EFFECTS OF ENVIRONMENTAL FACTORS ON GROWTH AND SURVIVAL AND CERTAIN REPRODUCTIVE TRAITS OF HAIR GOATS

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ABSTRACT

The present study was carried out to determine the growth and survival rate, the environmental factors affecting these characteristics and the reproductive characteristics of Hair goats raised under farm conditions in the province of Adıyaman, Turkey, for the first time in the region, from birth to weaning (90 days). The birth weight data of 13,751 kids born to Hair goats raised in 48 different enterprises between 2016–2018 was acquired, and the weaning weight data of 12,855 kids were used in the study. As a general average over three years, the birth weight, 60-day live weight, weaning weight and daily live weight gain (DLWG) of the kids were 2.80 ± 0.007, 11.34 ± 0.041, 15.59 ± 0.062 kg and 141.72 ± 0.690 g, respectively. Among the environmental factors examined related to these characteristics, the effects of the dam's age, the enterprise, the year of birth, the gender and the birth type were found to be statistically significant ($p<0.05$, $p<0.01$, $p<0.001$). The average survival rate of kids in weaning was 93.48%. Aside from gender, the effect of the dam's age, year of birth and birth type on the survival rate was determined to be significant ($p<0.001$). In the study, litter size and twin birth rates were generally 1.10 and 8.71%, respectively. The results of this research, based on the above data, revealed Hair goat breeding to be sustainable and successful in the region.

Keywords: Hair goat, growth, environmental factors, reproductive characteristics, survival rate

INTRODUCTION

Goats raised in almost all parts of the world have been an important source of food throughout human history (Webb *et al.,* 2005). According to the latest statistics, more than half of the world's goat population, amounting to 1.94 billion, is in Asia (53%) with 575.5 million head, and the largest populations by country can be found in India, China, Nigeria and Pakistan. Turkey ranks 23rd on this list (Anonymous, 2021a), and the 6,293,233 head recorded in 2010 had increased by 90.5% to exceed 11 million in 2020, ranking Turkey first among the European and Mediterranean countries (Anonymous, 2021b). Goat is an indispensable aspect of animal husbandry, being a species that is highly resistant to unfavourable care and feeding conditions, and that makes good use of natural resources that no other animal species can use (Şimşek and Bayraktar, 2006). The main indigenous goat breeds raised in Turkey are Angora, Honamlı, Kilis, and Hair goats, which constitute the majority (97%) (Anonymous, 2021b). The Hair goat is a contented breed that is resistant to the harsh climate of Anatolia and that can make use of weak pastures. It is raised in mountain villages, in forests and on the edge of forests, and is a dual-purpose goat breed that is raised for both meat and milk (GDAR, 2009; Akbaş and Saatcı, 2016). The growth and survival rates of kids in goat farming are an important factor in productivity (Lanari *et*

al., 2003). Bodyweight in goat breeding has a positive effect on the survival rate of kids and on, adult body weight and later productivity. Survival rate refers to the live birth and survival of offspring up to a certain age (Akçapınar and Özbeyaz 1999). Loss of animals is a leading problem in goat breeding, as is the case with all farm animals, and is primarily from kid rather than adult mortalitys (Ameh *et al.,* 2000).

It is important to examine the factors that affect kid growth to come up with approaches that can increase survival rates and fertility, and thus ensure farm sustainability. Increasing reproductive efficiency not only ensures the continuity of the herd size, but also provides a better base for the selection of future generations (Akçapınar, 1994).

The present study was carried out to determine growth traits, survival rates and reproductive characteristics and the effect of environmental factors on these characteristics.

MATERIALS AND METHODS

The phenotypic records of hair goat kids (N=13,751) reared in 48 enterprises were utilized for the present study. The average number of Hair goats per enterprise was 286.5 ±14.3 head between 2016 and 2018 in the Besni district of the Adıyaman province (37° 41'

39'' N and 37° 51' 39'' E) and raised under similar climatic conditions.

Flocks of Hair goats were grazed in open fields/pastures close to their shelters from early morning until noon between April and October, and no additional feeding was provided during this period. The goats were pastured on days when the weather conditions were favorable in winter, and provided with approximately 0.5–1 kg/head of concentrate feed (wheat and barley) and 1–2 kg/head of hay. The goats were freely mated with a male to female ratio of 1:20 between August 15 and October 15. The kids were dried on the first day after birth, weighed with digital scales (sensitive up to 10 g with a capacity of 50 kg) and numbered with a plastic earring, and the data of each kid (date of birth, earring number, birth weight, birth type, gender, dam's number) were recorded. The kids were weaned for around 90 days on average, and after 45–50 days of age, they were familiarized with feed by giving them a small amount of the feed given to their dams. After 60 days they were pastured. On days when the weather was unfavorable, they were fed only a small amount of fodder and hay. The weaning weights of the kids were measured using a digital cage scale with a capacity of 300 kg, sensitive up to 100 g. Using the recorded weights (birth weight and weaning weight), the daily live weight gains, and the 60th and 90th day live weights were calculated through interpolation, given the presence of kids between 42 and 126 days of age during weighing. The data were grouped according to the following factors: Dam's age, divided into six groups: (1) age ≤2 yrs, (2) 2< age ≤ 3 yrs, (3) 3 < age ≤ 4 yrs, (4) 4 < age ≤ 5 yrs, (5) 5 < age ≤ 6 yrs and (6) 6 yrs < age. The kids were grouped according to year of birth from 2016 to 2018.

The parameters determined for the breeding characteristics of goats were as follows:

Litter size = number of kids born alive/number of kidding does

Single birth rate = (Number of goats with a single kid/number of kidding does) × 100

Twinning rate = (Number of goats with twin kids/number of kidding does) × 100

Survival rate = (Number of kids alive at weaning/number of kids born) × 100

The statistical model used to analyze the birth weight of kids was;

Y_{ijklmn}: $\mu + A_i + E_j + Y_k + G_l + T_m + e_{ijklmn}$

For the kids' 60th day, weaning weight and daily live weight gain from birth to weaning;

Y_{ijklmn}: $\mu + A_i + E_j + Y_k + G_l + T_m + b_1X_{ijklmn} + e_{ijklmn}$

Symbols of the models;

Y_{ijklm} = i. dam's age, j. enterprise, k. year, l. gender, m. the birth weight of the kid from the effect of birth type.

μ = general (expected) average,

A_i = the effect of dam's age (i = 2-6),

E_j = the effect of the enterprise (j = 48 enterprise),

Y_k = the effect of the year (k = 2016, 2017, 2018),

G_l = the effect of the gender (l = female, male),

T_m = the effect of the birth type (m = single, twin),

b_1: Regression coefficient (partial regression of 60th-day weight, weaning weight and daily live weight gain according to birth weight),

X_{ijklmn}: = i. dam's age, j. enterprise, k. year, l. gender, m. the effect of birth type, n. birth weight of the kid,

e_{ijklmn} = random error.

In the present study, the effects of the dam's age, enterprise, year, gender and birth type of environmental factors on the growth performance of kids in various periods were defined using the "Least Squares Method". The statistical significance controls of the mean values were determined with an Analysis of Variance, and the differences between the averages were evaluated with a Tukey multiple comparison test. Due to the insufficient data in the subgroups, two- or three-way interactions among the factors were not included in the analysis. The GLM (General Linear Model) and Chi-square (X^2) procedures of the "Minitab-Version 18" program package were used for the statistical analysis of the data (Minitab, 2017).

RESULTS

The growth performance, the least square average live weights of the Hair goat kids in different growth periods, the standard errors and the effective factors are presented in Table 1, and the effect of shares of the factors affecting the live weight gain is given in Table 2. The birth weight, 60-day weight, weaning weight and DLWG of the kids were found to be 2.80±0.007, 11.34±0.041, 15.59±0.062 kg and 141.72±0.690 g, respectively. The effects of all the factors (dam's age, year of birth, gender and type of birth) on the live weight of kids in different growth periods were determined to be significant (p<0.05, p<0.01, p<0.001). The effect of the enterprise – one of the environmental factors – was found to have a significant (p<0.001) influence on the characteristics examined in the study, but was not given in the table due to the large number (48 enterprises).

The survival rates of the kids up to weaning age are presented in Table 2, and their average was found to be 93.48%. The effect of all factors aside from gender was found to be significant (p<0.001) on the survival rates of kids during weaning period. Some of the reproductive characteristics of Hair goats obtained during the 3 years between 2016 and 2018 are given in Table 3. The average litter size, single birth rate and twin birth rate were determined as 1.10, 91.29% and 8.71%, respectively.

Table 1. Least squares averages of the kids' live weight in various periods (x̄±sx̄).

FACTORS	Birth Weight (kg)		60th day weight (kg)		Weaning weight (90th day) (kg)		DLWG until weaning weight (g)	
	N	(x̄±Sx̄)	N	(x̄±Sx̄)	N	(x̄±Sx̄)	N	(x̄±Sx̄)
Dam's age (year)		***		***		***		***
2 (age ≤ 2)	1042	2.81±0.019^{bc}	988	11.20±0.090^{bc}	988	15.39±0.135^{bc}	988	139.46±1.500^{bc}
3 (2 < age ≤ 3)	2541	2.75±0.012^{c}	2355	11.16±0.061^{c}	2355	15.32±0.091^{c}	2355	138.70±1.010^{c}
4 (3 < age ≤ 4)	3226	2.80±0.011^{b}	3147	11.11±0.053^{c}	3147	15.25±0.080^{c}	3147	137.88±0.887^{c}
5 (4 < age ≤ 5)	2311	2.81±0.013^{b}	2251	11.46±0.060^{ab}	2251	15.77±0.091^{ab}	2251	143.73±1.010^{ab}
6 (5 < age ≤ 6)	2094	2.78±0.013^{bc}	1979	11.52±0.065^{a}	1979	15.87±0.098^{a}	1979	144.79±1.080^{a}
7 (6 < age)	2537	2.88±0.012^{a}	2135	11.58±0.063^{a}	2135	15.96±0.094^{a}	2135	145.77±1.050^{a}
Year of birth		***		***		***		***
2016	4549	2.68±0.009^{c}	4177	10.32±0.047^{c}	4177	14.06±0.070^{c}	4177	124.68±0.777^{c}
2017	4485	2.84±0.011^{b}	4208	12.53±0.052^{a}	4208	17.37±0.078^{a}	4208	161.50±0.869^{a}
2018	4717	2.90±0.010^{a}	4470	11.18±0.049^{b}	4470	15.35±0.073^{b}	4470	138.99±0.813^{b}
Gender		*		***		***		***
Male	6978	2.81±0,009^{a}	6548	11.61±0.042^{a}	6548	16.00±0.063^{a}	6548	146.22±0.702^{a}
Female	6773	2.79±0,009^{b}	6307	11.07±0,043^{b}	6307	15.19±0.064^{b}	6307	137.22±0.708^{b}
Birth type		***		**		**		**
Single	11547	2.85±0.006^{a}	10859	11.43±0.028^{a}	10859	15.73±0.042^{a}	10859	143.28±0.465^{a}
Twin	2204	2.76±0.013^{b}	1996	11.25±0.063^{b}	1996	15.45±0.094^{b}	1996	140.17±1.040^{b}

*: $p<0.05$ **: $p<0.01$ ***: $p<0.001$ a, b, c: Differences between averages with different letters in the same column are significant ($p <0.05$)

DISCUSSION

Growth is a physiological characteristic with practical and economical importance in animal husbandry (Akçapınar and Özbeyaz, 1999). Birth weight affects postnatal growth and survival rate in kids (Husain *et al.*, 1995; Demirören *et al.*, 1999). The birth weight value found in Hair goat kids in the present study is higher than the values reported for Hair goats (2.63 kg) in the study by Şengonca *et al.* (2003) on144 Hair goats and 386 head of Saanen x Hair goat crossbreeds, taking into account such environmental factors as genotype, year, gender and birth type. The birth weight values in the present study are also higher than those reported in the study of Oral Toplu and Altınel (2008) involving 439 Hair goats (2.19 kg), in which environmental factors such as year of birth, enterprise, gender, birth type and dam's age are taken into account, but similar to the value reported by Şimşek and Bayraktar (2006) for the 34 Hair goats in their study of a total 63 goats (34 Hair goats, 29 Saanen x Hair goat crossbreeds) considering environmental factors such as genotype, gender, birth type and dam's age. In contrast, the values in the present study are lower than those reported in the study by Tekin and Arlı (2019) of 23,428 Hair goats (3.48 kg) taking into account the year of birth, gender, birth type and dam's age from among the environmental factors.

The differences between the birth weight values reported in literature and those reported in the present study may be attributable to the geographical structure in the working areas, the male goat effect and nutritional conditions of the dams. The low birth weight in the present study may be related to the fact that the goats were fed depending on the pasture conditions, and that the pregnancy period of the goats coincided with the winter season, when pasture conditions were insufficient. According to Savaş (2007), the nutritional conditions of the dam, the genetic structure and the environment provided by the mother to the offspring (the dam's uterus) can affect kid birth weights.

In the present study, the lowest birth weight was obtained from 3-year-old dams (2.75 ± 0.012 kg) and the highest birth weight from $7 \leq$ year-old dams (2.88 ± 0.012 kg). The increase in kid birth weight with increasing dam age and the lower in body weights of kids born from younger goats could be explained by the high reproductive performance of goats of adult age. In the present study, the highest birth weight (2.90 ± 0.010 kg) was achieved in 2018. The differences in birth weight values from year to year may be a consequence of the prevailing climatic conditions in the region and the maintenance-feeding conditions in the enterprises. Furthermore, the birth weight values recorded for male and female kids in the present study were found to be higher than those reported in the study by Oral Toplu and Altınel (2008) on 218 male (2.46 kg) and 221 female

(1.92 kg) Hair goat kids. In contrast, the birth weight values recorded in the present study were lower than those reported by Tekin and Arlı (2019) in their study of 11,714 male (3.40 kg) and 11,714 female (3.55 kg) Hair goat kids; and lower also than the values reported by Elmaz *et al.* (2020) in their study of 11,877 male (3.52 kg) and 10,940 female (3.13 kg) Hair goat kids. In the present study it was determined that single kids were heavier than twins, and this finding is consistent with the finding of Tekin and Ögeç (2017), who concluded that single kids were heavier based on the recorded birth weights of 20,418 single kids and 5,019 twins of 3.15 kg and 2.88 kg, respectively, in their study of Hair goats. There have been many studies of Hair goats supporting the result of the present study (Şimşek *et al.,* 2007; Oral Toplu and Altınel, 2008; Erten and Yılmaz, 2013; Elmaz *et al.,* 2020), while any differences in results of the present study and those in literature may be due to the differences in climate in the research regions, the genetic structure, and the different care and feeding approaches to Hair goats.

In this study, the effects on birth weight of the dam's age, birth year, gender and type of birth were determined to be statistically significant ($p<0.05$, $p<0.001$). The effect of dam's age is significant on birth weight, consistent with the results of many earlier studies of Hair goats (Erten and Yılmaz, 2013; Tekin and Ögeç, 2017; Tekin and Arlı, 2019; Elmaz *et al.,* 2020), but inconsistent with the results of the study by Akbaş and Saatcı (2016). The effect of the year of birth was significant, consistent with most studies (Şengonca *et al.,* 2003; Oral Toplu and Altınel, 2008; Tekin and Arlı, 2019; Elmaz *et al.*, 2020), while the effect of gender was significant, consistent with the results of some studies (Akbaş and Saatcı, 2016; Tekin and Ögeç, 2017; Elmaz *et al.,* 2020), but inconsistent with others (Şengonca *et al.*, 2003; Şimşek *et al.*, 2007; Erten and Yılmaz, 2013). It was also observed that the effect of birth type was important and consistent with the results of some studies (Şimşek *et al.*, 2007; Akbaş and Saatcı, 2016; Tekin and Arlı, 2019; Elmaz *et al.*, 2020), but inconsistent with the results of Erten and Yılmaz (2013).

In the present study, the weaning weight values of the kids were found to be higher than those in the study of 79 Hair goats (12.32 kg) by Erten and Yılmaz (2013) considering environmental factors such as gender, birth type and dam's age, and higher also than the results of Yılmaz *et al.* (2013) in their study of 37 Hair goats (12.06 kg) and 65 Saanen x Hair goat crossbreeds, taking into account such environmental factors as genotype, gender, dam's age and live weight of the dam. The results of the present study were similar to those reported by Şimsek *et al.* (2007) in their study of 13 Saanen x Hair goat crossbreeds (G1) (15.62 kg) taking into account genotype, gender, birth type and dam's age from among the environmental factors; and lower than those reported

in the study by Şimşek and Bayraktar (2006) of 33 Hair goats (16.05 kg), taking into account genotype, gender, birth type and dam's age from the environmental factors. In the present study, the lowest weaning weight was identified in 4-year-old dams (15.25±0.080 kg) and the highest in 7-year-old dams (15.96±0.094 kg). In the present study, the highest weaning weight (17.37±0.078 kg) was found in 2017, and the lowest weaning weight (14.06±0.070 kg) in 2016. This difference was deemed to be related to changes in the climatic and pasture conditions in the region from year to year, although the differences in the management conditions from farm to farm may also have been a contributing factor.

In the present study, the weaning weight values of male and female kids were found to be higher than those reported in the study by Şimşek et al. (2007) of 22 male (15.14 kg) and 16 female (14.55 kg) kids, and by Yılmaz et al. (2013) in their study of 56 male (12.44 kg) and 46 female kids (11.68 kg). In contrast, the weaning weight values in the present study were lower than those reported by Elmaz et al. (2020) in their study of 11,310 male (18.50 kg) and 10,333 female (16.59 kg) specimens, taking into account such environmental factors as year, gender, birth type and dam's age. In the present study, the weaning weights of single and twin kids were determined as 15.73±0.042 and 15.45±0.094 kg, respectively – a greater weaning weight in single kids than in twins. Consistent with the results of the present study, in the study conducted by Erten and Yılmaz (2013) of Hair goats, weaning weight was reported as 12.52 kg in 55 single kids and 12.13 kg in 24 twins. There have been many studies conducted on Hair goats that support the result of the present study (Şimşek et al., 2007; Oral Toplu and Altınel, 2008; Yılmaz et al., 2013; Elmaz et al., 2020).

In the present study, the effect of dam's age, year of birth, gender and type of birth on weaning weight was found to be statistically significant (p<0.01, p<0.001), The significant effect of dam's age is consistent with the results of many studies (Erten and Yılmaz, 2013; Akbaş and Saatcı, 2016; Elmaz et al., 2020), but inconsistent with the results of the research by Şimşek et al. (2007). The significant effect of the year of birth was consistent with some studies conducted (Oral Toplu and Altınel, 2008; Elmaz et al., 2020); and the important effect of gender was consistent with many studies (Şengonca et al., 2003; Oral Toplu and Altınel, 2008; Akbaş and Saatcı, 2016), but inconsistent with others (Şimşek et al., 2007; Erten and Yılmaz, 2013). The significance of the effect of birth type was consistent with the reports of some studies (Şengonca et al., 2003; Akbaş and Saatcı, 2016), but inconsistent with the results of most studies (Şimşek et al., 2007; Erten and Yılmaz, 2013; Elmaz et al., 2020).

The DLWG value noted for the kids in the study was higher than the value reported by Erten and Yılmaz (2013) in their study of 71 Hair goats (102.51 g) considering such environmental factors as gender, birth type and dam's age; similar to the value reported by Şimşek et al. (2007) in their study on 13 Saanen x Hair goats (G1) (141 g); and lower than the value reported in the study conducted by Tekin and Arlı (2019) on 22937 Hair goats (159.1 g). In the present study, the lowest DLWG was obtained from the kids born to 4-year-old dams (137.88±0.887 g), and the highest DLWG was obtained from the kids born to 7≤ year-old dams (145.77±1.050 g). The highest DLWG (161.50±0.869 g) was found in 2017 and the lowest DLWG (124.68±0.777) in 2016 in the study – a difference that could be attributed to the pasture conditions, the enterprise management and the climatic conditions in the region. In the study, male kids (146.22±0.702 g) were found to have higher DLWG than female kids (137.22±0.708 g), and these results were higher than the values reported by Erten and Yılmaz (2013) in their study of 40 male (104.57 g) and 31 female (100.46 g) Hair goat kids. In contrast, the value was lower than that reported in the study by Tekin and Arlı (2019) of 11,472 male (166.8 g) and 11,465 female (151.4 g) Hair goat kids. In the present study, single kids recorded a greater DLWG than twins, concurring with the findings of the study of Hair goats by Tekin and Ögeç (2017) reporting that 15904 single kids (148.5 g) had a greater DLWG than 4008 twins (137.4 g). There have been many studies reporting results that concur with the findings of the present research (Şimşek et al., 2007; Erten and Yılmaz, 2013; Tekin and Arlı, 2019), and any differences between results may be attributable to enterprise size, the applied feeding systems and the plant flora in the pasture.

In the present study, the effect of dam's age, year of birth, gender and type of birth on DLWG until weaning was found to be statistically significant (p<0.01, p<0.001). The effect of dam's age is significant on DLWG was consistent with the results of many several earlier studies (Erten and Yılmaz, 2013; Tekin and Ögeç, 2017; Tekin and Arlı, 2019), but inconsistent with the results of the research by Şimşek et al. (2007). The effect of the year of birth was important and consistent with other studies (Tekin and Ögeç, 2017; Tekin and Arlı, 2019), as was the significance of the effect of gender and birth type (Tekin and Ögeç, 2017; Tekin and Arlı, 2019), although this effect was inconsistent with the results of other studies (Şimşek et al., 2007; Erten and Yılmaz, 2013).

In the present study, the highest survival rates of weaned Hair goat kids were 97.55% for those born to 4-year-old dams, 94.76% for those born in 2018, 93.84% for males and 94.04% for single kids. The average survival rate in the study was determined as 93.48%. The increased survival rate noted in the project can be attributed to the training and information given to shepherds under the project, and while the survival rate

was higher in the present study than that reported by Atay *et al*. (2010) (80.65%), Erten and Yılmaz (2013) (89.87%) and Yılmaz *et al*. (2013) (90.24%) for the same weaning period in Hair goat kids, it was lower than the values reported by Oral Toplu and Altınel (2008) (95.44%). This difference in survival rates may be attributed to climatic conditions, land conditions and enterprise management. In the present study, the effect of all factors on the survival rate other than gender was reported to be statistically significant (p<0.001). The effect of dam age on survival was significant, consistent with the study by Erten and Yılmaz (2013), and it was observed that the significance of the year of birth was consistent with the results of several studies (Şengonca *et al*., 2003; Tekin and Ögeç, 2017; Elmaz *et al*., 2020). In contrast, the effect of gender and birth type was found to be important, which was inconsistent with other studies (Şengonca *et al*., 2003; Erten and Yılmaz, 2013).

The reproductive characteristics of the Hair goats raised in the project are given in Table 3. The litter size varied between 1.07 and 1.14 over the years, with an

average of 1.10. This value was higher than the results of the studies of Hair goats conducted by Şengonca *et al*. (2003) (0.79) and Elmaz *et al*. (2020) (1.05), consistent with the results of Atay *et al*. (2010) (1.09); and lower than the value reported as 1.30 in Saanen x Hair crossbreds by Şengonca *et al*. (2003). Hair goat shepherds are generally averse to twin births, firstly, because twins have lower survival rates than single kids, and secondly, the growth of twins is generally lower than with single kids. In the present study, the lowest twin rate was 7.12% during 2017 and the highest was 10.98% during 2016, with an average twin rate of 8.71% by years. This value was higher than the rate reported by Elmaz *et al*. (2020) (5.1%) and lower than the value reported as 45% in 2–3-year-old goats and 58.3% in 4–5-year-old goats by Atay *et al*. (2010) and (9.21%) Erişir and Gürdoğan (2004). Studies of Hair goats have reported different results regarding reproductive characteristics, which may be attributable to environmental conditions, enterprise size and the genetic structure in the study area.

Table 3. Some reproductive characteristics of Hair goats.

Reproductive Characteristics	Years			General
	2016	2017	2018	
Number of kidding does	4099	4187	4363	12649
Number of kids born	4549	4485	4717	13751
Litter size	1.14	1.07	1.08	1.10
Number of goats with single kid	3649	3889	4009	11547
Number of goats with twin kids	450	298	354	1102
Single birth rate %	89.02	92.88	91.89	91.29
Twin birth rate %	10.98	7.12	8.11	8.71

Conclusion: The present study is the first of its size to be conducted in Hair goat enterprises assessing breeding conditions in the Adıyaman region, and has thus provided some important data about the growth characteristics and survival rate of kids up until weaning, and the reproductive characteristics of Hair goats. The high rate of survival of the kids and the litter size of 1.10 shows that the Hair goats are adapted to the region and the reproductive system, and that Hair goat breeding has been successful. It can be said that farming sustainability will increase if environmental factors are taken into account in the selection of breeder in Hair goat herds.

Conflicts of Interest: The authors of the current manuscript have no conflicts of interest to declare.

Table 2. Effect shares of factors affecting the live weights of kids in various periods (kg), and the survival rates of kids up to weaning age (90 days).

	N	Birth weight (kg)	N	60th day weight (kg)	N	Weaning weight (90th day) (kg)	N	DLWG until weaning weight (g)	Survival rate %
Dam's age (year)									***
2 (age ≤ 2)	1042	0.002	988	-0.136	988	-0.204	988	-2.262	94.82[c]
3 (2 < age ≤ 3)	2541	-0.054	2355	-0.181	2355	-0.272	2355	-3.017	92.68[d]
4 (3 < age ≤ 4)	3226	-0.002	3147	-0.230	3147	-0.346	3147	-3.844	97.55[a]
5 (4 < age ≤ 5)	2311	0.003	2251	0.120	2251	0.181	2251	2.005	97.40[ab]
6 (5 < age ≤ 6)	2094	-0.027	1979	0.184	1979	0.277	1979	3.072	94.51[c]
7 (6 < age)	2537	0.078	2135	0.243	2135	0.364	2135	4.046	84.15[e]
Year of birth									***
2016	4549	-0.125	4177	-1.023	4177	-1.534	4177	-17.043	91.82[c]
2017	4485	0.031	4208	1.187	4208	1.780	4208	19.776	93.82[ab]
2018	4717	0.094	4470	-0.164	4470	-0.246	4470	- 2.733	94.76[a]
Gender									NS
Male	6978	0.010	6548	0.270	6548	0.405	6548	4.503	93.84
Female	6773	-0.010	6307	-0.270	6307	-0.405	6307	-4.503	93.12
Birth type									***
Single	11547	0.041	10859	0.093	10859	0.140	10859	1.557	94.04[a]
Twin	2204	-0.041	1996	-0.093	1996	-0.140	1996	- 1.557	90.56[b]
Regression		-		0.1245±0.0414**		0.3133±0.0621***		-14.592±0.690***	
General average	13751	2.80±0.007	12855	11.34±0.041	12855	15.59±0.062	12855	141.72±0.690	93.48

**: $p < 0.01$ ***: $p < 0.001$ Regression: Partial regression of live weight to birth weight of goats in the period   NS: Not Significant ($p > 0.05$)
a, b, c, d, e: Differences between averages with different letters in the same column are significant ($p < 0.05$)

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