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General Status and Long Term Trend Analysis of Sheep and Goat Husbandry in the Eastern Anatolian Region of Turkey

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Abstract: This study presents a study of the current status and 15 year trend of sheep and goat husbandry in the Eastern Anatolian Region of Turkey. In this study, a simple index, chain index and least squares annual growth rate of the trend line method is used. The region is known as the livestock center of Turkey. In 2005, there were more than 10 million sheep and more than 1 million goats in the region. Accordingly, the share of the region in sheep and goat number is quite high with 36%. Forty percent of the total sheep in Turkey is kept in this region. However, the long term trend analysis found that number of animals has gradually fallen, resulting in a negative effect on the livestock sector. The reasons for this decline in all factor levels within the study may be that the region has security problems, pasture and meadows are not used or only have a limited use.

Key words: Sheep and goat husbandry, long term trend, animal products production

INTRODUCTION

Animal husbandry has important functions in a balanced and healthy diet. Animal products are not required for a balanced diet. Animal products are a principal cause in humans of heart disease and other major public health issues and in rural economic development. Animal husbandry is a very important sector which provides low-cost employment and which creates added value with the lowest investment by turning plant proteins into animal proteins (Aslan *et al*., 2001).

Animal husbandry activities which are carried out within agricultural enterprises provide a balanced use of the work power and a better utilization of principal and by-products of plant production. In addition, animal husbandry has a role in maintaining soil fertility, reduction of risks in enterprise incomes and provision of stability in incomes. Animal husbandry produces a range of marketable products and provides a regular cash income for agricultural enterprises (Hopkins and Heady, 1955; Oktay, 1989; Yıldırım, 1993; Şahin and Yıldırım, 2002) suggested that animal husbandry makes optimum use of the available resources and increases the net output of the enterprise. Sheep and goat husbandry has an important role in the Eastern Anatolian Region. More efficient utilization of work power in pasture and meadows is a considerably important activity. The utilization of pasture and meadows for feed requirements has a vital role for the long-term sustainability of animal husbandry activities. Because pasture and meadows are natural animal grazing areas which do not require any investments. However, as a result of security problems which emerged in the region during the 1980's and 1990's, the meadows have not been efficiently utilized. Aslan *et al*. (2001) suggested that this process led to a decline of the main flocks within the region since agriculture sector in the Eastern Anatolian Region largely depends on animal husbandry (Yıldırım and Koç, 1994), within which sheep and goat husbandry have an important role, this study assesses the current status and long term prospects for this sector.

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MATERIALS AND METHODS

This study-related data collected from 2008 to the year has started. This study consists of data collected from the Provincial Directorates of Agriculture in the region and statistical information provided on the web site of the Turkish Statistical Institute. In addition various related studies and publications were reviewed.

The scope of the study is Eastern Anatolia Region of Turkey. There total 13 provinces in the region. These are Ağrı, Ardahan, Bingöl, Bitlis, Erzurum, Erzincan, Elazığ, Hakkâri, Iğdır, Kars, Malatya, Van and Tunceli. General economic structure of the region is premised on agriculture and husbandry.

The raw statistical data was processed and interpreted in the tables. The analysis can be understood by reference to the formula below: The simple index of production of factors such as goat number, milk, meat production and leather which are the by-products:

$$İ = (P_i/P_0)\times 100$$

The chain index is:

$$İ = (P_i/P_{i-1})\times 100$$

and the annual average increase ratios are (Koç and Gül, 2001):

$$= (((\text{last year}/\text{first year})\ \hat{}\ (1/n)) - 1)\times 100$$

In the long term forecast, non-linear trends were tested but the least squares method trend line which best fitted the data was used. The average value and increase ratio can be obtained mathematically with this method. The trend line in this method is mathematically expressed as the function (Güneş and Arıkan, 1988):

$$Y = a+bx$$

where, b coefficient gives us the long-term trend (annual average value).

$$b = \frac{\sum xy - n\bar{X}, \bar{Y}}{\sum x^2 - n\bar{x}^2}$$

$$A = \bar{y} - b\bar{x}$$

Where:

- X = Coding according to year in the lead of the series
- Y = The factors to be long-term analyzed
- n = No. of years coded
- $\bar{X}$ = Average of the sum of the years coded
- $\bar{Y}$ = Average of the sum of the factor within the scope of the long-term analysis according to the years

According to this function the graphs for each factor for which the trend analysis was made were drawn and the trend equation of each curve was calculated. Then, according to average increases and decreases obtained here, future estimations were made.

RESULTS AND DISCUSSION

Sheep and Goat Husbandry in Turkey

Following the economic crisis of 2001, the Turkish economy entered a period of high growth. With 9.90% growth in 2004 and 7.60% growth in 2005, the Turkish economy has been one of the most rapidly growing economies in the world (Anonymous, 2006a).

In the agriculture sector, the growth rate was 5.6% in 2005 and 2.9% in 2006. The contribution of agricultural production to the Turkish economy was 33 billion TRY in the year 2002, increasing to 49 billion TRY in 2005. As a proportion of GDP, this contribution dropped from 12.00% in 2004 to 10.30% in 2005 and 9.20% in 2006. Per-capita income in the agricultural increased from 1.379 TRY in the year 2002 to 1.419 TRY in 2004 and to 2.095 TRY in 2005 (Anonymous, 2007).

While in the year 2003 plant production constituted 75.11% of the value of agricultural output, (animal production constituted 24.89%), in the following years this changed slightly in favor of crop production. By the year 2005, while agricultural production value reached 75.53%, the value of animal products dropped to 24.47% (Anonymous, 2006b). Across the European Union as a whole, the animal husbandry sector represents over 50.00% of the economic value of agricultural production (Babacan, 2006). The 24.75% of total meat production; 12% of total milk production and 63.18% of total leather production of Turkey are obtained from sheep and goats (Anonymous, 2003).

The total value of livestock increased from 1.4 billion TRY in 2003 to 2 billion TRY in 2005. In the year 2003, live animal value per capita was 204,8 TRY, plant product value was 577,7 TRY and animal products value was 191.4 TRY. And in the year 2005, plant product value per capital increased to 706.9 TRY; animal products value increased to 229 TRY and live animal value increased to 290.0 TRY (Anonymous, 2006).

In 2006, there were 10.1 million cattle and 31.6 million sheep and goats in Turkey, with only 2.3% of 3.076.000 agricultural enterprises involved in animal husbandry (Anonymous, 2006b). However, in recent years there has been a significant decrease in livestock numbers. The reasons cited for the decline in the sector include the small-scale and fragmented nature of livestock enterprises, the low productivity of sheep and goat breeds and lack of knowledge and equipment (Kaymakçı *et al*., 2000).

According to 2005 data, there were 10.249.672 sheep and 1.265.181 goats in the Eastern Anatolian Region. 302.091 t of milk is obtained from the sheep; 51.072 t of milk is obtained from the goats. 5.180 t of meat is obtained from the sheep and 1.513 t of meat is obtained from the goats. 272.733 leathers are obtained from the sheep and 79.121 leathers are obtained from the goat (Anonymous, 2005). According to this data, 36.00% of the total sheep and goat numbers in Turkey. Individually, 40.51% of sheep and 19.41% of goats in Turkey are held in this region. In relation to total national output, the Eastern Anatolian Region produces 7.02% of sheep meat and 12.21% of goat meat; 38.25% of sheep milk and 20.13% of goat milk. In addition, 6.07% of sheep leather and 11.00% of goat leather are produced in the region. In the year 2005, the share of Eastern Anatolian Region in animal products value in Turkey was 42.66% (Anonymous, 2005).

No. of Sheep and Goats in Eastern Anatolian Region of Turkey

Amongst the 14 provinces of the Eastern Anatolia Region, Van has the highest combined total of sheep and goats, followed by Ağrı and Muş Provinces. Van Province has the highest number of sheep, while Muş Province has the highest number of goats (Anonymous, 2005). The 22.23% of the total sheep and goats in the region are in Van Province. Ardahan Province has the lowest percentage of sheep and goats. In the Eastern Anatolian region of Turkey, sheep and goats are held in Van, Ağrı and relatively Muş Provinces. Goats are concentrated in Muş, Van, Bingöl, Bitlis and Hakkari Provinces (Table 1).

Table 1: Distribution of sheep and goats on provincial basis

	Percentage of sheep and goats (2005)		
Provinces	Sheep (%)	Goats (%)	Regional total (%)
Ağrı	22.68	7.46	21.01
Ardahan	0.44	0.09	0.40
Bingöl	4.14	11.95	5.00
Bitlis	5.40	10.83	6.00
Elazığ	3.00	5.65	3.29
Erzincan	2.85	2.73	2.84
Erzurum	7.17	6.64	7.11
Hakkari	5.47	10.11	5.98
Iğdır	5.52	3.14	5.26
Kars	3.52	2.27	3.38
Malatya	1.85	2.98	1.97
Muş	12.19	17.35	12.76
Tunceli	2.47	5.26	2.78
Van	23.30	13.52	22.23
Total	100.00	100.00	100.00

Table 2: Percentage distribution of sheep and goat milk production

	Milk production (2005)		
Provinces	Sheep milk (%)	Goat milk (%)	Total milk (%)
Ağrı	23.30	7.50	21.02
Ardahan	0.38	0.06	0.34
Bingöl	5.01	14.73	6.42
Bitlis	6.31	12.36	7.18
Elazığ	3.77	5.79	4.06
Erzincan	3.05	3.03	3.05
Erzurum	6.51	6.62	6.52
Hakkari	2.42	7.38	3.13
Iğdır	5.89	2.84	5.45
Kars	2.61	2.49	2.60
Malatya	3.08	3.17	3.09
Muş	9.06	16.76	10.17
Tunceli	3.68	7.04	4.17
Van	24.93	10.24	22.81
Total	100.00	100.00	100.00

Animal Products Production in Eastern Anatolian Region of Turkey

The livestock sector provides several important animal products: milk, meat and leather. The region produces 302.091 t sheep milk and 51.072 t of goat milk (total 353.163 t). Van Province has the highest sheep milk production, followed by Ağrı Province. Ardahan Province has the lowest sheep milk output (Anonymous, 2005). The highest goat milk production is in Muş Province, followed by Bingöl and Bitlis Provinces. Ardahan has the lowest goat milk production in (Anonymous, 2005). 22.81% of total sheep and goat milk is produced in Van Province; 21.02% is produced in Ağrı Province and 10.17% is produced in Muş Province. In proportional terms, the highest goat milk production is made especially in Muş, Bingöl, Bitlis and Van Provinces. The lowest sheep and goat milk was produced in Ardahan Province (Table 2).

Based on 2005 data, the total of 6.693 t of meat produced in Eastern Anatolian Region is composed of 5.180 t of sheep meat and 1.513 t of goat meat. Across the region, the largest producer of sheep meat is Erzurum Province with 1.147 t and the largest producer of goat meat is Elazığ Province with 661 t (Anonymous, 2005). Meat production obtained from sheep and goat husbandry in the region is concentrated in Erzurum and Elazığ Provinces. Bitlis and Malatya Provinces follow in terms of sheep and goat meat production. When sheep and goat husbandry is analyzed in terms of its sub segments, 22.14% of total sheep meat production of the region is produced in Erzurum; 13.38% is produced in Malatya and 10.48% is produced in Erzincan Province. 43.69% of goat meat is produced in Elazığ; 22.86% is produced in Bitlis Province (Table 3).

Table 3: Percentage distribution of sheep and goat meat production

	Meat production (2005)		
Provinces	Sheep meat (%)	Goat meat (%)	Total meat (%)
Ağrı	8.73	0.73	6.92
Ardahan	1.72	0.07	1.34
Bingöl	0.60	7.93	2.26
Bitlis	8.05	23.86	11.62
Elazığ	9.90	43.69	17.54
Erzincan	10.48	0.13	8.14
Erzurum	22.14	3.11	17.84
Hakkari	6.27	2.78	5.48
Iğdır	3.57	1.92	3.20
Kars	2.59	1.32	2.30
Malatya	13.38	4.43	11.36
Muş	2.39	2.64	2.45
Tunceli	0.15	1.39	0.43
Van	10.02	6.01	9.11
Total	100.00	100.00	100.00

Table 4: Percentage distribution of sheep and goat leather production

	Leather production (2005)		
Provinces	Sheep leather (%)	Goat leather (%)	Total leather (%)
Ağrı	8.03	0.61	6.36
Ardahan	1.96	0.04	1.53
Bingöl	0.41	7.54	2.01
Bitlis	8.99	34.13	14.65
Elazığ	8.65	33.10	14.15
Erzincan	11.86	0.11	9.21
Erzurum	23.58	3.24	19.01
Hakkari	5.53	2.34	4.82
Iğdır	3.46	2.13	3.16
Kars	1.96	1.33	1.82
Malatya	12.85	4.31	10.93
Muş	2.15	3.03	2.35
Tunceli	0.19	1.86	0.57
Van	10.37	6.22	9.44
Total	100.00	100.00	100.00

Based on 2005 data (Table 4), the total of 351.854 sheep and goat skins produced in Eastern Anatolian Region is composed of 272.733 sheep skins and 79.121 goat skins. Total sheep and goat leather production in the region is 351.854. The biggest producer of sheep leather is Erzurum Province with 64.315 leathers (23.58%); Malatya and Erzincan Provinces follow Erzurum with 35.049 (12.85%) and 32.334 (11.86%) leathers, respectively. The biggest producer of goat leather is Bitlis Province with 27.000 leather and Elazığ Province with 26.188 (Anonymous, 2005). In terms of goat leather production Bitlis Province ranks first with 34.13% and Elazığ Province ranks second with 33.10% (Table 4).

Animal Production Value in the Region

In 1995, the value of the livestock sector represented 49.00% of total agricultural output within the region, increasing to 50.98% in 2000. However, by 2005, the value of livestock production within the agricultural sector dropped to 42.66%. At a provincial scale, Erzurum Province had the highest livestock earnings (326.175.240 YTL), representing 16.99% of total regional production. The share of Erzurum Province in animal production value of Erzurum Province was 16.99%. Malatya, Ağrı, Elazığ and Muş Provinces followed Erzurum Province. In terms of per capita animal production value, Kars, Tunceli and Erzurum followed with 573, 533 and 342 TRY, respectively.

Table 5: Livestock sector: changes in annual average output

Periods	Sheep No.	Goat No.	Total milk (t)	Total meat (t)	Total leather (No.)
1991-1995	5.02	-6.88	-4.87	-4.15	-3.95
1996-2000	0.64	-1.77	-1.37	9.87	6.38
2001-2005	1.35	0.47	2.28	-9.26	-9.98
1991-2005	-1.59	-2.92	-1.91	-4.00	-4.24

Table 6: Simple index of some factors (1991-93 = 100)

Periods	Sheep No.	Goat No.	Total milk (t)	Total meat (t)	Total leather (No.)
1991-1993	100.00	100.00	100.00	100.00	100.00
1994	86.24	87.39	87.83	88.43	91.45
1995	79.20	68.96	79.09	66.42	66.48
1996	77.52	68.20	78.54	61.88	72.00
1997	71.21	62.78	70.42	86.77	84.93
1998	70.63	63.68	71.27	113.73	112.31
1999	81.06	64.02	72.51	110.48	110.64
2000	80.01	62.38	73.32	99.08	98.09
2001	75.39	61.64	67.86	72.32	71.87
2002	72.09	65.37	68.28	33.68	34.43
2003	74.39	65.69	65.03	39.72	36.83
2004	74.70	66.36	71.72	35.67	35.31
2005	80.62	63.12	75.97	44.49	42.48

Annual Average Increase Ratios and Simple and Chain Index of the Factors

During the period 1991-1995, a decrease occurred in sheep and goat numbers and in the related animal products. During the period 1996-2000, while total meat production and total leather production increased, an annual 1.77% reduction was calculated in goat numbers and a 1.37% decrease in total meat production. After 2000, sheep and goat husbandry went through a process of improvement. While a 1.35% annual increase was observed in sheep numbers, an annual 2.28% increase was observed in total milk production. However, during the same period, meat production fell by 9.26%. During the period 1991-2005, all the factors which were analyzed showed a decline in average annual totals, as shown in Table 5.

Table 6 shows the single annual index for the livestock sector (1991 to 2005). When compared to the base period (1991 to 1993) certain changes can be seen in the year 2005. A decrease of 19.38% in sheep numbers and a 36.88% decrease in goat numbers. The same pattern was observed for obtained animal products. However, during the 1998-99 period, although there was an increase of more than 10.00% in meat and leather production, in the following years continuous decreases were observed when compared to the base period. In 2005, total milk production decreased 24.03% and total meat production decreased 55.51%.

During the period 1991-98 decreases were observed in sheep numbers when compared to the chain index. In 1999, while sheep numbers increased 15.60% when compared to the previous year, numbers declined again between 2000-2002. In 2005, a 7.49% increase was observed in sheep numbers when compared to 2004. Goat numbers increased during the 1998-99 period and also between 2002-2004. However, in the year 2005 there was a 5.91% decrease compared to the previous year. In the year 2005, a 4.29% decrease was observed in total milk production when compared to the previous year. In the same period, increases were reported in meat and leather production (Table 7).

Long Term Analysis of Sheep and Goat Numbers in Eastern Anatolian Region

When the long term trend of sheep numbers is analyzed, a consistent decline in numbers is observed. Unless the existing animal husbandry policies are not revised, the 10.2 million total sheep number in the year 2005 is estimated to drop to 8.9 million in 2010 and to 6.8 million in 2020 (Table 8).

Table 7: Chain index of some factors (P_i/P_{i-1})

Periods	Sheep No.	Goat No.	Total milk (t)	Total meat (t)	Total leather (No.)
1991	-	-	-	-	-
1992	99.49	103.83	99.45	140.09	141.72
1993	93.77	97.03	96.60	89.51	89.70
1994	90.22	88.07	90.06	85.92	88.45
1995	91.83	78.91	90.05	75.11	72.70
1996	97.88	98.91	99.30	93.16	108.30
1997	91.86	92.05	89.67	140.23	117.95
1998	99.19	101.44	101.20	131.08	132.25
1999	114.76	100.52	101.75	97.14	98.51
2000	98.71	97.44	101.11	89.68	88.66
2001	94.22	98.82	92.55	72.99	73.27
2002	95.62	106.05	100.61	46.57	47.91
2003	103.19	100.49	95.25	117.92	106.96
2004	100.43	101.02	110.29	89.82	95.86
2005	107.92	95.11	105.92	124.71	120.32

Table 8: Long term trend analysis results of sheep number

Current status		Estimated period	
Years	Sheep No.	Years	Sheep No. (million)
1991	13.027.578	2006	9.8
1992	12.960.588	2007	9.6
1993	12.152.900	2008	9.4
1994	10.964.720	2009	9.4
1995	10.069.260	2010	8.9
1996	9.855.540	2011	8.7
1997	9.053.160	2012	8.5
1998	8.979.790	2013	8.3
1999	10.305.390	2014	8.1
2000	10.172.560	2015	7.8
2001	9.585.080	2016	7.6
2002	9.165.072	2017	7.4
2003	9.457.280	2018	7.2
2004	9.497.748	2019	7.0
2005	10.249.672	2020	6.8

Table 9: Long term trend analysis results of goat number

Current status		Estimated period	
Years	Goat No.	Years	Goat No. (million)
1991	1.974.439	2006	1.2
1992	2.050.050	2007	1.1
1993	1.989.160	2008	1.1
1994	1.751.840	2009	1.0
1995	1.382.320	2010	1.0
1996	1.367.200	2011	0.9
1997	1.258.480	2012	0.8
1998	1.276.590	2013	0.8
1999	1.283.260	2014	0.8
2000	1.250.460	2015	0.7
2001	1.235.650	2016	0.7
2002	1.310.443	2017	0.6
2003	1.316.824	2018	0.6
2004	1.330.231	2019	0.5
2005	1.265.181	2020	0.4

When the long term trend of goat numbers in Eastern Anatolian region is analyzed, it is estimated that numbers will decrease (from 1.3 million in 2005) to 1.0 million in 2010. However, numbers will fall to 0.7 million by 2015 and will continue to decline (to 0.4 million) until 2020 (Table 9).

Table 10: Long term trend forecast for total milk production

Current status		Estimated period	
Years	Total milk (t)	Years	Total milk (thousand-ton)
1991	471.951	2006	292.3
1992	469.334	2007	282.0
1993	453.395	2008	271.1
1994	408.326	2009	260.5
1995	367.679	2010	250.0
1996	365.123	2011	240.0
1997	327.394	2012	229.0
1998	331.309	2013	218.2
1999	337.106	2014	208.0
2000	340.855	2015	200.0
2001	315.476	2016	186.0
2002	317.412	2017	176.0
2003	302.322	2018	165.3
2004	333.424	2019	155.0
2005	353.170	2020	144.2

Table 11: Long term trend analysis results of produced meat

Current status		Estimated period	
Years	Total meat (t)	Years	Total meat (thousand-ton)
1991	12.349	2006	7.2
1992	17.300	2007	6.6
1993	15.485	2008	6.0
1994	13.304	2009	5.3
1995	9.993	2010	5.0
1996	9.309	2011	4.1
1997	13.054	2012	3.5
1998	17.111	2013	3.0
1999	16.622	2014	2.2
2000	14.907	2015	1.6
2001	10.881	2016	1.0
2002	5.067		
2003	5.975		
2004	5.367		
2005	6.693		

Table 12: Long term trend analysis results of leather production

Current status		Estimated period	
Years	Total leather (No.)	Years	Total leather (thousand-ton)
1991	673.701	2006	386.5
1992	954.754	2007	350.4
1993	856.418	2008	314.4
1994	757.494	2009	278.3
1995	550.682	2010	242.3
1996	596.374	2011	206.2
1997	703.432	2012	170.2
1998	930.257	2013	134.1
1999	916.403	2014	100.0
2000	812.467	2015	62.0
2001	595.327	2016	26.0
2002	285.221		
2003	305.075		
2004	292.430		
2005	351.854		

According to the long terms analysis of total milk production, total milk produced in the region from sheep and goats in the year 2005 was 353.170 t. This was estimated to decrease to 292.3 t in 2006 and then to gradually will continue to decline 250.0 t in 2010 and to 144.2 t in 2020 (Table 10).

It was estimated that in 2010 meat production will decrease to 5.000 t and continue to fall to 1.600 t in the year 2015 and finally to 1.000 t in the year 2016 (Table 11).

It was estimated that 351.854 pieces of leather production in the year 2005 would reach to its highest level in the year 2006 and that this level would gradually decrease. It was estimated that leather production would decrease to 242.300 in the year 2010; to 62.000 in the year 2015 and to 26.000 in the year 2016 (Table 12).

CONCLUSIONS

Thirty six percent of total sheep and goats in Turkey are held in Eastern Anatolian region. In addition, approximately 2/5 (40.00%) of total sheep milk and 1/5 (20.00%) of goat milk is produced in this region:

- While sheep are mainly concentrated in Van and Ağrı Provinces in the region, goats were mainly concentrated in Muş Province. Sheep and goat milk was mainly produced in Van and Ağrı Provinces
- During the 1991-2005 period, annual decreases were recorded in all factors (sheep and goat numbers and seep and goat products)
- According to the long term trend analysis, over the 15 year projection period (to 2020), there were estimated to be continuous decreases in sheep and goat numbers and in total milk and meat production
- As a result of security problems in the region, pasture and meadows are not sufficiently utilized, resulting in significant negative effects on sheep and goat production
- Based on the results of the study, it is recommended that new policies are required to support the livestock sector across the Eastern Anatolian Region and to ensure the continued economic viability of the sector

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