Animal fiber production in Turkey: Present situation and future

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Abstract

Primarily the production of wool, mohair, silk, goat coarse hair and cashmere fibers is made in Turkey. However, there has been a significant level of decrease in the production of these fibers for many years. The factors mainly causing this decrease can be said to include rapid increase in the use of chemical fibers, changes in fashion which have negative impacts on the consumption these fibers and systematic problems which negatively affect the production of sheep, Angora goat, hair goat and silkworm. However, although the production resources are continuing to decrease, Turkey still has a significant level of animal fiber production potential. Attainment of a more effective utilization of this potential will significantly contribute to the establishment of a sustainable textile industry and rural development and the preservation and development of folkloric culture and native farm animals which produce fibers.

Keywords: *Turkey, animal fiber, textile industry, rural development.*

Introduction

Animal fibers used in textile industry in today's world are obtained from 11 different animals, namely; sheep, goat, Angora rabbit, lama, alpaca, vicuna, guanaco, camel, yak, Northern American Buffalo and musk ox. These fibers greatly differ in terms of biological, chemical and physical features. Among the 11 fiber-producing animals, only silkworm is in the insect families while the others are in the mammal animal families. Displacement of natural fibers by petrochemical fibers in the textile sector and others roughly in the last half-century has caused significant decline in the production of animal fibers as well. However, depending on various factors such as the developments in organic agriculture, there has been a significant increase in the level of interest shown to natural fibers in recent years. In addition to this, various studies has been conducted to decrease the negative effects of synthetic fibers and current economic crisis on the agricultural businesses whose economic life largely depends on the production and processing of natural/ animal fibers. For this purpose, FAO announced the year 2009 as the international natural fibers year in order to draw the attention of the fiber sector and other circles to the importance of natural fibers (Anonymous, 2009). In the EU countries, projects for the development of fine animal fiber are being conducted in order to utilize areas which are inappropriate for agriculture and to economically support small family businesses (Russel, 1993). Present situation and near future of animal fiber production in Turkey is examined and things to be done to increase its contribution to the general and rural economy are discussed in this paper.

Animal Fiber Production in the World and the EU

According to 2011 figures, wool is the animal fiber which was produced at the highest level in the world (approximately 1.043.712.633 tons). The first three countries where this fiber was produced at the highest level are China (393.072 tons), Australia (361.806 tons) and New Zealand (165.800 tons) respectively. In the period of 1991-2001, there was a decrease at the level of approximately 11.9 % in the total grease wool production in the world. On the other hand, in this period there was a continuous increase in the wool production of China while there was a decrease in the production of Australia and New Zealand. Merino wool production is primarily made in Australia and South Africa in the world. Coarse wool production sector is primarily developed in New Zealand while both fine and medium wool are produced at important levels in Uruguay and Argentina. Because of the increase in demand for clothes made of light and soft wool, demand inclination has turned from medium wool to fine wool. However, there are some problems in the matter of expanding fine wool market. While medium wool can be used in the clothing sector and many other sectors, the fact that the market of fine wool is fragmented makes its marketing difficult and increases its price. According to 2011 figures, the most produced four fiber types after wool in the world are Angora rabbit wool (8.500 tons), cashmere (7.705 tons), Yak wool (7.500 tons) and mohair (4.900 tons) respectively. Of these fiber types, Angora rabbit wool and cashmere are produced at the highest level in China while Yak wool is produced in Tibet-China-Mongolia and mohair is produced in South Africa (McGregor, 2012**;** Anonymous, 2013a). According to 2011 figures in the EU-27, the total grease wool production is approximately 192.806 tons and its production showed a decrease which is at the level of 27.2 % in the period of 1991-2001. The first three countries where the production of wool realizes at the highest level in the EU-27 are the UK, Spain and Romania respectively. While there were significant decreases in the production levels of countries such as Poland, Bulgaria, Austria, Belgium and Denmark within this period, increases occurred in the production levels of Slovenia and Lithuania (Anonymous, 2013a). The production of fine lux fibers is at low levels in the EU. However, the production of fine-lux fibers such as fine wool, cashmere, mohair, Angora rabbit wool and Alpaca wool has been turned towards depending on changes in animal fiber production policies in recent years in order to attain a more effective utilization of non-arable land resources and to increase the income of small family businesses present in these places (Russel, 1993).

Animal Fiber Production in Turkey

The production of primarily wool, mohair, goat coarse hair, cashmere and silk fiber is made for commercial purposes in Turkey. In Table 1 is given the change in animal fiber production in the period of 1992-2012 and in Table 2 is given the change in the number of fiber-producing farm animals within the same period.

***Table 1**. Change in animal fiber production by years in Turkey (Anonymous, 2013b)*

Fiber Type	Production Amounts (ton)					1992-2012 Change (%)
	1992	1997	2002	2007	2012	
Coarse wool (native)	56.479	43.020	36.043	43.688	46.392	- 17.9
Fine wool (Merino)	2.586	2.612	2.201	3.063	4.788	+ 85.2
Goat coarse hair	3.855	3.071	2.589	2.536	3.570	- 7.4
Mohair	1.200	690	318	237	200	- 83.3
Wet cocoon	782	161	100	125	134	- 82.9

***Table 2**. Change in the number of fiber-producing farm animals by years in Turkey (Anonymous, 2013b)*

Farm Animals	Animal Numbers (Head)					1992 - 2012 Change (%)
	1992	1997	2002	2007	2012	
Native Sheep	38.575.828	29.376.000	24.473.826	24.491.211	25.892.582	- 32.9
Merino Sheep	840.110	862.000	699.880	971.082	1.532.651	+ 82.4
Hair Goat	9.439.600	7.761.000	6.519.332	6.095.292	8.199.184	- 13.1
Angora Goat	1.014.340	615.000	260.762	191.066	158.102	- 84.4
Silkworm (Opened Box Number)	27.732	5.741	3.839	5.273	5.576	- 79.9

Wool

Production

According to 2012 figures, an amount of approximately 46.392 tons of grease wool is produced in Turkey from native sheep breeds and almost all of this wool is of coarse quality. Mainly, the amount of fine grease wool produced from different crossbreeds Merino sheep is approximately 4.788 tons (Table 1). In the period of 1992-2012, there is a continuous decrease (17.9 %) in the production of coarse wool produced from native sheep breeds while there is a significant level of increase (82.4 %) in the production of Merino wool. It can be said that the decrease in the production of coarse wool primarily results from decrease in the number of native sheep breeds (32.9 %) while the increase in the production of fine wool results from increase in the number of pure and crossbreed Merino sheep (82 %) (Table 2).

Wool quality characteristics and areas of use

As it can be seen on Table 3 given below, coarse and low uniformity wool types are produced from a great majority of native sheep breeds in Turkey and these are used mostly in the production of carpet/rug and coarse fabric. On the other hand, good uniformity wool types which can be utilized in worsted industry are produced from Kıvırcık, Dağlıç, Merino and crossbreed Merino sheep genotypes (Pehlivan, 2007).

Table 3*. Wool quality characteristics and areas of use of some sheep breeds in Turkey (Pehlivan, 2007).*

Sheep Breed	Grease wool amount (kg)	Fineness (µm) and fleece structure	Color	Strength (g)	Length (cm)	Basic areas of use
Akkaraman	1.948	29.42; Coarse and non-uniform.	White	12.70	8.14	Straygarn industry
Morkaraman	1.484	34.92; Coarse and non-uniform	Purple-Black	13.71	10.50	Straygarn industry
İvesi	2.377	33.40; Coarse and non-uniform	White	17.95	14.60	Straygarn industry
Karayaka	2.620	41.37; Very coarse and non-uniform	White	18.90	20.07	Straygarn industry
Dağlıç	2.044	30.28; Coarse and medium uniform	White	23.76	15.82	Kamgarn industry
Kıvırcık	1.400	32.24; Coarse and medium uniform	White	21.40	9.20	Kamgarn industry
Sakız	1.360	28.09; Coarse and non-uniform	White	24.62	9.20	Straygarn industry
Merino	3.420	22.56; Fine and uniform	White	7.92	6.83	Kamgarn industry
Merino crosses	3.260	22.85; Fine and Medium uniform	White	9.06	7.41	Kamgarn industry

Wool sector

Studies conducted on the production of fine and uniform fabric wool can in Turkey can be divided in two periods, one of them being from 1841 to early 1930's and the other period being from 1934 to the present day. In the first period, primarily pure Rambouillet Merino sheep breed was intended to be benefited from while in the second period meat-wool Merino sheep was intended to benefited through crossbreeding (Pehlivan, 2007). However, there have been many negative changes in the production of especially coarse wool until today compared with the production of sheep meat and milk. This situation can be said to result from such factors as unsuccessful conduct of merinozation projects, serious increases in the use of synthetic-chemical fibers and yarns in Turkey as in the world, rapid changes in fashion which are against wool consumption and rapid decreases in the number of sheep because of socio-economic reasons. By years because of unability of wool prices to bear production costs, this production branch has lost its importance and its contribution to general economy has decreased. In the same vein, the share of wool production in the economic value of total animal product production in Turkey is approximately 70 million USD according to 2011 figures thereby being at a very low level (Anonymous, 2012).As it can be seen on Table 4, import figures transcend export figures in animal fiber and yarn sector in the period of 2008-2010. The total import value of animal fiber and yarn is 214 million USD in 2010. The most important export product is woollen yarns while the most important import products are grease and clear wool, hair and their remnants. Although the production of wool is at a low level in Turkey, it is the fourth biggest wool fiber consumer in the world in woollen yarn sector. Thus, it can be said that the fact that wool import figures transcend wool export figures results from this situation. Although Turkey has an export of raw silk, wool, coarse goat hair,

mohair fiber and yarn which amounts to approximately 76.097 million USD in 2010, there is not an institution which controls especially raw wool market and producers completely act on their own (Sevim, 2011).

Table 4. *Animal fiber and yarn export and import figures of Turkey (1000 dollars) (Sevim, 2011).*

Products	Export			İmport		
	2008	2009	2010	2008	2009	2010
Raw silk	170	503		1.955	1.202	
Silk and silk yarns	900	800	400	9.900	6.000	6.500
Grease and clear wool and hair	28.700	14.500	24.700	174.600	106.000	148.800
Woollen yarns	58.300	41.200	49.800	65.900	56.200	59.600
Mohair	489	213	1.197	3.027	300	-
Total	88.559	57.216	76.097	255.382	169.405	214.900

Wooled carpet and rug industry

Carpet and rug production occupy an important place in the economy and folkloric culture of Turkey. It is estimated that approximately 90 % of total carpet market comprises machine-made carpet. However, data regarding hand-made carpet is insufficient. Turkey's export and import figures of machine-made and hand-made carpet and rug are 1.158.262 and 210.302 USD respectively in 2008 (Kuyumcu, 2009).

Mohair

Production

As it can be seen on Table 1, raw mohair production amount is approximately 200 tons in Turkey according to 2012 figures. On the other hand, very high level of decreases occurred in the number of Angora goat and mohair production compared with wool and goat coarse hair production in the period of 1992-2012 (83.3 % and 84.4 % respectively). These decreases actually have been continuing rapidly for the last 45-50 years. This situation can be said to result from quitting Angora goat production for mohair prices do not meet production costs. Decreases in the number of Angora goat and mohair production occur at higher levels compared with decreases occurring in the number of sheep and hair goat and benefiting from meat and milk production of this sheep breed at an insufficient level economically is also effective in this situation. In addition to the fact that milk production of Angora goat is at very low levels, consumption of goat's meat and products is also at very low levels in the region (Central Anatolia region) where this sheep breed is primarily raised. In addition, some factors such as difficulties in workforce procurement in the region, coercion of businesses in forestry areas to quit raising goats, insufficient feed resources and difficulties in feed procurement and changes appeared in the socio-economic structures of breeding families can be said be effective in this decrease at an important level.

Mohair quality characteristics and areas of use

The value of mohair in the world market is largely determined by such quality characteristics as fineness, length, crease and strength. As it can be seen on Table 5, fineness of mohair produced in Turkey is not less than fineness mohair produced in the USA and Republic of South Africa (26.2–36.1 and 31.5–33.5 µm, respectively: Shelton, 1993). However, there have not been adequate number of studies which are conducted to examine the real fineness distribution of mohair produced in Turkey and show relationship between raw mohair and

mohair yarn. Mohair produced in Turkey, through industry and handicrafts, is used in the production of such products as fabric, rug, blanket, scarf and camlet.

Table 5. *Some quality characteristics and areas of use of mohair produced in Turkey (Erdoğan, 1989; Öztürk & Goncagül, 1994; Yavuzer, 1997).*

Sex and age	Grease mohair amount (kg)	Fineness (µm)	Strength (g)	Length (cm)	Basic areas of use
Kid (Female)	1.100	26.24	-	15.46	Through industry and handicrafts, in the production of products such as fabric, rug, blanket, scarf and camlet
Kid (Male)	1.200	26.21	-	15.49	
Two aged (Female)	2.100	29.46	23.63	13.28	
Three aged (Female)	2.400	31.08	22.68	14.53	
Female >3	2.500	33.76	-	15.14	
Buck	2.600	35.96	23.74	15.86	

Mohair sector

Although Turkey is the homeland of Angora goat, it exports raw mohair and imports it in some periods as well. However, Turkey does not export and import mohair yarn (Table 4). Mohair produced in Turkey is taken only by Mohair Union and given to the domestic market by this institution.

Cashmere and coarse hair

Production

Although the sources of cashmere fiber production in Turkey are primarily Hair and Kilis goat breeds, the production of this fiber type cannot be benefited sufficiently for cashmere production per goat is very low in both goat breeds. Thus, the data regarding this fiber type is at an insufficient level. According to 2012 figures, goat coarse hair production is approximately 3.570 tons in Turkey and this fiber type is mainly obtained from Hair and Kilis goats. The amount of produced goat coarse hair is at a very low level when compared with the number of tagged hair goat. In addition to this, there is a decrease of 7.4 % in the production of this fiber type in the period of 1992-2012 (Anonymous, 2013b).

Quality characteristics and basic areas of use of cashmere and coarse hair

As it can be seen on Table 6, fineness of cashmere fiber produced from Hair and Kilis goat in Turkey ranges between 13.54 and 17.60 µm. Fineness of first-class cashmere fiber produced in the world is 14–15 µm and this fiber type is mainly used in the production of knitwear. Fineness of cashmere fiber which has a lower quality is 17–18 µm and such fibers are utilized in the production of woven clothing (Westhuysen, 2005). Thus, it can be said that cashmere produced from hair and Kilis goat in Turkey can rank in both quality groups. On the other hand, distribution in terms of fineness and colour are important quality characteristics (Hopkins, 1993) when determining cashmere quality and area of use and a profitable cashmere production is primarily determined by the amount of cashmere obtained from per goat (Couchman, 1988). It is possible to say that at this stage it is difficult to use cashmere produced in Turkey in the textile industry because of such factors as fineness distribution of cashmere produced from hair and Kilis goats in Turkey is not fully known, low rates of white-colored cashmeres obtained from hair goats (approximately 14 %) and insufficient per goat cashmere production for a profitable cashmere production. On the other hand, cashmere produced mainly in Mediterranean, Aegean and Southern Anatolia regions is utilized in the

production of such handicrafts as hats, gloves, scarfs and socks in a pure manner or mixed with other fiber types thereby being benefited in domestic consumption and/or in local markets. Commercial use of goat coarse hair produced in Turkey is at a very low level for fineness of this type of hair is very high (64–88 µm). However, this type of hair is used in the production of tent and interlining in industry while it is used in the production of such handicrafts as tent, sack, mat and girth in rural areas.

***Table 6**. Some quality characteristics and using areas of cashmere and goat coarse hair produced in Turkey*

Goat Breed	Fiber Type	Grease Fiber Amount (g)	Fineness (µm)	Color	Length (cm)	Using Areas	References
Hair	Cashmere	40.00–51.42	13.54–17.60	MK, B, W	2.4 -5.49	Headdress, scarf, glove and socks	Dellal et al., 2001a; Gökmen & Boztepe, 2004
Hair	Coarse hair	336–596	64–93	D, BL, B, W	11.8 (single fiber length)	Hair tent, interlining, girth, mat, bag and sack	Dellal et al., 2001b
Kilis	Coarse hair	422.7±13.28	S:69.81±1.72 R:71.50±1.25 L:75.68±1.31	-	-	-	Tuncel, 1982
Kilis	Cashmere	49.68	16.12	-	5.22	-	Altınbaş, 1978

S: Shoulder, R: Rib, L: Leg, W: White, BL: Black, B: Brown, D: Dun, G: Gray, MK: Milky brown

Cashmere and coarse hair sector

Cashmere sector is not developed in Turkey and there is not cashmere export or import. However, some tradesmen buy and collect shirts made of tagged goat fiber at very low prices in spring and early summer months and market them in Turkey and foreign countries after they separate cashmere from coarse hair. Turkey exports and imports goat coarse hair despite being at low levels. This fiber type is currently best utilized in tent and interlining production sector.

Angora rabbit wool

Although there was a rapid increase in the establishment of Angora rabbit businesses at the beginning of 1990's in Turkey, most of these businesses were closed either because of unsuccess of exporting the produced wool or because of importing wool which is necessary for the sector from China at lower prices. Currently, data regarding Angora rabbit wool production, the sector's demand for this fiber and the way in which this demand is met is insufficient.

Silk

Production and sector

As it can be seen on Table 1 and Table 2, according to 2012 figures, the number of opened silkworm box and wet cocoon production are 5.576 and 134 tons respectively. On the other hand, there are important levels of decreases in both of them in the period of 1992-2012 (79.9 % and 82.9 % respectively). This situation can be said to result from such factors as increases in immigration from rural areas to urban areas in places where silkworm breeding is made, increases in the cutting of mulberry trees and use of agricultural and chemical drugs and earning more income through alternative agricultural production areas than silkworm

breeding. However, providing producers with free silkworm seed, distribution of young mulberry plants and direct payment support of wet cocoon production by the state as of 2002 have caused increases in production again (Dikici, 2008).Sericulture in Turkey dates back to approximately 1500 years and it is an agricultural production branch whose socio-economic contribution is still high. Despite the serious decreases in its production in the last 20 years, the importance of sericulture sector still preserves its importance place in the national economy and supports made by the state are really important in this situation. This sector is also important in terms of employment. Nearly a half million people are employed in such sectors as raw silk production, processing and marketing. All of wet cocoon produced in Turkey are bought by cooperatives which are affiliated to Kozabirlik (Association of Agricultural Sales Cooperatives for Silk Cocoons) and dry cocoons obtained are provided to the domestic and foreign market. However, a large part of raw silk demand is primarily provided from China, Uzbekistan and Brazil (Dikici, 2008).

The Future of Animal Fiber Production in Turkey

The highest level of decreases in animal fibers production in Turkey in the period of 1992-2012 are seen in the production of mohair (83.3 %) and wet cocoon (82.9 %). There are low level of decreases in the production of coarse wool produced from native sheep races and essentially in the production of coarse hair produced from hair goats (17.9 % and 7.4 %, respectively) while there is a high level of increase in the production of fine wool produced from Crossbreed Merino sheep (85.2 %). However, cashmere fiber production is not utilized in an effective manner. Increases in the use of synthetic-chemical fibers and yarns in textile and other relevant sectors, import of raw animal fiber and yarn needed by the sector at cheaper prices at the required level of quality, rapid changes in consumer preferences which are against animal fibers and structural and socio-economic problems which effect the breeding of primarily Angora goat, sheep, goat and silkworm can be mentioned as the factors which cause decline in the production of animal fibers in Turkey. It can be said that decrease in animal fiber production will continue in the oncoming years. However, in recent years organic agriculture, sustainability of ecosystems, environmental protection awareness, protection and development of rural economy, important changes in industrial production and consumer preferences have caused an increase of interest in animal fibers. For this reason, studies are being conducted to develop animal fiber production in the world and the EU. When the fact that Turkey has an important place in textile sector in the world is taken into consideration, development of animal fiber production in Turkey will greatly contribute to the formation of a sustainable textile industry and rural development, preservation and protection of the folkloric culture and fiber-producing farm animals in the future. Taking the following suggestions into consideration will contribute to better determination and conduct of studies in this direction.

1. In order to domestically produce fine quality of wool which is currently imported by the sector, it is necessary to work to genetically improve wool quality characteristics in the current pure and crossbreed Merino sheep population in accordance with the requirements of the textile sector.
2. Turkey has a very important accumulation and place in carpet and rug production in the world and it is expressed that most of wool produced from native sheep races can be primarily used in carpet and rug production. However, the number of studies conducted to this end is not at a sufficient level and the necessary stress is not laid on characteristics such as fiber fineness distribution, medullation rate and resilience which are important factors in determining the quality of a carpet. For this reason, it is necessary for Turkey, through comprehensive studies, to re-examine and determine whether wool produced from native

sheep breeds is appropriate to produce carpet in terms of physical and chemical features such as medullation rate and resilience. In addition to this, determination of relationships between raw wool and carpet/rug yarn produced from it, study of issues such as color, pattern and new areas of use which have a very important effect on carpet/rug consumption will bring about a positive effect on the development of quality carpet wool production.

3. In order to meet the mohair demand through at least domestic production, genetical and environmental improvement studies which enable to improve the amount and quality characteristics of mohair produced from the current Angora goats in accordance with the requirements of the textile industry should be concentrated upon. In addition to this, for consumer preferences have a very important effect on sustainable mohair production, studies which enable to attract the lost interest of consumers to this fiber should be conducted. Attainment of a more effective utilization of Angora goats especially in terms of meat production will positively contribute to the increase of mohair production and of the number of this goat race who has a rapidly decreasing population.

4. Although there is a serious goat population potential, especially goat hair breed, in Turkey to produce goat coarse hair and cashmere fiber, this potential cannot be used in an effective manner. Although cashmere produced from hair goats is at an acceptable level in terms of world standards thanks to its quality characteristics, its production is at a very low level and it is not possible to make a profitable cashmere production with this production level. For this reason, in order to develop a sustainable cashmere production in Turkey, the following three systems are suggested to be developed primarily in Mediterranean, Southern Anatolia, Aegean regions and especially in mountainous and forested lands; **a)** Production of pure Cashmere goat breeds and/or crossbreeding Hair goats with these goat breeds **b)** Increasing hair goats' meat and cashmere production by crossbreeding them with meat type goat breeds like Boer goat breed **c)** Rendering cashmere produced from current Hair goats in low-income agricultural businesses which are located in mountainous and forested areas into handicrafts thereby increasing their added value. Thanks to these three systems, goat coarse hair production will also be benefited in a more effective manner.

5. The silk sector in Turkey has started developing again, even if at a low level, as of 2000 thanks to the supports given by the state. Development of this sector to a higher level will greatly contribute to the general and rural economy and to the preservation of traditional folkloric culture linked to silk fiber along with mainly silk carpeting. For this purpose; **a)** encouraging especially low-income agricultural businesses or other families to take up sericulture in order to domestically meet raw silk and silk yarn imported by the sector **b)** developing the production of handicraft products which are require silk **c)** cultivation of mulberry trees in areas where sericulture is being already made and/or being planned to be developed should be encouraged and the current trees should be protected from factors such as chemical disinfection, unconscious fertilization and cutting **d)** current support provided by the state for wet cocoon production should be maintained **e)** structural and technical features of sericulture should be improved and current problems should be solved in order to increase productivity per box in silkworm breeding.

6. Data regarding both Angora rabbit wool production and the sector's demand for this fiber type in Turkey is insufficient. On the other hand, it can be said that Angora rabbit wool production is at a very low level and this situation results primarily from the fact that this fiber type can be imported from China at very low prices in Turkey as in the world. For this reason, first it is necessary to make sectoral analysis of this fiber and production planning should be made in accordance with the outcomes of this analysis.

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Animal fiber production in Turkey: Present situation and future

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Animal fiber production in Turkey: Present situation and future

- introduction
- animal fiber production in the world and EU
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  - wool (production, areas of use, sector)
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Animal fiber production in Turkey: Present situation and future

- Animal fibers used in textile industry in today's world are obtained from 11 different animals, namely; sheep, goat, Angora rabbit, lama, alpaca, vicuna, guanaco, camel, yak, Northern American Buffalo and musk ox.
- Displacement of natural fibers by petrochemical fibers in the textile sector and others roughly in the last half-century has caused significant decline in the production of animals fibers as well.

Animal fiber production in Turkey: Present situation and future

- Depending on various factors such as the developments in organic agriculture, there has been a significant increase in the level of interest shown to natural fibers in recent years.
- FAO announced the year 2009 as the international natural fibers year in order to draw the attention of the fiber sector and other circles to the importance of natural fibers (Anonymous, 2009).

Animal fiber production in Turkey: Present situation and future

- In the EU countries, projects for the development of fine animal fiber are being conducted in order to utilize areas which are inappropriate for agriculture and to economically support small family businesses (Russel , 1993).
- Present situation and near future of animal fiber production in Turkey is examined and things to be done to increase its contribution to the general and rural economy are discussed in this paper.

Animal fiber production in the world and EU

- According the 2011 figures, wool is the animal fiber which was produced at the highest level in the world (approximately 1.043.712.633 tons).
- In the period of 1991-2011, there was a decrease at the level of approximately 11.9 % in the total greasy wool production in the world.
- Wool production (the first three countries) China 393.072 tons, Australia 361.806 tons, New Zealand 165.800 tons.

Animal fiber production in the world and EU

- Merino wool production is primarily made in Australia and South Africa in the world.
- Coarse wool production is primarily developed in New Zealand while both fine and medium wool production are produced at important levels in Uruguay and Argentina.
- According to 2011 figures, the most produced four animal fibers after wool; Angora rabbit wool 8.500 tons, yak wool 7.500 tons, cashmere 7.700 tons and mohair 4.900 tons.

Animal fiber production in the world and EU

- According to 2011 figures, in the EU-27, wool production is 192.806 tons and its production showed a decrease which is at the level of 27.2 % in the period of 1991-2011.
- Wool production (the first three countries) UK, Spain and Romania respectively.
- Production of fine luxury fibers is at low levels in the EU.

Animal fiber production in the world and EU

- The production of fine-luxury fibers such as fine wool, cashmere, mohair, Angora rabbit wool and Alpaca wool has been turned towards depending on changes in animal fiber production policies in recent years in order to attain a more effective utilization of non-arable land resources and to increase the income of small family businesses present in these places (Russel, 1993).

Animal fiber production in Turkey

- The production of primarily wool, mohair, goat coarse hair, cashmere and silk fiber is made for commercial purposes in Turkey.

Animal fiber production in Turkey

Table 1. Change in animal fiber production by years in Turkey (Anonymous 2013b).

Fiber Type	Production Amounts (ton)					1992-2012 Change (%)
	1992	1997	2002	2007	2012	
Coarse wool (native)	56.479	43.020	36.043	43.688	46.392	- 17.9
Fine wool (Merino)	2.586	2.612	2.201	3.063	4.788	+ 85.2
Goat coarse hair	3.855	3.071	2.589	2.536	3.570	- 7.4
Mohair	1.200	690	318	237	200	- 83.3
Wet cocoon	782	161	100	125	134	- 82.9

Animal fiber production in Turkey

Table 2. Change in the number of fiber-producing farm animals by years in Turkey (Anonymous 2013b).

Farm Animals	Animal Numbers (Head)					1992 -2012 Change (%)
	1992	1997	2002	2007	2012	
Native Sheep	38.575.828	29.376.000	24.473.826	24.491.211	25.892.582	- 32.9
Merino Sheep	840.110	862.000	699.880	971.082	1.532.651	+ 82.4
Hair Goat	9.439.600	7.761.000	6.519.332	6.095.292	8.199.184	- 13.1
Angora Goat	1.014.340	615.000	260.762	191.066	158.102	- 84.4
Silkworm (Opened Box Number)	27.732	5.741	3.839	5.273	5.576	- 79.9

Animal fiber production in Turkey
Wool production

- According to 2012 figures, an amount of approximately 46.392 tons of grease wool is produced from native sheep breeds and almost all of this wool is of coarse quality in Turkey
- Mainly, the amount of fine grease wool produced from different crossbreeds Merino sheep is approximately 4.788 tons.
- In the period of 1992-2012, there is a continuous decrease (17.9 %) in the production of coarse wool produced from native sheep breeds while there is a significant level of increase (82.4 %) in the production of Merino wool.

Animal fiber production in Turkey
Wool quality characteristics and using areas

Table 3. Wool quality characteristics and areas of use of some sheep breeds in Turkey (Pehlivan , 2007).

Sheep Breed	Grease wool amount (kg)	Fineness (µm) and fleece structure	Color	Strength (g)	Length (cm)	Basic areas of use
Akkaraman	1.948	29.42; Coarse and non-uniform.	White	12.70	8.14	Straygarn industry
Morkaraman	1.484	34.92; Coarse and non-uniform	Purple-Black	13.71	10.50	Straygarn industry
İvesi	2.377	33.40; Coarse and non-uniform	White	17.95	14.60	Straygarn industry
Karayaka	2.620	41.37; Very coarse and non-uniform	White	18.90	20.07	Straygarn industry
Dağlıç	2.044	30.28; Coarse and medium uniform	White	23.76	15.82	Kamgarn industry

Animal fiber production in Turkey
Wool quality characteristics and using areas

Table 3. Wool quality characteristics and areas of use of some sheep breeds in Turkey (Pehlivan, 2007).

Sheep Breed	Grease wool amount (kg)	Fineness (µm) and fleece structure	Color	Strength (g)	Length (cm)	Basic areas of use
Kıvırcık	1.400	32.24; Coarse and medium uniform	White	21.40	9.20	Kamgarn industry
Sakız	1.360	28.09; Coarse and non-uniform	White	24.62	9.20	Straygarn industry
Merino	3.420	22.56; Fine and uniform	White	7.92	6.83	Kamgarn industry
Merino crosses	3.260	22.85; Fine and Medium uniform	White	9.06	7.41	Kamgarn industry

Animal fiber production in Turkey
Wool quality characteristics and of using areas

- All wools produced from native sheep breeds are coarse and have a low uniformity
- That's why these wools are used mostly in the production of carpet/rug and coarse fabrics.
- Wool types produced from Kıvırcık , Dağlıç , Merino and crossbreed Merino sheeps have a good uniformity and are used mainly worsted industry. (Pehlivan, 2007).

Animal fiber production in Turkey
Wool sector

- Studies conducted on the production of fine and uniform fabric wool can in Turkey can be divided in two periods, one of them being from 1841 to early 1930's and the other period being from 1934 to the present day.

- In the first period, primarily Rambouillet Merino sheep was intended to be benefited through inbreding
- in the second period meat-wool Merino sheep was intended to benefited through crossbreeding (Pehlivan , 2007).

Animal fiber production in Turkey
Wool sector

- There have been many negative changes in the production of wool production (especially coarse wool) compared with the production of sheep meat and milk until today because of mainly that reasons:
- -Failuring of merinozation projects,
- -İmportant increases in the use of synthetic-chemical fibers and yarns,
- -Rapid changes in fashion which are against wool consumption
- -Fast decreases in the number of sheep because of socio-economic reasons.

Animal fiber production in Turkey
Wool sector

- By years because of inability of wool prices to bear production costs, this production branch has lost its importance and its contribution to general economy has decreased.
- According to 2011 data, the share of wool production in the economic value of total animal product production in Turkey is approximately 70 million USD being at a very low level (Anonymous, 2012).

- The total import and export values of animal fibers and yarns are approximatley 215 and 77 USD, respectivley in 2010
- The total import and export values of grease and clear wool are approximatley 149 and 25 million USD, respectivley in 2010.

Animal fiber production in Turkey
Wool sector

Table 4. Animal fiber and yarn export and import figures of Turkey (1000 dollars) (Sevim, 2011).

Products	Export			İmport		
	2008	2009	2010	2008	2009	2010
Raw silk	170	503		1.955	1.202	
Silk and silk yarns	900	800	400	9.900	6.000	6.500
Grease and clear wool and hair	28.700	14.500	24.700	174.600	106.000	148.800
Woollen yarns	58.300	41.200	49.800	65.900	56.200	59.600
Mohair	489	213	1.197	3.027	300	-
Total	88.559	57.216	76.097	255.382	169.405	214.900

- The total import and export values of woollen yarns are approximatley 61 and 50 million USD, respectivley in 2010.
- The most important export products are woollen yarns while the most important import products are grease and clear wool, hair and their remnants.

Animal fiber production in Turkey
Wool sector

- Although the production of wool is at a low level in Turkey, it is the fourth biggest wool fiber consumer in woollen yarn sector of the world .
- There is not an institution which controls especially raw wool market and producers completely act on their own (Sevim , 2011).

Animal fiber production in Turkey
Wooled carpet and rug industry

- Carpet and rug production occupy an important place in the economy and folkloric culture of Turkey.
- It is estimated that approximately 90 % of total carpet market comprises machine-made carpet.
- Data regarding hand-made carpet is insufficient.
- Turkey's export and import figures of machine-made and hand-made carpet and rug are 1.159.000 and 210.302 USD, respectively in 2008 (Kuyumcu , 2009).

Animal fiber production in Turkey
Mohair production

- Raw mohair production amount is approximately 200 tons in Turkey according to 2012 figures.
- Very high level of decreases occurred in the number of Angora goat and mohair production compared with wool and goat coarse hair production in the period of 1992-2012(83.3% and 84.4% respectively).
- These decreases actually have been continuing rapidly for the last 45-50 years.

Animal fiber production in Turkey
Mohair production

- This situation can be said to result from quitting Angora goat production beacuse of mohair prices do not meet production costs.
- Decreases in the number of Angora goat and mohair production occur at higher levels compared with decreases in the the number of sheep and hair goat and wool and coarse hair production because of;
- -Economically benefiting from meat and milk production of Angora goats is an insufficient level

Animal fiber production in Turkey
Mohair production

- -The milk production of Angora goat is at very low levels,
- -The consumption of goat's meat and products is also at very low levels in the region (Central Anatolia region),
- -Some factors such as difficulties in workforce procurement in the region, coercion of businesses in forestry areas to quit raising goats, insufficient feed resources and difficulties in feed procurement and changes appeared in the socio-economic structures of breeding families can be said be effective in this decrease at an important level.

Animal fiber production in Turkey
Mohair quality characteristics and areas of use

- The value of mohair in the world market is largely determined by such quality characteristics as fineness, length, crease and strength.

- Fineness of mohair produced in Turkey is not less than fineness mohair produced in the USA and Republic of South Africa (26.2–36.1 and 31.5–33.5 µm, respectively: Shelton, 1993).

Animal fiber production in Turkey
Mohair quality characteristics and areas of use

Table 5. Some quality characteristics and areas of use of mohair produced in Turkey (Erdoğan, 1989; Öztürk & Goncagül, 1994; Yavuzer, 1997).

Sex and age	Grease mohair amount (kg)	Fineness (µm)	Strength (g)	Length (cm)	Basic areas of use
Kid (Female)	1.100	26.24	-	15.46	Through industry and handicrafts, in the production of products such as fabric, rug, blanket, scarf and camlet
Kid (Male)	1.200	26.21	-	15.49	
Two aged (Female)	2.100	29.46	23.63	13.28	
Three aged (Female)	2.400	31.08	22.68	14.53	
Female >3	2.500	33.76	-	15.14	
Buck	2.600	35.96	23.74	15.86	

Animal fiber production in Turkey
Mohair quality characteristics and areas of use

- There have not been adequate number of studies which are conducted to examine relationships between the real fineness distribution of mohair and raw mohair and mohair yarn characteristics in Turkey
- Mohair produced in Turkey is used in the production of such products as fabric, rug, blanket, scarf and camlet through industry and handicrafts.
-

Animal fiber production in Turkey
Mohair sector

- Although Turkey is the homeland of Angora goat, it exports raw mohair and imports it in some periods as well . In 2010, export value of raw mohair was approximatley 1.200.000 million USD. In 2009, import value of raw mohair was approximatley 300.000 million USD.
- Turkey does not export and import mohair yarn.
- Mohair produced in Turkey is taken only by Mohair Union and given to the domestic market by this institution.

Animal fiber production in Turkey
Cashmere and Coarse Hair production

- The sources of cashmere fiber production in Turkey are primarily Hair and Kilis goat breeds. But this goats breed cannot be benefited sufficiently for cashmere production because of cashmere production is very low per goat in both goat breeds.
- Thus, the data regarding this fiber type is at an insufficient level.

Animal fiber production in Turkey
Cashmere and Coarse Hair production

- According to 2012 figures, goat coarse hair production is approximately 3.570 tons in Turkey and this fiber type is mainly obtained from Hair and Kilis goats.
- The amount of produced goat coarse hair is at a very low level when compared with the number of sheared hair goat.
- In addition to this, there is a decrease of 7.4 % in the production of this fiber type in the period of 1992-2012 (Anonymous, 2013b).

Animal fiber production in Turkey
Quality characteristics and basic areas of use of cashmere and coarse hair

- Finenesses of cashmere fibers produced from Hair and Kilis goat is between 13.54 and 17.60 µm.
- Finenesses of first-class cashmere fibers produced in the world is 14–15 µm and mainly used in the production of knitwear.
- Fineness of cashmere fiber which has a lower quality is 17–18 µm and such cashmeres are utilized in the production of woven clothing (Westhuysen, 2005).

Animal fiber production in Turkey
Quality characteristics and basic areas of use of cashmere and coarse hair

- Thus, it can be said that cashmere produced from hair and Kilis goat in Turkey can rank in both quality groups.
- However, at this stage, using of cashmeres from these goats breeds in the textile industry is difficult because of such factors as :
- -Fineness distribution of cashmere produced from hair and Kilis goats is not fully known,
- -Rates of white-colored cashmeres obtained from hair goats are low (approximately 14 %: Söylemezoğulu et al.2002)

Animal fiber production in Turkey
Quality characteristics and basic areas of use of cashmere and coarse hair

- In these goat breeds, amounts of cashmere per goat are insufficient for a profitable cashmere production (Hair goat:40-51 g; Kilis goat 50 g)

- On the other hand, cashmere produced mainly in Mediterranean, Aegean and Southern Anatolia regions is utilized in the production of such handicrafts as hats, gloves, scarfs and socks in a pure manner or mixed with other fiber types thereby being benefited in domestic consumption and/or in local markets.

Animal fiber production in Turkey
Quality characteristics and basic areas of use of cashmere and coarse hair

- Commercial use of goat coarse hairs is at a very low level because of it's fineness is very high (64–88 µm).
- However, goat coarse hairs are used in the production of tent and interlining in industry and are used in the production of tent, sack, mat and girth as such handicrafts in rural areas.

Animal fiber production in Turkey
Quality characteristics and basic areas of use of cashmere and coarse hair

Table 6. Some quality characteristics and using areas of cashmere and goat coarse hair produced in Turkey.

Goat Breed	Fiber Type	Grease Fiber Amount (g)	Fineness (µm)	Color	Length (cm)	Using Areas	References
Hair	Cashmere	40.00–51.42	13.54–17.60	MK, B, W	2.4 -5.49	Headdress, scarf, glove and socks	Dellal et al., 2001a; Gökmen & Boztepe, 2004
Hair	Coarse hair	336–596	64–93	D, BL, B, W	11.8 (single fiber length)	Hair tent, interlining, girth, mat, bag and sack	Dellal et al., 2001b
Kilis	Coarse hair	422.7±13.28	S:69.81±1.72 R:71.50±1.25 L:75.68±1.31	-	-	-	Tuncel, 1982
Kilis	Cashmere	49.68	16.12	-	5.22	-	Altınbaş, 1978

S: Shoulder, R: Rib, L: Leg, W: White, BL: Black, B: Brown, D: Dun, G: Gray, MK: Milky brown

Animal fiber production in Turkey
Cashmere and coarse hair sector

- Cashmere sector is not developed in Turkey and there is not cashmere export or import.
- However, some trademens buy shared goat fiber fleeces at very low prices in spring and early summer months and after they separate cashmere from coarse hair market them in Turkey and foreign countries
- Turkey exports and imports goat coarse hair despite being at low levels.
- This fiber type is currently best utilized in tent and interlining production sector.

Animal fiber production in Turkey
Angora rabbit wool

- Although there was a rapid increase in the establishment of Angora rabbit businesses at the beginning of 1990's in Turkey, most of these businesses were closed either because of unsuccessful of exporting the produced wool or because of importing wool which is necessary for the sector from China at lower prices.

- Currently, data regarding Angora rabbit wool production, the sector's demand for this fiber and the way in which this demand is met is insufficient.

Animal fiber production in Turkey
Silk production and sector

- Sericulture in Turkey dates back to approximately 1500 years and it is an agricultural production branch whose socio-economic contribution is still high.
- According to 2012 data, the number of opened silkworm box and wet cocoon production are 5.576 and 134 tons respectively.
- On the other hand, there are important levels of decreases in both of them in the period of 1992-2012 (79.9 % and 82.9 % respectively).

Animal fiber production in Turkey
Silk production and sector

- This situation can be said to result from such factors:
- -İncreases in immigration from rural areas to urban areas in places where silkworm breeding is made,
- -İncreases in the cutting of mulberry trees
- -İncreases in use of agricultural and chemical drugs
- -Earning more income through alternative agricultural production areas than silkworm breeding.

- However, since 2002,
- -Providing producers with free silkworm seed,
  -Distribution of young mulberry plants and
- -Direct payment support of wet cocoon production by the state have caused increases in production of sericulture again (Dikici , 2008).

Animal fiber production in Turkey
Silk production and sector

- Despite the serious decreases in its production in the last 20 years, the importance of sericulture sector still preserves its importance place in the national economy and supports made by the state are really important in this situation.
- This sector is also important in terms of employment.

Animal fiber production in Turkey
Silk production and sector

- Nearly a half million people are employed in such sectors as raw silk production, processing and marketing in Turkey.
- All of wet cocoon produced in Turkey are bought by cooperatives which are memberships of Kozabirlik (Association of Agricultural Sales Cooperatives for Silk Cocoons) and dry cocoons obtained are provided to the domestic and foreign market.
- However, a large part of raw silk demand is primarily provided from China, Uzbekistan and Brazil (Dikici , 2008).

The future of animal fiber production in Turkey

- It can be said that decrease in animal fiber production will continue in the next years in Turkey.
- When the fact that Turkey has an important place in textile sector in the world is taken into consideration, development of animal fiber production in Turkey will greatly contribute to the formation of a sustainable textile industry and rural development, preservation and protection of the folkloric culture and fiber-producing farm animals in the future.

The future of animal fiber production in Turkey

Taking the following suggestions into consideration will contribute to better determination and conduct of studies in this direction:

1. In order to domestically produce fine quality of wool which is currently imported by the sector, it is necessary to work to genetically improve wool quality characteristics in the current pure and crossbreed Merino sheep population in accordance with the requirements of the textile sector.

The future of animal fiber production in Turkey

2. Turkey has a very important accumulation and place in carpet and rug production in the world and the most of wool produced from native sheep races can be primarily used in carpet and rug production.

   However, the number of studies on characteristics such as fiber fineness distribution, medullation rate and resilience which are important factors in determining the quality of a carpet is insufficient.

The future of animal fiber production in Turkey

For this reason, studing on those subjects will contribute to the development of quality carpet wool production:

-To re-examine and determine whether wool produced from native sheep breeds is appropriate to produce carpet in terms of physical and chemical features,

-To determine of relationships between raw wool and carpet/rug yarn produced from it,

- To study of issues such as color, pattern and new areas of use .

The future of animal fiber production in Turkey

3. In order to meet the mohair demand through at least domestic production, genetical and environmental improvement studies which enable to improve the amount and quality characteristics of mohair produced from the current Angora goats in accordance with the requirements of the textile industry should be concentrated upon.

In addition to this, for consumer preferences have a very important effect on sustainable mohair production, studies which enable to attract the lost interest of consumers to this fiber should be conducted.

The future of animal fiber production in Turkey

Attainment of a more effective utilization of Angora goats especially in terms of meat production will positively contribute to the increase of mohair production and of the number of this goat race who has a rapidly decreasing population.

The future of animal fiber production in Turkey

4. Although there is a serious goat population potential(especially hair goats) to produce goat coarse hair and cashmere, this potential cannot be used in an effectual in Turkey

   Although some quality characteristics of cashmeres produced from hair goats is at an acceptable level in terms of world standards, its production is at a very low level and it is not possible to make a profitable cashmere production with this production level.

The future of animal fiber production in Turkey

For this reason, in order to develop a sustainable cashmere production in Turkey, the following three systems are suggested to be developed primarily in Mediterranean, Southern Anatolia, Aegean regions and especially in mountainous and forested lands;

a) Production of pure Cashmere goat breeds and/or crossbreeding Hair goats with these goat breeds

b) Increasing hair goats' meat and cashmere production by crossbreeding them with meat type goat breeds like Boer goat breed

The future of animal fiber production in Turkey

c) The processing of cashmeres produced from Hair goats into handicrafts will contribute to the low-income of agricultural farms which are located in mountainous and forested areas

d) In addition in these three systems, goat coarse hair production will also be benefited in a more effective manner.

The future of animal fiber production in Turkey

5. The silk sector in Turkey has started developing again after 2000 year even if at a low level because of the supports given by the state.

   Development of this sector to a higher level will greatly contribute to the general and rural economy and to the preservation of traditional folkloric culture linked to silk fiber along with mainly silk carpeting.

   For this purpose;

The future of animal fiber production in Turkey

a) encouraging especially low-income agricultural farms or other families to take up sericulture in order to domestically meet raw silk and silk yarn imported by the sector

b) developing the production of handicraft products made of silk

c) cultivation of mulberry trees in areas where sericulture is being already made and/or being planned to be developed should be encouraged and the current trees should be protected from factors such as chemical disinfection, unconscious fertilization and cutting

The future of animal fiber production in Turkey

d) current support provided by the state for wet cocoon production should be maintained

e) structural and technical features of sericulture should be improved and current problems should be solved in order to increase productivity per box in silkworm breeding.

The future of animal fiber production in Turkey

6. Data regarding both Angora rabbit wool production and the sector's demand for this fiber type in Turkey is insufficient. On the other hand, it can be said that Angora rabbit wool production is at a very low level and this situation results primarily from the fact that this fiber type can be imported from China at very lowprices in Turkey as in the world.
For this reason, first it is necessary to make sectoral analysis of this fiber and production planning should be made in accordance with the outcomes of this analysis.

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