OPEN ACCESS
Advances in Animal and Veterinary Sciences
Research Article

The Effect of Ewe Age on Birth Weight and Litter Size of Texel Cross Sheep Mated with Dorper and Awassi Rams

Asrullah As[1], Adimas Sandi Purwoagung[1], Tri Eko Susilorini[1], Wike Andre Septian[1], Chairdin Dwi Nugraha[2], Rafika Febriani Putri[1], Ari Ardiantoro[1], Suyadi Suyadi[1]*

[1]Faculty of Animal Science, Brawijaya University, Malang 65145, Indonesia; [2]Research Center for Animal Husbandry, National Research and Innovation Agency Republic of Indonesia (BRIN), Bogor, 16911, Indonesia.

Abstract | This study evaluates the effects of ewe age and parity on lamb birth weight and litter size in Texel cross sheep bred with Dorper and Awassi rams in Indonesia. The research involved 110 Texel cross ewes divided into three parity groups based on age, mated with purebred Dorper and Awassi rams. Data on birth weight, litter size, and lamb sex ratios were collected and analyzed using ANOVA with Bonferroni post-hoc test, regression analysis, and Chi-Square tests. Results showed no significant effect of maternal age on lamb birth weight or litter size in either crossbreed (P>0.05), although there was a tendency for both to increase with advancing maternal age. Dorper x Texel cross lambs averaged 2.00±0.71 kg for birth weight and 1.56±0.71 for litter size, while Awassi x Texel cross lambs averaged 2.31±0.83 kg and 1.43±0.61, respectively. Litter size significantly influenced lamb birth weight (P<0.05), with single births producing the highest weights (Dorper cross: 2.24±0.86 kg; Awassi cross: 2.86±0.77 kg), followed by twins (Dorper cross: 2.11±0.78 kg; Awassi cross: 2.04±0.58 kg) and triplets (Dorper cross: 1.46±0.36 kg; Awassi cross: 1.41±0.50 kg). Higher variability in birth weights was observed in Dorper x Texel cross (CV 24.66%-47.12%) compared to Awassi x Texel cross (CV 25.69%-41.40%). Lamb sex did not significantly affect birth weight in either crossbreed (P>0.05). Sex ratios did not significantly deviate from the theoretical 1:1 ratio (χ^2 = 2.40 and 1.38, P>0.05) for both crosses. This study demonstrates that while maternal age does not significantly impact reproductive parameters, litter size substantially affects lamb birth weight in both crossbreeds under Indonesian conditions.

Keywords | Texel cross sheep, Dorper sheep, Awassi sheep, Ewe age, Litter size, Lamb birth weigh

Received | September 07, 2024; **Accepted** | January 21, 2025; **Published** | July 05, 2025
***Correspondence** | Suyadi, Faculty of Animal Science, Brawijaya University, Malang 65145, Indonesia; **Email:** suyadi@ub.ac.id
Citation | As A, Purwoagung AS, Susilorini TE, Septian WA, Nugraha CD, Putri RF, Ardiantoro A, Suyadi S (2025). The effect of ewe age on birth weight and litter size of texel cross sheep mated with dorper and awassi rams. Adv. Anim. Vet. Sci. 13(8): 1672-1680.
DOI | https://dx.doi.org/10.17582/journal.aavs/2025/13.8.1672.1680
ISSN (Online) | 2307-8316; **ISSN (Print)** | 2309-3331

INTRODUCTION

Sheep are integral to Indonesian smallholder farming systems, valued for their adaptability, rapid reproduction, and role as a protein source. However, the national sheep population has experienced a significant decline from 17.83 million in 2019 to 15.62 million in 2022, primarily due to genetic limitations, traditional management

practices, and limited access to advanced breeding technologies (BPS, 2022). This decline necessitates effective genetic improvement strategies to enhance sheep productivity.

Crossbreeding with exotic breeds, particularly Dorper and Awassi sheep, has emerged as a promising approach for genetic improvement in Indonesia. Dorper sheep, developed from Dorset Horn and Blackhead Persian crosses, are known for their superior growth rates and carcass quality. Adult Dorper rams can reach weights of up to 130 kg, while ewes typically weigh between 80-110 kg (Milne, 2000; Noor and Hidayat, 2017). Their reproductive performance is notable, with single birth weights averaging 3.5 ± 0.2 kg (Csizmar *et al*., 2013). Similarly, Awassi sheep from the Middle East offer valuable multipurpose traits, producing an average of 91 liters of milk per 100-day lactation period even under challenging conditions (Haile *et al*., 2017). Their adaptability to tropical environments and ease of handling make them particularly suitable for crossbreeding programs (Üstüner and Oğan, 2013).

Maternal age plays a crucial role in determining reproductive success in sheep populations. Research conducted in Indonesia demonstrates that mature ewes (>3 years) consistently outperform younger ewes in key reproductive metrics. Specifically, older ewes produce significantly heavier lambs (2.5 ± 0.3 kg compared to 1.8 ± 0.2 kg in younger ewes) and achieve higher litter sizes (1.76 ± 0.3 versus 1.33 ± 0.2 lambs) (Hudori *et al*., 2022). These reproductive advantages are primarily attributed to enhanced uterine capacity and optimized hormonal profiles characteristic of mature ewes (Anggraini *et al*., 2020).

While broad improvements through strategic crossbreeding have been documented in various studies (Tesema *et al*., 2020; Getachew *et al*., 2016), significant knowledge gaps persist regarding the specific interactions between maternal age and reproductive parameters in Dorper and Awassi crosses under tropical conditions. This understanding is particularly relevant given recent field observations showing distinct progeny sex ratio patterns: Dorper crosses tend toward male offspring (58.5%), while Awassi crosses show a female bias (56.9%) when bred with Texel cross ewes (Hudori *et al*., 2022). However, the combined effects of these genetic factors on critical production parameters such as birth weight, litter size, and sex ratios remain inadequately understood, particularly in tropical environments.

These preliminary observations underscore the complex interplay between genetic factors and physiological responses influenced by sire breed, highlighting the need for more comprehensive research to inform flock management and production strategies. Therefore, this study aims to evaluate how ewe age and parity influence reproductive performance, specifically focusing on lamb birth weight and litter size, in Texel cross sheep bred with Dorper and Awassi sires under tropical conditions. The findings will provide crucial data for optimizing breeding programs and enhancing the economic sustainability of sheep farming in Indonesia.

MATERIALS AND METHODS

Ethical Approval

This study was approved by the ethical clearance committee of Brawijaya University, Indonesia (Ethical Clearance No.192-KEP-UB-2024). All procedures were conducted in accordance with institutional guidelines for the care and use of animals in research.

Location of Study

The study was conducted at CV Kambing Burja, located in Bedali Village, Lawang Subdistrict, Malang Regency, East Java, Indonesia (7°50'20" S, 112°37'50" E). This location was purposefully chosen due to its active sheep breeding programs involving Texel cross ewes and purebred Dorper and Awassi rams. The research was carried out from April to June 2023 (dry season) for the mating period, and from September to November 2023 (rainy season) for the lambing period. The farm is situated at an altitude of approximately 550 meters above sea level, characterized by a tropical wet climate with an average temperature of 25–30°C and rainfall of 100–200 mm per month.

Experimental Animals

The experimental subjects included 110 Texel cross ewes, divided into three parity groups based on age: P1 (<2 years), P2 (2–3 years), and P3 (>3 years). These groups were stratified to ensure balanced representation, with 32, 37, and 41 ewes in P1, P2, and P3, respectively. These numbers were based on the ewes that gave birth during the September to November 2023 period. The breeding program utilized two sires: a purebred Dorper ram that was mated with 59 ewes and a purebred Awassi ram that was mated with 51 ewes. Both rams were mature breeding males, each weighing approximately 80 kg and aged over two years. Within each parity group, the ewes were randomly assigned to either of the two rams for mating (Figure 1).

Management and Feeding Practices

The sheep were managed under standardized husbandry practices. They were housed in elevated wooden-floored sheds to ensure proper ventilation and sanitation. The diet consisted of fresh Pakchong grass (*Pennisetum purpureum* cv. Thailand), provided at 10% of the ewe's body weight daily, supplemented with a formulated concentrate feed containing 14% crude protein. The ingredients used for making concentrate feed include cassava cobs, coffee husks, corn, kapok seeds, cassava peels, coconut meal, CGF (Corn Gluten Feed), SBM (Soybean Meal) or soybean meal,

DDGS (Distillers Dried Grains), soy sauce residue, iodised salt, lime, sheep premix, molasses, FML (Fermented Mother Liquor), Soby (Sodium Bicarbonate), and pollard. The selection and usage of these ingredients are tailored based on the sheep's gender and age phase. Clean drinking water was provided ad libitum. Health checks were conducted biweekly to monitor the general condition of the flock.

Figure 1: Phenotypic color variations in different sheep crossbreeds. **A:** Texel Cross Ewe showing white wool with a long tail pattern; **B:** One-day-old Dorper x Texel Cross Lamb with solid black or black-and-white pattern on the head, pure white body coloration, and long tail pattern similar to Texel Cross Ewe; **C:** One-day-old Awassi x Texel Cross Lamb displaying cream-colored wool with distinctive light brown patches on the head and face region, and long tail pattern resembling the Texel Cross Ewe.

Table 1: Sex Ratio of offspring from crossbreeding dorper and awassi rams with texel cross ewes.

Crossbreeding	Number of Dams	Number of Lambs	Male n (%)	Female n (%)	X^2
Dorper x Texel Cross	59	94	55 (58%)	39 (42%)	2.72
Awassi x Texel Cross	51	73	32 (44%)	41 (56%)	1.11

Note: Chi-square (X^2) test, critical value at $\alpha = 0.05$, df = 1 is 3.841 (P>0.05).

Data Collection

Data collection focused on key reproductive parameters, including birth weight, litter size, and lamb sex ratios. Birth weight was measured within 24 hours of lambing using a digital scale with an accuracy of 0.01 kg. Litter size was recorded as the total number of lambs per birth, categorized as single, twin, or triplet births. The sex of each lamb was also documented immediately after birth. Environmental factors such as ambient temperature and humidity were noted to evaluate their potential influence on the reproductive outcomes.

Statistical Analysis

Statistical analysis was performed to assess the relationships between ewe parity and reproductive performance. Prior to analysis, data were tested for normality using the Kolmogorov-Smirnov test and for homogeneity of variances using Levene's test. Analysis of variance (ANOVA) with a significance level of $\alpha = 0.05$ was employed to compare birth weights and litter sizes across parity groups based on age, while regression analysis was used to examine the relationship between parity and the measured reproductive parameters. Differences between treatments were further analyzed using Bonferroni post-hoc test. Additionally, the Chi-Square test was applied to analyze the association between ewe parity and the sex ratio of lambs. The R Studio Programme (version 2024.09.0) and IBM SPSS Statistics (version 26) used to anlyse the data.

RESULTS AND DISCUSSION

Lamb Sex Ratio

The chi-square analysis of the sex ratio in crossbred lambs showed a χ^2 value of 2.72 and 1.11 with a P-value > 0.05, both for Dorper x Texel Cross (58% male; 42% female) and Awassi x Texel Cross (44% male; 56% female) (Table 1). While these differences were not statistically significant, the contrasting patterns between the two crossbreeds warrant further discussion. The Dorper crosses' tendency toward male offspring and Awassi crosses' inclination toward female offspring may be attributed to several underlying factors related to breed characteristics and physiological mechanisms.

In Dorper crosses, the higher proportion of male offspring (58%) aligns with findings by Zülkadir and Karabacak (2013), who reported similar male-biased sex ratios in meat-type sheep breeds. This bias might be related to the Dorper's selection history for meat production traits, which could influence sex determination mechanisms. The larger body size and higher muscle mass characteristic of Dorper rams might affect sperm motility patterns or the survival rates of Y-chromosome-bearing spermatozoa. Similar findings were reported by Al-Thuwaini and Al-Hadi (2022), who observed a correlation between ram breed type and offspring sex ratio in meat-focused breeding programs.

Conversely, the Awassi crosses' tendency toward female offspring (56%) presents an interesting contrast that may be linked to their dairy breed characteristics. This pattern has been observed in other dairy sheep breeds, as reported by Boujenane and Diallo (2017), who found a slight female bias in dairy-oriented crossbreeding programs. The physiological basis for this bias might involve differences in placental development, maternal recognition of pregnancy, or hormone profiles characteristic of dairy breeds. However, it's important to note that these sex ratio differences were not statistically significant in our study, suggesting that other factors may influence sex determination.

The variation in sex ratio distribution patterns could also be influenced by environmental and management factors. Temperature, nutrition, and breeding season have been shown to affect sex ratios in sheep, as documented by

Thompson *et al.* (2021). The timing of mating during the dry season (April-June) might have interacted differently with the physiological characteristics of Dorper and Awassi rams, potentially influencing the sex ratio outcomes. Additionally, factors such as ram age, semen quality, ejaculation frequency, and scrotal circumference could contribute to these patterns, as suggested by Martínez-Velázquez *et al.* (2003).

A review of previous studies reveals inconsistent findings regarding breed-specific sex ratios. While some researchers have reported similar breed-based patterns (Kurnianto, 2022; Al-Shuhaib and Al-Hadi, 2022), others have found no consistent relationship between breed type and offspring sex ratio. This variability suggests that sex determination in sheep is a complex trait influenced by multiple genetic, environmental, and management factors. Future research should focus on larger sample sizes and multiple breeding seasons to better understand the mechanisms underlying these breed-specific patterns in sex ratio determination.

The practical implications of these findings for breeding programs warrant consideration. While the observed sex ratio differences were not statistically significant, understanding breed-specific tendencies could help farmers better plan their breeding strategies, particularly when specific sex ratios are desired for production or flock replacement purposes. However, more research is needed to confirm whether these patterns are consistently reproducible across different environments and management systems.

Lamb Birth Weight Based on Maternal Age

The statistical analysis revealed no significant effect (P>0.05) of maternal age on lamb litter size in both Dorper x Texel and Awassi x Texel crossbreeding programs. While not statistically significant, both crosses showed interesting trends: Dorper x Texel exhibited a consistent increase in litter size from P1 to P3, while Awassi x Texel showed an increase from P1 to P2 followed by a slight decrease in P3 (Table 2). The high coefficient of variation (CV: 39.87% to 47.16%) indicates substantial variability in litter size across both crossbreeding types.

The trend of older ewes (P3) producing heavier lambs compared to younger (P1) and intermediate-aged (P2) ewes aligns with findings by Meddah (2024) and Thompson *et al.* (2021). Ceyhan *et al.* (2019) attribute this pattern to the physiological maturity of older ewes, which optimizes fetal development. However, Gaur *et al.* (2021) suggest that younger ewes under optimized nutritional management can potentially bridge this performance gap in birth weights.

McGovern *et al.* (2020) and Abebe *et al.* (2023) emphasize that birth weight variations in sheep result from genetic variation, management practices, and climatic influences. Supporting this, Dwatmadji *et al.* (2017) notes that uniform management practices can minimize birth weight differences. Additionally, Al-Shuhaib and Al-Hadi (2022) highlight the importance of body condition scores in supporting lamb growth, suggesting an area for further investigation in tropical sheep farming.

Table 2: Effect of maternal age (parity) on birth weight of lambs from crossbreeding dorper and awassi rams with texel cross ewes.

Crossbreeding	Parity (n)	Number of Lambs	Mean Birth Weight (kg) ± Standard Deviation	CV (%)[1]
Dorper x Texel Cross	P1 (16)	21	1.93±0.61	31.61
	P2 (18)	29	1.94±0.56	28.87
	P3 (25)	44	2.08±0.98	47.12
Awassi x Texel Cross	P1 (16)	20	2.18±0.56	25.69
	P2 (19)	29	2.19±0.90	41.40
	P3 (16)	24	2.60±0.90	34.62

[1]**CV:** Coefficient of Variation, expressing the ratio of the standard deviation to the mean as a percentage, indicating the relative variability of birth weights within each group.

The lack of statistical significance can be attributed to several interrelated factors within the production system. The standardized feeding protocol at the research facility, which included consistent provision of Pakchong grass (10% of body weight) and concentrated feed (14% crude protein), may have equalized the nutritional status across all age groups. This optimal nutrition likely enabled younger ewes to compensate for their physiological limitations, allowing them to support fetal development comparable to older ewes.

The high coefficient of variation suggests substantial genetic diversity within the Texel cross population. Additionally, the controlled environment of the farm (altitude 550m, temperature 25-30°C) and strategic breeding timing (dry season: April-June, lambing during rainy season: September-November) may have provided optimal conditions for all ewes regardless of age. Younger ewes might have compensated for their physiological immaturity through more efficient nutrient utilization, better adaptation to the tropical environment, and enhanced placental development under optimal management conditions, aligning with McGovern *et al.* (2020)'s emphasis on the complex interaction between environmental factors and maternal physiology.

Lamb Litter Size Based on Maternal Age

The statistical analysis revealed no significant effect (P>0.05) of maternal age on lamb litter size in both Dorper x Texel and Awassi x Texel crossbreeding programs. While

not statistically significant, both crosses showed interesting trends: Dorper x Texel exhibited a consistent increase in litter size from P1 to P3, while Awassi x Texel showed an increase from P1 to P2 followed by a slight decrease in P3 (Table 3). The high coefficient of variation (CV: 39.87% to 47.16%) indicates substantial variability in litter size across both crossbreeding types.

Table 3: Effect of maternal age on litter size in dorper and awassi crosses with texel ewes.

Crossbreeding	Parity (n)	Number of Ewes	Mean Litter size ± Standard Deviation	CV (%)[1]
Dorper X Texel Cross	P1 (16)	16	1.31±0.60	45.80
	P2 (18)	18	1.61±0.70	43.48
	P3 (25)	25	1.76±0.83	47.16
Awassi X Texel Cross	P1 (16)	16	1.25±0.58	46.40
	P2 (19)	19	1.53±0.61	39.87
	P3 (16)	16	1.50±0.63	42.00

[1]**CV:** Coefficient of Variation, expressing the ratio of the standard deviation to the mean as a percentage, indicating the relative variability of litter sizes within each group.

The relatively high coefficient of variation (CV) values ranging from 39.87% to 47.16% indicate a large variability in litter size for both types of crossbreeding. These results show that although there is a trend of increasing litter size with advancing maternal age, maternal age is not the sole factor determining litter size, and there are likely other influential factors such as genetics, nutrition, and management practices. Differences in birth type are caused by genetic and environmental factors such as gene mutations, genetic selection, management practices, and molecular mechanisms that affect ovulation rate and follicle development. Montgomery (2024) identifies the role of complex genetic mutations and molecular mechanisms in regulating ovulation and follicle development. Hulsman Hanna *et al.* (2023) emphasize that a ewe's birth type (single vs. multiple) significantly influences her future reproductive performance, with single-birth ewes showing advantages in long-term productivity. This observation aligns with findings from Martínez-Velázquez *et al.* (2003) and Haya *et al.* (2020), who attribute the prevalence of single births to the predominant use of single-birth parents in breeding programs.

Despite the lack of statistical significance, older ewes (P3) demonstrated a tendency toward larger litters, consistent with research by Al-Janabi (2023) and Su (2024). These researchers identified both maternal age and genetic markers, particularly the FecB gene, as important determinants of litter size. The trend may be attributed to enhanced uterine capacity and improved hormonal regulation in mature ewes.

The study's high CV values suggest significant environmental and management influences on reproductive outcomes. Kandiwa *et al.* (2020) highlight the importance of seasonal variations and nutrition in determining litter size, particularly in tropical environments where heat stress and feed availability present unique challenges. The intensive management system employed may have optimized reproductive performance across age groups through consistent health monitoring and preventive care.

The crossbreeding program's impact on genetic variation in reproductive traits is reflected in the high CV values (39.87% to 47.16%). The tropical environment's influence on reproductive physiology may differ from temperate regions, affecting hormonal profiles and ovulation rates independently of age. These findings suggest that under optimal management conditions, maternal age may have less impact on reproductive performance than previously assumed, emphasizing the need for comprehensive approaches in sheep breeding programs that consider multiple environmental and genetic factors.

Lamb Birth Weight Based on Litter Size

Based on the data presented in Table 4, single births produce the highest birth weight, followed by twin births and triplets. Additionally, there are differences in lamb birth weights based on litter size from crossbreeding Dorper and Awassi rams with Texel cross ewes. In the Dorper x Texel cross, birth weights of lambs with litter sizes 1 and 2 show no significant difference ($P>0.05$), but both differ significantly ($P<0.05$) from litter size 3, which has a lower birth weight. A similar pattern is observed in the Awassi x Texel cross, where birth weights of lambs with litter size 1 differ significantly ($P<0.05$) from both litter sizes 2 and 3.

Table 4: Effect of litter size on lamb birth weight in dorper and awassi crosses with texel ewes.

Cross-breeding	Litter Size	Number of Lambs	Mean Birth Weight (kg) ± Standard Deviation	CV (%)[1]
Dorper x Texel cross	1	33	2.24 ± 0.86[a]	38.40
	2	39	2.11 ± 0.78[a]	36.97
	3	22	1.46 ± 0.36[b]	24.66
Awassi x Texel Cross	1	32	2.86 ± 0.77[a]	29.92
	2	32	2.04 ± 0.58[b]	26.92
	3	9	1.41 ± 0.50[c]	35.46

[1]**CV:** Coefficient of Variation, expressing the ratio of the standard deviation to the mean as a percentage, indicating the relative variability of birth weights within each group. [a,b,c] Different superscripts within the same column indicate significant differences ($P<0.05$).

The coefficient of variation (CV) values ranging from 24.66% to 38.40% indicate a fairly high variability in the birth weights of these crossbred lambs. Birth weights based on litter size show a significant negative correlation ($P<0.05$) in both Dorper x Texel Cross and Awassi x Texel

Cross. Birth weight shows a decreasing trend with increasing litter size, where litter size 1 shows the highest average birth weight, followed by litter size 2, and litter size 3 shows the lowest birth weight. The inverse relationship between litter size and birth weight, where single-born lambs were significantly heavier than twins and triplets (P<0.05), aligns with findings by Behrem (2021) and Aksoy *et al.* (2023). This trend can be attributed to nutrient competition during gestation, as highlighted by Gaur *et al.* (2021). Single lambs benefit from greater placental resource allocation, resulting in higher birth weights.

Studies across tropical regions consistently demonstrate the inverse relationship between litter size and birth weight. Research by Pinheiro *et al.* (2020) in Brazil showed that single births yielded higher weights compared to multiple births due to reduced maternal resource competition. Similarly, Olateju and Chineke (2022) found that larger litter sizes significantly decreased individual birth weights across various livestock species, highlighting this as a universal biological principle.

Chay-Canul *et al.* (2019) emphasized that environmental factors and maternal health significantly influence these birth outcomes.

The tropical climate plays a crucial role in birth weight patterns. Bakhtsiyarava *et al.* (2018) demonstrated in Kenya and Mali that temperature and precipitation variations directly affect fetal development. Adi (2023) further noted that higher temperatures intensify the effects of intrauterine competition in multiple pregnancies, highlighting the critical relationship between climate and reproductive outcomes in tropical livestock production." to "The tropical climate plays a crucial role in birth weight patterns. Bakhtsiyarava *et al.* (2018) demonstrated in Kenya and Mali that temperature and precipitation variations directly affect fetal development. Adi *et al* (2024) further noted that higher temperatures intensify the effects of intrauterine competition in multiple pregnancies, highlighting the critical relationship between climate and reproductive outcomes in tropical livestock production. Chay-Canul *et al.* (2019) emphasized that environmental factors and maternal health significantly influence these birth outcomes.

Table 5: Effect of lamb sex on birth weight in dorper and awassi crosses with texel ewes.

Cross-breeding	Sex of lambs	Number of Lambs	Mean Birth Weight(kg) ±Standard Deviation	CV (%)[1]
Dorper x Texel cross	Male	55	2,00±0,71	28,09
	Female	39	2,01±0,90	44,79
Awassi x Texel Cross	Male	32	2,26±0,82	36,64
	Female	41	2,36±0,83	35,49

[1]**CV:** Coefficient of Variation, expressing the ratio of the standard deviation to the mean as a percentage, indicating the relative variability of birth weights within each group.

Multiple factors influence lamb birth weight beyond litter size. Boujenane and Diallo (2017) found that single lambs benefit from enhanced nutrient access throughout pre- and postnatal development. Habtegiorgis *et al.* (2022) identified additional factors including ewe parity, management practices, and seasonal variations, noting increased litter sizes during dry seasons and higher birth weights during rainy seasons. Long-term selection programs have proven effective in improving both litter size and birth weight across generations, emphasizing the importance of proper management and adequate feeding, particularly for high-parity ewes and multiple births.

Lamb Birth Weight Based on Sex

Based on the data in Table 5, in the Dorper x Texel cross, the difference in birth weight between male and female lambs does not show statistical significance (P>0.05), indicating that sex does not have a significant effect on birth weight in this cross. Meanwhile, in the Awassi x Texel cross, there is a small difference between the birth weights of male and female lambs, but statistically it also does not show a significant difference (P>0.05). Regression analysis confirms a positive correlation between sex and birth weight, but this relationship is not statistically significant (P>0.05).

The coefficient of variation (CV) values in the Dorper x Texel cross show that female lambs have a much higher CV (44.79%) compared to male lambs (28.09%), indicating high variability in birth weight in the female group. On the other hand, the Awassi x Texel cross displays a more balanced variability between the two sexes, with CV values of 36.64% for males and 35.49% for females, indicating better consistency in birth weight variability. The difference in CV patterns between the two crosses suggests that the genetic background of the rams (Dorper and Awassi) potentially influences the level of uniformity in lamb birth weights based on sex.

These results show that sex does not significantly affect birth weight in crossbred lambs. The main determining factor is the individual body size of the lamb at birth, regardless of sex. At the research location, it was found that lamb body size positively correlates with birth weight, where the larger the lamb's body size, the greater the birth weight obtained. These results differ from Heryanto *et al.* (2019) who stated that the average birth weight of males is higher than females in both single and twin births due to the influence of the hormonal system. Previous research results also show different outcomes from this study, where the average birth weights were: Dorper males 3.90 ± 0.19 kg and females 3.71 ± 0.11 kg (Csizmar *et al.* 2013), Awassi

males 4.79 ± 0.03 kg and females 4.46 ± 0.03 kg (Sireli *et al.* 2015), Texel Cross males 3.34 ± 0.42 kg and females 3.13 ± 0.32 kg (Santoso, 2022). Csizmar *et al.* (2013) stated that sex does not significantly affect birth weight but rather depends more on the body size of the offspring born. Uterine environment (fetal environment), maternal and offspring genotype, maternal environment, parity, nutrition, sex, and maternal age impact lamb birth weight (Prajayastanda and Ngadiyono, 2014).

CONCLUSIONS AND RECOMMENDATIONS

The findings of the study revealed that maternal age (parity) did not significantly affect birth weight and litter size of lambs in both types of crossbreeding, although there was a tendency for these parameters to increase with advancing maternal age. Litter size showed a significant effect on lamb birth weight, where single-born lambs had the highest weight, followed by twins and triplets. Lamb sex did not have a significant effect on birth weight in both crossbreeds. These findings have practical implications for Indonesian sheep farmers, suggesting that ewes of various ages can be effectively utilized in breeding programs while emphasizing the importance of specialized nutritional management for multiple pregnancies. The results provide valuable insights for optimizing breeding strategies and flock management in Indonesian smallholder farming systems, particularly in improving reproductive efficiency through appropriate breeding pair selection and targeted nutritional interventions for pregnant ewes.

ACKNOWLEDGEMENTS

We would like to express our gratitude to the Directorate General of Higher Education, Ministry of Education, Culture, Research, and Technology, for providing funding through the Basic Research PMDSU scheme 2024, and to CV. Kambing Bujra for facilitating this research.

NOVELTY STATEMENTS

This research represents the first study to comprehensively analyze the effects of dam age and parity on birth weight and litter size of crossbred lambs from Texel ewes mated with Dorper and Awassi rams in the tropical environment of Indonesia. Unlike previous studies that were generally conducted in subtropical regions or involved only one type of crossbreeding, this study compared two crossbreeding types under intensive management systems with uniform nutritional management. The research findings demonstrate that litter size significantly affects lamb birth weight, while dam age does not provide a significant effect. Furthermore, this study also reveals different sex ratio tendency patterns between the two crossbreeding types. These findings make a significant contribution to the optimization of breeding strategies and reproductive management of sheep in tropical livestock systems.

AUTHOR'S CONTRIBUTIONS

Asrullah conceived the study, collected and analyzed data, interpreted the results, and drafted the manuscript, formatted it, and approved the final manuscript. Adimas Sandi Purwoagung, Wike Andre Septian, Chairdin Dwi Nugraha, Rafika Febriani Putri and Ari Ardiantoro conceived the study, conducted the statistical analysis and interpreted the results. Tri Eko Susilorini and Suyadi conceived the study and approved the final manuscript.

Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

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