Chapter 11

Lamb and Kid Raising Practices and Advanced Techniques

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Abstract

Lamb and kid rearing is a critical process for herd productivity and economic profitability in small ruminants. Care, feeding, and health management practices implemented from birth to weaning directly impact lamb development and survival. In recent years, the use of advanced techniques, in addition to traditional methods, has played a significant role in increasing lamb and kid rearing success. In this context, ensuring timely and adequate colostrum intake is crucial for early immune development. Artificial lamb and kid rearing systems offer an effective alternative in cases of motherlessness or inadequate lactation in multiple births. Automatic lamb and kid feeding systems, combined with fixed ration planning, optimize growth performance while reducing the risk of stress and disease. Furthermore, supporting rumen development with early provision of concentrated feed and high-quality forage facilitates post-weaning adaptation. Among advanced technological applications, sensor-based monitoring systems that allow monitoring of body temperature, activity level, and feed consumption offer significant advantages for early disease diagnosis and intervention. Furthermore, selecting individuals with high lamb and kid rearing potential through genetic selection programs increases growth and survival rates across the flock. Consequently, integrating modern management strategies and advanced techniques into lamb and kid rearing not only improves individual animal performance but also ensures the sustainability of productivity across the flock. Therefore, increasing producers' technical knowledge and developing infrastructure will increase the effectiveness of modern lamb and kid rearing practices. This study evaluates studies on the effective parameters and advanced techniques for offspring growth in small ruminant farming and offers recommendations.

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1.Introduction

Lamb and kid sales are among the primary sources of income for small ruminant farms and play a critical role in the economic sustainability of this production line. Lamb and kid breeding, in particular, is a strategic process that directly impacts not only individual animal performance but also herd health and farm efficiency. In this context, effective management of the period from birth to weaning increases survival rates and ensures the development of healthy, fast-growing individuals.

In modern animal husbandry practices, the lamb and kid rearing process should be based on scientific foundations and supported by developing technologies. The methods employed in this process are among the primary determinants of lamb and kid growth performance, health status, immune system development, and the future production potential of the herd. Lamb rearing encompasses a multifaceted management process, beginning with pre-birth preparation and extending through the post-weaning period.

This study examines the interaction of lamb and kid rearing practices with physiological, behavioral, and environmental factors, emphasizing the importance of science-based approaches for sustainable small ruminant farming.

1.1. Prenatal and Early Postnatal Period in the Growth of Lambs and Kids

In small ruminant farming, raising healthy lambs and kids is a fundamental process that directly impacts herd productivity and economic gain. The success of this process depends on scientifically based care and nutrition practices, starting from prenatal to postnatal. Adequate and balanced nutrition of sheep and goats, especially during pregnancy, is one of the most important factors determining the birth weight and viability of lambs and kids (Castillo-Gutierrez et al., 2022). Maternal nutritional strategies during the last third of pregnancy play a decisive role in offspring development and postnatal performance. Inclusion of essential amino acids, particularly methionine, in the maternal diet can support fetal development and increase birth weight. Methionine supplementation during pregnancy has been reported to positively affect birth and growth parameters but does not significantly alter milk yield and composition (Castillo-Gutierrez et al., 2022).

Rapidly establishing a bond between the lamb and its mother immediately after birth is critical for lamb health. This bond is supported by the lamb's acquisition of the suckling reflex and contact with the mother. Furthermore,

feeding colostrum in the first hours after birth provides a protective barrier against infection, laying the foundation for the immune system. Passive immunity depends on the absorption of colostrum-derived immunoglobulins (Gökçe et al., 2022; Zamuner et al., 2024). Feeding kids colostrum or milk replacer containing 80 mg/ml IgG is expected to provide twice the immune effect compared to feeds with low IgG levels. For optimal performance, colostrum consumption of at least 10% of birth weight within the first 6 hours after birth is recommended (Koşum et al., 2018). It has been determined that each hour of delay after birth significantly reduces IgG absorption, and absorption efficiency decreases significantly, especially with 12-hour delays (Zamuner et al., 2024). Colostrum intake positively affects intestinal health (Zhu et al., 2022). Timely and adequate intake of colostrum directly affects lambs' survival and growth performance. Adequate body reserves in sheep and goats are critical for both the healthy progression of pregnancy and supporting postpartum offspring development (Tozlu Celik et al., 2021; Cimpean, 2025). It has been suggested that offspring born heavier and larger grow faster in the postpartum period; this may increase reproductive performance by triggering the earlier onset of puberty (Castillo-Gutierrez et al., 2022). Therefore, maternal nutrition plans should be optimized not only for milk yield but also for offspring survival and long-term productivity goals. In this context, planning the lamb rearing process in accordance with physiological, immune-based, and environmental requirements is indispensable for the sustainability of small ruminant farming.

1.1.1. The Effect of Mother-Offspring Relationship on Growth

Maternal behaviors in sheep and goats are among the fundamental biological processes that increase the offspring's chances of survival, and the expression of these behaviors is influenced by various environmental and physiological factors (Fonsêca et al., 2016). Reproductive parameters such as parity, litter size, and offspring sex are thought to play a determinant role in maternal behaviors exhibited in the early postpartum period (the first 7 days). Understanding the neuroendocrine mechanisms underlying these behaviors is important for both animal welfare and production efficiency. In this context, maternal behaviors such as suckling, care, following, tending, and udder rejection were observed in Han sheep, and the body weights of the lambs were monitored for 35 days. Additionally, serum estradiol, oxytocin, norepinephrine, dopamine, nitric oxide (NO), and γ-aminobutyric acid (GABA) levels in the dams were determined using ELISA and correlated with behavioral data. Study findings showed that ewes with multiple births exhibited less udder rejection and tending behavior, while higher lamb body

weights were achieved. While ewes with twin lambs exhibited more frequent lactation, ewes giving birth to ewe lambs exhibited significantly higher levels of lactation and caregiving. Neuroendocrine assessments revealed a positive correlation between the quality of maternal behaviors and oxytocin and norepinephrine levels. This study demonstrates that parity, litter size, and litter sex are important factors in the expression of maternal behaviors and that these behaviors are closely linked to neuroendocrine underpinnings (Wang et al., 2021).

1.1.2. Season of Birth

Lamb and kid mortality occurring before weaning in small ruminants causes significant economic losses for producers. To reduce these losses, understanding the effect of calving season on lamb and kid development and survival rates is crucial. A study investigating the influence of calving season on lamb performance demonstrated that lambs born during the winter season exhibited significantly greater live weight and enhanced growth metrics compared to those born in other seasons. These findings indicate that calving season exerts a substantial impact on the growth trajectory and developmental patterns of lambs. In this context, it was concluded that winter lambing provides an advantage in terms of growth performance and can be considered an alternative production strategy in sheep farming (Yilmaz et al., 2007). A study conducted by Ceyhan and Kozaklı (2023) reported statistically significantly higher survival rates for lambs born in summer and autumn. The same study suggested that closer monitoring of male, twin, low birth weight (<3.5 kg) lambs, and those born in winter, could increase survival success (Ceyhan and Kozaklı, 2023).

Another study on Norduz lambs reported that lambs born in winter reached 0.5 kg, 1.6 kg, and 1.7 kg higher live weights at birth, 90, and 180 days, respectively, compared to those born in spring, and these differences were statistically significant ($P < 0.01$) (Yılmaz et al., 2007). According to data by Ceyhan and Kozaklı (2023), the overall pre-weaning survival rate was 75.7%, and the mean survival time was calculated as 62.25 days. In the post-weaning period, birth season and sex had no significant effect on average daily live weight gain (ADG), with single-born lambs having ADG values 16 g/day higher than twin lambs ($P < 0.01$). These findings suggest that birth season has a significant effect on lamb growth patterns and that winter lambing, in particular, provides an advantage in terms of growth performance. In this context, production strategies based on birth season should be evaluated in order to increase productivity and reduce lamb and kid losses in small ruminant farming.

1.1.3. Effect of Birth Weight, Sex and Birth Type

An increase in birth weight stands out as a factor that directly affects neonatal survival. Because low-birth-weight offspring have limited metabolic and physiological adaptation capacities, they are more vulnerable to stress factors encountered in extrauterine life. It has been noticed that offspring with an ideal birth weight tend to have better survival rates and more consistent growth until they are weaned. Lamb birth weight and the difference in birth weight between lambs born in the same litter are among the main parameters affecting survival and growth performance in small ruminants (Juengel et al., 2018). Genetic analyses performed in Texel sheep assessed both direct and maternal genetic influences on birth weight, weaning weight, and post-weaning weight. The estimated direct heritability values for these traits were 0.11, 0.37, and 0.31, respectively. The results underscore the presence of considerable genetic variability in growth-related traits, highlighting the potential for genetic enhancement through targeted selection strategies (Canaza-Cayo et al., 2024). Juengel et al. (2018) conducted a study on 7033 lambs born on pasture, and it was reported that birth weight was significantly affected by factors such as lamb sex, birth type, maternal weight, and parental breed; however, embryo loss and ovulation patterns had no effect on birth weight. Birth weight is considered to be a moderately heritable trait, with a heritability estimate of $h^2 = 0.20$ (Juengel et al., 2018). Maternal age, sex, month of birth, and year of birth were also reported to affect average birth weight, weaning weight, and daily live weight in Kilis goats (Gül et al., 2021).

Male lambs have been reported to show higher live weight gains than females (Rabaa et al., 2025). In Norduz sheep, it has been emphasized that sex and birth type have statistically significant effects on lamb growth, and these factors should be considered in productivity planning (Yilmaz et al., 2007). Another study reported that birth type affects lamb weaning weight (Hızlı et al., 2022). Genotype, birth type, and sex were found to have statistically significant effects on live weights of kids from birth to 6 months of age ($P<0.05$). Furthermore, dam age was found to have a significant effect on live weights, particularly at birth and at 2.5 months of age ($P<0.05$) (Tozlu Çelik and Olfaz, 2018). These results demonstrate that growth performance is closely related to genetic and environmental factors, and herd management strategies should be optimized by considering these variables. Focusing on improving body weight through nutritional, genetic, and management solutions is thought to be beneficial for lamb survival and growth of twins and triplets (Juengel et al., 2018).

2. Postpartum Growth of Lambs and Kids

2.1. Housing and Environmental Effect

Housing conditions in lamb and kid farming are among the key environmental factors that directly impact animal welfare and growth performance. It is vital that lambs, who are susceptible to hypothermia, especially in the first weeks after birth, have a housing environment that is dry, clean, draft-free, and well-ventilated (Figure 1) (Broster et al., 2017). One study reported that reducing the flock size of triplet ewes by 10 during lambing increased the survival of triplet lambs by 1.5% ($P < 0.001$). Lambing triplet ewes in smaller flocks can significantly increase the survival of triplet lambs (Lockwood et al., 2023). Crowded housing increases the risk of disease transmission; therefore, adequate space planning is necessary for lamb and kid per lamb. Significant increases in lamb mortality are observed during periods of concurrent rainfall, low temperatures, and high winds. However, under these stressful environmental conditions, providing shelters that lambs can effectively utilize can play a significant protective role in reducing mortality rates (Broster et al., 2017). It has been reported that flock size (10-150 head), sheep body condition score (2.8-3.5), and feed supplementation (800-2500 kg dry matter/ha) during lambing can have an impact on lamb survival rates (Thompson et al., 2023).

Welfare-focused management systems are implemented in modern lamb and kid shelters, and technological solutions such as high hygiene standards, mechanical ventilation and heating systems, and intra-herd behavioral monitoring reduce stress factors and limit negative effects on growth performance (Altınçekiç and Koyuncu, 2012). It is emphasized that stress negatively affects vital functions in animals, such as the immune system, growth rate, and disease resistance; therefore, shelter-related stress factors must be carefully managed (Atkin-Willoughby et al., 2022).

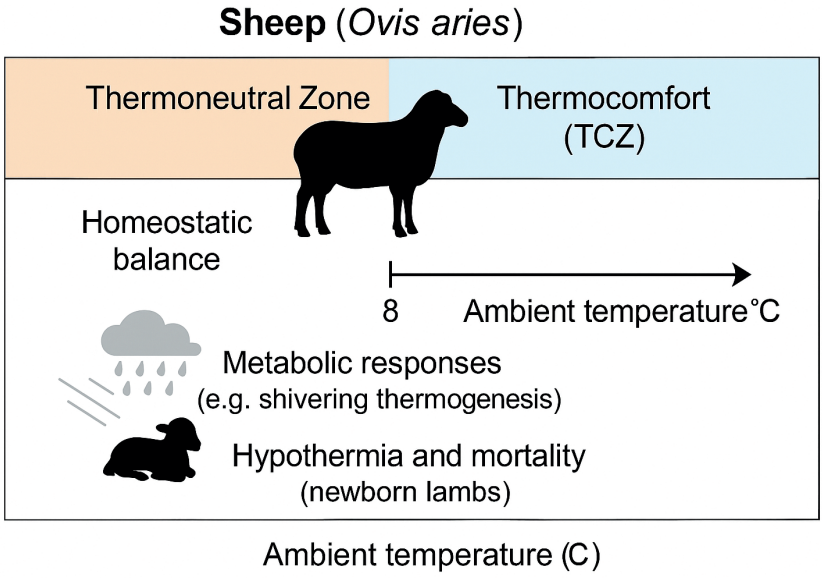

Figure 1. Thermal Zones and Survival Dynamics of Newborn Lambs

Barn ventilation systems play a critical role, particularly in controlling temperature, humidity, and harmful gases (CO_2, NH_3, H_2S). One study reported a 15% increase in live weight and increased thyroxine hormone levels in lambs in fan-cooled barns (Koluman and Daskiran, 2011). Consequently, designing and managing lamb and kid barns to meet physiological needs both improves animal welfare and supports production efficiency. In this context, integrated management of elements such as barn hygiene, ventilation, and stress management is a fundamental requirement for sustainable small ruminant farming.

2.2. Feeding Effect

Sheep and goat farming in developing countries is critical for climate resilience and socioeconomic contributions. However, global heat stress causes significant economic losses in production systems and negatively impacts sheep's productivity, reproductive performance, and growth performance. These negative effects can be mitigated through management, genetics, and, particularly, nutritional strategies. Nutritional interventions stand out as one of the most cost-effective methods for alleviating heat stress. In this context, antioxidant supplements (e.g., vitamins B and E, selenium, zinc, naringin, seaweeds, etc.), electrolyte supplements (sodium bicarbonate, potassium bicarbonate, sodium hydroxide), mineral mixtures

(chromium, zinc, mineral blocks), and probiotics (various bacterial and yeast strains) support animal physiological responses, immunity, and production efficiency. Furthermore, prebiotics and various herbal supplements (e.g., rosemary, cinnamon, turmeric, and moringa) have positive effects on growth performance, feed intake, antioxidant capacity, and reproductive health. Effective implementation of these nutritional strategies can contribute to the sustainability of sheep production under changing climatic conditions (Rebez et al., 2025).

Feed additives (prebiotics and probiotics) are used to stabilize a healthy gut microbiome by supporting beneficial microorganisms, thus improving animal growth rate. One study found that increasing prebiotics to 0.15% increased average daily gain and feed efficiency compared to the control group, and prebiotic supplementation was reported to improve nutrient digestibility and nutritional value (Shoukry et al., 2023). Furthermore, further research is needed to investigate the effects of prebiotics, probiotics, and synbiotics as feed additives on productivity and reproductive performance in ruminants (Shoukry et al., 2023).

Feeding strategies in lamb farming aim to promote rumen development, leading to early weaning and healthy growth. Providing lambs fed milk in the first week of life with highly digestible, energy- and protein-rich starter feeds and clean water from the second week onward is critical for early activation of rumen functions. Weaning usually occurs between 6 and 10 weeks of age. This process should be planned individually based on the lambs' feed intake and developmental stage. Nutritional programming implemented early in the lambing period shapes later-term productivity characteristics and has lasting effects on the immune system, digestive capacity, and growth performance. In this context, functional foods such as natural plant extracts (e.g., garlic, thyme, and propolis), functional oils (especially omega-3 fatty acids), microminerals, and vitamin supplements offer supportive contributions to physiological development (Atılgan and Karabıyıklı Çiçek, 2021).

Individual monitoring and performance optimization can be achieved with technologies such as automated feeding systems developed to meet individual care needs in large herds and RFID-supported feeders that monitor milk consumption and weight gain per lamb (Kavurur, 2023; Tüfekci and Tozlu Çelik, 2024). These systems, as a reflection of digitalization in herd management, increase animal welfare and production efficiency.

A study conducted in subtropical climate conditions found that the use of eubiotics (probiotics and prebiotics), either alone or in combination,

increased feed efficiency and dietary energy utilization in Pelibuey × Katahdin crossbred lambs, was effective in reducing the negative effects of heat stress, and improved fattening performance. A probiotic-prebiotic combination was reported to significantly improve daily live weight gain (Estrada-Angulo et al., 2021). Similarly, a study by Mohamed et al. (2022) found that 5 g of daily probiotic supplementation positively affected live weight gain, digestibility, and feed conversion rates.

In a study conducted on the Mediterranean islands of Spain, the meat quality of Mallorquina and Roja Mallorquina male lambs was evaluated depending on the rearing system. Lambs fed continuous breast milk had higher lactic acid and milk aroma notes in their meat, while lambs fed concentrates had higher undesirable fatty acids. These results suggest that prolonged access to breast milk before weaning is a determining factor in sensory quality in traditional Mediterranean lamb production (Gutiérrez-Peña et al., 2022).

3. Factors Affecting Survival in Lambs and Kids

Survival and growth performance in lamb and kid farming are closely linked to preventive health practices against infectious diseases, biological factors, and environmental stressors. Diarrhea and respiratory infections, particularly common during the growing season, can negatively impact lamb and kid development; therefore, regular vaccination programs, parasite control, and hygiene practices are crucial (Hatami et al., 2022; Alavedra et al., 2025). Biosecurity measures aim to minimize the risk of disease transmission, and preventive measures such as barn cleaning, navel disinfection, and antiserum applications support lamb and kid health (Sejian et al., 2021).

One study found a positive correlation between lamb survival and birth weight; when the birth weight difference between lambs born in the same litter was >1.3 kg, the survival rate decreased to 73.3%, while this rate ranged from 82.8% to 85.7% in lambs with lower birth weight differences (Juengel et al., 2018). Birth weight has also been reported to be positively correlated with the growth performance of twin and triplet lambs, with lambs with moderately high birth weight differences having approximately 3% higher growth rates. In a survival analysis conducted by Ceyhan and Kozaklı (2023) using data from 11523 lambs, the overall pre-weaning survival rate was 75.7%, and the average survival time was 62.25 days. It has been determined that male lambs have a higher risk of mortality than females, singleton lambs have a lower risk of mortality than twins,

and lambs with a birth weight over 3.5 kg have a higher probability of survival (Ceyhan and Kozaklı, 2023). On the other hand, heat stress, one of the environmental stress factors for small ruminants in semiarid regions, challenges thermoregulatory capacity and can limit growth performance. In a study conducted by Silveira et al. (2025), the relationships between thermoregulatory responses and hematological, behavioral, morphometric, and carcass characteristics in 4-month-old male lambs were evaluated. Thermoregulatory variables were reported to be significantly correlated with non-carcass components ($P = 0.002$), carcass performance ($P = 0.027$), commercial meat cuts ($P = 0.032$), and morphometric measurements ($P = 0.029$), while a trend toward behavioral responses ($P = 0.078$) was observed. These findings suggest that lamb survival and growth performance are shaped not only by genetics and feeding strategies but also by environmental stressors and physiological adaptability. Therefore, developing climate-resilient and welfare-focused breeding programs should be considered a strategic imperative for the sustainability of small ruminant farming.

4. Advanced Techniques in Lamb and Kid Raising

In addition to traditional rearing methods, with the advancement of livestock technologies, awareness is rising regarding the use of advanced techniques to increase growth performance, reduce environmental stress, and improve animal welfare. New technologies are improving animal welfare, health, and the sustainability of production through the monitoring and management of animal behavior. Increasing awareness of solutions developed for these systems can encourage adoption. The use of technologies for sheep and goat farming focuses on thermal stress, colostrum intake, passive immunity, offspring survival, metabolic disease biomarkers, and parasite resistance (Silva et al., 2022).

Sensor and imaging technologies, including wearable sensors that monitor parameters such as body temperature, mobility, and eating and drinking behaviors within the scope of Precision Livestock Farming (PLF), thermal cameras for early disease detection, image processing, and artificial intelligence-based weight estimation systems enable continuous monitoring of the growth process (Kavurur, 2023; Tüfekci and Tozlu Çelik, 2024). Early weaning and functional rumen development have been promoted to reduce feed costs and achieve more efficient growth. In this process, the digestive system is supported by rumen development-promoting starter feeds, probiotic and prebiotic additives, and inert yeast cultures (Estrada-Angulo et al., 2021; Mohamed et al., 2022). The success of early slaughter is directly related to the provision of high-quality starter feeds and access

to clean water. The risk of disease in lambs and kids is high during the growing period. Therefore, disease resistance is being increased by using new-generation vaccines (recombinant, subunit) and natural immune stimulants (β-glucans, inactivated yeast cell walls). Vaccination schedules are being tailored to specific pathogens. Advanced biotechnological applications such as genomic selection (using SNP chips), embryo transfer, and early-age sex determination, which identify genetic factors affecting growth rate, enable the reproduction of superior genotypes. These methods accelerate the process of genetic advancement. The primary goals of these technologies are to reduce labor costs, minimize the need for supplemental feeding, and increase production performance on an individual animal basis. However, extensive sheep farming systems are influenced by numerous external factors, such as local and global market conditions, government policies, and cultural dynamics, which can limit the adoption of innovative technologies (Odintsov Vaintrub et al., 2021). As noted in a qualitative study conducted by Kaler and Ruston (2019), the financial sustainability of farms, producers' level of trust in technology, and openness to new ideas stand out as the primary constraints preventing the widespread adoption of PLF technologies. However, current economic and environmental trends affecting the agricultural sector have the potential to alter these dynamics. In this context, the widespread adoption of PLF technologies may be facilitated by farmer profiles that are more open to innovation and have a higher capacity for adaptation (Odintsov Vaintrub et al., 2021).

The use of advanced, intelligent analysis methods is recommended to reveal correlations between physiological and morphological parameters associated with thermoregulation in production animals and to clarify the underlying biological mechanisms driving these relationships. The identified phenotypic biomarkers are of particular importance in the context of animal welfare and environmental adaptation. In this context, longitudinal studies examining changes in thermoregulatory responses across different environmental conditions and timeframes can provide important information for assessing the adaptive capacity of animal populations to climate change. These findings highlight the need to combine phenomic data and computational modeling techniques to guide genomic selection strategies within the context of breeding programs prioritizing climate resilience and animal welfare (Silveira et al., 2025).

5. Conclusion

The study demonstrates that the integration of new technologies into widespread sheep and goat farming systems contributes to improved animal

welfare by enabling more accurate monitoring and prediction of health, lambing, nutrition, and management problems. These technologies have been successfully implemented in species such as poultry and dairy cattle and also hold promise for small ruminants. The findings highlighted in the review highlight the need for a scientific and technical approach to developing sustainable solutions for widespread production systems, emphasizing the need for a holistic and global perspective. The success of this process depends on a high level of integration and collaboration among not only the research community but also all stakeholders, including farmers, technicians, veterinarians, animal production specialists, consumers, and policymakers (Silva et al., 2022).

Advanced techniques used in lamb and kid rearing positively impact not only individual development but also herd health, economic profitability, and environmental sustainability. These scientifically based practices increase production efficiency, particularly in commercial enterprises, shaping the future of modern small ruminant farming. However, the successful implementation of these techniques requires a combination of trained personnel, technical equipment, and appropriate management strategies.

Lambs and kids should be weighed regularly to monitor growth performance, weight gain should be monitored, and individuals exhibiting developmental delays should be identified early. Practices such as early weaning, group separation, individual or group-based feeding, and castration of male lambs and kids should be planned in line with production goals. The adoption and economic support of new practices in this area will enable the implementation of modern techniques in small ruminant farming, thereby increasing breeders' incomes.

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