SUPPLEMENTARY MATERIAL AVAILABLE ONLINE

Indian Journal of Animal Sciences **96** (7): 559–565, July 2026/Article
https://doi.org/10.56093/ijans.v96i7.162437

Effect of floor space allowance on feeding, lying, and social behaviour of post-weaned indigenous lambs

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Received: 14 July 2025; Accepted: 20 July 2026

ABSTRACT

The present study was aimed to examine the influence of varying floor space allocations on the behavioral patterns of post-weaned indigenous lambs. The experimental groups denoted as T_1, T_2, and T_3, were subjected to different floor space provisions: 0.8, 0.7, and 0.6 m2 per lamb within the covered area, and 1.6, 1.4, and 1.2 m^2 per lamb within the open area, respectively. Each group comprised six animals, and the duration of the study spanned 210 days. There were significant differences in the time spent lying inside and outside the shed between treatments and periods. Lambs in treatment group T_3 spent significantly more time at the manger (156.93±5.75 minutes/day) compared to T_2 (141.52±5.17 minutes/day) and T_1 (123.12±5.41 minutes/day). The average number of attempts at the water trough was significantly higher in T_3 (10.24±0.27) compared to T_1 (8.10±0.39) and T_2 (8.83±0.44). T_3 also showed significantly higher time spent standing inside the shed (164.07±1.79 minutes/day) compared to T_1 (137.93±1.98 minutes/day) and T_2 (147.40±1.89 minutes/day). Time spent standing outside the shed was significantly higher in T_3 compared to other two groups. Additionally, T_1 exhibited highest time spent lying inside the shed (687.45±3.32 minutes/day), followed by T_2 (662.31±2.76 minutes/day) and T_3 (644.83±3.18 minutes/day). Lambs in T_3 also showed significantly higher agonistic behavior time (65.71±2.10 minutes/day) compared to T_1 (49.05±2.08 minutes/day) and T_2 (60.93±2.06 minutes/day), with higher frequencies of pushing, butting, and resource displacement. Overall, treatment groups significantly influenced behavioral patterns ($P \leq 0.05$), with T_3 exhibiting more aggressive behavior and altered activity patterns. Overall, the findings underscored significant influence of floor space allowances on post-weaned lamb behavior. Treatment group T_3 demonstrated altered activity patterns, with increased feeding and water consumption, elevated activity levels, and higher levels of aggressive behavior. The results highlighted the importance of optimal floor space management in promoting desirable behavioral outcomes and overall welfare in post-weaned lamb populations.

Keywords: Aggressive behavior, Activity patterns, Indigenous lambs and space allowances

In India, sheep husbandry serves as a livelihood for numerous rural and landless individuals, providing a source of income (Nayak *et al.* 2008). Sheep constitute a significant portion of the livestock biodiversity in India. As stated by Arora *et al.*(2010), they play a pivotal role in supporting marginalized farmers and landless laborers facing adverse climatic conditions. Consequently, sheep farming is often recognized as a means of poverty alleviation (Dastagiri and Rao, 1990). Presently, Gujarat is home to 17.87 lakh sheep, while India's total sheep population stands at 74.26 million (DADH 2020). Behavior serves as a primary indicator of welfare and adaptation for individuals to their environment (Metz *et al.* 1997). Animal behaviour and productivity are impacted by intensive production practices, which are defined by housing a large number of animals in small areas (Castillo-Trujillo *et al.* 2020). Compared to individual feeding, group feeding promotes social contact and results in higher feed intake, more consistent growth rates, and improved social behaviour (Titto *et al.* 2010). Feed and water consumption, as well as aggressive behaviour, tend to increase with the number of animals housed in pens (Van *et al.* 2007). Leme *et al.* (2013) and Costa *et al.* (2019) has demonstrated that social interaction facilitates lambs' feeding behaviour in groups, leading to higher feed intake than lambs housed alone.

Animal behaviours such as feeding, lying, and standing are influenced by the amount of floor space accessible to them (Centoducati *et al.* 2015). Insufficient space availability frequently results in the emergence of aberrant behaviour, which can be harmful to the individual animal as well as the other members of the group (Manson *et al.* 2007). The impact of group size on the behaviour of male Santa Ines lambs in cramped areas was examined by Leme *et al.* (2013). They noticed that a greater proportion of lambs kept in double pens stayed upright than lambs kept

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in communal pens. Lambs in double pens showed 6.9% more feeding activity than lambs in collective pens, but there was no difference in rumination activity between the two groups.

The effect of spatial allocation on sheep behaviour and physiological responses was examined by Navarro *et al.* (2020). Their findings indicated that doubling the space allowance led to a reduction in stress levels, decreased instances of pushing behavior, and a diminished need for sheep to hold their heads close together. Conversely, Wang *et al.*(2021) observed that animals with a lower space allowance exhibited increased engagement in fighting and feeder occupation while allocating less time to lying and resting. These observations suggested that crowded environments associated with reduced space allowance resulted in heightened occupying behavior and aggression among the animals. However, Sharma *et al.*(2022) found that animals were able to exhibit normal behavior across different floor space allowances. Nonetheless, feeding behavior was observed to be superior in groups with a 12.5% lower floor space allowance compared to the recommendation by the Bureau of Indian Standards (BIS).

As the size of the group expanded, antagonistic behaviour increased linearly, probably as a result of reduced individual spacing that forced individuals to interact with fewer possibilities to flee from assailants. Thus, the goal of the current experiment was to determine how post-weaned indigenous lambs behaved in response to varying floor area allowances.

MATERIALS AND METHODS

The current research took place at the Livestock Farm Complex (LFC), situated within the College of Veterinary Science and A.H., Kamdhenu University in Anand. Following a recommendation from the Institutional Animal Ethics Committee (IAEC) with Approval no. F. No. 382/LFC/2022, the Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA) granted approval for the experimental protocols. All protocols for the handling and care of animals closely followed the established guidelines.

Experimental animals and management: The experiment involved eighteen post-weaned indigenous lambs, selected randomly based on age and body weight criteria. These lambs were allocated to three treatment groups (T_1, T_2, and T_3) with differing floor space allowances: 0.8, 0.7, and 0.6 m^2/lamb in the covered area, and 1.6, 1.4, and 1.2 m^2/lamb in the open area, respectively. Each treatment group consisted of six animals (Table 1). The lambs were housed in a meticulously monitored, well-ventilated structure with an asbestos roof, oriented in an east-west direction, and featuring an earthen floor maintained with proper hygiene protocols. The daily ration, formulated as a total mixed ration (TMR), was prepared as a combination of Nutri-power concentrate mixture and roughage (both green and dry) in a ratio of 55:45, as per ICAR guidelines (2013).

Behavioural observations: Behavioral traits and daily activities were methodically evaluated by observing two lambs from each treatment continuously over a 24-hour period on two consecutive days at monthly intervals throughout the duration of the experiment. Individual lambs were distinguished through the application of color markings on their bodies. In each pen, two PTZ IR camera (2.0 MP, Model-DS-2DE22021- DE3: HIK vision) were strategically positioned to capture activities in both sheltered and exposed areas. The camera system was integrated with a Network Video Recorder (NVR) of the DS-7700 series, specifically the model DS-7716NI-14-HIK Vision, for the purpose of storing data. This integration served to facilitate subsequent analysis of the recorded information.

Behavioral observations encompassed the recording of various parameters, including the time spent at the manger and water trough, standing and lying durations, attempts made to access the manger and water trough, as well as occurrences of agonistic behaviors like pushing, butting, and resource displacement. These behaviors were systematically documented, and their definitions are provided in Table 2. Data collection was organized

Table 2. Ethogram (Modified Averos *et al.* 2014) used to study the behaviour of indigenous lambs

Behavior	Definition
Feeding	Standing next to the feeder and fully immersing his head in it
Drinking	Standing next to the drinker and using it
Moving	Moving within the pen, either by running or walking
Standing	Without moving, just remain standing with all four feet on the ground
Lying	Lie down on the floor (Rest sternally or laterally)
Agonistic behaviour	Butting- sudden strong contact with other lambs Displacing from resources- force another lamb to leave the feeder or drinker Displacing from resting place- force another lamb to leave its resting place Pushing – pressing the head against another lamb to force the pass

Table 1. Floor space allowance for post-weaned indigenous lambs in different treatment groups

Treatment	Floor space allowance (per lamb)		Number of lambs in each group
	Covered area (m^2)	Open area (m^2)	
T_1(As per BIS recommendations)	0.8	1.6	6
T_2 (12.5 % below BIS recommendations)	0.7	1.4	6
T_3 (25.0 % below BIS recommendations)	0.6	1.2	6

according to the type of behavior observed, considering both the frequency and duration of occurrences.

Statistical analysis: The mean values of the treatment group underwent statistical analysis following the methods detailed by Snedecor and Cochran (1994). SPSS computer software version 27 was utilized for all statistical procedures. Significant differences among means across various treatments were assessed using the Duncan Multiple Range Test (Duncan, 1955). The study employed general linear univariate regression models to investigate the impact of treatments, periods, and the interaction between treatment and period.

RESULTS AND DISCUSSION

The data presented in Table 3 and Figure (Supplementry figure 1-13) elucidate the behavioral patterns of lambs across different treatment groups. The mean duration spent at the manger per day for T_1, T_2, and T_3 groups was found to be 123.12±5.41, 141.52±5.17, and 156.93±5.75 minutes, respectively. These results indicated significant diffrence in feeding time among the treatment groups. Although, the mean number of feeding attempts made by lambs in T_1 (28.48±0.89), T_2 (28.33±0.89), and T_3 (28.43±0.86) groups exhibited no statistically significant variance.

The findings indicated that prolonged feeding durations observed under reduced space allowances which could be attributed to heightened competition for access to the feeder. Social facilitation mechanisms is likely to prompt synchronization of feeding behaviors among lambs, resulting in intensified rivalry and aggression, particularly evident in lambs subjected to lower space allowances (T_3) compared to those allocated higher space allowances (T_2 and T_1). The present study's findings align with previous research indicating that animals under reduced space allowances exhibited prolonged feeding durations. Shinde *et al.* (2004) observed similar trends, noting significant differences in feeding time between animal groups of varying dominance value, with higher-density animals spending more time-consuming fodder. According to Averós *et al.* (2014), ewes' proportion of time spent in eating was greatly impacted by space allowance, with higher occurrences at 1 m²/ewe. They also observed heightened eating activity in animals with reduced space allowances, particularly during morning and evening hours. This trend, supported by Thakur *et al.* (2017), suggested that limited space constraints might lead to increased feeding durations due to restricted exploration opportunities.

Similarly, Vik *et al.* (2017) found significantly higher eating behavior in groups with smaller space allowances, consistent with this study's results. Additionally, Tosawada (2021) reported higher feeding rates in groups with reduced space allowances compared to those with larger allowances, further supporting the current findings. Furthermore, Sharma *et al.* (2022) documented that the mean duration spent at the feeding trough was significantly higher under T_1 followed by T_2, with the control group exhibiting the shortest duration. Their finding of average number of attempts made by Surti kids to access the feeding trough under different treatment groups was comparable with the findings of the current study.

The present results are in opposition to Caroprese *et al.* (2009) and Leme *et al.* (2013), who noted that animal groups kept at lower stocking densities exhibited more grazing behaviour than those kept at higher densities. Further, Tapki *et al.* (2006) reported that calves kept in the high space allowance group had considerably higher overall eating behaviours than those in the medium and small space allowance groups. Norouzian (2017) also noted that as pen size increased, lambs spent more time eating, contrary to the findings of the current study. Krawczel *et al.* (2012) found that increasing stocking density by restricting access to free stalls and headlocks led to a decrease in feeding time compared to the control group. Conversely, Centoducati *et al.* (2015) found that during the summer

Table 3. Behavioural observation of different treatment groups

Attributes	T_1	T_2	T_3
Time spent on feeding (min/d)	123.12^{a}±5.41	141.52^{b}±5.17	156.93^{c}±5.75
Feeding Attempts (no./d)	28.48±0.89	28.33±0.89	28.43±0.86
Time spent on water trough (sec/d)	68.76^{ab}±1.37	67.40^{a}±1.66	71.81^{b}±2.23
Number of attempts to water trough (no./d)	8.10^{a}±0.39	8.83^{a}±0.44	10.24^{b}±0.49
Time spent for standing under the covered area (min/d)	137.93^{a}±1.98	147.40^{b}±1.89	164.07^{c}±1.79
Time spent in standing outside the shed (min/d)	41.60^{a}±1.30	46.43^{b}±1.62	59.60^{c}±1.40
Time spent for lying down under the covered area (min/d)	687.45^{a}±3.32	662.31^{b}±2.76	644.83^{c}±3.18
Time spent in lying down outside the shed (min/d)	56.60^{a}±1.59	57.21^{a}±1.10	43.79^{b}±1.37
Time spent on moving in premises (min/d)	10.79^{a}±0.45	9.90^{ab}±0.47	9.07^{b}±0.42
Time spent on agonistic behavior (sec/d)	49.05^{a}±2.08	60.93^{b}±2.06	65.71^{c}±2.10
Agonistic behavior (Pushing) (no./d)	5.45^{a}±0.30	7.40^{b}±0.40	8.69^{c}±0.31
Agonistic behavior (Butting) (no./d)	3.98^{a}±0.27	5.10^{b}±0.30	6.62^{c}±0.29
Agonistic behavior (displacement from resources) (no./d)	7.33^{a}±0.28	9.93^{b}±0.31	11.17^{c}±0.37

Mean with different superscripts (a to c) in the row differ significantly ($P<0.05$)

period, ewes housed with less space allowance exhibited lower total feeding time and feeding frequency. However, no significant differences attributable to stocking density were observed during the winter period. Norouzian (2017) observed that as pen size increased, lambs spent more time in eating. These outcomes are contradictory to the current study's conclusions.

Larger space allowances in our study did not lead to increased food consumption behaviours, in contrast to Mohammed (2014) and Castillo *et al.* (2020). The results of Wang *et al.* (2016), Fregonesi and Leaver (2002), and Hill *et al.* (2009) all found no significant effects on feeding time with changes in stall availability or stocking density, which runs counter to our findings. However, our study aligns with Shinde *et al.* (2004) and Averós *et al.* (2014), showing increased drinking frequency in groups with smaller space allowances, which was also consistent with Tosawada (2021) and Thakur *et al.* (2017). In contrast to our findings, Norouzian (2017), Sharma *et al.* (2022), and El-Sabry *et al.* (2023) reported no discernible variations in drinking patterns between the groups.

During the experimental period, significant differences were observed in the time spent standing inside the shed among the treatment groups (T_1: 137.93±1.98, T_2: 147.40±1.89, T_3: 164.07±1.79 minutes per day). Similarly, significant variations were noted in the time spent standing outside the shed (T_1: 41.60±1.30, T_2: 46.43±1.62, T_3: 59.60±1.40 minutes per day), with the T_3 group exhibiting significantly longer durations. The T_3 group, characterized by a smaller space allowance, displayed prolonged standing behavior compared to other groups, possibly due to increased walking activity in larger spaces, leading to reduced standing time. These findings underscored the complex relationship between space allocation and behavioral patterns, offering insights into animal behavior dynamics in diverse spatial environments.

Previous research has also documented similar findings regarding standing behavior in various animal species. According to Napolitana *et al.* (2004), buffalo calves in a group with a reduced space allowance showed more standing postures than those in a group with a larger space limit. Calves spent more time doing other things and less time standing when the size of the pen rose, according to Tapki *et al.* (2006). Consistent with the findings of the current investigation, Caroprese *et al.* (2009) observed longer standing times in animals kept at greater stocking densities. Thakur *et al.* (2017) also reported elevated proportions of standing time in groups subjected to smaller space allowances.

Jensen and Kyhn (2000) observed that smaller group pens calves engaged in less locomotory play and spent more time standing than those in larger pens. Hanlon *et al.* (1994) suggested that group-housed animals might exhibit increased standing and active behaviors due to forced social interactions. Centoducati *et al.* (2015) found that seasonal changes and space allocation affected behavior patterns, with reduced space allowance leading to increased total standing time during summer and elevated stocking densities resulting in increased standing time during winter. Norouzian (2017) found that lambs housed in smaller pens exhibited a significantly higher frequency of standing posture compared to those in larger pens. Vik *et al.* (2017) observed that the time spent standing significantly decreased as space allowance increased. Tosawada (2021) also revealed significantly increased standing times in treatment groups subjected to smaller space allowances compared to control groups with larger space allowances.

However, conflicting results were reported by Leme *et al.* (2013), Engeldal *et al.* (2013), Caroprese *et al.* (2009), Averós *et al.* (2014), and Shinde *et al.* (2004), indicating the complexity inherent in assessing the influence of space allocation on standing behavior. Mohammed (2014) found contrasting standing durations among different space allowances for goats. Sharma *et al.* (2022) observed variable standing times among treatment groups inside and outside the shed, highlighting the influence of experimental factors on standing behavior. These discrepancies underscore the variability in results across studies, suggesting that housing conditions, stocking densities, and experimental methodologies may influence standing behavior in animals.

The mean time spent lying inside the shed per day was highest in T_1 (687.45±3.32), followed by T_2 (662.31±2.76), and T_3 (644.83±3.18) groups. The mean time spent lying outside the shed was 56.60±1.59 in T_1, 57.21±1.10 in T_2, and 43.79±1.37 in T_3 groups. Significant differences ($P \leq 0.05$) were observed between treatments and periods of time spent lying inside and outside the shed. Reduction in available resting space correlated with decreased lying time, particularly evident in the T_3 (0.6 m^2) group, indicating increased discomfort and stress levels in lambs. Resting behavior is crucial for ensuring animal comfort and well-being. Leonard *et al.* (1996) emphasized that unfavorable housing conditions can hinder animals from lying down, consequently impacting their productivity. The observed resting time in the group with reduced space allowance aligns with Haley *et al.*'s (2001) reports on loose-housed cows but falls below the reported norms. Loretz *et al.* (2004) noted a significant decrease in lying time as floor space allowances decreased, consistent with Andersen and Boe's (2007) findings regarding lying behavior inside covered areas. Boe *et al.* (2006) also observed reduced lying time with decreased floor space. However, Leme *et al.* (2013) found more sitting posture in collectively housed pens, diverging from Mogensen *et al.*'s (1997) observations which noted a reduction in lying time when space allowance decreased. Similarly, Fregonesi *et al.* (2007) observed decreased resting time in dairy cows with reduced space allowance.

Tapki *et al.* (2006) reported statistically significant differences in resting behavior across treatment groups, contradicting our findings. Krawczel *et al.* (2012) observed a decreased lying time with increased stocking density, consistent with Mohammed's (2014) findings in goats. Centoducati *et al.* (2015) and Panda *et al.* (2016) provided

supportive evidence for reduced lying time with decreased space allowance, consistent with Thakur *et al.*'s (2017) observations in kids. Variability between research was demonstrated by the contradictory results provided by Averós *et al.* (2014), Orihuela *et al.* (2016), and Keane *et al.* (2017). In contrast with our findings, Sharma *et al.* (2022) likewise reported no significant effect of space allowance on lying time in Surti kids. These discrepancies underscored the complexity of factors influencing resting behavior in animals.

Lambs in the T1, T2, and T3 treatment groups moved around the premises for an average of 10.79±0.45, 9.9±0.47, and 9.07±0.42 minutes per day, respectively. These differences were statistically significant ($P \leq 0.05$) between treatment groups and time periods. According to Hanlon *et al.* (1994), there may be fewer ewes wandering in high-density stocked groups because of a smaller area allowance, which results in fewer opportunities for physical connection. According to the current study, there was a statistically significant difference ($P \leq 0.05$) in the amount of time that the T1 group spent roaming around the premises when compared to the T2 and T3 groups. According to Thakur *et al.* (2017), decreased movement may be the consequence of mobility issues brought on by physical closeness, as mentioned by Averós *et al.* (2014). They also noticed higher movement levels in groups with bigger space allowances.

Estevez *et al.* (2007) found that other domestic species experienced comparable impact from space restriction. These results were consistent with those of Caroprese *et al.* (2009), who observed that more ewes were walking at 3 m^2/ewe space as opposed to 1.5 m^2/ewe. In accordance with Tapki *et al.* (2006), calves that had larger pens spent more time walking ($P < 0.01$), and their locomotor activity was recorded at 2.87%, 7.03%, and 8.44% in small, medium, and big pens, respectively. A favourable link between space allowance and locomotor activity was reported by Jensen and Kyhn (2000) in group-housed calves, who noted increased locomotor activity with increasing space allowances from 1.5 to 4.0 m^2 per calf. Engeldal *et al.* (2013) investigated the impact of sheep stocking density on behavioral patterns, revealing significant differences across experimental groups. Movement frequencies were recorded as 183.17 in 3.2 m^2/ram, 141.99 in 1.6 m^2/ram, and 108.34 in 0.8 m^2/ram. The study concluded that increasing space allowance led to higher levels of movement among the animals, supporting the present study's findings and emphasizing the significant influence of spatial constraints on locomotor behavior in animal populations.

The mean duration of agonistic behavior, irrespective of period and treatment, was 58.56±1.35 seconds per day. Significant differences ($P \leq 0.05$) in agonistic behavior were noted among treatment groups, notably higher in T_3 (65.71±2.10) compared to T_2 (60.93±2.06) and T_1 (49.05±2.08). Pushing frequencies among indigenous lambs were as follows: T_1 (5.45±0.30), T_2 (7.40±0.40), and T_3 (8.69±0.31). Significantly higher pushing frequencies ($P \leq 0.05$) were observed in T_3 compared to T_2 and T_1 group lambs. While significant effects between treatments and periods were noted, the interaction between treatment and period ($P \times T$) did not affect pushing frequency expression across varying floor space allowances. The overall mean pushing frequency was 7.18±0.22. The average observation of butting behavior during the initial phase was numerically higher under T_3 (4.17±0.70), followed by T_2 (3.17±0.48) and T_1 (1.50±0.43), respectively. These findings resonated with Caroprese *et al.* (2009), who explored the impact of stocking densities on ewe behavior. They noted that ewes in high stocking density conditions exhibited significantly higher frequencies of aggressive behaviors (e.g., butting, clashing, pushing) compared to those in low stocking density conditions. Similarly, Engeldal *et al.* (2013) observed a higher prevalence of agonistic behavior in low stocking density conditions compared to high stocking density. Thakur *et al.* (2017) also observed increased aggressive behavior in kids housed in smaller spaces compared to those in larger spaces. This heightened aggression might have stemed from intensified social interaction in confined spaces, leading to heightened competition among animals, consistent with the findings of Fregonesi and Leaver (2002).

Consistent with the present study, Mohammed (2014) observed that smaller floor space allowances resulted in significantly higher frequencies of aggressive behavior. Vik *et al.* (2017) similarly found that total aggressive interactions decreased with increasing space allowance. Tosawada (2021) also noted significantly higher negative social interactions in smaller space allowance groups compared to larger ones. These findings suggested that reduced space might lead to heightened stress and discomfort, triggering unfavorable social responses. Navarro *et al.* (2020) reported increased pushing behavior in sheep under low space allowance conditions, likely due to competition for space. However, Hickey *et al.* (2003) and Keane *et al.* (2017) found no significant effects of space allowance on negative social interaction in steers and heifers, respectively. Loretz *et al.* (2004) also observed no significant impact of space allowances on aggressive interactions within the lying area. Engeldal *et al.* (2013) similarly found no significant differences in agonistic behavior among rams across different stocking density levels.

In contrast, Centoducati *et al.* (2015) found no significant effect of seasonal variations and reduced space allowance on agonistic behavior patterns. These disparities highlight the complexity of evaluating the influence of stocking densities and environmental factors on agonistic behaviors in animal husbandry. The current study's findings suggested that reduced space allowance leads to increased pushing and butting behavior among lambs, which was consistent with the previous research by Panda *et al.* (2017) and Vik *et al.* (2017). This indicated that animals with limited space exhibit more aggressive behaviors due to restricted mobility and heightened competition for resources. However,

conflicting findings exist, such as those reported by Loretz *et al.* (2004) and Orihuela *et al.* (2016), suggesting variations influenced by factors like animal age and breed. Overall, the study underscored the importance of adequate space allowances in mitigating aggressive behaviors in livestock, highlighting the multifaceted nature of factors influencing social interactions in animal husbandry settings.

The investigation revealed that the group with the lowest space allowance (T_3, 0.6m^2) experienced notably greater displacement from resources. This aligns with Panda *et al.* (2017), who found that reduced space allowance led to increased displacement from food resources. Similarly, Bøe *et al.* (2006) observed rising displacements of ewes with decreased space allowance. Additionally, Lynch *et al.* (1985) noted increased fights in sheep within restricted shelter areas, supporting the observed increase in displacements. Vik *et al.* (2017) reported displacement as a prevalent aggressive interaction, decreasing with increasing space allowance, corroborating our findings. Similarly, Mayes *et al.* (2022) found increased agonistic and displacement interactions in animals confined within restricted spatial environments, consistent with our results.

These consistent patterns across diverse settings underscored the significance of spatial constraints on social dynamics, emphasizing the need for further exploration of underlying mechanisms driving these behaviors.

In conclusion, this study elucidated the significant influence of varying space allowances on the behavior of lambs within experimental settings. Our findings revealed that total feeding duration increased with lambs in the T_3 (25.0 % below BIS) group allocating significantly more time to feeding activities at the manger and water trough compared to T_1 (As per BIS recommendations) and T_2 (12.5 % below BIS). While attempts to access the manger did not differ significantly across treatments, the T_3 group exhibited notably more attempts at the water trough, suggesting a heightened demand for resources in smaller space allowances. Differences in standing duration were also observed among treatment groups, with the T_3 group spending significantly more time standing, potentially influenced by increased walking activity in larger spaces.

Moreover, mean lying time, both inside and outside the shed, varied significantly among treatment groups, with T_1 and T_2 groups displaying longer lying durations compared to T_3. This underscores a correlation between reduced resting space and decreased lying time, indicating potential discomfort and stress associated with smaller space allowances. Additionally, nuanced locomotor behavior influenced by space allowance was observed, with the T_1 group displaying more movement within the premises compared to T_2 and T_3. Furthermore, the study revealed notably elevated levels of agonistic behavior, including pushing, butting, and displacement from resources, in the T_3 group compared to T_2 and T_1. This suggests increased stress and discomfort in lambs subjected to smaller space allowances, leading to heightened social aggression. Overall, our findings highlight the intricate interplay between space allowance, behavior patterns, and animal welfare in experimental settings. These results underscore the importance of considering spatial dynamics in animal husbandry practices to optimize animal welfare and mitigate the adverse effects of spatial constraints on behavior and well-being. Further research exploring the underlying mechanisms driving these observed behaviors is warranted to inform evidence-based management strategies for enhancing animal welfare in agricultural settings.

ACKNOWLEDGEMENTS

Authors acknowledge the Director of Research, Kamdhenu University, Gujarat, for providing the necessary facilities to facilitate this research endeavor.

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