by an understanding of the birds' preferences and perching behaviour. Therefore, further research is needed on the perching behaviour of broiler breeders to ensure appropriate implementation (Vasdal et al. 2022b).

1.3.4 Mating behaviour

In natural conditions, mating is typically preceded by courtship behaviours, including tidbitting, waltzing, and vocal signals. These behaviours help minimize aggression and promote female receptivity (Millman et al. 2000). However, in the broiler breeders, the aggression of the males towards the females arises from the fact that mating events are primarily forced by the males, rather than following courtship behaviour (Millman et al. 2000).

Male broiler breeders are more aggressive towards females than male layer breeders (Millman et al. 2000) and more aggressive towards females than the Old English Game breed, which was selected for male/male fighting (Millman & Duncan 2000). Broiler breeder males often exhibit aberrant sexual behaviour and heightened levels of aggression, which have been linked to genetic selection rather than feed restriction (Millman et al. 2000). This results in stress and physical damage to the females due to the rough mating acts of the males (Millman et al. 2000). Perches may interfere with mating activity if females use them to avoid males seeking to mate (Gebhardt-Henrich et al. 2020).

1.3.5 Nesting behaviour

Chickens exhibit gregarious nesting behaviour, meaning that hens tend to prefer nests already occupied by other hens rather than empty ones. This behaviour can lead to overcrowded nests, negatively impacting hen welfare (Riber 2010).

To be attractive, a nest should offer privacy, a shelter, dimly lit environment, soft nesting material and easy access, which together support the hen's natural nesting motivation. Many hens may share a preference for nests located in specific

areas, such as those positioned at the ends of rows or in corners. (Riber 2010). Visual isolation and reduced disturbances are important features that encourage nest use and reduce the incidence of floor laying (Riber 2010).

When nests become too crowded, some hens may lay their eggs outside the designated nesting area. These so-called floor eggs are usually of lower quality and require additional labour for collection (van den Brand et al. 2016).

1.3.6 Dustbathing and Preening behaviour

Dustbathing behaviour

Dustbathing is a strongly motivated behaviour in poultry, crucial for plumage maintenance and parasite control (Yu et al. 2023). Poultry dustbathe primarily to clean and maintain their feathers, which is essential for thermal insulation, waterproofing, and overall feather condition (Paneru et al. 2024). Dustbathing also helps to remove excess oil and skin parasites such as mites or lice (Kilpinen et al. 2005).

The typical sequence of dustbathing includes bill-raking or ground-scratching, squatting, wing-flapping, and rolling in loose material, followed by thorough preening (Lindberg & Nicol 1997). When parasites and dirt is removed, oil is applied to the feathers from the preening gland, and the plumage is maintained (Paneru et al. 2024).

If the birds are not provided a suitable litter for dustbathing this has been associated with behavioural frustration and deterioration of feather condition (Riber et al. 2018). While dustbathing is recognized as a behavioural need in poultry, limited research exists on how broiler breeders engage in this behaviour (Baxter et al. 2018). As far as we are aware, no research has explicitly looked at how broiler breeders utilize designated dustbathing spaces or assessed their substrate preferences.

However, in broiler housing systems, birds have shown a clear preference for peat and oat hulls as dustbathing substrates compared to wood shavings, straw pellets, and standard house litter (Baxter et al. 2018).

Preening behaviour

Preening is a natural behaviour in poultry that is essential for maintaining feather health and overall hygiene. During preening, birds utilize their beaks to spread oil from the uropygial gland across their feathers, which helps keep their plumage flexible, waterproof, and clean (Li et al. 2020). A well-maintained plumage is essential for thermoregulation, social signalling, and protection against environmental stressors (Li et al. 2020).

When birds are prevented from dustbathing or experience poor feather condition, preening behaviour may increase as a compensatory response or, conversely,

decline due to reduced feather quality, flexibility, waterproofing, and insulation (Florkowski et al. 2024).

1.4 Research aim

There are currently limited information and knowledge regarding the use of elevated places such as slats or perches, and behaviours of broiler breeders on farms (Vasdal et al. 2022b). Detailed information on how birds utilize different areas and resources within the housing environment is currently lacking. Furthermore, information on how mating behaviour varies between different functional areas within the housing environment remains limited. These knowledge gaps hinder our understanding of how broiler breeders interact with their environment, which is essential for assessing welfare in existing housing conditions.

Therefore, we conducted an observational study to examine how male and female broiler breeders used the litter and slatted areas for resting, sleeping, preening, mating, and dustbathing during the critical laying period (27–29 weeks of age), which coincides with peak production and fertility (Baxter & O’Connell 2025). This research aims to explore whether there is sufficient room on slatted surfaces for sleeping at night, and what proportion of birds use slats and litter for sleep. It also aims to assess, how specific behaviours differ between slatted and littered areas, particularly resting, preening, mating, dustbathing, and nighttime sleeping.

By examining the spatial and behavioural preferences of birds, this research seeks to demonstrate how housing design can better support natural behaviours and improve welfare outcomes. The findings may help in the development of evidence-based guidelines for broiler breeder management, aligning production needs with ethical and sustainable animal husbandry practices.

2. Material and Methods

2.1 Material

2.1.1 Animals and housing

The study was conducted using Ross 308, broiler breeder parents. The selected birds were hatched on 30th September 2024. Before the birds were housed for study, they were reared under similar conditions as production houses, including the use of slats and litter. However, the litter area during rearing was slightly larger than in the production housing. In rearing, males and females were kept in the same house but in separate pens. After the rearing period, the birds were transferred to the production house over one week at 19 weeks of age. Males were transferred first, followed by females 3 to 5 days later.

The production house contained approximately 12,000 birds, consisting of both males and females with a male-to-female ratio of 7.5%.



Figure 1. The slat and litter area in the production house. Nestboxes are visible in the background.

The production house was equipped with separate elevated slatted areas positioned above manure pits, of the same size as the littered floor area. The litter material consisted of double heat-treated wheat straw, which was selected due to its relatively high moisture absorption capacity to keep the litter dry. Both males and females had access to both slatted and littered areas.

Nest boxes were located on the slatted area, positioned behind the water lines. After the birds were moved to the production house, the nest boxes were kept closed for the first five days. Then they were open daily from 02:00 a.m. until 6:30 p.m., with a stocking ratio of approximately three hens per nest box. The total running

length of the nest boxes provided approximately 41.5 cm of nest space per hen, with each nest being of equal size.

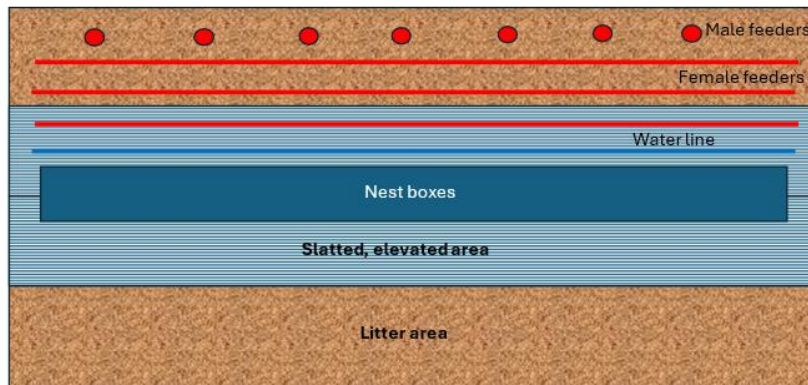


Figure 2. Outline of the design of the broiler breeder housing. Water and feed were provided on both sides of the nest boxes but are omitted on one side for clarity of the illustration.



Figure 3. Feeding chain for female birds and waterline of all birds.



Figure 4. Feeding pans over the litter area, accessible only to the male birds.

There were feeding cups for male and feeding troughs with chains of female birds to ensure sex-specific feed allocation. Feeding chains for hens were installed on both the litter and slatted areas, along with water lines. Male feed was provided separately on the littered floor at a raised height to prevent females from accessing it, outside the shared areas. The design of the female feeding troughs includes fitted metal bars above the feed line, which only allow the smaller heads of hens to access the feed, thereby preventing males from eating from the female line.

The feeding chain for females operated four times each morning, beginning three minutes before the lights gradually turned on at 06:00. The first three feeding rounds lasted 11 minutes each, while the fourth round lasted 20 minutes, with all cycles completed within one hour. Male broiler breeders were usually fed alongside females, beginning around 06:00 in the morning. However, they were given a smaller feed ration and finished their meals earlier. After feeding was completed, the feeding chains and feed cups remained in place and were not lifted. Water was provided *ad libitum* to both males and females throughout the entire lights-on period.

The lighting period was maintained from 06:00 to 19:00, totalling 13 hours per day. Gradual dimming applied during both lights-on and lights-off transitions, beginning approximately 10 minutes prior to the full change in lighting. The lighting schedule remained consistent throughout the entire production period of birds.

There were no perches provided, either raised or integrated into the slatted area.

2.2 Method

2.2.1 Study design

The study was conducted using behavioural video data collected between March and April 2025, corresponding to the birds' 27th, 28th, and 29th weeks of age. The video monitoring was performed using two cameras installed in the house to capture behavioural data. The camera view covered part of the slats and part of the litter area with the females' feeding chain.



Figure 5a. Region captured by the camera, encompassing parts of the slatted and littered areas.

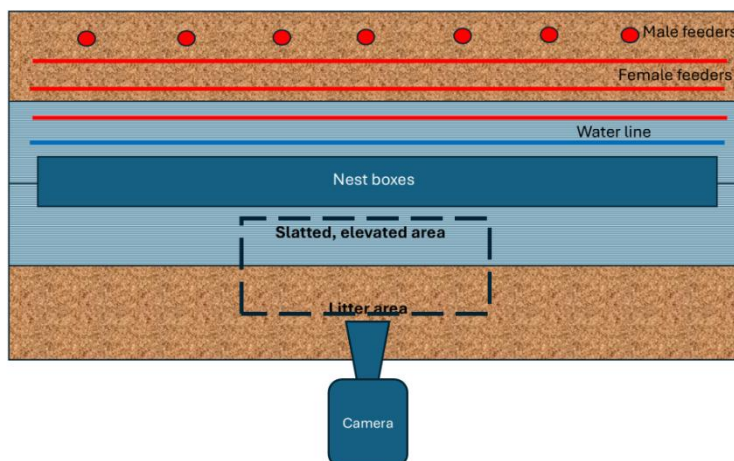


Figure 5b. A schematic illustration, where the dashed line is showing the parts of the barn captured by the camera.

Observations were conducted based on a predefined ethogram using the Boris software a program where behavioural data can be conveniently and effectively extracted or registered from videos (v. 8.27.10 2024.10.07).

Table 1: Ethogram (based on the literature (De Jong et al. 2003, 2009; McGary et al. 2003; Merlet et al. 2005; Pereira et al. 2013; Arrazola et al. 2020; Gebhardt-Henrich et al. 2020; Jacobs et al. 2021; van den Oever et al. 2021; Tahamtani et al. 2024).

Behavior	Description
Resting	The bird bends its legs and lies with the entire ventral body in contact with the floor. No specific activity is observed. The head may exhibit slight movement and remain upright or semi-upright (not fully bent toward the floor). The bird appears alert, with eyes open, and typically maintains this posture for an extended period.
Sleeping	The bird lies with its ventral body in contact with the floor and remains motionless for an extended period. There are no alert movements. The eyes are closed, or the head is tucked under the feathers at the wing base.
Preening	The bird directs its beak toward its own body and feathers, often bending the neck backward to reach different areas. It uses its beak to manipulate and arrange its plumage. The behavior includes brief pauses between each beak-to-body contact.
Mating	The male bird approaches the female and attempts to mount her body. During this process, the male grasps the female's head with his beak, and copulation occurs.
Dust bathing	The bird lies on its side and kicks litter onto its body, vigorously wiggling to spread dust through its feathers. It may bend and roll to ensure full contact with the litter material. After the activity, the bird stands up and shakes off the dust and debris.

Before starting actual data collection, the ethogram was tested, further developed and finalized by observing video recordings and referencing relevant literature. If all or even some of the behavioral criteria listed in the ethogram were observed, the behavior was recorded as the specified behavior.

Behavioral observations were done using continuous observation of the first 10 minutes of every other hour during the light-on period, from 06:00 to 18:00. During the lights-off period (after 19:00), the proportion of birds sleeping on the slats and litter was recorded. Data from the two cameras installed in the same house were treated as separate observation sources for each day.

Some behavioral observations were conducted using focal sampling, and other behaviors were recorded by observing all visible birds. When most of the birds were engaged in resting behaviors, observations were made by recording the behavior of all visible birds. This approach was used to capture a broader representation of group-level activity and to obtain a more accurate proportion of behaviors such as resting, preening, or dustbathing, which are typically performed simultaneously by many individuals.

During other times, particularly around feeding periods when bird activity increased and behaviors were more varied, focal sampling was used to observe individual birds more closely. Focal sampling was used to monitor randomly selected male and female birds. All birds performing the relevant behaviors in the selected area were observed in each session. If a bird moved out of the camera frame or approached the feeding chain, it was replaced by another bird within the same area for continued observation.

Resting and other comfort behaviors were recorded during specific time periods, and disturbances or unclear views led to skipping and resuming at the next suitable occasion. If any disturbances were observed, such as workers moving within the stable, or if it was difficult to distinguish between male and female birds, those time segments or those birds were skipped. The video was then forwarded to a point with no disturbances and where the birds could be clearly identified.

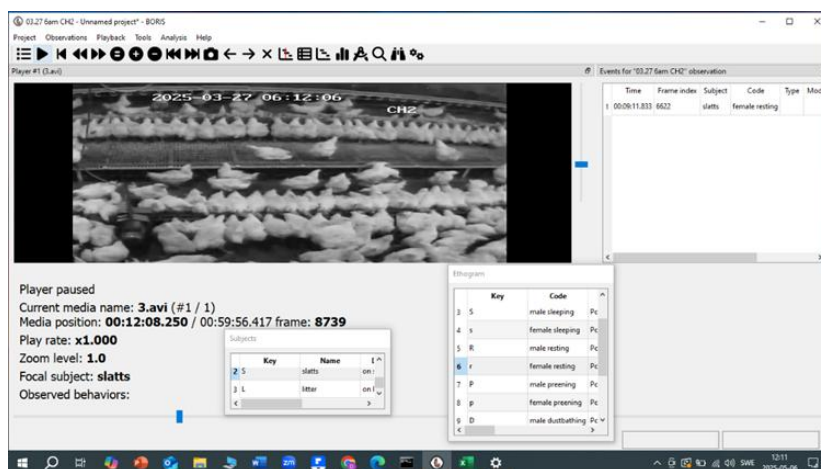


Figure 6. Behavioural observation done using 'Boris' software.

The behaviours of birds at the two different locations; slatts and litter were observed separately as both these areas could not be observed simultaneously. During each selected time period on the videos, observations were first conducted on birds located on the litter, followed by observations of birds on the slatts.

Sleep was observed during the night (at 11 PM) by counting all birds sleeping and registering their position.

2.2.2 Statistical analysis

Due to data unavailability, behavioral data such as nighttime sleeping, resting, preening, mating and dustbathing were collected from video footage recorded by two cameras on one observation day per week at 27, 28, and 29 weeks of age. For each behavior, mean values were calculated for males and females separately and grouped by floor type (litter or slats), behaviors such sleeping, mating, and female dustbathing behaviors were analyzed without sex separation.

The dataset comprising behavioral observations across age, flooring type, and sex was analyzed using Minitab statistical software. The boxplot graphs and descriptive statistics were used to summarize the data distribution. The boxplots were created for data to visually represent the differences, clearly highlighting the variation in data samples results.

Data was non-normally distributed and the non-parametric Kruskal-Wallis test was used to compare behaviors on slats to behaviors on litter.

3. Results

Videos were available on week 27, 28 and 29 only and hence no age comparisons were made as the age span was too short.

The null hypothesis (H0), $p \geq 0.05$ was that there was no significant effect of floor type (slats or litter) on the behavior of broiler breeders. The alternative hypothesis (H1), $p < 0.05$ was that there was a significant effect on floor type with Behavioral analysis.

3.1 Behavioral analysis

3.1.1 Nighttime Sleeping Behavior

Sleeping behaviour was observed at 11.00 PM during darkness. During the observations for all three weeks, birds were only observed sleeping, not performing any other behaviors at nighttime (Figure 7). Due to the darkness and the position of the birds with head either on the floor or tucked under the wing's, sexes could not be differentiated. The slats were on all observation occasions filled with birds whereas there was space available on the litter (Figure 7).



Figure 7. Sleeping behaviour on slats and litter at nighttime. Screenshot from the observational video that showing the distribution of birds exhibiting sleeping behaviour on the slats and litter at nighttime.

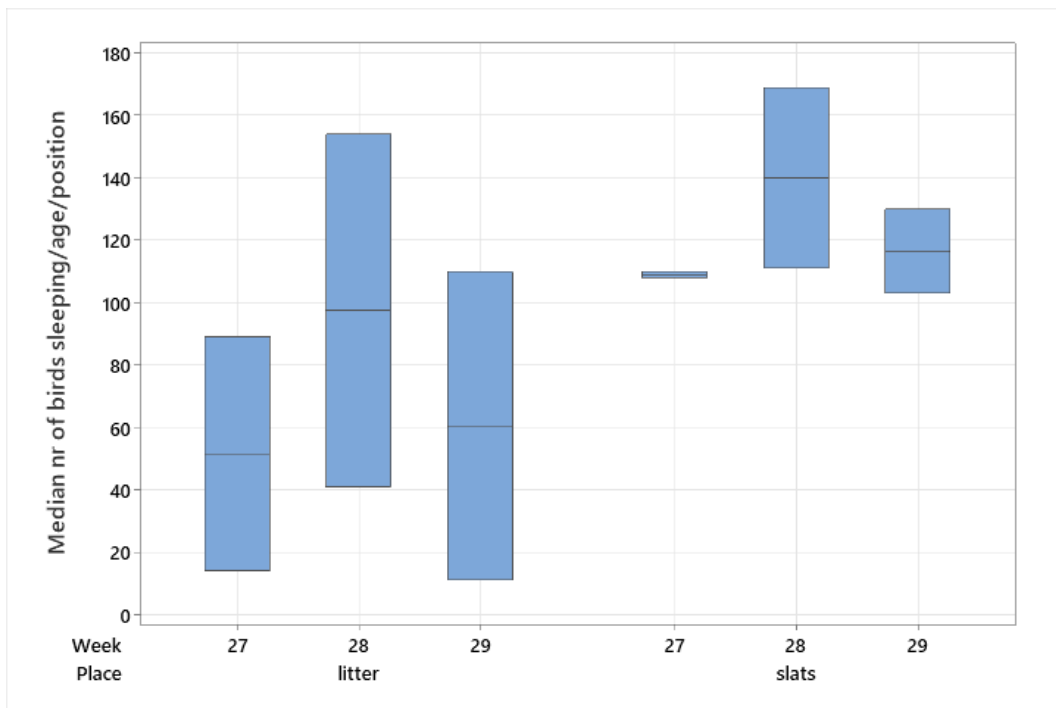


Figure 8. Box-plot graph of median number of nighttime sleeping birds (frequency of sleeping behaviour) per observation on either litter or slats during three weeks of the laying period. Males and females could not be differentiated.

The boxplot (Fig.8) illustrates the distribution of nighttime sleeping behaviour in broiler breeders in the observational area, across three weeks of age (27, 28, and 29) and two flooring types (litter and slats). The Y-axis represents the median number of birds performed sleeping behaviour, which corresponds to the median number of recorded sleeping behaviours, as the number of birds exhibiting sleep remained consistent throughout the entire lights-off period.

The box-plot graph shows that broiler breeders tend to sleep more on slatted floors than on litter across all observed weeks. The difference observed indicated a tendency ($H= 2.84$, $P = 0.092$), implying a trend rather than a statistically significant effect.

3.1.2 Mating behaviour

The boxplot (Fig.9) illustrates the number of observed mating behaviour in broiler breeders in the observational area, across the age groups (weeks 27, 28, and 29) and two floor types (litter and slats).

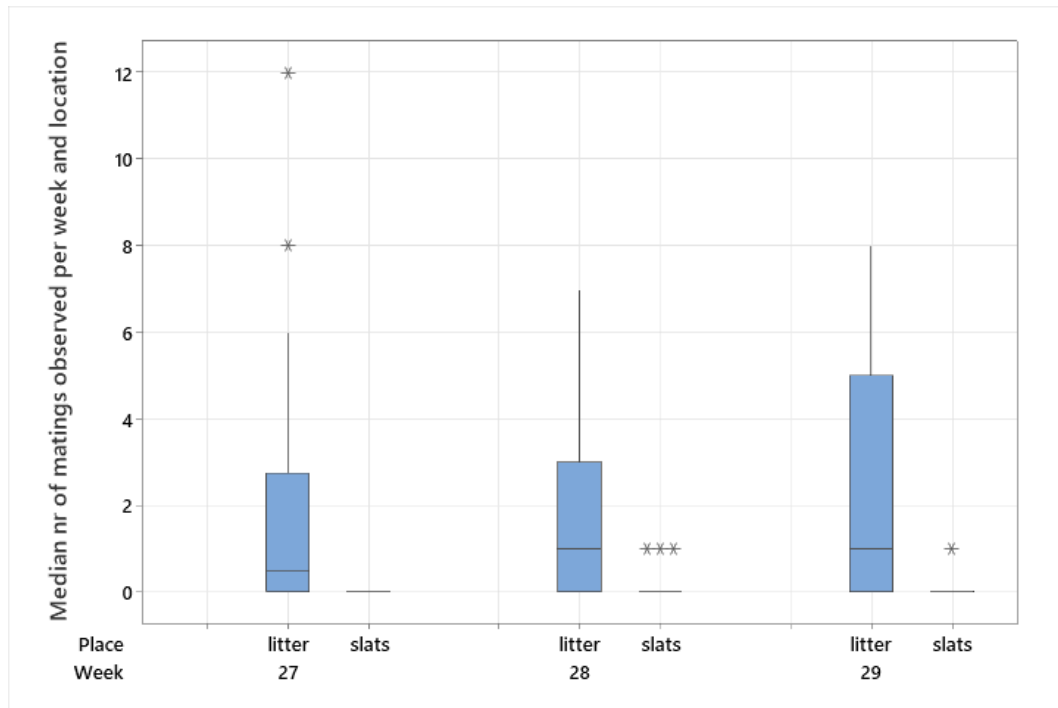


Figure 9. Box-plot graph of median number of observed mating behaviour of broiler breeders on slats and litter floor with weeks of age.

The box-plot graph shows that number of observed mating behaviour was consistently higher on litter floors than on slatted floors across all observed weeks, with almost all matings occurring on the litter, and the difference was statistically significant ($H=38.0$, $P<0.001$).

The number of observations of matings on litter remained higher throughout the observation period, with total number of 104 observations, while for slats only four observations.

3.1.3 Dustbathing behaviour

Boxplot of female dustbathing

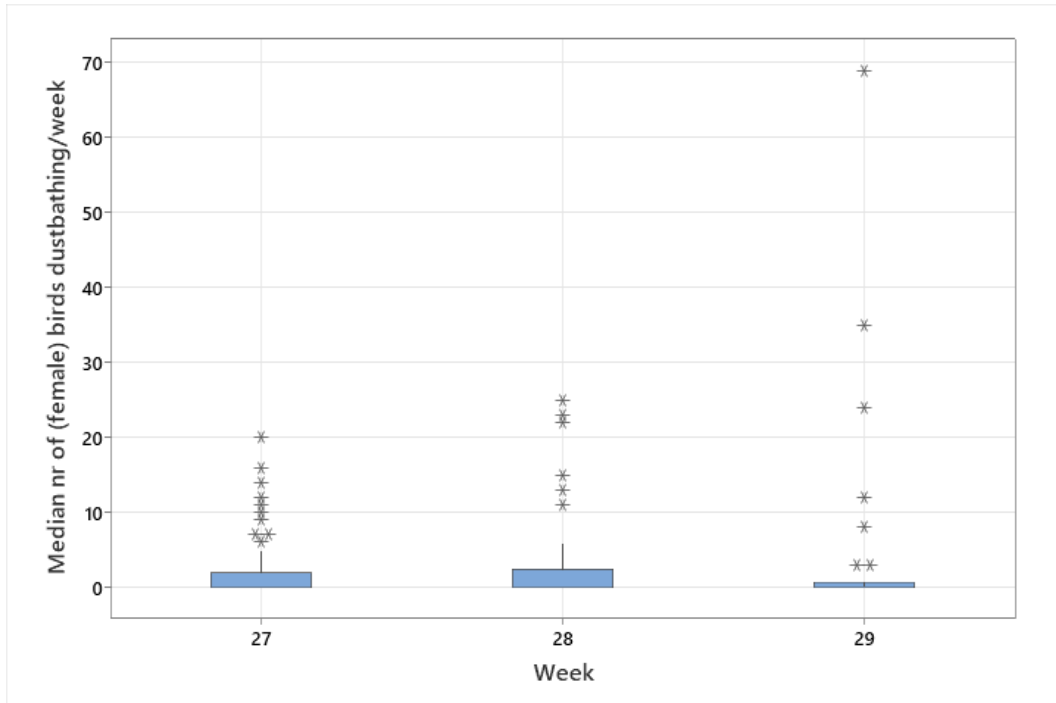


Figure 10. Boxplot graph of median number of observed dustbathing bouts of female broiler breeders, only on litter, for each week of age.

The boxplot (Fig.10) illustrates the distribution of number of observed dustbathing behaviours in female broiler breeders in observational area, at weeks 27, 28, and 29. Overall, the median values for all weeks remained very low, indicating that most females exhibited little to no dustbathing activity during the observation periods.

Dustbathing behaviour was observed exclusively in females, with no dustbathing recorded among males.

3.1.4 Day time resting behaviour

Boxplots were generated separately for male and female resting behaviour to visually assess the distribution and variability across weeks and floor types.

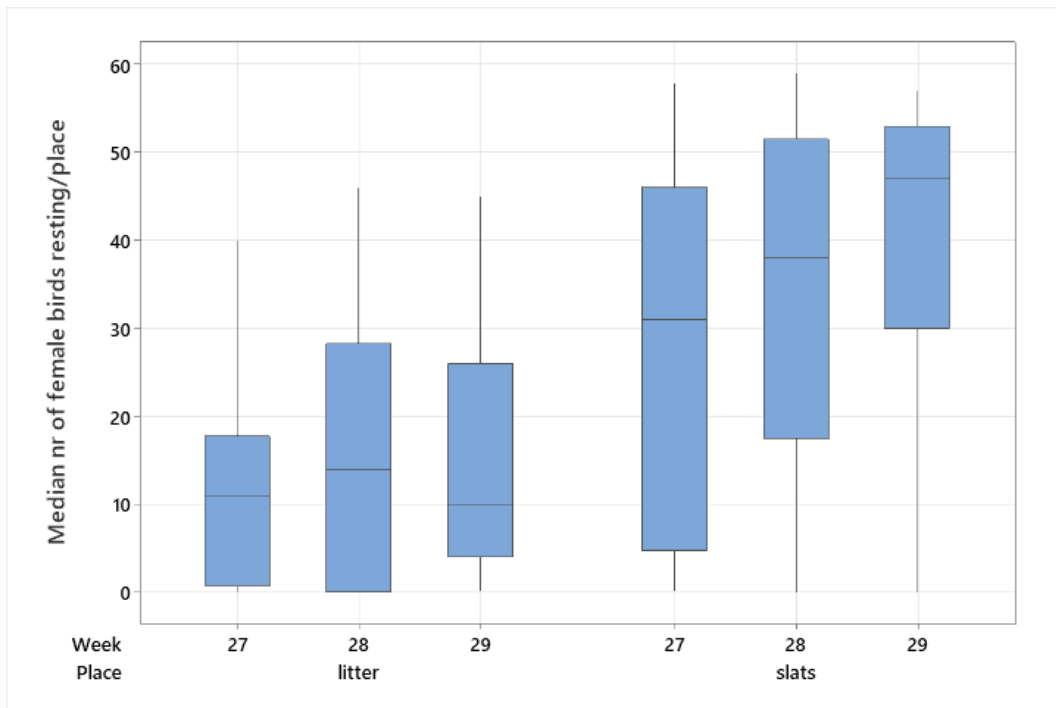


Figure 11. Boxplot graph of number of observed female daytime resting behaviour on litter and slats with weeks of age.

The boxplot (Fig.11) illustrates the number of observed female daytime resting behaviour in observational area, across weeks 27, 28, and 29 on litter and slatted floors. The Y-axis represents the number of female birds performed resting behaviour, which corresponds to the number of observed female resting behaviours. As the box-plot graph and the statistical analysis, the females rested (on daytime) significantly more on the slats compared to the litter ($H=26.9$, $P<0.001$).

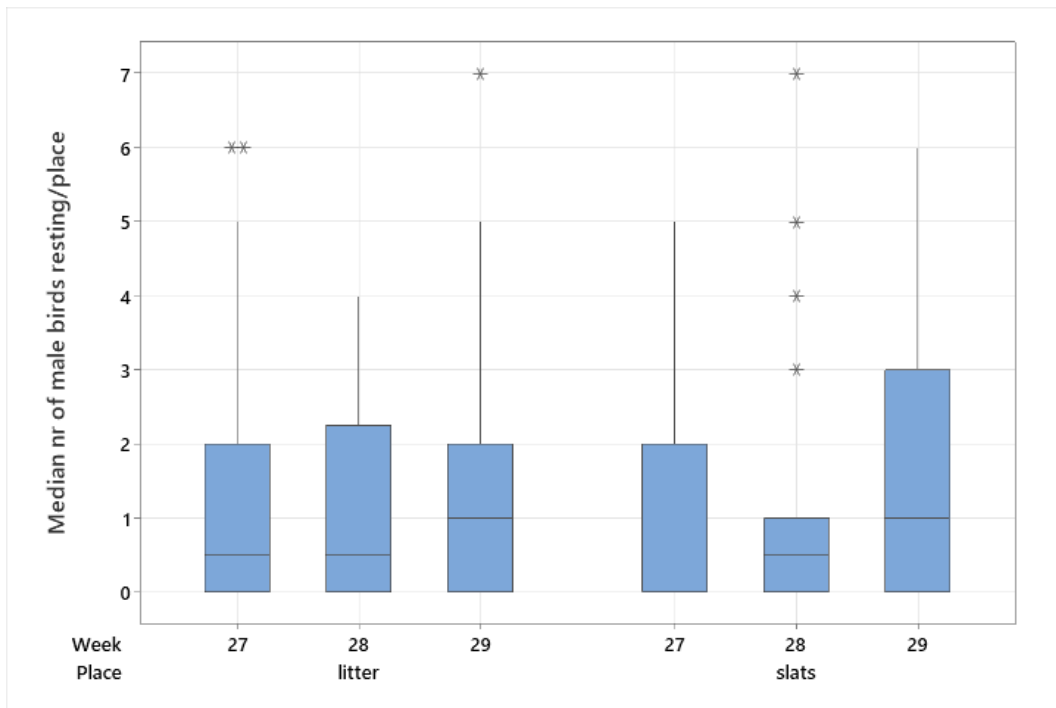


Figure 12. Boxplot graph of number of observed male daytime resting behaviour on litter and slats with weeks of age.

The boxplot (Fig.12) illustrates number of observed male daytime resting behaviour in the observational area, across weeks 27, 28, and 29 on litter and slatted floors. The Y-axis represents the number of male birds performed resting behaviour, which corresponds to the number of observed male resting behaviours.

Male daytime resting values were consistently numerically higher on slats than on litter, though not statistically significantly ($H=0.16$, $P=0.69$).

3.1.5 Preening behaviour

Boxplots were generated separately for male and female preening behaviour to visually assess the distribution and variability across weeks and floor types.

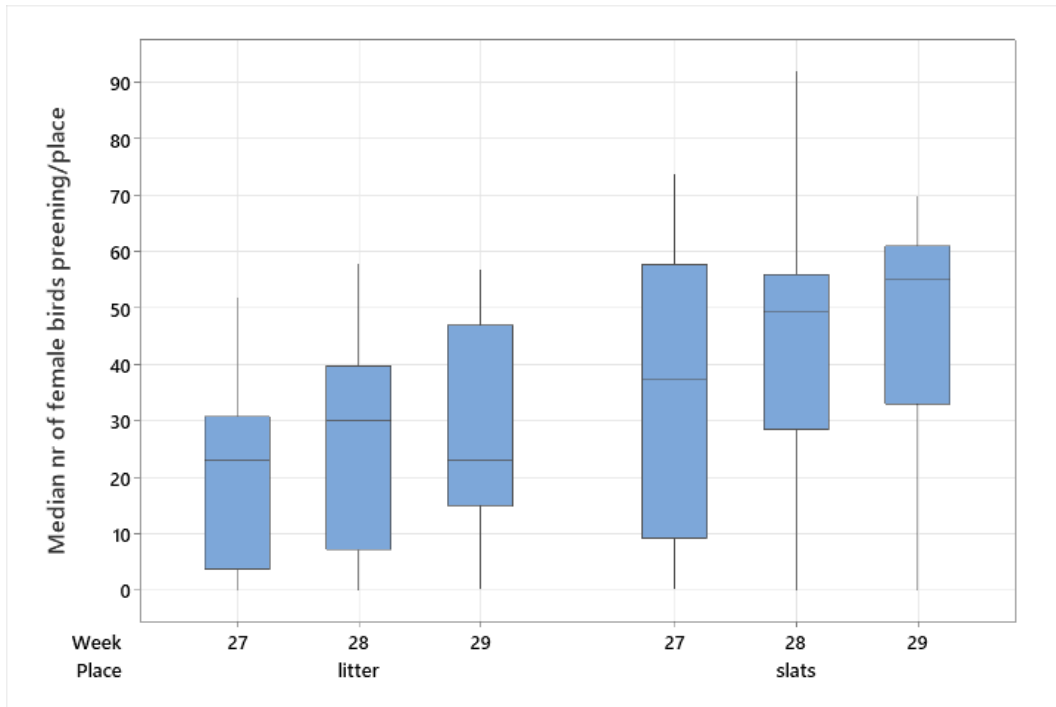


Figure 13. Boxplot graph of number of observed female preening behaviour on litter and slats with weeks of age.

The boxplot (Fig.13) illustrates the distribution of number of observed preening behaviour in female broiler breeders, in observational area, across weeks 27, 28, and 29 on both litter and slatted floors, where preening was observed significantly more on the slats. As the box-plot graph, the slatted flooring supported higher and more uniform female preening behaviour, while litter remained lower with greater variability in all three ages ($H=19.73$, $P<0.001$).

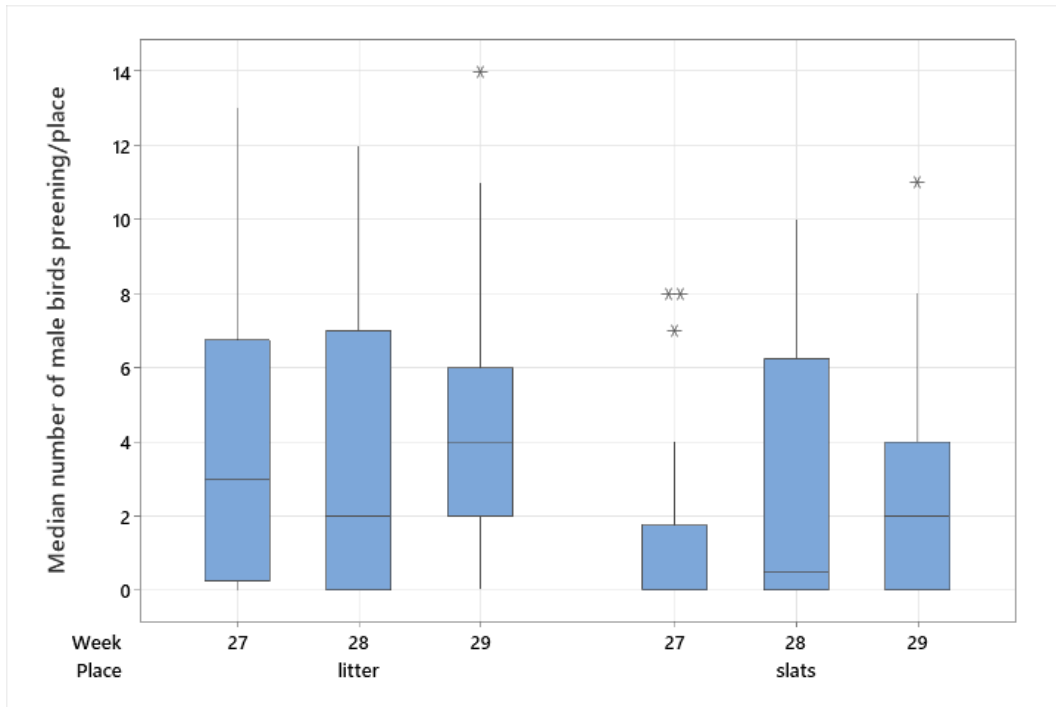


Figure 14. Boxplot graph of number of observed male preening behaviour on litter and slats with weeks of age.

The boxplot (Fig.14) displays number of observed preening behaviour in male broiler breeders in observational area, across weeks of age 27, 28, and 29 on both litter and slatted floors, but significantly more often on the litter ($H=14.87$, $P<0.001$).

4. Discussion

The primary objective of this study was to compare the relative preference for the two different locations to perform resting and comfort behaviours such as sleeping, preening, mating, and dustbathing in male and female broiler breeders, during the critical laying period of 27 to 29 weeks of age. The results showed that broiler breeders' resting, and other comfort behaviours differed between slatted and litter floors but as observations were condensed for three weeks during peak production, no age effects could be studied. These results underline the importance of enhancing broiler breeder housing with appropriate environmental enrichments to support bird welfare.

Sleeping behaviour, observed during the dark period, showed a statistical tendency for a preference for sleeping on the slatted, elevated area. These patterns may relate to the natural instincts of the species. The wild ancestors of modern commercial chicken breeds naturally roosted in trees at night, using branches as elevated perching sites for safety and rest (Blokhuis 1984). Chickens tend to choose the highest available roosting spots at night, likely because greater elevation provides better protection from predators (Gebhardt-Henrich et al. 2018). While slatted floors are not equivalent to tree branches, they may offer a similar sense of elevation and stability, satisfying natural roosting preferences to some extent (Mens & van Emous 2022).

Even though sleeping in an elevated position is a natural behaviour a large proportion of birds slept also on the litter in this study. This may have several causes. Firstly, sleeping behaviour and location choice may be influenced by the availability of slat space (Brendler & Schrader 2016), as slatted areas were mostly fully occupied during observations. During the lights dimming period, video observations revealed some birds actively seeking space on the slatted area. In cases where space was available, they attempted to jump onto the slats, but some birds fell or struggled due to interference from other birds competing for the same space. Birds choosing to sleep on the litter could also be due to them having difficulties flying up on the slats. Because broiler breeders have been found to experience difficulties in accessing elevated structures (Mens & van Emous 2022).

It is known that rearing of pullets substantially affects the adult perching behaviour in layers, showing that perches or other elevated structures need to be provided early and throughout the rearing period to elicit normal and spontaneous perching behaviour (Skånberg et al. 2024). This has not been extensively studied in broiler breeder pullets, however Vasdal et al. (2022b) found that perching during the hour before dusk was performed to a very high extent in the slower growing hybrid compared to the fast growing, implying the motivation to perch may be hampered by birds' physical ability. The study by Vasdal et al. (2022b) was not completely comparable to the present one, as the broiler breeders in the present

study had access to elevated slats, not perches and also as observations of this study was done during the night and finding very high utilisation of the elevated area.

Interestingly the broiler pullets in the study by Vasdal et al. (2022b) showed that perching started at 2 weeks of age and combined with the knowledge from Skånberg et al. (2024) on early development of perching, this pinpoints the importance of providing resources early in life. Furthermore, the study by Vasdal et al. (2022b) registered perch use as birds/m whereas in this study birds used the whole area of the slats. There was room available in the Vasdal et al. (2022b) study whereas in this study the slat space was completely occupied, showing that an elevated area where it is easy for the heavy adult birds to sit may be a very valuable resource for these birds. An older study Brake et al. (1994), did not observe the perching behaviour per se but found that broiler breeder pullets reared with perches were less fearful compared to pullets reared without perches (Ohara et al., 2015).

In recent study by Mens & van Emous (2022) revealed that, older broiler breeders continue to favour elevated positions for sleeping and very few used the floor surface when all birds had room in the elevated positions. The behavioural observations in current study were confined to a narrow age range of 27 to 29 weeks, which could not fully represent age-related trends in broiler breeder sleeping behaviour.

The daytime resting behaviour was significantly influenced by floor type, in females displaying more resting on the slats compared to the litter. A numerically higher number of males rested in the elevated position on the slats compared to the litter and although this difference was not statistically significant it may still be biologically relevant. Roosting at higher elevations above the ground is believed to provide birds with a stronger sense of security (Brendler et al. 2014), suggest that slatted flooring may provide a more favourable environment for both sleep and daytime rest, potentially due to reduced disturbances, improved cleanliness, or better thermal comfort by improving air circulation around the body.

The more frequent daytime resting behaviour observed in females may be associated with their typically lower activity levels compared to males, as well as their differing social behaviours. In particular, the higher levels of sexual aggression exhibited by males could contribute to increased resting behaviour in females. This study, in agreement with earlier research Riber et al. (2017b), indicates that in broiler breeder systems, males are generally more active and tend to remain in the littered areas, whereas females more frequently utilize raised slats for resting.

Daytime resting behaviour is relatively stable in adult birds and might not differ as much as between adolescents and adults (Vigors et al. 2021). In broiler breeders resting behaviour tends to increase with age, as older birds typically exhibit reduced feeding and locomotor activity, while behaviours such as sitting and lying become more frequent (Sgavioli et al. 2023). The use of elevated resting places is also

influenced by several factors, including genotype, age, environmental temperature, flock size, and stocking density (Riber et al. 2018). Resting behaviour may vary with wider age intervals, as behavioural patterns can change as birds mature. However, in this study, observations were limited to birds aged 27 to 29 weeks, which may not be sufficient to study age effects.

Mating behaviour in the study was strongly significantly affected by floor type, with birds on litter exhibiting higher frequencies of mating compared to those on slatted floors. In contrast, birds on slats exhibited minimal mating activity, with most values nearing zero. Research has shown that the inclusion of raised slats in broiler breeder housing can reduce mating behaviour, and one possible explanation is that males tend to remain on the littered area, while females more frequently rest or roost on the slats, leading to reduced physical interaction between the sexes and consequently fewer mating attempts (van den Oever et al. 2021).

Males staying on the litter may have several potential explanations. Firstly, the natural behaviour on daytime is to forage on the ground for around 80% of the time (Dawkins 1989) however broilers and broiler breeders forage less than e.g. birds of the layer strains (Jones 1 et al. 2004), so this explanation might be less likely. Secondly male broiler breeders may, if not motivated to forage, have two other main motivations i.e. feeding and mating. Both these behaviours take place on the litter (Jones 1 et al. 2004). Hence it may be a bad strategy for males to spend a large proportion of their time on the slats. If this speculative explanation has anything to do with reality needs to be researched further.

Somewhat supportive is the indication that mating activity may be reduced because females actively use perches to avoid mating attempts by males, as mating generally takes place on the litter (Gebhardt-Henrich et al. 2020). In our study there were no perches, but the elevated slats could have been used by the female in the same way to avoid mating. These findings have important welfare and production implications and might indicate a goal conflict. While slatted floors are beneficial for hygiene and resting behaviour, they may interfere natural reproductive behaviours (van den Oever et al. 2021). But there were no indications of reduced fertility at the farm in this study and the hen does not need to mate daily to produce fertile eggs. After mating, she can store sperm in specialized sperm storage tubules within her reproductive tract, allowing subsequent eggs to be fertilized for an extended period. On average, the duration of fertility from a single mating range from 10 to 14 days (Brillard 2003).

In this study, as observations were limited to birds aged 27 to 29 weeks, this period may have been too narrow to detect any potential age-related differences. In general, the number of matings is higher in younger males (27 to 29 weeks) compared to older males aged 35–37 and 55–57 weeks, indicating a decline in mating activity with mature age (Hocking & and Bernard 2000). This study only covered a narrow age range of 27 to 29 weeks, which is not sufficient to obtain a

clear understanding of age-related effects on mating frequency. And as focal animals could not be followed over time, no estimation of individual mating frequency could be done.

Dustbathing behaviour in this study was observed exclusively in females. Overall, the median values for all weeks remained very low, indicating that most females exhibited little to no dustbathing activity during the observation periods. This finding aligns with broader research indicating that dustbathing is a highly motivated and important behaviour in poultry, particularly in hens, and is typically expressed less frequently or less intensely by males under commercial conditions (Baxter & O'Connell 2025a). Even when broiler chickens are kept in enriched or less intensive environments, the expression of natural behaviours, such as dust bathing, remains limited, especially among fast-growing males (Riber et al. 2018). This may be due to physical limitations related to their body weight and genetic selection for rapid growth, which can reduce both the motivation and capacity to perform such comfort behaviours (Riber et al. 2018). In the study Baxter & O'Connell (2025), males were only occasionally observed foraging, and notably, no males were seen performing dustbathing behaviour during the observation periods.

In female broiler breeders, dustbathing is a key comfort behaviour closely associated with good welfare, feather condition, and body temperature regulation (Baxter & O'Connell 2025). Dustbathing is strongly affected by the availability, quality, and accessibility of litter, which are crucial for its expression (Riber et al. 2017b). Furthermore, a dry friable litter suitable for dustbathing is also good for bird feet and dustbathing may potentially be an indirect indicator of good foot health (Shepherd et al. 2017) and hence important for welfare from several aspects.

Recent research indicates that dustbathing is a highly motivated behaviour in broiler breeders, with its expression varying depending on age and laying phase (Baxter & O'Connell 2025). Furthermore, dustbathing is a behaviour typically synchronised with group members, and this is also found under commercial conditions where large groups of birds dustbathed together, if there are suitable litter and space available (Baxter & O'Connell 2025).

Preening behaviour in this study was significantly influenced by both floor type and sex, showing that females consistently engaged in more preening than males, and birds located on slatted floors displayed higher frequencies of preening behaviour compared to those on litter. Environmental cleanliness and minimal disturbance are known to encourage comfort behaviours such as preening, as birds are more likely to engage in plumage maintenance when conditions are favourable (Bukunmi Adeniji 2012), which may explain the pattern observed in this study. In a study by Bukunmi Adeniji (2012), preening rates were found to be higher in broiler breeder females than males of a similar genetic background, which aligns with the results observed in the present study. This may be because females

generally exhibit more preening than males, as the behaviour is closely linked to comfort, feather upkeep, and social communication. Functions that are often more pronounced in females due to their reproductive responsibilities and the physical strain associated with egg laying (Bukunmi Adeniji 2012).

Unlike the females, male broiler breeders in the current study exhibited higher frequencies of preening behaviour on litter compared to slatted floors. This aligns with findings from a recent study by Baxter & O'Connell (2025), which reported that female birds tending to prefer the cleaner, elevated slatted floors for resting, whereas males are more often found on the litter, where they are more active and engage in behaviours such as preening and foraging.

The preening behaviour in broiler breeders tends to become more frequent as they grow older, indicates that with maturity, birds engage more often in both sitting and preening activities (Branco et al. 2021). However, in this study, observations were limited to narrow birds aged 27 to 29 weeks, which may not be sufficient to get a clear result.

4.1 Ethical and sustainability aspects

This study shows that housing design, particularly floor type, plays a crucial role in shaping the expression of comfort behaviours in broiler breeders. The expression of natural behaviours like resting, preening, sleeping and dustbathing etc. plays a significant role in the overall welfare of birds. Ethically, allowing animals to exhibit these behaviours aligns with current animal welfare principles (Webster 2016).

This study emphasizes the responsibility of producers to enable broiler breeder birds to express essential comfort behaviours. Observing and analysing comfort behaviours such as resting, sleeping, preening, and dustbathing allows for a better understanding of whether current housing systems meet the birds' natural needs.

Animal welfare is a comprehensive concept, and suggestions for what is acceptable welfare for farm animals requires at least maintaining good health, meeting their behavioural needs, and promoting positive emotional states (Newberry et al. 2001). These judgments are ultimately ethical decisions made at the societal level (Vigors et al. 2021). The Five Freedoms framework emphasizes the significance of allowing animals to engage in natural behaviours, recognizing this ability as a core component of animal welfare standards (Mellor 2016). Providing birds with environments that support the expression of natural, instinctive behaviours, such as comfort and self-care routines, generally lead to improve welfare in commercial poultry production systems, since these behaviours are strongly connected to both their physical condition and mental well-being (Neethirajan 2025).

Broiler breeders are often kept in barren environments with high stocking densities, which can result in various welfare challenges due to their extended

production period and restricted feeding practices (De Jong et al. 2003). Elevated stocking densities restrict natural behaviours in poultry, including walking, stretching, feeding, preening, and dustbathing. This restriction can lead to compromised welfare and increased stress among the birds, leading to low production (de Jong & van Emous 2017). To help to minimize welfare problems, researchers have recommended offering enriched and stimulating environments that encourage natural behaviours (Riber et al. 2017b).

In this study, sleeping behaviour was observed more frequently on slats than on litter, and in fact leaving no spare space on the slats. Since it is well known that broilers are highly motivated to sleep in an elevated location (Mens & van Emous 2022), the limited space available on the slatted areas can be a welfare concern.

While increasing slatted space for broiler breeders would incur additional costs, these costs could potentially be offset by consumers who are willing to pay more for products produced under higher welfare standards. While many consumers are drawn to the lower prices of fast-growing meat chickens, others prioritize additional attributes like positive welfare, which offer value when purchasing (Fanatico et al. 2007). Consumers who are interested in premium labels such as organic, free-range, or pasture-raised poultry are more likely than the average customer to pay a higher price for slow-growing broilers (Fisher et al. 2015).

Livestock with better environmental enrichment, allows natural behaviours, tend to be healthier, high productive, and require less veterinary care, improving overall efficiency. In the short term, introducing such measures often leads to higher costs, primarily due to facility modifications and increased labour requirements. In the long term, enhancing animal welfare has the potential to boost productivity and contribute to greater sustainability within farming systems (Ahmed et al. 2020), While these findings are primarily based on research in cattle, similar principles may apply to poultry, including broiler breeders, as enrichment can support welfare, performance, production and profitability.

Ultimately, it is essential to strike a balance between animal welfare and economic viability, with effective approaches aiming to enhance both the well-being of the animals and the long-term profitability of the farm. Housing systems that promote welfare-friendly behaviour in broiler breeders may also support environmental sustainability through improved efficiency and reduced waste (Ahmed et al. 2020).

4.2 Research Strengths, limitations and Future research

4.2.1 Research Strengths

One of the key strengths of this study lies in its detailed behavioural analysis across multiple comfort behaviours like resting, sleeping, preening, dustbathing, and

mating, allowing for a comprehensive assessment of how floor type, sex affect broiler breeder welfare.

For behavioural observations, the use of both continuous observation and focal sampling enhanced the accuracy of data collection, ensuring that both individual- and group-level behaviours were captured.

The study's real-world relevance is enhanced by utilizing data from commercial production settings, which increases the practical applicability of the findings for housing design and welfare improvements in broiler breeder systems.

4.2.2 Research limitations

This study had several limitations that should be considered when interpreting the findings. The behavioural observations were confined to a narrow age range of 27 to 29 weeks, which may not fully represent age-related trends in broiler breeder behaviour.

All birds in the study were housed under the same stocking density and slat design, which makes it challenging to compare the specific effects of floor types with other influencing management factors. A more comprehensive comparison would require the inclusion of different housing setups with varying slat and litter space allocations to better understand how these variables impact behaviour and welfare outcomes.

During sleep behaviour observations, slats were often completely occupied, while litter areas were underutilized, possibly resulting in biased estimates of floor preference due to space limitations rather than genuine behavioural choice.

The use of short observation windows and mixed sampling methods, combining focal and group-level observations, may have also missed minor or infrequent behaviours. Due to unavailability of data at certain times, behavioural observations were limited to the first 10 minutes of every other hour. Additionally, because of a lack of data in some weeks, data were analysed only one day per week using footage from two cameras. This restricted observation schedule may have diminished the ability to capture the full range and frequency of behaviours throughout the study period. Furthermore, focal animals could not be followed for several days as they were not ID-marked and hence e.g. stability of individual differences in preferences are impossible to assess.

4.2.3 Future research

To build on the findings of this study and address its limitations, future research should consider a broader age range to capture behavioural changes throughout the production cycle of broiler breeders. Expanding the observational period beyond the 27–29-week age will provide deeper insights into how behaviours change with age. Additionally, since one housing in the current study made it challenging to separate the precise impacts of floor type, future research should include various

housing circumstances with different slat and litter space combinations. Improved data collection methods, such as continuous video monitoring across several days per week and using more than two cameras, would also enhance the accuracy and representativeness of behavioural observations. Ensuring timely access to data and minimizing gaps in recording will help reduce bias and allow for a more thorough analysis.

Ultimately, future research should aim to develop housing strategies that not only enhance bird welfare but also support the long-term sustainability of poultry production systems.

5. Conclusion

The study findings revealed that the floor type plays a significant role in shaping comfort behaviour, with slatted areas generally supporting more resting, preening and some range in sleeping, while mating and dustbathing occurred almost exclusively on litter. Sleeping behaviour was observed more frequently and higher proportion on slats than on litter, and in fact leaving no spare space on the slats. The variations in result of sleeping behaviour may be influenced by the availability of limited slatted area. The results showed that broiler breeders' resting, and other comfort behaviours differed between slatted and litter floors, but observations were limited to narrow birds aged 27 to 29 weeks, which may not be sufficient to get a clear result. There were some sex-related behavioural variations, though these could have been caused by either behavioural element being performed to a different level or due to the lower number of males. Also the short observation period might have impacted this no statistical evaluation was conducted when e.g. males were not observed performing a behaviour at all, such as dustbathing.

The findings indicate that housing design has a direct impact on the birds' ability to exhibit their natural behaviours and impacts their welfare, especially the proportion of slatted to litter areas. Furthermore, it suggests that improving more-space slatted area may not only support comfort behaviours like resting, sleeping and preening but also lower welfare concerns associated with overcrowding and mating aggression, factors that significantly impact broiler breeder management efficiency. Further research is necessary to improve housing systems that effectively support broiler breeders' biological needs to express natural behaviours while also meeting practical realities of commercial farming. Understanding and enhancing these behavioural needs by providing appropriate slats with enough space is essential, not only for improving animal welfare, which is an integral part of sustainability, but also for promoting economic and environmental sustainability. This can be achieved, for example, through improved societal acceptance, better health and productivity when bird stress is reduced, and improved economic returns if birds perform better. Additionally, enhanced welfare and housing design can reduce waste, improve resource efficiency, and lower the environmental footprint of poultry production.

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Popular science summary

'Broiler breeders' are the special parent birds that produce fruitful eggs and hatch into broiler chickens used for meat. These birds are usually kept in large indoor houses with high animal density, where their living conditions and welfare are important for their health and productivity. In this study, I observed how broiler breeders act in two different parts of their housing: slatted floors (elevated platforms) and littered floors (covered with wheat straw). I focused on natural comfort actions (behaviours) like resting, sleeping, preening (Itching like behaviour), dustbathing, and mating, and I looked at how these actions were changed by the birds' age, sex, and the type of floors.

The results showed that broiler breeders liked to rest, sleep, and preen more on slatted floors, while dustbathing and mating mostly occurred on the litter. Female birds were more active in comfort behaviours like resting, preening, and dustbathing than male birds. Overall, the study found that the type of floor strongly changed how birds behaved. These findings suggest that improving the design of poultry housing, especially by providing a good, suitable balance between slats and litter, can help birds express their natural actions, which is important for both animal welfare and sustainable (productive) farming.

Understanding how birds use their surrounding environment helps farmers and creates better living conditions for poultry, leading to healthier animals, better productivity, and higher animal welfare standards. This research supports the idea that good animal welfare can go together with successful, responsible poultry production.

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