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The Evaluation of Environmental Effects to Establish Genetic Parameter Calculation in the Sheep Breeds

MSc Thesis

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1. Introduction

In the past, hunting people have tried various ways to make more use of sheep, and they have played a major role in the domestication of sheep. With domestication, people began to use animal products for their own benefit. After the domestication of sheep, people met the basic needs of sheep's wool, hide, flesh and milk and the importance of breeding began to be understood after meeting basic needs.

Sheep breeding has an important place in animal production. Sheep breeding is increasing in the world. The reasons for this are factors such as ease of care and feeding in sheep, less labor and capital needed to start sheep breeding, and evaluating poor quality pastures very well. In many countries of the world, cattle are regarded as milk animals, while in some countries sheep's milk is also utilized. In many Asian and African countries, sheep milk is an important source of income for sheep breeding. In addition, sheep milk has high fat and protein content. So, many countries prefer sheep milk for cheese production (Şahin and Akmaz, 2004).

The aim of animal husbandry is to reach the level of economic benefit in the production of animal products (Yıldız.A and Yıldız.N, 2002). If the animal is breeding, in a shorter time, more and better quality products can be obtained (Aksoy, 2003). Genotype and environmental effects determine the level of yield characteristics in sheep. All factors outside the genotype can be called environmental effects and these environmental effects affect the yield characteristics. The effects of some environmental factors on yield characteristics can be calculated. Genotype breeding, pure breeding, and selection or hybridization are performed to increase the yield in livestock. In breeding studies, more hybridization method is used. Because selection is an expensive method and takes a long time to apply. However, hybridization is an easy method and results in a short time. Selection is important in genotype breeding in pure breeding and hybridization. The main condition for success in sectioning is the separation of individuals with the best genotype characteristics into breeding. Phenotypic values are very important to determine the genotype values of the animals that we will allocate for breeding. Environmental factors significantly affect yield characteristics and make it difficult to estimate genotypes of individuals. Therefore, elimination of environmental factors and determination of genotypic values are very important in selection (Esenbuğa and Dayıoğlu, 2002). Meat and milk production in sheep is one of the most important sources of yield. Environmental factors affecting milk yield in sheep are farm, age, diet, lambing season and litter size (Şahin and

Akmaz, 2004). Some of the factors affecting the meat yield of lambs are farm, age of dam, sex, litter size and year (Küçük et al, 1999).

1.1. Research Aims

The aim of this study is to determine the effect of the environmental factors on the weaning weight, growth rate and yearling weight in German Mutton Merino, Hungarian Merino, Lacaune and Suffolk sheep breed. Also, the objective of this study is to determine the effect of environmental factors on milking days and milk production in Lacaune sheep breed.

2. Literature review

This chapter is provided Technical Literature Review for the dissertation.

2.1. Merino sheep breed

The Merino sheep is a very significant and popular breed. Merinos emerged in Spain and are very valuable for wool production. Merino sheep are numerous in China, Australia and New Zealand. Little Asian phenomena introduced the *merino coyon* to North Africa and the Berber tribe Marinids may have introduced the basic stocks of the Merino at the end of the twelfth century.

Spanish breeders wanted to develop Merino sheep in the thirteenth and fourteenth centuries and therefore introduced the British sheep breeds that they used and raised with local sheep breeds. This was documented by the Spanish writers of that period. Nobles and churches had most of these animals. The animals were grazed in the southern plains of Spain in summer and the northern highlands of Spain were preferred to graze the herd in winter. Nowadays Merinos can be found all over the world (Roysfarm, 2019).

Table 1. Physical Characteristics of Merino sheep

Sheep	Ewe	Ram
Breed Weight	57 to 82 kg	80 to 107 kg
Breed Height	Unclear-they are a medium size	Unclear-they are a medium size
Hair	Soft, fine, strong, dense and uniform in length	Soft, fine, strong, dense and uniform in length
Ears	Small ears that stick out to the side of the head	Small ears that stick out to the side of the head
Horns	If they have horns, they are curled tight against their head	If they have horns, they are curled tight against their head
Puberty Age	5 to 12 months	5 to 7 months
Breeding Age	18 months	1 year
Breeding Traits	They can breed throughout the year	Cover 5 to 30 Ewes in 1 season
Color	White	White

Source: (Irvine, 2019)

Table 2. Ewe Breeding &Milking Information

Breeding Period/cycle:	Usually lasts 24 to 36 hours
Estrous cycle:	Ave. 17 days/13 to 19 days
Gestation Period:	Usually, around 150 to 155 days but most gestation is 152 days
No. Lambs/Litter:	1 to 2 (twins)
Lactation Period:	Usually, around 150 to 240 day but most are milked for 180 days
Milking From:	4 to 6 weeks after lambing
Milk Quality:	Good
Milk Ideal for:	Lambs

Source: (Irvine, 2019)

Table 3. Sheep Meat Production Information

Sheep	Lamb	Hogget /Mutton
Approx. Maturity Weight:	58 kg	79 kg

Source: (Irvine, 2019)

Table 4. Sheep Wool Production Information

Sheep	Ewe	Ram
Age they produce from:	6 to 8 months	6 to 8 months
Approx. Length:	6.35 to 10 cm	6.35 to 10 cm
Microns:	22 to 17	22 to 17
Approx. Quantity:	Around 5.4 to 9 kgs a year	Around 11 kgs a year

Source: (Irvine, 2019)

2.2. Historical and genetic development and some genetic properties of the Merino sheep

Merino sheep used to be very thin, much curved fleece, small size animals. However, within the scope of the growing direction and the wool characteristics required by the industry, in this type of merino, body size, fleece yield and attention to the length of the ring length by combining selection and partly hybridization Scallop Merino was developed. In these Merinos, when it cannot answer to changing demands and requirements (1900 years); in merino breeding, characteristics such as fertility, meat yield and growth rate have been given importance and these characteristics have been significantly improved. Thus, meat-wool and meat merino cultivation started (Pega, 2016). Having a long mating season in sheep is genetically dominant. For this reason, Merino hybrid sheep show a long mating season like the Merino sheep breed. (Dellal, Cedden 2002). In some studies, it was determined that the flock structure differs from race to race. In Merino sheep, the whole flock is tightly coalesced and

almost no subgroups are formed within the flock. Sheep are close to each other while grazing, and there are no separate groupings unless there is any feed restriction. For example, in Southdown sheep, the herd is divided into several subgroups, but these subgroups do not move independently while grazing and resting. In Dorset Horn sheep, the herd is divided into numerous subgroups (Metin and Kaliber, 2011). As seen in the research, in the Merino sheep breed, the herd of merino sheep acts as a single body. This may be disadvantageous for non-homogenous pastures for merino sheep breeds. Because in pastures where there is no homogenous vegetation, some animals in the herd may not graze in inefficient areas. Therefore, they cannot be fed enough (Blackshaw, 1984). Also, in a flock of sheep grazing, almost no animal exhibits dominance. Sheep in the flock compete with other sheep for the plants in front of them. However, they try to defend their grazing areas with small thrusts rather than toast. In a study by Squires and Daws (1975), a competitive feeding situation was created in the Merino and Border Leicester sheep and the relationship between dominance and obedience to the dominant individual was examined. This study showed that while there was an almost linear hierarchy in the Merino sheep, it was seen that there was a less rigid social structure against this scenario in the Border Leicester sheep (Metin and Kaliber, 2011).

2.3. Merinos in Turkey

In Turkey, meat and milk yields of wool of domestic sheep breeds were inadequate. Wool produced in Turkey was very inadequate for textile industry. That's why weaving mills exported wool. Therefore, the first aim of the breeding activities was to meet the wool need of the weaving industry. In 1844 the government supported merino sheep breeding and the government issued a circular for it. During the First World War, the presence of sheep in Anatolia has fallen significantly. Therefore, in the Republican period, the breeding activities started again. The first import sheep were brought from Hungary in 1928, 1929 and 1930 as 3 parties. Some of the sheep were grown as pure, the other part was used for crossbreeding and these sheep were crossed with Kıvırcık sheep (Günaydın, 2009).

Merino breed of sheep is very popular in Turkey. There are varieties of merino sheep in Turkey. Karacabey merino comes first among these sheep. Karacabey merino was the result of the hybridization of the German Mutton Merino sheep and Kıvırcık sheep breeds. The other kind of merino sheep is located in Turkey Anatolian Merino breed of sheep. Anatolian Merino sheep, German Mutton Merino sheep and Akkaraman sheep breeds were founded as a result of hybridization (Sönmez et al, 2009).

Table 5. Changes in the number of sheep by years in Turkey

Years	Sheep (domestic head)	Sheep (Merinos head)
2005	24 551 972	752 353
2006	24 801 481	815 431
2007	24 491 211	971 082
2008	22 955 941	1 018 650
2009	20 721 925	1 027 583
2010	22 003 299	1 086 392
2011	23 811 036	1 220 529
2012	25 892 582	1 532 651
2013	27 485 166	1 799 081
2014	29 033 981	2 106 263
2015	29 302 358	2 205 576
2016	28 832 669	2 151 264
2017	31 257 408	2 420 228

Source: (ZMO, 2018)

Figure 1: Merino sheep breed: (Irvine, 2019)

2.4. Suffolk sheep breed

Suffolk sheep's homeland is the United Kingdom. They are the result of the crossing of Norfolk Horn ewes to the Southdown sheep breed rams. Suffolk sheep breed was accepted as a breed in 1810. The Suffolk Sheep breed is widespread all over the world and is the most popular sheep in the United States.

The record for the Suffolk sheep breed in the US shows that the breed accounts for more than fifty percent of pure breed sheep in the US. Mr. G. Streeter first brought the Suffolk sheep into

the United States in 1888. But the western states do not has the Suffolk sheep breed until 1919. The English Suffolk Sheep Society donated to the University of Idaho two rams and three ewes in 1919 (Irvine, 2019).

2.5. The purpose of Suffolk sheep breeding

Suffolk sheep is a breed first raised for meat. Suffolk sheep is a large breed of sheep and Suffolk is known as suitable breed for meat production because of their large and muscular structure. Also, Suffolk sheep are preferred in wool production (WTO, 2019).

2.6. General features of Suffolk sheep

Suffolk sheep are a black-faced, open-faced breed. The face of them is open and black and legs of them is black. Also, they have a White woolen bodies (WTO, 2019). For Suffolk sheep, breed weight of ewe is 80-160 kg and breed weight of ram is 110-160kg. Suffolk sheep is a large breed. Puberty age is 5 to 12 months for ewe and is 5 to 7 months for ram. Breeding age for Suffolk sheep is18 months for ewe and 1 year for ram (Irvine, 2019). Also, the birth season is important for sheep. The breeding season of sheep is important in terms of reaching maturity. For example; Suffolk lambs are born in spring if they reach the maturity of about 30 weeks of age, but if Suffolk lambs were born in the autumn, they reach the maturity of about 50 weeks of age (Foster et al., 1988). In Suffolk sheep, the birth time for the first sheep is 41.0 minutes. The delivery time for the second sheep is 39.0 minutes. For the third sheep, the delivery time is 41.0 minutes. For the fourth sheep, the delivery time is 42.0 minutes (Dwyer and Lawrence, 2000).

2.7. Genetic properties of Suffolk sheep

Suffolk is one of the best known sheep breeds. Suffolk sheep emerged from the cross-breeding of Southdown and Norfolk sheep breeds. Among the meat type sheep, the milk of Suffolk sheep is the most abundant. Problems such as feet and nipples are almost non-existent. Births are very easy in Suffolk sheep because their structure is suitable for birth. Head and foot parts are black, fleece is white and sheep are medium thin. In this way, it can be used in various sectors with fleece. Each sheep has an average wool yield of 2.5-3kg (WTO, 2017).

2.8. Suffolk sheep in Turkey

A private company in Turkey brought the Suffolk breed from Australia and it is also known that the lamb production has started **(**Kaymakçı, Taşkın 2009**).**

Figure 2: Suffolk sheep breed (Roysfarm, 2019)

2.9. Lacaune sheep breed

Neolithic shepherds brought the ancestors of Lacaune sheep to France from 4000 to 6000 years ago. Lacaune is a French sheep breed. Milking sheep are generally raised in the south of France and each region is represented by one or two local breeds (Barillet, 2001). The Lacaune sheep is raised in the Roquefort region (Regli, 1999). Today, there are 800000 sheep in this region. These sheep are used for milk production. Until 1990, it has fallen to 280 liters per year. But now Lacaune sheep is one of the highest milk producing sheep in the world. The reason for this increase is the work of the French government (WTO,2019). The first Lacaune sheep in North America was born in 1999 on Joseph Regli's farm. This farm is located in Ontario, Canada. Today Lacaune sheep is one of the most important sheep breeds found in US dairy products (Engle and Palko, 2014).

2.10. General features of Lacaune sheep

Lacaune sheep is hornless and resistant to high temperatures. Furthermore, it can easily adapt to seasonal changes. Lacaune sheep is excellent grazing and can be adapted to a wide range of

conditions. They are particularly resistant to diseases so they can be a suitable choice for modern dairy plants (Engle and Palko, 2014).

Table 6. The yield features of the Lacaune sheep

Sheep	Ewe	Ram
Live weight	70-80 kg	95-110 kg
Height at withers	70 cm	80 cm
Wool yield	2.5 kg	1.5-2 kg
Lactation milk yield	200 lt	-
Increase in milk each birth	%2.4(5.7kg)	-

Source: Yeniyurt and Vuran, 2016

2.11. Genetic advances in Lacaune sheep breeds

In the 1960s and 1970s, Lacaune sheep were grown for both milk and meat production. Because of the low milk production of Lacaune sheep, the income from meat production and the income from milk production were equal. There are two ways to increase yield in milk sheep. One of them is crossbreeding and the other is purebre-reeding selection. Studies were carried out on these two paths, and in 1970 experiments were carried out with the French Lacaune and Sordonian and German Friesian breeds (Barillet, 2001). Also, in French Lacaune, annual genetic improvement for milk yield is calculated as 2.4% or 5.7 kg (Barillet, 1995). With the current availability of both East Friesian and Lacaune breeding in North America, UW-Madison initiated a study in 1998 to compare sheep sired by East Friesian rams and Lacaune rams for lamb, milk, and wool production under dairy sheep production conditions in Wisconsin. According to this study, Eastern Friesian and Lacaune sheep lambs were similar for lamb production. Eastern Friesian ewe lambs are 15% higher for lactation length than Lacaune ewe lambs. Eastern Friesian ewe lambs are 21% superior to Lacaune ewe lambs for milk yield. Eastern Friesian ewe are 9% higher for milk fat yield than lambs Lacaune ewe lambs. Eastern Friesian ewe lambs are 10% superior to milk protein than Lacaune ewe lambs. In addition, breeding, lamb deaths, and lamb development are similar to Eastern Friesian and Lacaune ewes (Thomas et al, 2014).

2.12. Lacaune sheep breed in Turkey

In Turkey, the Ministry of Agriculture and Forestry issued a criterion for sheep to be imported. Sheep breeds that can be imported according to this criterion: East Friesian, Merino, Dorset Down, Charollais, Lacaune, Dorper, Ile de France, Suffolk, German and Assaf breeds. According to this criterion, on the day of selection, the minimum live weight (kg) of the animals should be as follows:

Breed	**Female**	**Male**
East Friesian	45	75
Merinos	45	75
Lacaune	40	65
Suffolk	50	90

(https://www.tarimorman.gov.tr**)**

Figure 3: Lacaune sheep breed (WTO, 2015)

2.13. German Meat Merinos sheep breed

It is known that there are 3 German Merino breeds. The first of them is Merinoslandschaf (Merinoslandsheep), the second, Merinofleischschaf (Merino Mutton sheep) and the third, Merinolangwollschaf (Merino longwoll sheep) breed. However, these sheep have different history and developmental processes. In Germany, 40 percent of the sheep population is Merinoslandschaf (Merinoslandsheep). One of these sheep breeds, Merinofleischschaf (Merino Mutton sheep), extends to the Ural Mountains on the east side of the Elbe. Merino Mutton

sheep is a very resistant sheep breed and has good meat yield. In addition, the fertility of German Mutton sheep is very good (3 reproduction in 2 years) so farmers can use German Merino Mutton sheep for intense milk-lamb production. Furthermore, the wool quality of German Merino sheep is better than that of Merinolandsheep. Wool yield of ewe German Merino Mutton sheep is 4-5 kg, while ram German Mutton Merino sheep wool yield is 7-10 kg (Mason, 1996).

2.14. General features of German Mutton Merino sheep

The body colors of the German Mutton Merino sheep are white. Except for the head part of this sheep breed, all their bodies are covered with fleece and the fleece is short and thin. Also, wool yields are very good and wool yield of ewe German Mutton Merino sheep is 4-5 kg, while ram German Mutton Merino sheep wool yield is 7-10 kg (Mason, 1996). In German Mutton Merino sheep, ram lambs develop rapidly and can reach 30-40 kg when they reach 4 months of age. Milk yields of German Mutton Merino sheep are not good. But the milk yield of these sheep is sufficient for their lambs. German Mutton Merino sheep gives 30-40 kg of milk during lactation. In addition, this sheep breed has a high rate of twins and this rate is 60-70%. From German Mutton Merino sheep, it can be obtained 4-6 offspring in 2 years. Furthermore, the lambs of German Mutton Merino sheep weigh 4-4.5 kg. Almost all sheep are hornless, but their rams may have horns. The live weight of German Mutton Merino sheep weighs 60-80 kg in females and 80-110 kg in males. The tails of German Mutton Merino sheep are thin (Turgut, 2019).

2.15. The purpose of breeding German Mutton Merino sheep

German Mutton Merino sheep are raised in many European countries for meat production, not for wool production. In addition, German Mutton Merino sheep are bred in many countries for breeding purposes. German Mutton Merino sheep hybridization was performed in Turkey. These studies led to the presence of the Turkish Merino (Karacabey Merino). In addition, German Mutton Merino sheep are bred for wool-meat production in Turkey (Gürcan and Akçapınar, 2002).

2.16. Genetic Development in German Mutton Merino Sheep

At the end of the 19th century, the former comb wool sheep were turned into German Merino sheep by using the French Mutton Merino**.** (Sa´nchez and Sa´nchez, 1986). In Turkey, German

Mutton Merino sheep used for breeding and German Mutton Merino breed and domestic sheep were crossed and Karacabey Merino breed, Anatolian Merino breed and Malya sheep breed emerged (Sönmez et al, 2009).

2.17. German Mutton Sheep in Hungary

German Mutton Merino had two varieties grown until 1992. They are East German type and West German type. Today, however, it is only used and kept for West German breeding. West German type is grown in Hungary. Wool yield is 3-5 kg and average productivity is 130-150%. The body weight of these adult rams is 90-130 kg. The average body weight of adult ewe is 70-80 kg (Jávor, 2013).

2.18. German Mutton Sheep in Turkey

The raw material is very important for the textile industry and a large part of this raw material is made from sheep. Therefore, wool production is very important in sheep breeding. Furthermore, the quality of wool is very important for textile industry and merino sheep is a very important breed in terms of wool quality. Textile sector in Turkey is very important for the economy. So merino sheep in Turkey are one of the most popular breeds. The German Mutton Merino sheep is very resistant to environmental conditions. The adaptability of German Mutton sheep is very good. In addition, German Mutton Merino sheep can live in steppe areas. This is an important reason for them to be brought into Turkey by the German Mutton Merino sheep (Gürcan and Akçapınar, 2002). German Mutton Merino was brought to Turkey in the 1934-1935 year. German Mutton Merino was hybridized with the native breeds in Turkey. It was hybridized with Kıvırcık sheep and Akkaraman sheep. By crossing German Mutton Merino and Akkaraman sheep breeds, Anatolian Merino and Malya sheep breeds were obtained. Turkish Merino (Karacabey Merino) was obtained by crossing German Mutton Merino and Kıvırcık sheep breeds (Ertuğrul, 2019).

The German Muton Merino and Karacabey Merino were compared with a study on the Karacabey farm (body weight, head length, height at withers, etc.). According to the results of the research, German Mutton Merino and Karacabey Merino genotopype were found to be very similar to each other. This study shows that the German Mutton Merino, the ancestor of the Karacabey merino, and Karacabey merino have similar characteristics and the two genotypes have similar body sizes (Gürcan and Akçapınar, 2002).

Figure 4. German Mutton Merino breed: (WTO, 2018)

2.19. Environmental effect on sheep growth trait

Sheep farming is very important for the livestock sector. Meat production is the most important among the sheep yields. For this reason, it is very important to create fast-growing sheep breeds that give more meat. Factors such as maternal age, gender, type of birth, year and the amount of milk suckled from the mother are effective on the growth of lambs.

In lamb growth, if the amount of milk absorbed from the mother of the lamb is high, the growth rate will be so high. Therefore, if we know the effects of environmental factors on the growth of lambs during and after milk sucking, we can determine the duration of milk sucking and lamb fattening activities in terms of lamb meat production. It will also help increase the selection effect. The effects of environmental factors must be known before making a breeding and yields should be equalized according to these factors. These will increase the success of breeding work. In addition, if we know the environmental factors, it will be easier for us to intervene to increase the yield. In lambs, the highest growth rate is the period of milk sucking. The impact of environmental factors during this period is too much for growth. During the milk sucking period, some factors affect the growth rate. These factors include sex, birth weight, type of delivery, diet, and maternal age (Küçük et al, 1999).

Knowledge of environmental factors is very important for breeding studies. When we make selection, animals with good genotype characteristics should be reserved for breeding. We need to accurately estimate the genotypic values of the animals we are going to devote to breeding. Phenotype values are very important for determining genotypic values. Environmental factors

significantly affect yield characteristics and make it difficult to predict genotype of individuals. Therefore, if we eliminate environmental factors, we can standardize genotypic values. This is very important for selection. The characteristics that define growth are birth weight and live weight at various periods. Genotype and environmental factors are effective in shaping an animal's live weight and birth weight. In addition, a study was conducted by Özsoy at the Faculty of Agriculture of Atatürk University. This study is a study on pure and hybrid sheep of Merino and Morkaraman. According to this study, the effects of genotype, year of birth, and maternal age on live weight of lambs at various periods are very important. In addition, Özsoy made another study on Merino, Morkaraman, and triple hybrid sheep. This study showed that maternal age is significantly effective only for birth weight. Casoli et al. (1987) said that gender and genotype analysis is important on Suffolk x Appenniene, ile de France x Appenniene, Dorset x Appennine, Southdown x Appennine hybrids and pure Appennine breed lambs. The type of birth affects growth in certain periods. These periods are birth weight and milk sucking period. Single birth lambs have a higher birth weight than twin lambs. Single-born lambs grow faster than twin-born lambs. In a study on German Mutton Merino, it was found that the type of birth was important for these characteristics. For birth weight, single born sheep are 21% heavier than twin born lambs. For weaning weight, single-born sheep are 22% heavier than twin-born sheep. Also, in a study conducted in Turkey, the growth rate of single-born lambs is better than twin lambs and male lambs were better than females. Anna Kremer et al. (1987) say that there is no difference between singles and twins for weight and growth rate (Demirsoy and Akçapınar, 1997).

2.20. Environmental effect on sheep milk production

Sheep can adapt to different environmental conditions and are managed in flock. Thanks to these features, sheep breeding is very important and sheep breeding is carried out all over the world (Şahin and Akmaz, 2004).

Thanks to sheep breeding, we can obtain many kinds of yields. The order of importance of these yields depends on the purpose of sheep breeding. Sheep breeding yield varieties are lamb, milk, wool, fertilizer, meat, leather. Sheep breeding is made to generate income and 20-40% of this income comes from milk production. 9,503,755 tons of annual milk production is done in Turkey. 7.6% of this production is from sheep milk (FAO, 2002). Sheep milk has high fat and protein. Therefore, the importance given to sheep milk is increasing in Italy, France and Spain. Some countries are working on breeding to increase sheep milk yield (Şahin and Akmaz,

2004). In Turkey, milk yield of Akkaraman and Morkaraman races is low. Therefore, Ivesi sheep breed was used to increase milk yield of these sheep breeds (Özsoy and Vanlı, 1986). Also, in Turkey, Curly milk yield is not sufficient. Hence, Thirova (25% Curly, 75% Ost Frize) breed was obtained by hybridizing with the German Ost Frieze.

The lactation period is very important in sheep milk yield. Lactation can be defined as the secretion of milk from the mammary glands. In sheep, the duration of lactation is different for flesh and dairy breeds. The duration of lactation is 3-4 months for beef breeds and 7-8 months for dairy breeds. When we look at sheep breeds with high milk yield in the world, we see that lactation milk yield is 600-700 kg (Şahin and Akmaz, 2004).

Environmental factors such as age, care and feeding for milk yield in sheep population are important factors for evaluation. Taking these factors into account, the actual yield capabilities of sheep are revealed. For success in breeding selection, we need to determine yield capabilities well. Some studies say that the effect of age on milk yield is important, while some studies have reported that age is not effective on milk yield in sheep. Some researchers have reported that lambing is also effective on milk yield characteristics

Karaca et al. said that the farm and age have got significant on milking days and milk production in their studies and in their studies, milking production has increased up to 3 years and it remains stable between 3 -5 years. After that, it decreased after 5 years.

Karaca et al. found that milk yield characteristics of single and twin sheep were very close to each other and found the difference between them statistically insignificant in their study (Karaca et al, 2003).

3. Materials and Methods

3.1. Materials

3.1.1.The materials for German Mutton Merino

Table 7. The numerical data of German Mutton Merino sheep

Number of farms used in the research	338
Number of animals used in the research	31917
Sex and number of them	
Male	8154
Female	23763
Age of dam	
Number of animals under 2 years	4125
Number of animals from 3 to 5 years	17548
Number of animals older than 5 years	10244
Number of animals in seasons	
Spring	10272
Summer	3673
Autumn	5285
Winter	12687
Litter size	
1	14113
2	16905
3	888
4	11

This study was conducted to determine that environmental factors effect on weaning weight, growth rate and yearling weight in German Mutton Merino. Animal's data was collected from 338 different farm. Also, 31917 German Mutton Merinos used for this study and the number of male sheep is 8154 while the number of female sheep is 23763. The age groups of animals used are <2, 3-5 and >5 years. The number of animals under 2 years is 4125 and the number of animals from 3 to 5 is 17548 and the number of animals older than 5 years is 10244. Also, in

this study we examined season and the number of animals is 10277 for Spring., 3673 for Summer, 5285 for Autumn and 12687 for Winter. In addition, this study conducted litter size. The number of animals is 14113 for 1 litter size, 16905 for 2 litter size, 888 for 3 litter size and 11 for 4 litter size.

3.1.2. The materials for Hungarian Merino

Table 8. The numerical data of Hungarian Merino sheep

Number of farms used in the research	253
Number of animals used in the research	18743
Sex and number of them	
Male	7152
Female	11591
Age of dam	
Number of animals under 2 years	1944
Number of animals from 3 to 5 years	10688
Number of animals older than 5 years	6111
Number of animals in seasons	
Spring	4048
Summer	1943
Autumn	2885
Winter	9867
Litter size	
1	9396
2	8952
3	386
4	9

This study was conducted to determine that environmental factors effect on weaning weight, growth rate and yearling weight in Hungarian Merino. Animals data was collected from 253 different farm. Also, 18743 Hungarian Merinos used for this study and the number of male sheep is 7152 while the number of female sheep is 11591. The age groups of animals used are

<2, 3-5 and >5 years. The number of animals under 2 years is 1944 and the number of animals from 3 to 5 is 10688 and the number of animals older than 5 years is 6111. Also, in this study we examined season and the number of animals is 4048 for Spring., 1943 for Summer, 2885 for Autumn and 9867 for Winter. In addition, this study conducted litter size. The number of animals is 9396 for 1 litter size, 8952 for 2 litter size, 386 for 3 litter size and 9 for 4 litter size.

3.1.3. The materials for Lacaune

Table 9. The numerical data of Lacaune Merino sheep

Number of farms used in the research	34
Number of animals used in the research	2079
Sex and number of them	
Male	1535
Female	544
Age of dam	
Number of animals under 2 years	277
Number of animals from 3 to 5 years	1211
Number of animals older than 5 years	591
Number of animals in seasons	
Spring	1222
Summer	31
Autumn	116
Winter	710
Litter size	
1	714
2	1123
3	206
4	33

This study was conducted to determine that environmental factors effect on weaning weight, growth rate and yearling weight in Lacaune. Animals data was collected from 34 different farm. Also, 2079 Lacaune used for this study and the number of male sheep is 1525 while the number of female sheep is 544. The age groups of animals used are <2, 3-5 and >5 years. The number of animals under 2 years is 277 and the number of animals from 3 to 5 is 1211 and the number

of animals older than 5 years is 591. Also, in this study we examined season and the number of animals is 1222 for Spring., 31 for Summer, 116 for Autumn and 710 for Winter. In addition, this study conducted litter size. The number of animals is 714 for 1 litter size, 1123 for 2 litter size, 206 for 3 litter size and 33 for 4 litter size.

3.1.4. The materials for Suffolk sheep

Table 10. The numerical data of Suffolk sheep

Number of farms used in the research	139
Number of animals used in the research	11634
Sex and number of them	
Male	2817
Female	8817
Age of dam	
Number of animals under 2 years	1863
Number of animals from 3 to 5 years	6970
Number of animals older than 5 years	2801
Number of animals in seasons	
Spring	5932
Summer	689
Autumn	396
Winter	4617
Litter size	
1	3641
2	7158
3	811
4	24

This study was conducted to determine that environmental factors effect on weaning weight, growth rate and yearling weight in Suffolk. Animal's data was collected from 139 different farm. Also, 11634 Suffolk used for this study and the number of male sheep is 2817 while the number of female sheep is 8817. The age groups of animals used are <2, 3-5 and >5 years. The number of animals under 2 years is 1863 and the number of animals from 3 to 5 is 6970 and

the number of animals older than 5 years is 2801. Also, in this study we examined season and the number of animals is 5932 for Spring., 689 for Summer, 396 for Autumn and 4617 for Winter. In addition, this study conducted litter size. The number of animals is 3641 for 1 litter size, 7158 for 2 litter size, 811 for 3 litter size and 24 for 4 litter size.

3.1.5. The materials for Lacaune for milk analysis

As indicated in the Table 11 below, this study was conducted to determine that environmental factors effect on the milking days and milk production in Lacaune. Animal's data were collected from 64 different farm. Also, 30776 Lacaune used for this study. In this study, we examined lambing season and the number of animals is 10292 for Spring, 852 for Summer, 2198 for Autumn and 17434 for Winter. This study was conducted on animal groups from 1 to 13 years and the number of animals is 1044, 9053, 7104, 5201, 3679, 2325, 1291, 662, 281, 99, 29, 6,2 respectively. In addition, this study conducted the effect of litter size at birth and litter size at weaning on milking days and milk production. The number of animals is 14385 for 1 litter size, 14923 for 2 litter size, 1324 for 3 litter size, 127 for 4 litter size, 16 for 5 litter size and 1 for 6 litter size in litter size at birth. The number of animals is 2515 for 0 litter size, 14579 for 1 litter size, 12747 for 2 litter size, 868 for 3 litter size, 65 for 4 litter size, 1 for 5 litter size and 1 for 6 litter size in litter size at weaning.

Table 11. The numerical data of Lacaune sheep for milk analysis

Number of farms used in the research	64
Number of animals used in the research	30776
Lambing season	
Spring	10292
Summer	852
Autumn	2198
Winter	17434
Age	
Number of animals for 1 year	1044
Number of animals for 2 years	9053
Number of animals for 3 years	7104
Number of animals for 4 years	5201
Number of animals for 5 years	3679
Number of animals for 6 years	2325
Number of animals from 7 years	1291
Number of animals older than 7 years	1079
Litter size at birth	
1	14385
2	14923
3	1324
4	127
5	16
6	1
Litter size at weaning	
0	2515
1	14579
2	12747
3	868
4	65
5	1
6	1

3.2. Methods

Analyses of variance were conducted to determine the effect of farm, year, sex, season age of dam and litter size on weaning weight, growth rate and yearling weight in German Mutton Merino, Hungarian Merino, Lacaune and Suffolk sheep breed. Also, Analyses of variance were conducted to determine the effect of farm, lambing season, lambing year, age, litter size at birth and litter size at weaning in Lacaune sheep breed.

4. Results

4.1. Effect of sheep farm, year, season, sex, age of dam and litter size on weaning weight in German Mutton Merino

As indicated in the Table 1 below, the result revealed that the farm, year, season, sex, age of dam and litter size have got significant (P<0.001) effect on the weaning weight.

Table 12: Effect of sheep farm, year, season, sex, age of dam and litter size on weaning weight in German Mutton Merino

Effects	**P-value**
Farm	< 0.001
Year	< 0.001
Season	< 0.001
Sex	< 0.001
Age of dam	< 0.001
Litter size	< 0.001

4.2. The mean weaning weights of German Mutton Merino sheep in 4 seasons and age of dam

Table 13: The mean weaning weights of German Mutton Merino sheep in 4 seasons and age of dam

	Average weaning weight in German Mutton Merino
Season	
Spring	20.41
Summer	20.49
Autumn	20.48
Winter	19.96
Age of dam	
<2	20.04
3-5	20.46
>5	19.99

4.3. Effect of sheep farm, year, season, sex, age of dam and litter size on growth rate in German Mutton Merino

As indicated in the Table 2 below, the result revealed that the farm, year, season, sex, age of dam and litter size have got significant (P<0.001) effect on the growth rate.

Table 14: Effect of sheep farm, year, season, sex, age of dam and litter size on growth rate in German Mutton Merino

Effects	**P. value**
Farm	< 0.001
Year	< 0.001
Season	< 0.001
Sex	< 0.001
Age of dam	< 0.001
Litter size	< 0.001

4.4. The mean growth rate of German Mutton Merino sheep in 4 seasons and age of dam

Table 15: The mean growth rate of German Mutton Merino sheep in 4 seasons and age of dam

	The average growth rate in German Mutton Merino
Season	
Spring	297.41
Summer	327.99
Autumn	323.52
Winter	320.16
Age of dam	
<2	320.99
3-5	314.94
>5	310.50

4.5. Effect of sheep farm, year, season, sex, age of dam and litter size on yearling weight in German Mutton Merino

As indicated in the Table 3 below, the result revealed that the farm, year, and sex have got significant (P<0.001) effect on the weaning weight and season and litter size have got significant(P<0.05) effect on the weaning weight in German Mutton Merino. The age of dam has not got significant (P>0.05) effect on the weaning weight in German Mutton Merino.

Table 16: Effect of sheep farm, year, season, sex, age of dam and litter size on yearling weight in German Mutton Merino

Effects	**P. value**
Farm	< 0.001
Year	< 0.001
Season	< 0.05
Sex	< 0.001
Age of dam	> 0.05
Litter size	<0.05

4.6. The mean yearling weight of German Mutton Merino sheep in 4 seasons and age of dam

Table 17: The mean yearling weight of German Mutton Merino sheep in 4 seasons and age of dam

	Average yearling weight in German Mutton Merino
Season	
Spring	60.04
Summer	61.19
Autumn	60.49
Winter	60.61
Age of dam	
<2	59.98
3-5	60.83
>5	60.05

4.7. Effect of sheep farm, year, season, sex, age of dam and litter size on weaning weight in Hungarian Merino

As indicated in the Table 5 below, the result revealed that the farm, year, sex, and litter size have got significant (P<0.001) effect on the weaning weight in Hungarian Merino. The season and age of dam have not got significant (P>0.05) effect on the weaning weight in Hungarian Merino.

Table 18: Effect of sheep farm, year, season, sex, age of dam and litter size on weaning weight in Hungarian Merino

Effects	**P. value**
Farm	<0.001
Year	<0.001
Season	> 0.05
Sex	<0.001
Age of dam	> 0.05
Litter size	<0.001

4.8. The mean weaning weights of Hungarian Merino sheep in 4 seasons and age of dam

Table 19: The mean weaning weights of Hungarian Merino sheep in 4 seasons and age of dam

	Average weaning weight in Hungarian Merino
Season	
Spring	20.05
Summer	20.54
Autumn	20.93
Winter	19.45
Age of dam	
<2	19.99
3-5	19.96
>5	19.83

4.9. Effect of sheep farm, year, season, sex, age of dam and litter size on growth rate in Hungarian Merino

As indicated in the Table 6 below, the result revealed that the farm, year, season, sex, and litter size have got significant (P<0.001) effect on the growth rate and age of dam have got significant (P<0.05) effect on the growth rate in Hungarian Merino.

Table 20: Effect of sheep farm, year, season, sex, age of dam and litter size on growth rate in Hungarian Merino

Effects	**P. value**
Farm	<0.001
Year	<0.001
Season	<0.001
Sex	<0.001
Age of dam	<0.05
Litter size	<0.001

4.10. The mean growth rate of Hungarian Merino sheep in 4 seasons and age of dam

Table 21: The mean growth rate of Hungarian Merino sheep in 4 seasons and age of dam

	The average growth rate in Hungarian Merino
Season	
Spring	298.87
Summer	347.51
Autumn	331.21
Winter	309.55
Age of dam	
<2	321.27
3-5	313.86
>5	313.51

4.11. Effect of sheep farm, year, season, sex, age of dam and litter size on yearling weight in Hungarian Merino

As indicated in the Table 7 below, the result revealed that the farm, year, sex, and age of dam have got significant (P<0.001) effect on the yearling weight. The season and litter size have not got significant (P>0.05) effect on the yearling weight in Hungarian Merino.

Table 22: Effect of sheep farm, year, season, sex, age of dam and litter size on yearling weight in Hungarian Merino

Effects	**P. value**
Farm	<0.001
Year	<0.001
Season	> 0.05
Sex	<0.001
Age of dam	<0.001
Litter size	>0.05

4.12. The mean yearling weight of Hungarian Merino sheep in 4 seasons and age of dam

Table 23: The mean yearling weight of Hungarian Merino sheep in 4 seasons and age of dam

	Average yearling weight in Hungarian Merino
Season	
Spring	61.04
Summer	61.54
Autumn	62.22
Winter	58.51
Age of dam	
<2	60.44
3-5	60.01
>5	59.66

4.13. Effect of sheep farm, year, season, sex, age of dam and litter size on weaning weight in Lacaune

As indicated in the Table 8 below, the result revealed that the season and litter size have got significant (P<0.0001) effect on the weaning weight and the farm and sex have got significant (P<0.05) effect on the weaning weight in Lacaune. The year and age of dam have not got significant (P>0.05) effect on the weaning weight in Lacaune.

Table 24: Effect of sheep farm, year, season, sex, age of dam and litter size on weaning weight in Lacaune

Effects	**P. value**
Farm	<0.05
Year	>0.05
Season	<0.001
Sex	<0.05
Age of dam	>0.05
Litter size	<0.001

4.14. The mean weaning weights of Lacaune sheep in 4 seasons and age of dam

Table 25: The mean weaning weights of Lacaune sheep in 4 seasons and age of dam

	Average weaning weight in Lacaune
Season	
Spring	20.30
Summer	21.74
Autumn	23.23
Winter	21.30
Age of dam	
<2	20.38
3-5	21.00
>5	20.68

4.15. Effect of sheep farm, year, season, sex, age of dam and litter size on growth rate in Lacaune

As indicated in the Table 9 below, the result revealed that the farm and sex have got significant (P<0.001) effect on the growth rate in Lacaune. The year, season, age of dam and litter size have not got significant (P>0.05) effect on the growth rate in Lacaune.

Table 26: Effect of sheep farm, year, season, sex, age of dam and litter size on growth rate in Lacaune

Effects	**P-value**
Farm	<0.001
Year	>0.05
Season	>0.05
Sex	<0.001
Age of dam	>0.05
Litter size	>0.05

4.16. The mean growth rate of Lacaune sheep in 4 seasons and age of dam

Table 27: The mean growth rate of Lacaune sheep in 4 seasons and age of dam

	The average growth rate in Lacaune
Season	
Spring	316.11
Summer	291.77
Autumn	336.46
Winter	308.25
Age of dam	
<2	309.76
3-5	314.75
>5	315.16

4.17. Effect of sheep farm, year, season, sex, age of dam and litter size on yearling weight in Lacaune

As indicated in the Table 10 below, the result revealed that the year, season, sex have got significant (P<0.001) effect on the yearling weight and the farm have got significant (P<0.05) effect on the yearling weight in Lacaune. The age of dam and litter size have not got significant (P>0.05) effect on the yearling weight in Lacaune.

Table 28: Effect of sheep farm, year, season, sex, age of dam and litter size on yearling weight in Lacaune:

Effects	**P-value**
Farm	<0.05
Year	<0.001
Season	<0.001
Sex	<0.001
Age of dam	>0.05
Litter size	>0.05

4.18. The mean yearling weight of Lacaune sheep in 4 seasons and age of dam

Table 29: The mean yearling weight of Lacaune sheep in 4 seasons and age of dam

	Average yearling weight in Lacaune
Season	
Spring	62.25
Summer	66.32
Autumn	69.50
Winter	63.60
Age of dam	
<2	62.77
3-5	62.72
>5	64.29

4.19. Effect of sheep farm, year, season, sex, age of dam and litter size on weaning weight in Suffolk

As indicated in the Table 11 below, the result revealed that the farm, year, season, sex and litter size have got significant (P<0.001) effect on the weaning weight in Suffolk. The age of dam has not significant (P>0.05) effect on the weaning weight in Suffolk.

Table 30: Effect of sheep farm, year, season, sex, age of dam and litter size on weaning weight in Suffolk

Effects	**P-value**
Farm	<0.001
Year	<0.001
Season	<0.001
Sex	<0.001
Age of dam	>0.05
Litter size	<0.001

4.20. The mean weaning weights of Suffolk sheep in 4 seasons and age of dam

Table 31: The mean weaning weights of Suffolk sheep in 4 seasons and age of dam

	Average weaning weight in Suffolk
Season	
Spring	23.94
Summer	24.17
Autumn	21.61
Winter	23.46
Age of dam	
<2	22.85
3-5	23.94
>5	23.62

4.21. Effect of sheep farm, year, season, sex, age of dam and litter size on growth rate in Suffolk

As indicated in the Table 12 below, the result revealed that the farm, year, season, and sex have got significant (P<0.001) effect on the growth rate in Suffolk. The age of dam and litter size have not significant (P>0.05) effect on the growth rate in Suffolk.

Table 32: Effect of sheep farm, year, season, sex, age of dam and litter size on growth rate in Suffolk

Effects	**P-value**
Farm	<0.001
Year	<0.001
Season	<0.001
Sex	<0.001
Age of dam	>0.05
Litter size	>0.05

4.22. The mean growth rate of Suffolk sheep in 4 seasons and age of dam

Table 33: The mean growth rate of Suffolk sheep in 4 seasons and age of dam

	The average growth rate in Suffolk
Season	
Spring	306.75
Summer	325.37
Autumn	314.08
Winter	341.99
Age of dam	
<2	323.86
3-5	321.97
>5	321.20

4.23. Effect of sheep farm, year, season, sex, age of dam and litter size on yearling weight in Suffolk

As indicated in the Table 13 below, the result revealed that the farm, year and sex have got significant (P<0.001) effect on the yearling weight in Suffolk. The season, age of dam and litter size have not got significant (P>0.05) effect on the growth rate in Suffolk.

Table 34: Effect of sheep farm, year, season, sex, age of dam and litter size on yearling weight in Suffolk

Effects	**P-value**
Farm	<0.001
Year	<0.001
Season	>0.05
Sex	<0.001
Age of dam	>0.05
Litter size	>0.05

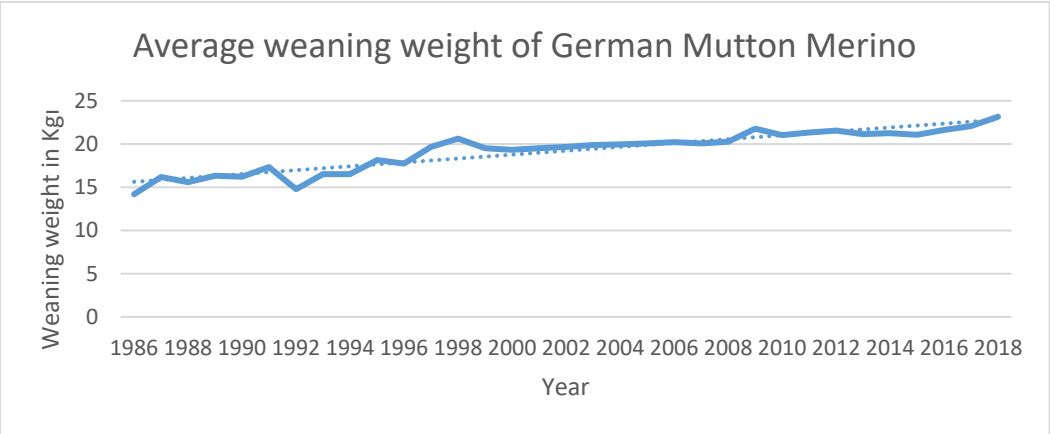
4.24. The mean yearling weight of Suffolk sheep in 4 seasons and age of dam

Table 35: The mean yearling weight of Suffolk sheep in 4 seasons and age of dam

	Average yearling weight in Suffolk
Season	
Spring	65.82
Summer	67.25
Autumn	62.68
Winter	66.59
Age of dam	
<2	65.05
3-5	66.26
>5	66.40

4.25. The mean weaning weights of German Mutton Merino sheep between 1986 and 2018

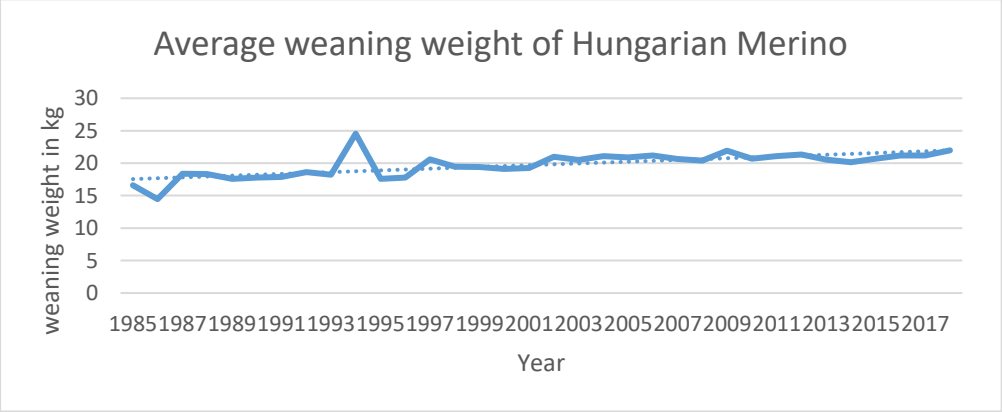
As indicated in the Graph.1 below, the mean weaning weights of German Mutton Merino sheep increased between 1986 and 2018.



Graph.1: The mean weaning weights of German Mutton Merino sheep between 1986 and 2018

4.26. The mean weaning weights of Hungarian Merino sheep between 1985 and 2018

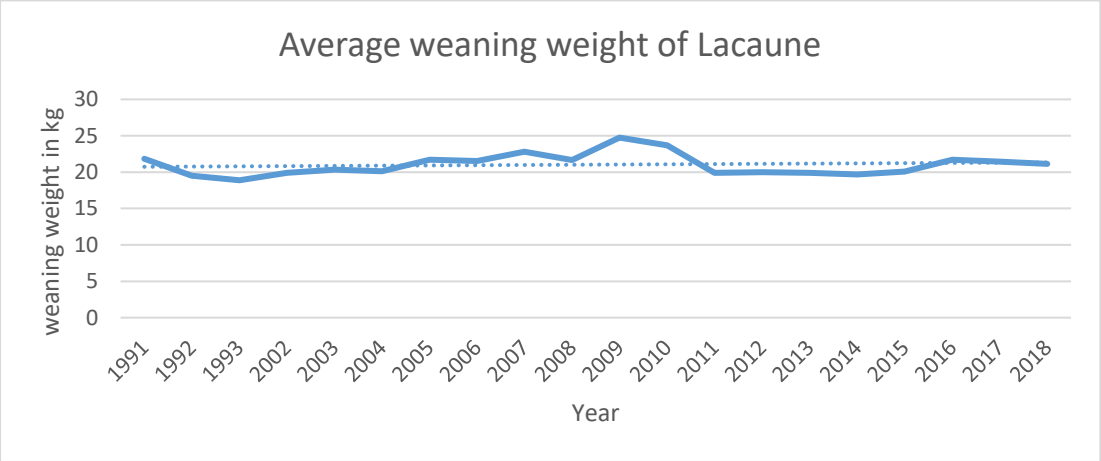
As indicated in the Graph.2 below, the mean weaning weights of Hungarian Merino sheep has increased sharply between 1993 and 1994 and it sharply decreased between 1994 and 1995. After that, it slowly increased between 1995 and 2018.



Graph.2: The mean weaning weights of Hungarian Merino sheep between 1985 and 2018

4.27. The mean weaning weights of Lacaune sheep between 1991 and 2018

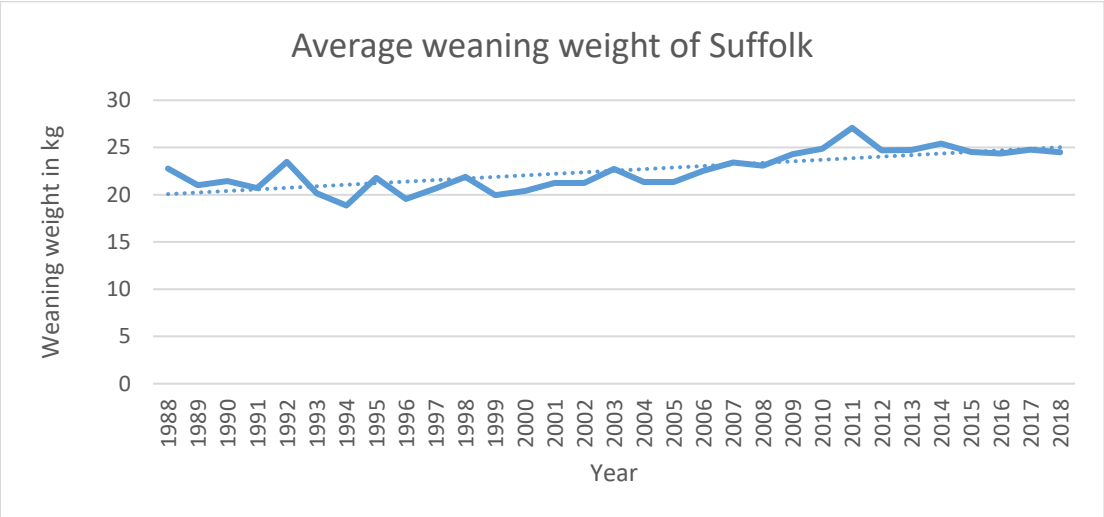
As indicated in the Graph.3 below, the mean weaning weights of Lacaune sheep remained steady except for a sharp decrease and increase between 2008 and 2011.



Graph.3: The mean weaning weights of Lacaune sheep between 1991 and 2018

4.28. The mean weaning weights of Suffolk sheep between 1988 and 2018

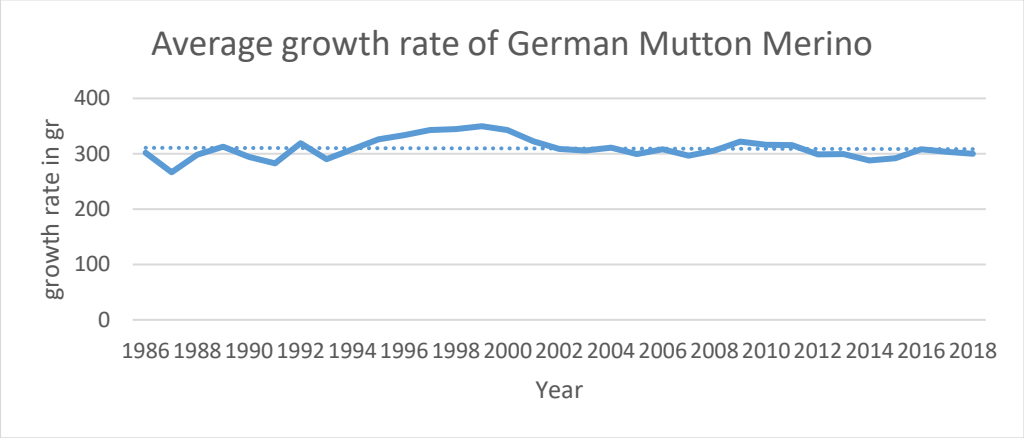
As indicated in the Graph.4 below, the mean weaning weights of Suffolk sheep increased slowly between 1988 and 2018.



Graph.4: The mean weaning weights of Suffolk sheep between 1988 and 2018

4.29. The mean growth rate of German Mutton Merino sheep between 1986 and 2018

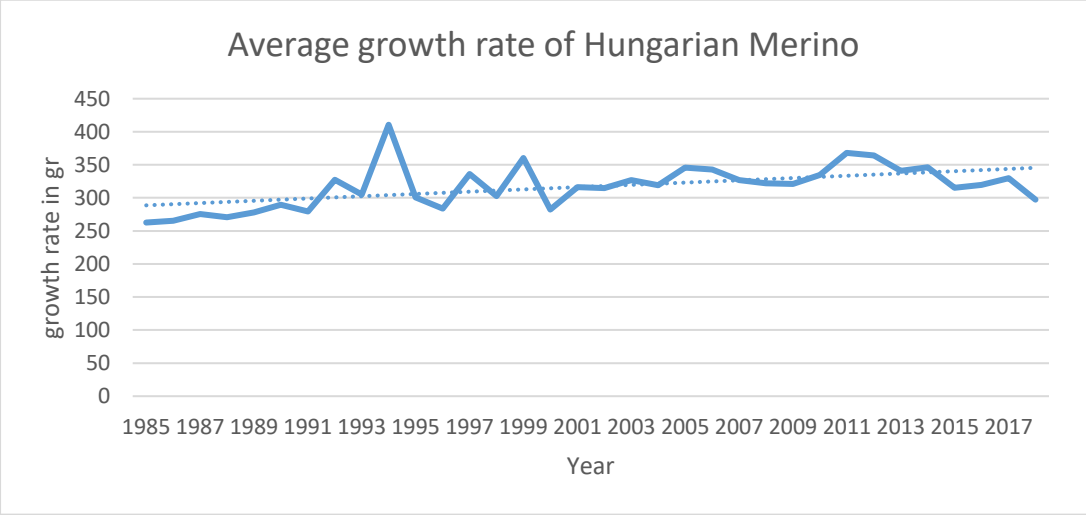
As indicated in the Graph.5 below, the mean growth rate of German Mutton Merino sheep remained steady between 1986 and 2018.



Graph.5: The mean growth rate of German Mutton Merino sheep between 1986 and 2018

4.30. The mean growth rate of Hungarian Merino sheep between 1985 and 2018

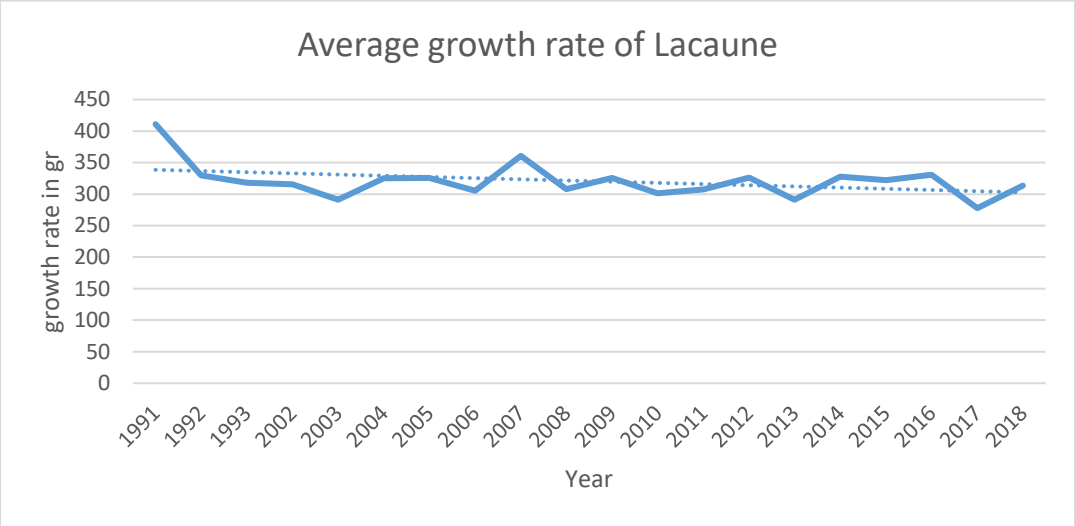
As indicated in the Graph.6 below, the mean growth rate of Hungarian Merino sheep has increased sharply between 1993 and 1994 and it has decreased sharply between 1994 and 1995. It has increased slowly between 1985 and 2018.



Graph.6: The mean growth rate in Hungarian Merino sheep between 1985 and 2018

4.31. The mean growth rate of Lacaune sheep between 1991 and 2018

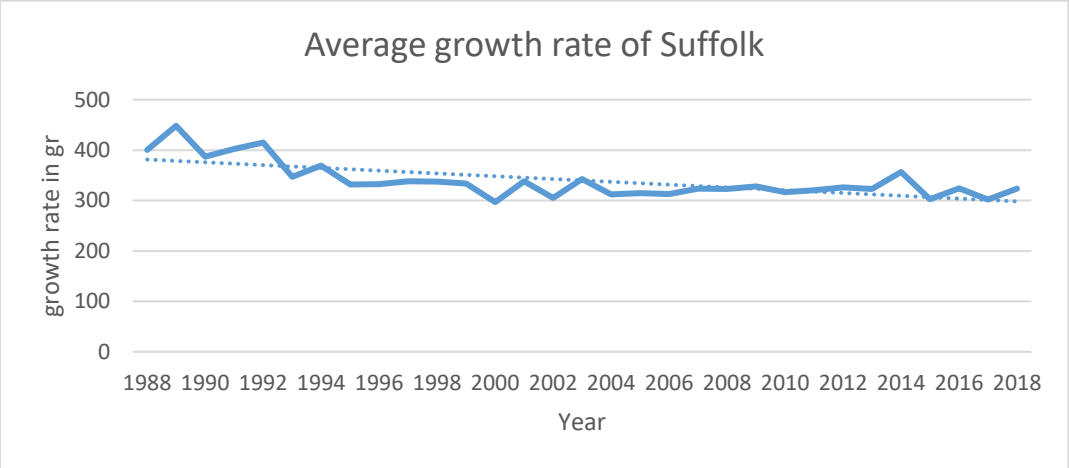
As indicated in the Graph.7 below, the mean growth rate of Lacaune sheep has decreased sharply between1991 and 1993. After that, it remained steady between 2002 and 2018.



Graph.7: The mean growth rate in Lacaune sheep between 1991 and 2018

4.32. The mean growth rate of Suffolk sheep between 1988 and 2018

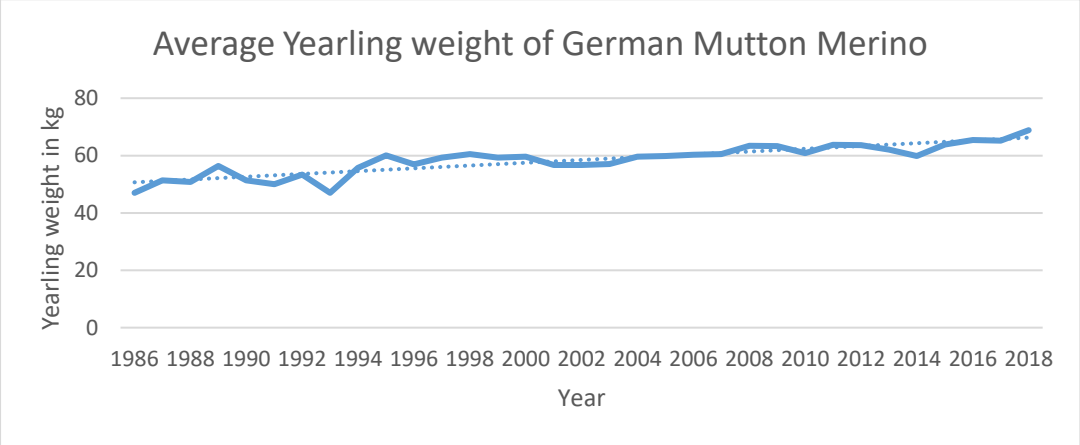
As indicated in the Graph.8 below, the mean growth rate of Suffolk sheep has decreased between 1988 and 2018.



Graph.8: The mean growth rate in Suffolk sheep between 1988 and 2018

4.33. The mean Yearling weights of German Mutton Merino sheep between 1986 and 2018

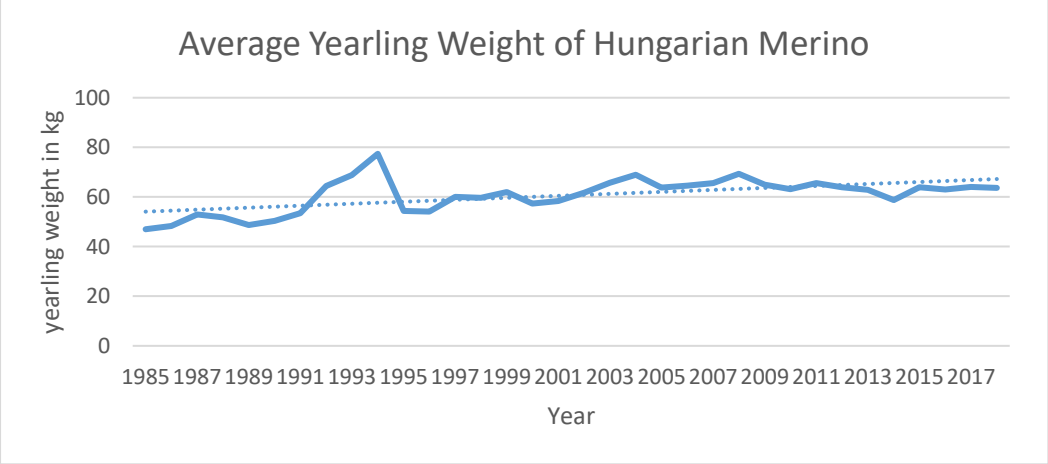
As indicated in the Graph.9 below, the mean yearling weight of German Mutton Merino sheep has increased between 1986 and 2018.



Graph.9: The mean Yearling weights of German Mutton Merino sheep between 1986 and 2018

4.34. The mean Yearling weights of Hungarian Merino sheep between 1985 and 2018

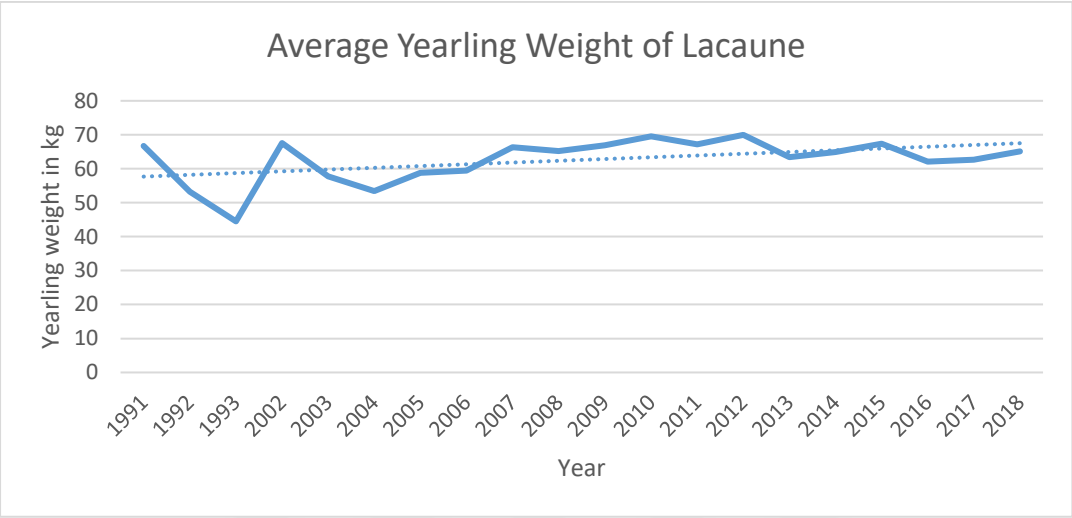
As indicated in the Graph.10 below, the mean yearling weight of Hungarian Merino sheep has increased sharply between 1991 and 1994 and it has decreased sharply between 1994 and 1995. After that, it has increased slowly.



Graph.10: The mean Yearling weights of Hungarian Merino sheep between 1985 and 2018

4.35. The mean Yearling weights of Lacaune sheep between 1991 and 2018

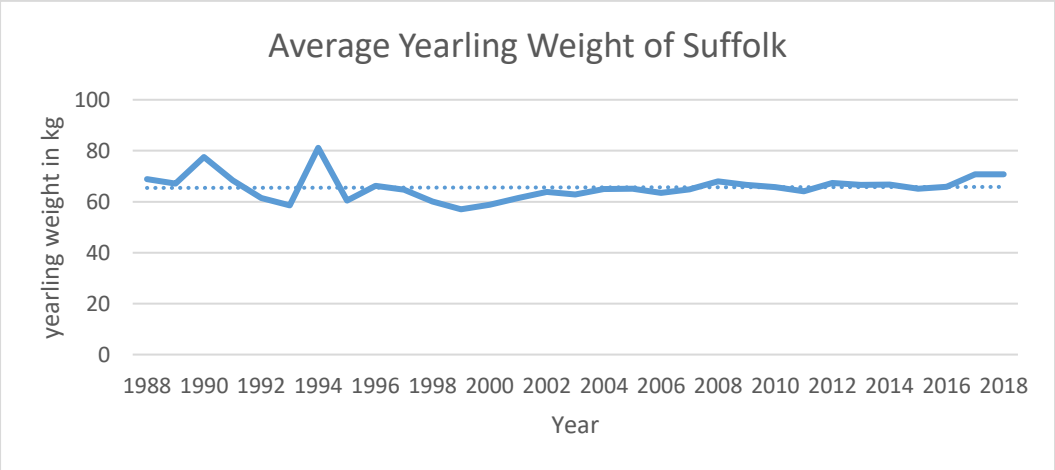
As indicated in the Graph.11 below, the mean yearling weight of Lacaune sheep has decreased sharply between 1991 and 1993 and it has increased sharply between 1993 and 2002. It has decreased in 2002 and 2004. After that it has increased slowly between 2004 and 2018.



Graph.11: The mean Yearling weights of Lacaune sheep between 1991 and 2018

4.36. The mean Yearling weights of Suffolk sheep between 1998 and 2018

As indicated in the Graph.12 below, the mean yearling weight of Suffolk sheep has increased sharply between 1989 and 1990. It has decreased sharply between 1990 and 1993. It has increased sharply between 1993 and 1994 and it has decreased sharply between 1994 and 1995. After that, it remained steady between 1995 and 2018.



Graph.12: The mean Yearling weights of Suffolk sheep between 1988 and 2018

4.37. Effect of sheep farm, lambing year, lambing season, age, litter size at birth and litter size at weaning on milking days in Lacaune

As indicated in the Table 23 below, the result revealed that the farm, lambing year, lambing season, age and litter size at birth, litter size at weaning has got significant (P<0.001) effect on the milking days.

Table 36: Effect of sheep farm, lambing year, lambing season, age, litter size at birth and litter size at weaning on milking days in Lacaune

Effects	**p-value**
Farm	<0.001
Lambing year	<0.001
Lambing season	<0.001
Age	<0.001
Litter size at birth	<0.001
Litter size at weaning	<0.001

4.38. Effect of sheep farm, lambing year, lambing season, age, litter size at birth and litter size at weaning on milk production in Lacaune

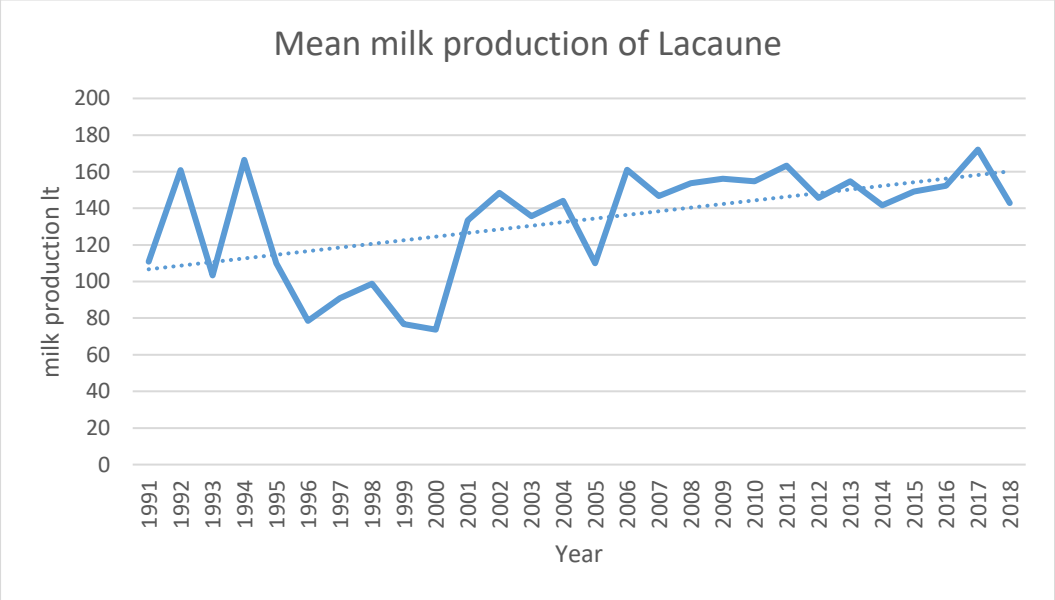
As indicated in the Table 24 below, the result revealed that the lambing year, lambing season, age and litter size at birth has got significant (P<0.001) effect on the milk production and the farm has got significant (P<0.05) effect on the milk production in Lacaune. The litter size at weaning has not got significant (P>0.05) effect on the milk production in Lacaune.

Table 37: Effect of sheep farm, lambing year, lambing season, age, litter size at birth and litter size at weaning on milk production in Lacaune

Effects	**p-value**
Farm	<0.05
Lambing year	<0.001
Lambing season	<0.001
Age	<0.001
Litter size at birth	<0.001
Litter size at weaning	>0.05

4.39. The mean milk production of Lacaune sheep between 1991 and 2019

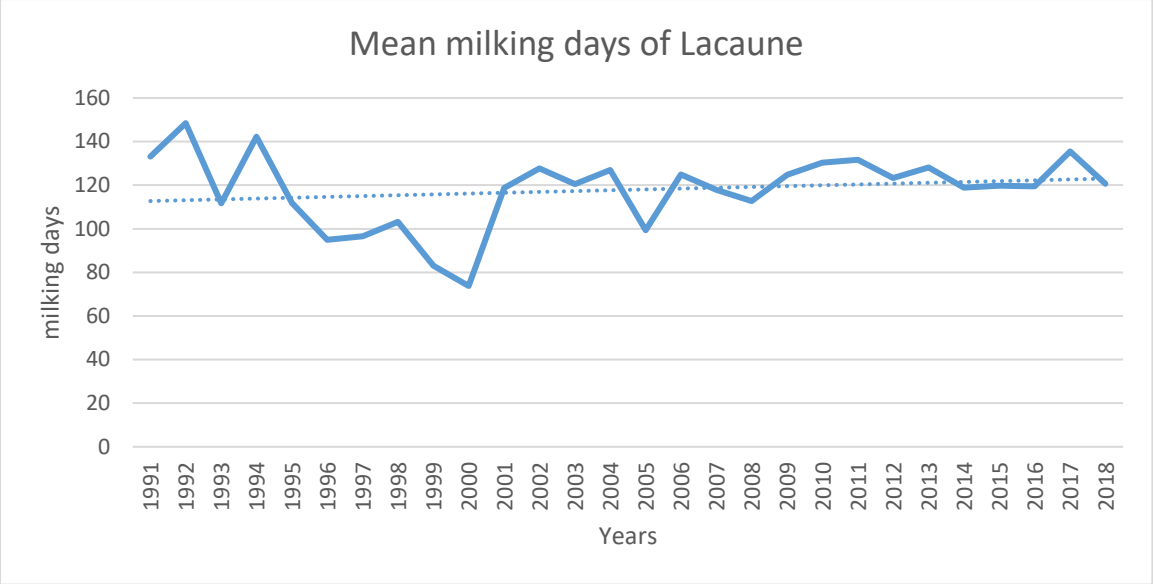
As indicated in the Graph.13 below, milk production of Lacaune sheep has increased sharply between 1991 and 1992. It has decreased sharply between 1992 and 1993 and it has increased sharply between 1993 and 1994. It has decreased sharply between 1994 and 1996. It has increased sharply between 2000 and 2002. It has decreased sharply between 2004 and 2005 and it has increased sharply 2005 and 2006. After that, it has increased slowly between 2006 and 2018.



Grap.13: The mean milk production of Lacaune sheep between 1991 and 2019.

4.40. The mean milking days of Lacaune sheep between 1991 and 2018

As indicated in the Graph.13 below, milking days of Lacaune sheep has increased sharply between 1991 and 1992. It has decreased sharply between 1992 and 1993 and it has increased sharply between 1993 and 1994. It has decreased sharply between 1994 and 1996. It has decreased sharply between 1998 and 2000. It has increased sharply between 2000 and 2002. It has decreased sharply between 2004 and 2005 and it has increased between 2005 and 2006. After that, it remained steady between 2006 and 2018.



Grap.14: The mean milking days of Lacaune sheep between 1991 and 2018

5. Discussion and conclusion

5.1. Discussion

In this study, the weaning weight, growth rate and yearling weight characteristics and environmental factors affecting it were investigated in German Mutton Merino, Hungarian Merino, Lacaune and Suffolk sheep breeds.

5.1.1. The weaning weights

The Farm, year, season, sex, age of dam and litter size have got significant($P<0.001$) effect on weaning weight in German Mutton Merino. But, results for other sheep breeds are not the same. For Hungarian Merino, the farm, year, sex and litter size has got significant ($P<0.001$) while the season and age of dam have not significant ($P>0.05$) effect on the weaning weight. For Lacaune, the farm and sex have got significant ($P<0.05$) effect on the weaning weight and the season and litter size have got significant ($P<0.001$) effect on the weaning weight while the year and age of dam have not got significant ($P>0.05$) effect on the weaning weight. For Suffolk, the farm, year, season, sex and litter size have got significant ($P<0.001$) effect on the weaning weight while the age of dam has not got significant ($P>0.05$) effect on the weaning weight.

Ünal et al. (2003) found that the effect of the year on weaning weight was important. The year has a significant effect on weaning weight. In studies conducted on the characteristics of growth and development, it was reported that the year was an important source of variation while some stated that it had no statistical effect on these characteristics of the year (Esenbuğa and Dayıoğlu, 2002). Narayonaswami et al (2002) stated that age of dam was effective on weaning weight in their studies. Akçapınar (1983) stated that the age of dam was effective on weaning weight. Özsoy et al. (1998) Stated that age of dam was effective on weaning weight. However, Macit (1994) stated that age of dam had no significant effect on growth and development characteristics of lambs. In a study, the effect of age of dam on the weaning weights of Gökçeada lambs was insignificant (Ceyhan et al, 2013). Kaymakçı et al. (2006) reported that sex was effective on weaning weight in Menemen lambs and determined that males developed more than females in weaning. Ünal et al. (2003) reported that litter size has got significant effect on weaning weight in sheep. Çep et al. (1998) determine that litter size has got significant effect on weaning weight in sheep. Ürşün and Emsen (2010) found that the season has got significant effect on weaning weight in sheep in their studies.

5.1.2. The growth rates

The Farm, year, season, sex, age of dam and litter size have got significant($P<0.001$) effect on growth rate in German Mutton Merino and Hungarian Merino and the age of dam has got significant ($P<0.05$) effect on the growth rate in German Mutton Merino and Hungarian Merino. But, results for other sheep breeds are not the same. For Lacaune, the farm and sex have got significant ($P<0.001$) effect on growth rate while the year, season and age of dam have not got significant ($P>0.05$) effect on growth rate. For Suffolk, the farm, year, season and sex have got significant ($P<0.001$) effect on growth rate while the age of dam and litter size have got not significant (P>0ç05) effect on growth rate.

The farm has got significant effect on growth rate in sheep (Ağdacı, 2013). P.S. Burfening and M.Carpio.P. said that the year has got significant effect on growth rate in sheep (Burfening and Carpio, 1993). Some researches determine that the year has not significant effect on growth rate in sheep in their studies (Esenbuğa and Dayıoğlu, 2002).

In a study conducted on Menemen lambs, it was reported that daily live weight gain in male and female lambs was 183.3 and 120.50 gr, respectively. This shows us that gender has a significant effect on the growth rate (Kaymakçı et al. 2006).

Demirsoy and Akçapınar determine that the age of dam has not got significant effect on growth rate in sheep in their studies. In another study, it was found that while the age of dam has a statistically significant ($P <0.05$) effect on growth rate until weaning, age of dam has not got significant effect on growth rate in other periods (Esenbuğa and Dayıoğlu, 2002).

Ceyhan at al. (2007) determines that the litter size has significant effect on the growth rate in sheep. Also, Ceyhan at al. (2007) determines that the litter size has not got significant effect on growth rate between 6 months and yearling in sheep. (Makale9). Demirsoy and Akçapınar found that the litter size has got significant effect on growth rate in sheep (Demirsoy and Akçapınar, 1997).

5.1.3. The yearling weights rates

The Farm and year have got significant($P<0.001$) effect on yearling weight and season and litter size have got significant ($P<0.05$) effect on yearling weight while the age of dam has not got significant ($P>0.05$) effect on yearling weight in German Mutton Merino. The farm, year and age of dam have significant ($P<0.05$) effect on yearling weight while the season and litter

size have not got significant (P>0.05) effect on yearling weight in Hungarian Merino. The farm has got significant (P<0.05) effect on yearling weight and the year, season and sex have got significant (P<0.001) effect on yearling weight while the age of dam and litter size have not got significant effect on yearling weight in Lacaune. The farm, year and sex have got significant (P<0.001) effect on yearling weight while the season, age of dam and litter size have not got significant (P>0.05) effect on yearling weight in Suffolk.

Gamasaee et al. found that the farm, sex and year has got significant effect on yearling weight in Mehreban sheep. Also, the farm has got significant on yearling weight in sheep and reasons for this may be differences in management, food availability and climate conditions (Gamasaee et al, 2010). Narayanaswami et al (1975) and Akçapınar (1983) found that the age of dam has got significant effect on yearling weight in İvesi and Morkaraman sheep. But Macit (1994) said that the age of dam has not got significant effect on yearling weight in İvesi and Morkaraman sheep. Notter and Brown found that the litter size has got significant effect on yearling weight (Notter and Brown, 2015). Gamasaee et al found that type of birth has got significant effect on weaning weight while it has not got significant effect on yearling weight in Mehreban sheep (Gamasaee et al, 2010).

5.1.4. The milking days

The farm, lambing year, lambing season, age, litter size at birth and litter size at weaning have got significant (P<0.001) effect on the milking days in Lacaune.

Karaca et al. (2003) said that the farm and age have got significant on milking days in Karakaş sheep. Yılmaz and Altınel found that age has got significant effect on milking days in kıvırcık and Karacabey Merino (Yılmaz and Altınel, 2003). Sönmez et al (1991) found that the age has got significant effect on milking days. Kaygısız and Dağ found that year has got significant effect on milking days in İvesi sheep. Also, Kaygısız and Dağ found that the farm has got significant effect on milking days. The reason for this may be climate conditions (Kaygısız and Dağ, 2017). Yıldız.A and Yıldız.N (2002) found that lambing season has got significant effect on milking days in İvesi sheep.

5.1.5. The milk production

The farm has got significant (P<0.05) effect on milk production and the lambing year, lambing season, age, and litter size at birth have got significant (P<0.001) effect on the milking days in Lacaune. The litter size at weaning has got significant (P>0.05) effect on the milk production in Lacaune.

Some studies say that the effect of age on milk yield is important, while some studies have reported that age is not effective on milk yield in sheep. Some researchers have reported that lambing is also effective on milk yield characteristics (Karaca et al. 2003). Karaca et al. said that the farm and age have got significant on milk production in their studies and in their studies, milking production has increased up to 3 years and it remains stable between 3 -5 years. After that, it decreased after 5 years (Karaca et al. 2003). Karaca et al. (2003) found that milk yield characteristics of single and twin sheep were very close to each other and found the difference between them statistically insignificant in their study. Yıldız.A and Yıldız.N (2002) found that lambing season has got significant effect on milk production in İvesi sheep. Kaygısız and Dağ (2017) found that the type of birth has not got significant effect on milk production in İvesi sheep.

5.2. Conclusion

Genetic parameter evaluations and estimates are needed for implementation of breeding programmers and assessment of progress of present programmers. From the results above, for German Mutton Merino, the farm, year, season, sex, age of dam and litter size have got significant effect on weaning weight and growth rate. Also, all traits have got significant effect on yearling weight except age of dam. For Hungarian Merino, the farm, year, sex and litter size have got significant effect on the weaning weight while the season and age of dam have not significant effect on the weaning weight. Also, all traits have got significant effect on the growth rate. In addition, all traits have got significant effect on the yearling weight except for the age of dam. For Lacaune, the farm, season, sex and litter size have got significant effect on the weaning weight while the year and age of dam have not significant effect on the weaning weight. Also, almost all traits have not got significant effect on the growth rate except the farm and sex. In addition, all traits have got significant effect on the yearling weight except the age of dam and litter size. Also, the farm, lambing year, lambing season, age, litter size at birth and litter size at weaning has got significant effect on milking days and milk production except litter size at weaning because it just has got significant effect on milking days. For Suffolk, the farm, year, season, sex and litter size have got significant effect on the weaning weight while the age of dam has not significant effect on the weaning weight. Also, the farm, year, season and sex have got significant effect on the growth rate while the age of dam and litter size have not got significant effect on the growth rate. In addition, the farm, year and sex have got significant effect on yearling weight while the season, age of dam and litter size have not significant effect on yearling weight.

6. Summary

This study was conducted in Hungary to understand the effects of environmental factors on the growth characteristics of sheep breeds in German Mutton Merino, Hungarian Merino, Lacaune and Suffolk sheep breeds. In this study, recorded data of 31917 German Mutton Merino sheep, recorded data of 18743 Hungarian Merino sheep, recorded data of 2079 Lacaune sheep, recorded data of 11634 Suffolk sheep and recorded data of 30776 Lacaune sheep were used. In this study, the effects of farm, year, season, sex, age of dam, and litter size traits on weaning weight, growth rate, yearling weight were investigated in German Mutton Merino, Hungarian Merino, Lacaune and Suffolk sheep breeds. In this study, the effect of farm, lambing year, lambing season, age, litter size at birth and litter size at weaning properties on milking days and milk production were investigated in Lacaune milk sheep. R software program was used for analysis of variance. When we examined the effect of farm, year, season, sex, age of dam, and litter size on weaning weight, growth rate, yearling weight, different results were obtained for 4 sheep breeds excluding year and sex. The effect of all properties on weaning weight is found important for the German Mutton Merino while, all the traits are important except for the season and age of dam for the Hungarian Merino, all the traits are important except for the year and age of dam for Lacaune, all the traits except the important age of dam for Suffolk. When we look at the effect of the above-mentioned features on the growth rate, the effect of all the traits was found to be important for German Mutton Merino and Hungarian Merino. However, the effect of most of these properties on growth rate was insignificant in Lacaune sheep and only the effect of farm and sex was significant. When we look at the Suffolk breeds, the effect of all properties on the growth rate was found to be significant except age of dam and litter size. When the effect of these factors on another growth feature of yearling weight was examined, the effect of age on the yearling weight was found to be insignificant for these 4 sheep breeds, while the effect of farm, year and sex on yearling weight was found to be significant in these 4 sheep breeds. When the effect of the season on yearling weight was examined, it was significant for German Mutton Merino and Lacaune, while it was insignificant for Hungarian Merino and Suffolk. When we look at the effect of Litter size on Yearling weight, only it was found important in the German Mutton Merino and it was insignificant for other races. Also, when the effects of the factors mentioned above, farm, lambing year, lambing season, age, litter size at birth and litter size at weaning on milking days and milk production were examined, the effect of all traits on milking days and milk production was found to be significant. However, the effect on litter size at weaning on the milk production was insignificant.

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