AN ASSESSMENT OF THE PASTURE AND FORAGE PRODUCTION OF TURKEY

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SUMMARY

In this essay, Turkey's present production patterns of forage and pasture have been evaluated, and the current opportunities available to maximize production have been examined. In the introductory part, as a general framework, the country geographic location, land area, arable and pastoral lands, ruminant and farming sectors have been delineated with the use of some statistics. In the second and third parts, the soil and topographic characteristics along with the climate and agro-ecological zones are presented in-depth. The fourth and fifth parts of the essay cover the ruminant livestock production systems with historical perspectives and pasture resources in the country. And, in the last section, the existing opportunities for improvement of pasture resources have been probed. As a conclusion, although Turkey has a great potential for forage and pasture production, it has not reached the desired level yet.

Key Words: Pasture, Meadow, Rangeland, Forage Crop, Livestock Sector, Production, Turkey

TÜRKİYE'NİN ÇAYIR-MERA YEM BİTKİLERİ ÜRETİMİNİN DEĞERLENDİRİLMESİ

ÖZET

Bu çalışmada, Türkiye'nin mevcut çayır-mera ve yem bitkileri üretim sistemleri değerlendirilmiş ve potansiyel üretime ulaşabilmek için mevcut fırsatlar incelenmiştir. Giriş kısmında, genel bir çerçeve olarak ülkemizin coğrafik konumu, arazi durumu, ekilebilir ve otlanan alanlar, hayvancılık ve çiftlik sektörleri bazı istatistikler kullanılarak tahlil edilmiştir. İkinci ve üçüncü bölümlerde, toprak ve topoğrafik özelliklerle birlikte iklim, tarımsal-ekolojik bölgeler kapsamlı olarak sunulmuştur. Bu tahlilin dördüncü ve beşinci bölümleri tarihi perspektifleriyle hayvancılık üretim sektörünü ve ülkedeki çayır mera kaynaklarını kapsamıştır. Son bölümde, mera kaynaklarının geliştirilmesi için mevcut fırsatlar incelenmiştir. Sonuç olarak, Türkiye, çayır-mera ve yem bitkileri üretimini geliştirmek için büyük bir potansiyele sahip olmasına rağmen, bu üretim henüz istenilen düzeye gelmemiştir

Anahtar Kelimeler: *Çayır, Mera, Yem Bitkileri, Hayvancılık sektörü, Üretim, Türkiye*

1. INTRODUCTION

1.1. Country Location

Turkey forms a natural bridge between Europe and Asia, which has a small part called Thrace in Europe and a larger part called Anatolia in Asia. Geographically, Anatolia is the westernmost point of Asia, which is separated from Europe by the Bosporus and Dardanelles straits, and the Marmara Sea (Figure 1). In order to situate Turkey, one must look at the roughly rectangular region between the latitudes of 36° and 42° N, the longitudes of 26° and 45° E. Turkey covers the 774,815 sq km area, which makes it one of the biggest countries in Europe and the Middle East. Turkey is a huge peninsula bordered by seas on three sides; the Black Sea on the north, the Aegean on the west and the Mediterranean on the south. Its unique geographic location between Europe and Asia has exposed the region to diverse influences and contributed to its historical and cultural evolution. The neighbors are Greece and Bulgaria on the north-west, Armenia and Georgia on the northeast, Iran and Iraq on the southeast and Syria on the south.

Figure 1. Map of Turkey

1.2. Land Area, Arable and Pastoral Areas

Agriculture and Forest Area

The agricultural land and forest areas, as reported from 1985 to 2004, are given in Table 1. In the last 20 years, the cultivated area, forest land size, and land allocated to fruit trees have been more or less the same, and have not changed considerably. During the same period of time, land kept fallow or allocated to olive trees and vineyards have decreased while vegetable growing areas have significantly increased (Table 1)

Table 1. Agricultural land and forest area, (000 hectare (ha)) (SIS, 2005)

	Area (ha)						
Years	Area sown	Fallow land	Vegetable gardens	Vineyards	Area of fruit trees	Area of olive trees	Forests
1985	17,908	6,025	662	625	1,489	821	20,199
1990	18,868	5,324	635	580	1,583	866	20,199
1995	18,464	5,124	785	565	1,340	556	20,199
2000	18,207	4,826	793	535	1,418	600	20,703
2001	18,087	4,914	799	525	1,425	600	20,703
2002	18,123	5,040	831	530	1,435	620	20,703
2003	17,563	4,991	818	530	1,500	625	20,703
2004	18,107	4,956	805	520	1,558	644	20,703

Field crop area:

The area of field crops (cereals, industrial crops, oil seed crops, pulses and fodder) for 1985 to 2004 is shown in Table 2. In the last 20 years, the area allocated to cereal, industrial crops and oil seed crops has not changed much. Pulse cropping area reached a peak of 2 million (m) ha in 1990, and fell to 1.2 m ha in 2004, whereas the fodder crop sown area has steadily increased from 496,395 ha in 1985 to 758,940 ha in 2004.

Table 2. The cultivation areas (hectare) of the field crops; cereals, industrial crops, oil seed crops, pulses and forages in 1985 to 2004, (SIS, 2005)

Years	Cereals	Industrial crops	Oil seed crops	Pulses	Fodder crops
1985	13,844,625	1,258,097	1,489,566	1,193,800	494,395
1990	13,710,615	1,392,325	1,556,741	2,010,480	567,292
1995	13,816,470	1,401,116	1,537,137	1,585,200	587,219
2000	13,962,638	1,387,919	1,319,247	1,308,330	591,827
2001	13,907,355	1,346,839	1,335,816	1,313,150	601,575
2002	13,785,650	1,426,006	1,429,818	1,354,400	603,250
2003	13,413,600	1,298,456	1,384,710	1,255,150	659,900
2004	13,827,435	1,229,889	1,302,635	1,219,350	758,940

Cereals: wheat, barley, rye, oats, spelt, maize, millet, rice, canary grass, mixed grain: *Industrial crops*; tobacco, sugar beets, flax fibre, hemp fibre, poppy capsule, cotton lint, aniseed, dry pepper, cumin, lupin, hops: *Oil seed*; sesame, sunflower, flax seed, hemp seed, poppy seed, cotton seed, ground nuts, soybeans, safflower, rapeseed: *Pulses*; broad bean, pea, chick pea, dry bean, kidney bean, lentil, *Fodder crops*: alfalfa, sainfoin, common vetches, bitter (wild) vetches, fenugreek, grass pea, fodder beet

Pastoral Area:

In Turkey, the exact area of pastureland is not known. Table 3 shows the change of range area along with stocking rate and herbage production over 60 years. According to these estimations, the range area decreased from 44.2 million hectares in 1940 to 13.2 million hectares in 2001, and accordingly stocking rate declined from 4.3 in 1940 to 1.2 ha/Animal Unit (AU) in 2001.

The range area, herbage yield and stocking rate of the seven geographical regions are given in Table 4. The greatest portion of range area is located in Eastern Anatolia, followed by Central Anatolia. According to the 2001 census, 75.9 percent of the total range area is situated in the arid regions, which are Central, Eastern and South-Eastern Anatolian Regions. After 1950, the introduction of large-scale agricultural machinery enabled immense areas to be cultivated. The range areas were ploughed to grow crops, especially cereals, while meadows were converted to cropping lands mainly for industrial crops. It is generally accepted that the maximum extent of cultivation has been reached.

Table 3. The rangeland area, stocking rate and dry-herbage production in 1940 to 2001

Years	Rangeland Area (ha)	Animal Unit (AU) (Million)	Stocking rate (ha/AU)	Dry-herbage production (000 ton)
1940*	44,217,000	10.2	4.3	26,500
1950*	37,906,000	10.5	3.5	23,000
1960*	28,658,000	13.2	2.2	17,400
1970**	21,748,000	13.5	1.6	16,370
1991***	12,377,600	11.0	1.1	10,500
2001***	13,167,375	10.5	1.2	7,900

1 AU= 500 kg live weight

Sources: * Ö, Bakır, 1987; ** Anonymous, 1980;*** SIS, 1991 and 2001 Agriculture Census,

Livestock feeding largely depends upon pasture grazing, and it is especially true for small ruminant production. The Eastern and Central Anatolian regions have 35.4 and 33.3 percent of a total range area in Turkey. The ruminant population is the highest (2.2 million AU) in the Black Sea Region and the lowest (0.78 millions) in South East Anatolian Region.

Table 4. The range area and dry matter (DM) yield of the seven geographic regions in 1970 and 2001

Regions	1970 Rangeland Area (ha)*	Ratio (%)	2001 Rangeland Area (ha)**	Ratio (%)	DM yield (kg/ha)	Animal Unit(AU)***	Stocking rate (ha/ AU)
Marmara	463,600	2.20	518,501	3.94	600	1,318,171	0,393
Aegean	1,027,900	4.70	750,055	5.70	600	1,420,899	0,528
Mediterranean	1,002,400	4.60	630,729	4.79	500	923,487	0,683
Central Anatolia	5,884,200	27.10	4,388,276	33.33	450	1,779,075	2,467
Black Sea	1,993,100	9.20	1,269,176	9.64	1,000	2,235,450	0,568
Eastern Anatolia	9,162,600	42.30	4,662,289	35.41	900	2,056,029	2,268
SE Anatolia	2,165,100	9.90	948,349	7.20	450	787,356	1,204
Total	21,748,900	100.00	13,167,375	100.00	-	1,0520,468	1,252

Source: * Anonymous, 1980; **SIS, 2001 General Agriculture Census; ***1 AU=500 kg live weight

1.3. Ruminant Sector

The livestock sector is indispensable for its economic and social consequences in Turkey, i.e. 6 percent of the total gross production (Anonymous, 2004c). Since the establishment of the Republic, the large and small ruminant populations increased until after 1980, when several factors such as migration to big cities, implementation of changed agriculture policies and the reorganization of the administrative structure in the Ministry of Agriculture and Rural Affairs played a major role. Over the last 20 years, as number of livestock decreased, productivity per animal has increased; however, total production has not improved due to various prevailing constraints. The number of livestock changes from 1985 to 2004 is given in Table 5. The number of small ruminants has dramatically dropped from 42,500,000 in 1985 to 25,201,000 in 2004. In the same period, there was a decline in cattle number from 12,466,000 to 10,069,000; however the possession of high yielding breeds and cross-breeds has dramatically expanded.

Table 5. Number of livestock by type and race (SIS, 2005)

	Small ruminants (thousand head)					Large ruminants (thousand head)				
	Sheep			Goat		Cattle (thousand heads)				Buffalos
Years	Total	Merino	Domestic	Ordinary goats	Angora goats	Total	Culture	Cross-Bred	Domestic	Domestic
1985	42,500	-	-	11,233	2,103	12,466	-	-	-	551
1990	40,553	842	39,711	9,698	1,279	11,377	1,013	3,670	6,694	371
1995	33,791	806	32,985	8,397	714	11,789	1,702	4,776	5,311	255
2000	28,492	773	27,719	6,828	373	10,761	1,806	4,738	4,217	146
2001	26,972	759	26,213	6,676	346	10,548	1,854	4,620	4,074	138
2002	25,174	700	24,474	6,519	261	9,804	1,860	4,358	3,586	121
2003	25,431	742	24,689	6,516	256	9,789	1,941	4,285	3 563	113
2004	25,201	763	24,439	6,380	230	10,069	2,109	4,395	3,565	102

Though Turkey has a great potential and suitable climatic condition for livestock husbandry, most of the growers exercise traditional methods of production with the primary purpose being for home-consumption. According to the General Agriculture Census (SIS, 2001), the sole livestock and the dual production of crop and animal growers constituted 2.36 and 97.64 percent, respectively. The completion of a livestock inventory is targeted in 2008. The vast majority of animal growers are subsistence farmers with limited choice of options. In general, because of inadequate record keeping the consequences are manifested as difficulties in breeding and production planning.

The vast majority of livestock owners have few animals, grown with little attention to management or breeding. A proper timing for slaughter is generally ignored, resulting in yield and revenue losses. Moreover, a shortage of good quality forage production from both native pastures and forage crops obliges a farmer to increase the use of cereal straw and concentrates,

which raises production costs Some constraints in the livestock sector outlined by the Livestock and Seafood Production Committee (Anonymous, 2004c) are as follows: *(1)* Despite the significant effort to replace local races with new breeds or cross-breeds since the early years of the Republic, 18.97, 44.45 and 36.57 percent of ruminant population were the new breeds, cross-breeds and local races in 2002, respectively. *(2)* The number of the breeding-stock farms and their stock production is far from satisfactory for the current demand. *(3)* The artificial insemination has not been successful at the satisfactory level, and there is a need to improve the infrastructure. *(4)* In ruminant production, wide-implementation of extensive growing system and the unbalanced prices between livestock products and feed staffs hinders yield quantity and quality. *(5)* The large proportion of subsistence farmers possessing few numbers livestock thwarts the implementation of development policies. *(6)* For the current livestock population, the shortage of good quality roughages is estimated to be 60 percent. Though in the developed countries, at least 20 to 30 percent of the cultivatable land is allocated to forage crop production, while it is barely 6 to 7 percent in Turkey.

Subsidies for Livestock Production

The objectives of the subsidy are *(1)* to improve livestock production, *(2)* to enhance breeding efforts through artificial insemination and pedigree-inventory, along with promoting the use of new-bred stocks. The conditions of subsidization can be outlined as follows (Anonymous, 2004d): *(a)* in the purchase of a heifer with a full-blooded certified or breeding-stock certificate, 400 YTL (267 USA$)/head and 200 YTL (133 USA$) /head are reimbursed respectively. *(b)* The growers with artificial insemination certificates are refunded with 7.5 to 15 YTL (5 to 10 USA$)/head. *(c)* In the calves obtained from the insemination of crossing the same pedigree and same race of bull, then 30 to 60 YTL (20 to 40 USA$) /calf are paid back.

Meat and Milk Production

Over the last ten years meat production has varied from 300,000 to 400,000 tons, and the largest part of production originates from large ruminants, followed by sheep (SIS, 2005). The milk production has fluctuated around 10 million tons, which was lowest in 2002. Large ruminants produced the major share of milk followed by sheep (SIS, 2005).

1.4. Farming Sector

Despite successful developmental efforts for urbanization, 35 percent of the population still lives in the rural areas (SIS, 2000). In 1927 one out of four people lived in cities; but in 2000 two-thirds of the population live in urban areas; while the total population increased about five fold.

Agriculture is not only an economic activity, but also a process with social, cultural and ecological consequences. In the last 40 years, the contribution of agriculture to the National Gross Production has steadily decreased from 39.8 percent in 1968 to 11.4 percent in 2003 (SIS, 1998; Anonymous, 2004a).

Since the establishment of the Turkish Republic, the introductions of new technologies and high yielding varieties have created many positive agricultural developments. Although Turkey still preserves its special stature as an agricultural country, it is no longer self-sufficient in its agricultural production. The existence of vast soil and water resources and wide climatic variation and topography enables growth of a large variety of crops. However, despite this great richness of flora and fauna, agricultural development has not reached its desired level. The high proportion of subsistence farming brings about many constraints to cropping practices, which hinders the use of sufficient inputs. As a result, low productivity and high production costs have dampened interest in the agricultural sector in general (Anonymous, 2004b).

SOIL AND TOPOGRAPHY

2.1. Topography.

Turkey, stretching from west (Aegean Sea) to east (Mountain Ararat), resembles a high plateau with a 1,000 m average elevation. The slope distribution map of Turkey is given in Figure 2 (Anonymous, 1987).

It is for the most part a mountainous country, and true lowlands are restricted to the coastal fringes. Roughly 25 percent of the total covering area has an altitude of more than 1,219 m, and less than 20 percent is positioned below 450 m Mountain peaks go above 2,250 m. in many places, particularly in the Eastern Anatolian Region. Steep slopes are common throughout the country, while flat or gently sloping land makes up barely one-sixth of the total area. These relief features affect other aspects of the physical environment, producing climates often much harsher than might be expected for a country of Turkey's latitude and reducing the availability and productivity of agricultural land (Keskin, 2001). Land formation and topographic structure were described on a regional basis (Anonymous, 1987), which is summarized as below

1. Central Anatolia: This region has a rough topography with a 1,000 meter average altitude. While the south half is relatively flat, the areas in the north and east have gentle to steep slops (6 to 20 percent) and encompass the Provinces of Sivas, Çankırı, Eskişehir and Kayseri.

2. Coastal Mountains: Taurus Mountains in the south and Black Sea Mountains in the north rise up immediately after the coast and reach 2,000-3,000 m elevation. Mountain ranges of the Black Sea Region are situated closer to the sea; therefore, generally there is no flat area between the coast line and mountains, except the Çarşamba and Bafra basins. In the south, one finds the alluvial plains of Antalya, Silifke and Çukurova; in the eastern Mediterranean the Taurus mountain ranges stretch towards the east. To the east of the city of İskenderun there is a low alluvial plain covering from Hatay to Kahramanmaraş Provinces.

3. Eastern Anatolia: The Eastern extension of the Taurus Mountain Ranges covers a wide swath across the Kahramanmaraş, Bingöl and Hakkari Provinces. Eastern Anatolia as far north as the Black Sea Mountain Ranges, possesses steep and ragged terrain varying from 1,500 to 2,500 m in altitude. The mountains exceed 3,000 m in elevation at high summits and mountain passes. To the north and east of Lake Van in Eastern Anatoloia, the surrounding areas of Erzurum and Kars Provinces have relatively flat terrain, slope varying from 6 to 20 percent, with small and large alluvial plains (the plains of Erzurum, Hasankale, Muş, Saray and Iğdır), which have greater potential for animal husbandry and cereal cultivation. The mountain ranges stretching from Siirt Province to Hakkari are the most ragged topography in Turkey, in the deep valleys of which prevails the mild Mediterranean climatic effects.

4. Southeastern Anatolia: A broad area with gent sloping (1 to 6 percent) topography forms an arch-shaped alluvial plain to the southeast of the Taurus Mountains with an elevation of 500 to 600 m.

5. Aegean and South Marmara: Mountain ranges with varying altitudes of 1,500-2,000 m and stretching out from east to west, are the typical topography of this region, where one finds the 10-20 km wide alluvial plains such as Gediz, Küçük Menderes, Büyük Menderes, Bakırçay, and Karacabey. There is a broad spectrum of terrain in this region, including highly jagged mountains and low-lying plains with great potential for agriculture. Mountains reach up to 2,500 m at their summits.

6. Thrace and Kocaeli Peninsula: This terrain, receiving 600 to 700 mm annual rainfall, with mildly sloping terrain (6 to 20 percent) and low altitudes varying from 600 to 700 m, provides the setting for considerable agricultural activity. The Sakarya Basin in particular has great agricultural potential. The flat Thrace terrain has an average of 100 m to 200 m elevation.

Figure 2. SLOPE DISTRIBUTION MAP OF TURKEY

Symbol	Color	Slope Group and %		Land use suitability	Area, (Ha)
0		Coastal alluvial plains	% 0 - 2	Suitable for cultivation	7 776 008
A		High alluvial plains	% 0 - 2	Suitable for cultivation	7 776 008
1		Gentle slopes	% 0 - 6	Suitable for cultivation with cultural measures	10 405 156
2		Moderate slopes	% 6 - 20	Mostly suitable for cultivation with cultural measures	21 261 850
3		Steep slopes	% 20 +	Suitable for range and forestry	36 384 635
Lake					

2.2. The soils of major zones

The soil zone is described as the relatively homogeneous areas with similar climate and flora, and analogous soil origins. A summary of the soils of major zones (see Table 6.) follows (Anonymous, 1987):

1. Central Anatolia Zone Soils: The area receives limited rainfall (400 mm), has dry summers, and natural vegetation consists of forbs, shrubs and oak trees. In parallel with increasing elevation, the precipitation also increases and accordingly the plant cover pattern gradually changes from herbaceous plants to shrubs and to forest. Great Soil Groups of this zone are Brown and Chestnut soils.

Brown soils are the most widespread soil group, covering 15,298,750 ha, characterized by the formation of a fawn colored top layer of soil, and below which there are plain brown or reddish colored soil layers. A total depth of these two layers is generally 50-70 cm, and underneath is a white limestone layer. The humus content of soil is low (1-1.5 percent). In the warmer parts of south central and south east Anatolia, red-brown soils are prevalent. The wetter and colder north central, west central and east central Anatolian areas, covering 4,485,178 ha, have more densely populated herb cover, shrubs and oak trees, which grow on deep and fertile dark brown soils with richer humus content (1 to 3 percent).

2. Transition Zone Soils: Non-Calcic Brown Soils, enveloping the 6,091,544 ha, are formed under the mixture of herb-grass-bush-forest cover, transitioning from herb to forest sector or on non-calcareous existence and main acidic components. This soil type extensively coveres the Aegean, Eastern Anatolia and Thrace regions. The top soil is brown and reddish-brown, underneath of which the soil stratum has more reddish color and clay buildup. The free-calcareous is totally washed out, or is not present in mother material. Under similar conditions, they have deeper soils than that of the herbaceous zone, but on steep sloppy topography, like in Eastern Anatolia, their soil layer becomes shallow. The variable

temperature and humidity along with the acidic mother material are factors in the formation of this soil in Eastern Anatolia.

3. Humid Forest Zone Soils: The humus rich forest soil, which occurs in the Black Sea, Mediterranean, Aegean, Marmara and south east Taurus Mountains areas, possess brush plants and trees, while receiving a minimum precipitation of 600 to 700 mm rainfall. *The brown forest soils* are pervasive in lower boundaries of the forest zone, next to the herb transition on limestone mother material, which covers 12,287,648 ha. These soils are dark colored, humus rich (2 to 3 percent), and fertile. The prevailing forest can have broad leaved trees like oaks or some pine trees. Brown and chestnut color soils are both found in the transition zones. Underneath the A and B layers a lime buildup may appear. *The non-Calcic brown forest soils* possess similar characteristics but the free-lime is totally washed out or posses acidic schist material. These soils dominate the 7,978,960 ha. When compared to the previous two soil types, these are relatively light in color. *The podsolic soils* cover 3,211,260 ha in areas receiving highest rainfall and permeable mother material (schist). These soil types commonly are widespread in the Black-Sea Region, and they are not well-suited to cropping due to steep topography and a rigid B layer. In the forest zone, but above the forest boundary (2,000 m.) and under the pasture plant cover, *the high mountain-pasture soils* (Alpine grasslands) occur with 10-30 cm depth and a rich content of humus. These soils cover 302,094 ha in the Eastern Black Sea region, which are not used for cropping but are important for grazing farm animals.

4. Mediterranean Zone Soils: This zone can be categorized as a true brush-forest area. The coast line of the Mediterranean-Aegean regions forms a distinctive zone, which is characterized by the prevailing conditions of high temperature and drought in summer and the largest part of precipitation in winter and spring. The *red Mediterranean soils* are formed by the high oxidation and intensive washing out of limestone. Lime in soil usually is washed away; it may contain high clay content and a build up of a lime layer. The natural plant cover is the lemur (maki) formations, e.g. *Quercus ilex*, or in some places pine trees become widespread. Although it may appear all over the forest zone, the Rendizans (with shallow depth 40-50 cm), blackish color and rich in humus forms on soft-lime mother material, prevail in the Mediterranean zone, partially including the Marmara region. The Mediterranean zone soils start to appear first south of Marmara Sea, and become ubiquitous in the south-west Aegean and east. *The Red-Brown Mediterranean soil group* is represented by red Mediterranean and Rendzina soils covering 2,239,629 and 602,172 ha respectively.

5. The Excluded Zone Soils: These soils, not pursuing a certain climate and plant cover, may appear in all zones, and they form under the conditions of mother material or specific topography (Table 6).

Table 6. Distribution of great soil groups (Anonymous, 1987)

Zone	Great Soil Group	Area (ha)	Proportion to Turkey's total area (%)
Arid (grasslands)	Brown	15,298,750	19.7
	Chestnut	4,485,178	5.8
Transition	Non Calcic Brown	6,091,544	7.8
Humid Forest	Brown Forest	12,287,648	15.8
	Non Calcic Brown Forest	7,978,960	10.2
	Podsolic	3,211,260	4.1
	Alpine Meadow	302,094	0.4
Mediterranean	Red Mediterranean	2,239,629	2.9
	Rendzina	602,172	0.8
Azonal and Intrazonal	Vertisols	589,866	0.8
	Basaltic Vertisols	1,061,027	1.4
	Regosols	669,243	0.9
	Litohosols	9,136,719	11.7
	Alluvial and Colluvial	7,776,008	10.0
	Rock Surfaces	2,930,933	3.8
Total		74,661,031	96.1

3. CLIMATE AND AGRO-ECOLOGICAL ZONES

Because of Turkey's placement in the subtropical zone it can be divided into climatic subdivisions, which can be described in every respect as a Mediterranean climate. The climatic zones of Turkey are well described (Anonymous, 1987) and summarized herein;

1. Marmara-Aegean-Mediterranean Zone: This zone is characterized as a truly Mediterranean climate, and the mean annual temperature is 13-15^{0}C in Marmara and 16-19^{0}C near the Aegean and Mediterranean. The mean annual precipitation of this zone is 600-700 mm, but in the costal line between the Muğla - Anamur and the highlands between İçel – Kahramanmaraş it exceeds 1,000 mm. The drought prevails during summers, 43 to 65 percent of the annual precipitation falls in winter, and spring rain is abundant in most years.

On coastal areas and low hill sides, there are typical Mediterranean scrub (maki) formations and oak trees, while with higher elevation, pine, fir, cedar and stone pines occur. In the arable land, the cultivation of citrus trees, olive trees, cotton, fig trees, grape and vegetables are customary.

2. South-Eastern Anatolian Zone: This zone is as warm as the Mediterranean zone, but it is relatively continental and dry. The mean annual rainfall varies from 400 to 600 mm, reaching 700 mm in Mardin and Siirt Provinces, and 800 mm in Adıyaman. The true and lengthy dry summer prevails and the average temperature of the coldest month varies from 2 to 5^{0}C in January.

It is a grassland belt, and the oak trees and wild pistachio grow at higher altitudes. Cotton, cereals and lentil are grown on cultivated land; olive trees are widespread in the southwestern part of the region.

3. Black Sea Zone: The Black-Sea climatic zone has cooler weather and more precipitation than that of the Mediterranean zone. The average annual rainfall ranges from 650-1,200 mm, which reaches up to 2,500 mm in the east. When it is compared to the Mediterranean zone, the seasonal distribution of rainfall is much more even and 20 percent falls in summer. The temperatures of the mean annual and January and August months are 13-14^{0}C, 3-7^{0}C and 21-23^{0}C respectively. The high elevation inlands have a dense bush and forest belt -- with oak, beech, pine, cedar, fir, spruce the common trees. Hazelnut is found across the region, and tea and citrus are widely grown in the eastern area.

4. Central Anatolian Zone: The Central Anatolian plateau is separated from the coastal areas by high mountains. The plateau has droughty summers with cold and rainy winters. The mean annual rainfall varies from 300-400 mm; with little rain during summer, and largest part of precipitation (70 percent) falling in winter. The temperatures of the mean annual and January and August months are 9-11.5^{0}C, 0–2 ^{0}C and 23^{0}C respectively. It is a grassland belt, but in higher-elevation lands oak trees, wild pear and haw trees appear. Cereals are predominantly grown on cropped land.

5. Central – West Central – North Transition Zones: While passing from Central Anatolia towards the west and north, one finds a distinctive transition region, differing from both continental inlands and humid coastal areas. This linear zone, stretching from Burdur to Kütahya and Bolu to Tokat, is warmer and more humid (400-600 mm mean annual rainfall) than that of the Central Anatolia. This distinctness manifests itself through forest formations. The temperatures of the mean annual and January and August months are 10-13^{0}C, -0.6–2.3 ^{0}C and 24^{0}C respectively. It is a mixed belt of grassland and forest, patchy brush plants, oak, pine trees, and wild pistachios.

6. Eastern Anatolian Zone: Due to high altitudes and far distances from the coastal areas, it is the coldest region of Turkey. The mean annual temperature varies from 5-10 ^{0}C, but in some places it can exceed this average such as in the plains of Iğdır, Bingöl and Elazığ. The mean temperatures of January and August are -1^{0}C and -10^{0}C, and 20-26 ^{0}C respectively. The north half of the region is colder and drier, whereas southern part of the region is warmer and wetter. The warm valleys, resembling the climatic conditions of the Mediterranean-southeast, occur in the southern half of the Van Province together with Hakkari and Bitlis

provinces. The average annual rainfall ranges from 350-600 mm, but reaches up to 1,250 mm on the south aspects. It is a grassland belt; there are oak trees in highlands, and wild pistachios in southern valleys of the region. The cereals are common crops, but cotton and some fruits can be grown in the Iğdır Basin.

4. RUMINANT LIVESTOCK PRODUCTION SYSTEMS

4.1. History of the Turkish pastoral culture:

Pastures are an integral ideological part of the "Steppe Culture" in a Turks' life. And, principles of the Turkish steppe economics, by virtue of its unique landscape and climatic conditions of the highland plateaus and hill pastures, are forged by the shepherd and animal husbandry (Gükkuş and Koç, 2001). Turan (1965) determined rom historical records that during Seljuk time (any one of the Turkish dynasties that ruled Asia Minor from the 11th to the 13th centuries) excess livestock was exported to Iran, Iraq and Syria and livestock feeding was largely dependent upon rangeland grazing. In 1226 A.D. two million sheep were dispatched to Tebriz City at once Turks traditionally regulated the communal pasture lands by dividing it into the over-wintering (*kışlak*) and summer (*yaylak*) grazing areas. The nomadic tribes use low pastures in winter and just prior to dry summers they move to cool highland grasslands (Ögel, 1991). The nomads became the major livestock growers. In the 18th Century of Ottoman times during the administrative restructuring period (*Tanzimat*) a land law was enacted on range use. According to this act, for a flock of 300 sheep a levy of one sheep was given to gain grazing rights to a particular piece of rangeland.

4.2. Pastoral Systems

In Turkey, the pastoral structure can be divided into two systems, which are (1) Quasi-nomadic and (2) Sedentary.

(1) *Quasi-nomadic system*: In this system, livestock flocks spend quite some time outside their settlements to seek fresh forage. The movement of small ruminant flocks from south-eastern Anatolia to eastern Anatolia is a good example of a quasi-nomadic system. Although the nomadic way of livestock production has slowed over the last two decades, it continues in some locations of east and south-eastern regions of Turkey. The small ruminants, sheep and goat, are the major livestock in the lives of Turkish nomadic people. The nomads, during winter dwell in low lands, and dry summers they move to cool highland pastures (*Yayla*). The early 1980s' onwards, the production system was altered by abandoning the pasture dependent extensive system and migrating to the big cities. Since then use of highland pastures has become less intense and many highland pasturelands have been transformed to areas that attract tourists (Gökkuş and Koç, 2001).

Sedentary system: This system can be divided into three: (1) the exclusively--natural pasture dependent (extensive system) (2) partially-natural pasture dependent (semi-extensive) (3) hand feeding (intensive system). In the fully or partially natural pasture dependent systems, low and highland pastures are the main feed resources for livestock.

In general, the lowland pastures are grazed in spring and early summer, and their herbages are finished off with the initiation of the dry season. Then, the herds and flocks are driven to higher elevation pastures that are located nearby settlements. These highland pastures provide fresh feed to the animals. Tosun and Altın (1981) classified the high land pastures, according to their elevations, into three groups:

(a) Low-elevated highland pastures: Their altitude varies from 900-1,200 m and they share territory with the settlement areas and arable lands. The animals are taken in May, and graze there for 140-160 days. The highland pastures of Aegean, Marmara and Thrace Regions can be grouped in this category.

(b) Mid-elevated highland pastures; these pasturelands are situated nearby forest land and their altitudes vary from 1,200-1,600 m. Livestock is moved there in June, and stay for 100-140 days. The Central Anatolian highland pastures are part of this group.

(c) High-elevated highland pastures; these pastures are confined to the areas with elevations of more than 1600 m. Livestock start to graze there in July and stay for a relatively short time of 60-80 days. Eastern Anatolian pastures are included in this group.

4.3. Feeding systems

Despite the fact that the pasture areas have substantially decreased over last fifty years, natural pastures play major role in animal feeding. The main portion (70-90 percent) of the roughages in the daily rations is obtained from natural pastures. Small ruminant sheep and goats acquire almost all of their feed needs from natural grazing lands, except during the winter indoor time when herbage is totally grazed out. The herbage obtained from the forage crops is usually used during winter-indoor-time, or is supplemented when pasture foliage is scarce. Almost all over Turkey, the residuals of field and horticultural crops, in the form of leaves, branches, tubers and straw are all used in livestock feeding. Furthermore, in coastal areas the residues of industrial and horticultural crops constitute the main source of feed stuffs. These crop residues are available in large quantities but they are generally of low quality; therefore of limited value without additional supplementation in animal feeding systems (Gökkuş and Koç, 2001). Natural pastures are the most cost effective source of quality feed, providing a good source of energy and protein.

In dryland farming (receiving less than 400 mm annual rainfall) areas of Turkey, the cereal-fallow cropping system is widely practiced, and a considerable size of land is allocated to fallow annually. The grazing of fallow-lands becomes critical, especially prior to cereal harvest when forage is scant on rangelands. Stubble grazing is very crucial after cereal harvesting for small ruminant feeding.

The major feeding systems employed in the Central Anatolian region are shown in Figure 1 (Fırıncıoğlu et al,1997). There are two different main systems represented as the mountain and plateau regions Small ruminants in the mountains are more dependent on rangeland, whereas-not surprisingly- much more cereal stubble grazing is found on the plateau. On the plateau, rangeland is grazed to some extent throughout the year, while in the mountains grazing starts in March and ends in mid-November. Vetch straw is used as a supplement in the mountains, while barley grain and concentrates are more common on the plateau (Figure 1 a).

Cattle depend on rangeland more in the mountains than the plateau, but in the mountains their diet is supplemented by a more diverse feed mix, including hay, vetch straw and grain, and smaller amounts of barley grain. Cattle start grazing on rangeland at the beginning of April, one month after small ruminants (Figure 1 b). Because large stubble areas of the cereals exist in plateau, small ruminants are mostly grazed on this stubble, after the cereal harvest (Figure 1 a)

In Turkey the roughages produced from the natural pastures and forage crop cultivation, and the shortages of the good quality dry-forage is estimated to be 8.9 and 2.6, and 17.3 million tons respectively (Fırıncıoğlu, 2005). The crop residuals, stubble and fallow grazing are predicted to provide the 43.7 million tons of additional feed (Kılıç, 2001). And, at this production level, the roughages supply a sufficient amount of energy, but they lack protein, and as a consequence all nutritive requirements cannot be obtained from the current roughage production (Kılıç, 2001).

Because the small family enterprises are predominant in small ruminant rearing in Turkey, the structure of small ruminant enterprises is of importance for continuation of extensive and conventional production pattern (Personal Communication with Dr. Sema Yaman). Especially in the east, south east and central Anatolia small ruminants are kept inside the barns and stall fed only in 3-4 months (winter) of the year. Except during harsh winter conditions, small ruminants are grazed almost year long and except stall feeding in winter there is no supply of feed during grazing. In winter time wheat and barley straw are fed to

animals together with very small amount of whole barley or compound feed. Compound feed consumption is not common and sufficient to supply animals in winter time (Personal Communication with Dr. Sema Yaman).

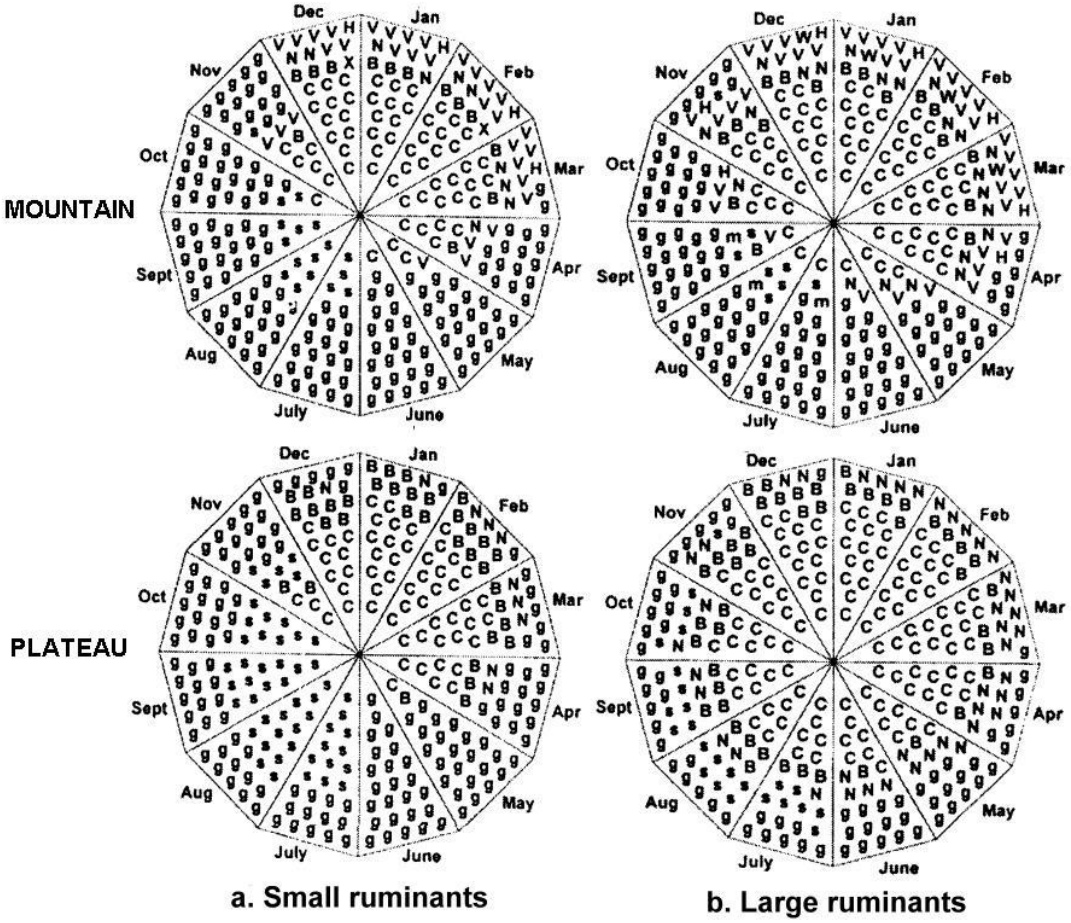

Figure 1. Grazing calendars of small and large ruminants in the Central Anatolian Highlands. Ingredients of diets are as reported by farmers; each symbol represents 4% of the diet in each month. Upper-case symbols denote hand feeding: C=cereal straw; B=barley; N=concentrates; V=vetch straw; H=hay; X=wheat grain. Lower-case symbols denote that animals were grazing: s=cereal stubble, m=meadow; g=rangeland. (Fırıncıoğlu et al., 1997)

Feeding and rearing conditions are not much different for small ruminants. In winter animals are supplied mainly with straw and small amounts of hay and compound feed. During early spring animals go out to the meadow-pastures near the villages for grazing. During grazing they can get no supplementation. An exception would be in west Anatolia where the number of large modern dairies has increased in population, increasing the prevalence of intensive feeding in stalls and barns (Personal Communication with Dr. Sema Yaman).In these dairy enterprises feeding and rearing conditions have been improved. Silage making and usage are very common. Silage corn and fodder crop cultivation are increased and dairy producers are very mindful in preparation and feeding practices. Shortage of good quality fodders is the most limiting factor in feeding of animals leading producers to use higher quantities of compound feeds that compensate for good quality forage. Improper practices lead to uneconomic results and/or metabolic disorders in the animals (Personal Communication with Dr. Sema Yaman).

4.4. Integration of livestock into farming system:

Historically, crop-livestock integration has been managed through both intensive and extensive land-use systems. The small ruminant production, as an example of the extensive system, integrates natural pasture grazing with cereal cultivation in rainfed areas. Another example is the integration of highland pasture (*yayla*) with lowland systems (natural pastures and /or cereal stubble grazing)

There are two types of intensive agricultural systems, which are mainly located in the areas receiving sufficient rainfall in coastal areas and irrigated lands within the dryland farming. In coastal areas, major crops are the industrial crops such as sunflower, potato, and sugar beet, which produce residues that can be utilized in livestock feeding. This is also true for irrigated lands where sugar-beet production produces residues widely exploited in cattle fattening.

4.5. Limitations

Owing to high production cost and lack of awareness, the fattened cattle are slaughtered long after reaching an optimum live weight. This raises the costs of production but also worsens the meat quality (Anonymous, 2004c). Lack of forage crop production and good quality herbage from pastures leads to excessive use of the cereal straw as roughage, and need to use concentrates to offset the poor quality of the roughage

Turkey, having a common border with seven countries, is always in danger of introduced livestock diseases. The eradication of the cattle plague has recently been a success story. The act of animal movements within the country is regulated by the Act Number 3285 of the Animal Health and Constabulary Office so as to prevent the spread of disease. In recent years, the Ministry of Agriculture and Rural Affairs have initiated a promising program of livestock description and inventory in order to control animal movements and disease pandemics.

Low quality herbage from pastures and lack of good quality forage are the main reasons that explain the general practice of using high amount of compound feed for dairy, and this reality leads uneconomical feeding and metabolic syndromes in large ruminants (Personal Communication with Dr. Sema Yaman).

4.6. Socio-economic limitations

The vast majority of livestock growers are subsistence farmers, who do not have adequate basic knowledge and infrastructure for proper animal management. These growers are traditionally self-sufficient within the customary marketing system, and also strive to meet local market demand. In this system, because records are not kept, breeding practices are inefficient and production potential is not achieved. Growers do not acquire necessary tools and equipments (Anonymous, 2004c). Increasingly, it is recognized that a huge proportion of subsistence livestock producers could be considered as the main obstacle in the development of livestock sector. It should not be overlooked that the emergence of big commercial animal farms is not necessarily due to logical and progressive development of the sector (Akman et al., 2001).

In Turkey the dual constraints that harm the improvement of production are the farmers' unorganized structure and capital shortages. The main factor in supply of farm capital is from the net return stemming from the marketing of products. The need for credit is clear.

In 1995, the first Cattle Growers Union was established with the aim of resolving constraints and providing some services. Accordingly, some functions conducted by the Agriculture Ministry were displaced to Unions such as artificial insemination, health care, inventory and record keeping. Since their establishment they have achieved many goals but there is much work yet to accomplish.

4.7. The use of communal pastures

In Turkey nearly all of the native pastures are public lands and used communally. Smaller areas of meadowlands are in owned privately. When these public grazing lands were granted to the farmers for a communal use, there were a relatively small number of livestock, and overgrazing was not an issue. However, the development of cereal culture displaced common pastures, a side effect of which has increased environmental degradation. As a result, many of the permanent pastures have been converted to cropped land, particularly during an intense conversion period during 1940 to 1960 due to rapid mechanization in Turkey (Bakır, 1971). Rapid increase in human population has encouraged the conversion of pasture to cultivated land. Simultaneous enlargement in livestock number has concentrated more animals on a smaller area. The mismanagement of pasture lands by overgrazing has resulted in a reduction in the number of pasture species. The rangeland is grazed from early spring to winter as a common practice. The ideal grazing season, which enables pasture species to recover, is between 15 May and 15 September in the Central Anatolian Region (Büyükburç 1983a). As a result of this extended use and overstocking, the grazing capacity of the common land has been dramatically depleted. Socioeconomic constraints often restrict the sustainable use of common lands. Because of traditional and excessive use, rangelands never reach their full productive capacity, and farmers are not aware of the gains that could be obtained by adopting better management techniques (Fırıncıoğlu et al., 1997). In fact, unorganized communal utilization of rangeland prevents land users from investing in improvements because there is no guarantee that they will receive the benefits from the investment. In the past, development projects on rangeland consisted of on-farm studies and demonstrations of seeding, fertilizing and feeding. However, the planted pasture demonstrations, initially accepted by farmers with great interest, failed because of the relatively high cost of establishment and the subsequent mismanagement of the pastures (Munzur, 1989).

5. PASTURE RESOURCES

5.1. Description of main vegetation zones

In Turkey the conditions, production and utilization pattern of the natural pastures were first described by Bakir (1971), whose region-based description is modified, updated and summarized below:

1. *Grazing lands of the Black Sea region*

The most productive rangelands of Turkey are located in this region. The annual precipitation increases from 600-2,000 mm from west to east. The climate is very supportive for growing pasture plants. In the east part of the region the rangelands are the most productive due to greater rainfall, which is generally localized on high mountains. Alpine pastures are frequently seen in this region. Highland pastures of the coastal area have alpine vegetation, while the pasturelands in inner areas of this region have the steppe vegetation type (Personal Communication with Tamer Yavuz). The average annual hay production is 900 kg/ha. In comparison with other regions, the green foliage production period of these rangelands is significantly longer. This region has the largest number of livestock with 2,235,450 Animal Units (AU) (SIS, 2001), and stocking rate is quite low at 0.568 hectare/ Animal Unit.

2. Rangelands of Marmara region

Only 3.94 percent (SIS, 2001) of the rangelands of Turkey are located in this region, in which intensive farming is practiced. Environmental conditions are favorable for range plant growth, therefore, fairly productive grazing lands produce about 600 kg/ha hay, all of which is made during summer months. For large ruminant production, the intensive system with high output and input is widely employed; as a result, concentrated feeds are used more intensively than any other region. Milk cows and feed lots are situated around the big cities. According to the Agriculture Census (SIS, 2001) 1,318,171 AU exist, and stocking rate is the lowest with 0,393 ha/AU. The pasturelands of the Çanakkale Province possess sparse-shrub

formations along with some dominant herbs such as *Dactylis glomerata*, *Lolium* sp., *Poa bulbosa*, *Hordeum bulbosum*, and *Bromus arvensis*. *Sarcopoterium spinosum* is predominant in the abandoned lands, and oak trees (*Quercux* sp.) are also ubiquitous (Personal Communication with Dr. Hakan Hakyemez). The small ruminant extensive production system depends mostly on the communal pasture grazing, whereas the hand feeding as an intensive system is practiced in large ruminant production. In that region, the proper grazing season falls into the dates between 20 March and 20 November, while actual grazing lasts continuously year-round (Personal Communication with Cengiz Kurt and Dr. Arif Semerci).

3. Rangelands of Aegean region

This region resembles the Marmara region except that the Maki which is the characteristic shrub vegetation of the Mediterranean region occupies large parts of the coastal areas where there are 1,420,899 animal units of livestock, and a stocking rate of 0.528 ha/AU (SIS, 2001).

Gençkan (1970) identified the 35 legume plant species, of which *Medicago marina*, *M. polymorpha*, *M. hispida* and *Trifolium tomentosum* are widespread, whereas in the flora of the coastal line *Festuca* sp. *Bromus* sp. *Lotus* sp. and *Trifolium* sp. are the most common species (Avcıoğlu, 1989). Dr. Hüseyin Özpınar (personal communication) reported that pasturelands are usually grazed, though in some flatlands pasture mowing is also practiced, but in general grazing is uncontrolled, and the village livestock production is largely dependent on the communal pasture. Some feed lots, mostly located in the coastal area, employ an intensive production system.

4. *Grazing lands of the Mediterranean region*

Intensive farming is practiced in most parts of the plain areas; however, in the mountainous areas the farming system is extensive in character. Almost all of the coastal areas up to 500 m are covered with maki vegetation being composed of shrubs and small trees which have no economic value for feed, but does serve a role as for fuel and soil protection. The dominant species of maki in this region is *Quercus coccifera*, a small shrub 1-2 m in height. Only goats can graze this shrub together with the other constituents of the vegetation, there being a sparse herbaceous cover in the openings between shrubs. The other rangelands of this region, which are mostly located in the Taurus Mountains, are not generally as productive as the rangelands of the Aegean and Marmara regions. On average, the grazing lands produce only about 450 kg/ha hay. Grazing livestock on native rangelands, on maki vegetation and on forest areas has resulted in a type of nomadic animal husbandry. Livestock in most of the villages are taken out of the barns in the early spring, they are grazed on the three types of vegetation mentioned above and after seven to eight months returned to the village. This region possesses 923,487 animal units (SIS, 2001) of livestock and 0.683 ha/AU stocking rate. In this region, the dominant plant species are *Hordeum* sp., *Poa* sp., *Cynodon dactylon*, *Lolium* sp., *Trifolium resupinatum*, *T. fragiferum*, *Plantago* sp., *Echinops* sp., *Eryngium* sp., *Euphorbia* sp., *Cirsium* sp., *Centaurea* sp. and *Cardus* sp.,. The hill pasture grazing (Yayla) in the Taurus Mountains is greatly valued during summer; however, the year-round uncontrolled grazing is a common practice, though grazing is stopped in few villages from December to April (Personal Communication with Dr. Mustafa Avcı and Mr. Selahaddin Çınar).

5. *Rangelands of Central Anatolia region*

The most unproductive rangelands of Turkey are located in this region, because of the prevailing unfavorable climatic condition and the existence of overgrazing for extended periods over the past decades. The annual precipitation varies between 289-500 mm from Karapınar County to the northern transient zone. Since there are prevalent periods of hot temperature and drought during summer, most of the range plant species completely dries out for 2.5 months of grazing season. Due to excessive grazing pressure, the range vegetation has been severely deteriorated to the extent that the plant cover can not sufficiently protect the soil in some places. For this reason, in the Karapinar area, as a worst example wind erosion caused

formation of sand dunes. But, the deleterious effect of the water and wind erosion frequently occurs in most parts of the region. The Central Anatolian rangelands have a steppe character, but as the case in true steppes, the grass species are not dominant. Grass species such as *Festuca ovina*, *Bromus tomentellus* and *Poa bulbosa* var *vivipara* are accompanied by shrub species such as *Thymus squarrosus* and *Artemisia fragrans*. In some parts of region, as a result of further degradation, *Artemisia* rangelands have been replaced by *Thymus* pasturelands. Grasses constitute about 40 percent of the vegetation. Though the Central Anatolian region is a high plateau, unlike other regions there is no adjoining area of high mountain pastures on which livestock might be grazed during the hot summer season. After cereal harvest, animals are driven to graze on the stubble, which becomes an important part of the daily ration. Because of this heavy grazing, the dried hay production of the rangelands has been reduced to an average of 300 kg/ha. Central Anatolia, among others, has the largest stocking rate at 2.467 ha/AU (Personal Communication with Dr. Sabahaddin Ünal) with 1,779,075 animal units (SIS, 2001) . In the western and north-west transition zones of Central Anatolia, the major plant species are *Festuca ovina*, *F. rubra*, *Agropyron desertorum*, *A. cristatum*, *Dactylis glomerata*, *Stipa* sp., *Astragalus* sp., *Thymus* sp., *Plantago* sp. in rangelands, whereas in meadows *Agropyron intermedium*, *Festuca arundinacea*, *Lotus corniculatus*, *Phleum* sp., *Trifolium repens*, *T. pretense*, *Carex* sp., *Lolium* sp. and *Juncus* sp. are common species. Shrub species such as *Crategus monogyna*, *Rubus caesius* and *Palirus spina* are prevalent in pasturelands (Personal communication with Mr. Levent Sever and İsmail Kara). In this part of Central Anatolia, *Juncus* sp. is intensely encroached upon in the meadows. Livestock grazing in the hill pastures is a common practice during hot summers. For small ruminant production, a quasi-nomadic system is practiced, e.g. the flocks are driven from the Aydın and Manisa Provinces to the Gölcük Hill pastures in the Simav district of Kütahya Province.

6. *Rangelands of Eastern Anatolian region*

The largest range area is found in the Eastern Anatolian Region. The grazing pressure is relatively low compared with other regions. Therefore, range condition is also in relatively better shape than that of other regions, and excluding the Eastern Black Sea region, the climatic condition is more favorable for plant growth than any other region. The botanical composition of this region's pasturelands is represented by grasses such as *Festuca ovina*, *Bromus tomentellus* and *Koeleria cristata*; the major leguminous family species are the spiny-*Astragalus ericephalus* and the various wild alfalfa species (*Medicago falcata*) are widespread (Personal communication with M. Merve Özgöz, Süreyya Dumlu, Erdal Aksakal, Mustafa Uzun). Eastern Anatolia is more suited to animal husbandry and the cropping of cereal and industrial crops have some constraints owing to high elevation. More interestingly, most of the productive meadows are situated in this region, which has a great capacity for animal husbandry and forage production and most of the villagers invest in livestock production for their livelihoods. A total of 2,056,029 AU of small and large ruminants (2001, SIS) with 2,268 ha/AU stocking rate exists in this region .

7. *Rangelands of South-Eastern Anatolian region*

The rangelands of this region have more or less the same conditions as the Central Anatolian pasturelands, mainly because of the dry climate. Since summer and high temperature become prevalent earlier, the pasture forage dries out quickly, and the small ruminants are driven towards higher plateaus and pasturelands of Eastern Anatolia and highlands of south -eastern Taurus Mountains. The rangelands of this region are grazed heavily. South-eastern Anatolia has 787,356 AU (SIS, 2001) equivalents of small and large ruminants with a 1.20 ha/AU stocking rate. Proper grazing times lie between 15 April and 30 June for spring, and from 15 September to 30 November for autumn, but these timeframes are not respected and uncontrolled grazing is widely practiced (Personal Communication with Mr. Mehmet Salih Sayar). In the South-eastern Anatolia Project (GAP) Area, confined mostly to the Urfa Province, the plant cover ratios of grass, legume and other species were determined to be the 11, 2.5 and 85.5 percent, respectively (Polat et al.,1996). *Dactylis* sp., *Avena* sp.,

Phlaris sp., *Bromus* sp. , *Hordeum* sp, *Festuca* sp. of the grass family, and *Astragalus* sp, *Vicia* sp., *Lathyrus* sp. *Pisum* sp., *Trifolium* sp., *Trigonella* sp., *Medicago* sp., *Coronilla* sp. of the legume family are the major species in the GAP region. In general, an uncontrolled use of the communal land is widespread. Livestock feeding is largely dependent upon rangeland; all of the small ruminants and major portion of cattle (local breeds) graze on pastureland for most of the year (Personal Communication with Mr. Abdullah Çil and Ayşe Çil).

5.2. Improved pastures, sown forages and crop residues

a) Rangeland Improvement

Bakır (1971) reported that in Turkey the range improvement studies first began in 1952-53 with the initial research on range fertilization, control of noxious weeds and clearing of stones. Since then, much more research work has been conducted and invaluable information has been generated. Altın et al. (2005) outlined several improvement methods that are in keeping with range condition classes, summarized in Table 7.

Table 7. Rehabilitation methods applicable and in accordance with vegetation condition class and structure.

Range condition	**Applicable techniques**
Excellent (climax)	Proper management (grazing complying with carrying capacity and grazing season; rotational grazing may be considered)
Good	Proper management + fertilization + weed control (if necessary)
Fair	Proper management + fertilization + weed control + artificial re-seeding (over-seeding or strip-seeding)
Poor	Proper management + fertilization + weed control + artificial re-seeding (strip-seeding or seeding after seed bed preparation)
Bushy rangelands with satisfactory plant cover	Proper management + prescribed burning/weed control + fertilization
Bushy rangelands with poor plant cover	Proper management + prescribed burning/weed control + fertilization + artificial seeding
Flat land with deep soil and deficiency of water	Proper management + fertilization + appropriate water regime + weed control (if necessary)
Flat land with deep soil and excess of water	Proper management + fertilization + water regime (especially drainage) + weed control (if necessary)

The rangeland rehabilitation can be achieved by employing the following techniques:

(1) <u>Re-seeding</u>

Two distinct methods of re-seeding can be employed, which are *(1)* natural re-seeding and *(2)* artificial re-seeding (Altın et al. 2005). The selection of method is largely dependent on *(1)* ratio of desirable plant species, *(2)* cost and benefit relations, *(3)* soil structure and *(4)* topography.

In Turkey, most of the rangelands are in poor condition, and in which ratio of the desirable plant species is not more than 25 percent; therefore, the long term exclusion of grazing animals did not necessarily achieve its goals (Alpay, 1970; Alınoğlu, 1971). Tükel (1988) suggested that a minimum annual 500 mm rainfall is required to be successful in such pastures situated on shallow soil and steep slopes. Bakır (1985) reported that for success in natural re-seeding, the ratio of desirable range species within the botanical composition should be at least 25 percent. In Central Anatolia near Ankara, despite eight years of complete resting, herbage production increased three fold, but its forage quality did not change considerably (Alınoğlu, 1971). Fertilization along with resting (natural re-seeding) increased the herbage yield, but it decreased the forage quality in Ankara Province (Büyükburç, 1983b). In Eastern Anatolia, in Erzurum Province, artificial seeding increased herbage yield as well as its feeding quality (Tosun et al. 1977a, Gökkuş, 1987).

(2)Fertilization

Altın (1975) suggested a 150 kg/ha dose of nitrogen fertilizer in meadows and the 50-100 kg/ha for the rangelands of Erzurum Province. Tosun and Altın (1981) recommended the same doses of nitrogen in the rangelands of Erzurum Province. The 40 kg/ha phosphorous was recommended for the meadowlands of Erzurum and Ankara Provinces. Büyükburç (1983b) investigated the fertilization responses in detail, in the rangelands of Yavrucak village of Ankara Province, where six years after annual fertilization application at the doses of 100 kg/ha nitrogen and phosphorous, the cover ratio of the shrub species *Thymus squarrosus* Fisch. Et. Mey. decreased from 38 to 1 percent, whereas grass species percentage in the botanical composition increased from 20.5 to 73 percent. But, an initial cover ratio (barely 0.5 percent) of the legume species did not increase significantly.

Altın et al (2005) summarized the broad doses of the fertilization for each regional grazinglands recommended for rangeland rehabilitation, as follows;

1. *Mediterranean and Aegean Regions*: In the rangelands with the vegetation predominantly annual grasses and encroached with bushy species, fertilization is not feasible. The rangelands, not severely degraded and located in low or middle altitudes require 100 kg/ha nitrogen and phosphorous for satisfactory development. In the highland pastures, 50-100 kg/ha nitrogen and the 50-75 kg/ha phosphorous are sufficient in lightly degraded rangelands. As the ratio of legume species increased, amount of nitrogen can be decreased in parallel with the increment of phosphorous.
2. *Marmara Region*: Due to high precipitation, even severely degraded grazing lands can be highly responsive to the fertilization. The 100 kg/ha nitrogen and 50 kg/ha phosphorous give satisfying results. Owing to wide distribution of the herbaceous and brush species, mere fertilization is not recommended for range improvement. Though the fertilization doses may change in accordance with plant species composition, in general 75-100 kg/ha nitrogen and 50-75 kg/ha are recommendable quantities.
3. *Black Sea Region:* This region receives highest precipitation, and studies have proved the good responses of grassland vegetation to fertilization. The amount of the 50-75 kg/ha nitrogen and phosphorous produce significant results in the inlands of the region, but the doses of 75 and 100 kg/ha nitrogen and phosphorous generate the satisfactory outcome in coastal areas and high elevation pastures.
4. *Central Anatolian Region:* The studies on the fertilization of rangelands in terms of the economic feasibility have not indicated consistent results. However, in parallel with the increment of perennial species 50 kg/ha nitrogen is recommended, and if the rangeland vegetation has an adequate amount of legume species, then 40 kg/ha phosphorous is a reasonable quantity. In the higher elevation rangelands with greater rainfall 50-75 kg/ha nitrogen and 50 kg/ha phosphorous are considered to be an effective amount.
5. *Eastern Anatolian Region:* The region is distinct because of its high elevation and short season for vegetative growth. Rangelands are in relatively better condition; this is especially true for hill pastures. The range areas without encroachment by spiny *Astragalus* sp. species are mostly inhabited by herbaceous plants that are grazed by livestock. When the grazinglands are near to populated areas and with poor content of leguminous species, then 50-75 kg/ha nitrogen application is the appropriate dose. If the ratio of leguminous species is not less than 10 percent, an additional 50 kg/ha phosphorous can be applied. In the high hill pastures with a good condition, 75-100 kg/ha nitrogen and 50-100 kg/ha phosphorous give satisfactory results.
6. *South-Eastern Anatolia:* The vegetation of the lowland grazing lands has been severely destroyed, and fertilization does not produce a desirable effect in these rangelands. In the highland pasture, if vegetation is not much deteriorated, then the quantities of the 50 to 75 kg/ha nitrogen and 50 kg/ha phosphate are advisable. In the GAP region, on the relatively flat pasturelands, over-sowing and fertilization with mostly phosphorous and the proper

grazing improve the range condition, and grazing on cereal stubble and the quasi-nomadic system is a common practice (Personal Communication with Mr. Abdullah Çil and Ms. Ayşe Çil).

b) Sown Forages

Although Turkey with its great ecologic variation is well suited to produce various kinds of forage crops, shortages of good quality forage have been stated by many authors. As a main goal, the cultivated area of forage crops has been targeted to increase from the current 5-6 percent of the arable land to 25 percent but it has not been achieved. Marketing constraints for animal products and low prices and mediocre yield potentials of livestock populations could be improved through proper exploitation of forage crop cultivation. The traditionally grown crops are common vetch (*Vicia sativa*), alfalfa (*Medicago sativa*), sainfoin (*Onobrychis sativa*) and bitter vetch (*V. ervillia*). Hungarian vetch (*V. pannonica*), silage maze (*Zea mays*), sorghum (*Sorghum bicolor*) and fodder beet (*Beta vulgaris rapa*), fenugreek (*Trigonella foenum-graecum*) and grass pea (*Lathyrus sativus*) are grown to a limited extent.

Vetches

Common Vetch: The common vetch is the largest cultivated annual forage crop in Turkey. In almost all parts of Turkey common vetch can be grown, but in general it is grown for hay in coastal areas as autumn sown forage, whereas in hinterlands such as Central and Eastern Anatolia it is produced for seed and straw as spring grown forage. Fırıncıoğlu et al. (1996) reported that in the Central Anatolian region three years average seed and straw yields of common vetch were 770 kg/ha and the 1,270 kg/ha respectively. In the coastal areas or irrigated lands, 5.0-7.5 tons/ha of the dried herbage can be produced (Çakmakçı et al. 1987, Gökkuş et al. 1996, Konak et al. 1997). The sown area, seed and dried herbage production of common vetch have increased from 212,000 ha, 162,000 tons and 301,990 tons in 1985 to 320,000 ha, 120,000 tons and 410,000 tons in 2004, respectively (Table 8).

Bitter vetch: Though it used to be widely grown in Anatolia for the feeding of oxen, gradual removal of draft animals from agriculture activities and difficulties in harvesting have helped to diminish the area grown. Today, the production area is limited to few provinces, its sown area dramatically decreased from 18,000 ha in 1985 to 3,200 in 2004. Three year average seed and straw yields of bitter vetch were 800 and 1010 kg/ha respectively in Central Anatolia (Fırıncıoğlu et al., 1997).

Hungarian vetch: Hungarian vetch is the most cold tolerant among annual forage legumes grown in Turkey. In recent years, its cultivation area has been extended in both inlands and transition zones. It can be grown in a mixture with barley for hay production, which can produce up to 3-4 tons/ha of dried herbage in rainfed areas.

Table 8. The sown area (ha) grain production (ton) of some chief annual feed legumes in the last 20 years (SIS, 2005)

	Common (cow) vetches		Bitter (wild) vetches		Fenugreek		Grass pea	
	Area sown (Hectare)	Production (Tons)	Area sown (Hectare)	Production (Tons)	Area sown (Hectare)	Production (Tons)	Area sown (Hectare)	Production (Tons)
1985	212,000	169,000	18,000	19,000	3,357	4,240	5,602	5 352
1990	259,000	175,000	11,000	11,000	846	1,031	1,698	1,862
1995	270,000	160,000	9,200	7,300	1,241	1,567	1,515	1,735
2000	225,300	134,000	3,550	3,600	700	670	877	1,037
2001	240,000	127,000	2,900	3,000	425	400	600	700
2002	234,227	129,124	2,850	3,000	1,500	1,900	2,373	2,876
2003	250,000	121,000	3,000	2300	2,000	2,100	3,500	3,750
2004	320,000	130,000	3,200	2,500	850	1,000	4,50	4,500

Alfalfa:
Alfalfa is generally distinguished as "*the queen of forage crops*" in written literature, but Elçi (2005) further upholds it to "*Empress of Forage Crops*" in Turkey. Actually, alfalfa named *Yonca* in Turkish is considered by many authors as the most important forage crop in Turkey. Alfalfa, depending on the climatic conditions, is usually sown in two different seasons as late summer and spring plantings. In general, in cold inlands of Central and Eastern Anatolia, it is planted in spring, but late summer sowing is also possible if irrigated to get established adequately and hardened before winter, whereas in the coastal areas planting season is more suited to autumn. In a growing season, the numbers of herbage cuttings in alfalfa stands are 2-4 in Eastern, 4-5 Central, 5-7 Aegean, 7-10 in Mediterranean and South-eastern regions. The cultivated area and herbage production of alfalfa have increased substantially from 137,439 ha and 1,848,825 tons of green and 1,105,819 tons of dried herbage in 1990 to 320,000 ha, 2,300,000 tons of green and 2,000,000 tons of dried herbage in 2004 respectively (Table 9).

Sainfoin:
Sainfoin is usually cultivated in Central Anatolia, transition zones and Eastern Anatolian Regions. Sainfoin with its high cold and drought tolerance can grow well in soils with high lime content and low water holding capacity, on which others can not prevail. Under the rainfed conditions its stand can only be cut once per year. The 10 tons/ha of green foliage or 2.5 to 5 tons/ha of dried hay can be produced if the sainfoin stand is timely mown (Balabanlı, 1999; Serin and Gökkuş, 1997). In dry farming areas, the life span of sainfoin stand is quite short and it only lasts the 3 years, due to the larva of the two insects; *Sphenoptera carcieli*, *Dipsosphecia scopigera* that infest the crown and cause serious root damage. The cultivation area of sainfoin has merely risen from 95,759 ha in 1990 to 107,000 ha in 2004 (Table. 9).

Table 9. The sown area (ha) and production (ton) of alfalfa and sainfoin in the last 15 years (SIS, 2005)

	Alfalfa					Sainfoin				
	Area (Ha)		Production (Tons)			Area (Ha)		Production (Tons)		
	Sown	Harvested	Grain	Green	Dried	Sown	Harvested	Grain	Green	Dried
1990	197,439	197,008	1,292	1,848,825	1,105,819	95,759	95,609	2,449	318,047	293,826
1995	214,010	212,283	953	1,803,190	1,399,341	88,953	87,816	2,349	271,909	316,391
2000	250,800	249,654	1,900	1,807,000	1,540,000	107,500	106,594	1,938	200,000	330,000
2001	249,000	246,712	1,910	1,830,000	1,563,000	105,500	103,869	1,925	203,000	334,000
2002	260,000	246,465	2,300	1,900,000	1,700,000	99,000	97,943	2,500	204,000	350,000
2003	290,000	287,232	3,200	2,100,000	1,800,000	108,000	107,666	2,000	220,000	360,000
2004	320,000	318,590	3,500	2,300,000	2,000,000	107,000	106,880	2,000	270,000	330,000

Grass pea:
The production area of grass pea (*Mürdümük*) is limited to a few provinces. Since it is not cold resistant, in dry inland areas it is planted in spring and usually grown for its seed and straw yield. The cultivated area of grass pea has been very inconsistent in the last 15 years, varying widely from 600 ha in 2001 to 4,500 ha in 2005 (Table 8).

Fenugreek
Fenugreek named as *Çemen* in Turkish is an ancient crop and native to the Mediterranean region. To a limited extent, its grain and hay is used for animal feeding, and its sown area is restricted to a few thousand hectares, varying from 3,357 ha in 1990 to 425 ha in 2003 (Table 8). The dried herbage yield ranged from 1,500 kg/ha to 3,000 kg/ha (Açıkgöz, 2001).

Table 10. The fodder production (ton) of maize, common and bitter vetches and fodder beets (SIS, 2005).

	Maize	Common (Cow) vetches		Bitter (Wild) vetches Tons		Fodder beet	
	Silage	Green	Dried	Green	Dried	Area sown (Ha)	Production (Tons)
1990	229,161	294,460	301,990	-	2,021	1,550	70,000
1995	551,000	390,658	350,232	1,493	2,038	2,300	110,000
2000	700,000	395,000	261,000	360	800	3,100	140,000
2001	710,000	420,000	310,000	255	1,000	3,150	150,000
2002	740,000	450,000	368,000	950	1,050	3,300	160,000
2003	650,000	455,000	370,000	1,400	1,000	3,400	160,000
2004	600,000	540,000	410,000	3,600	1,550	3,390	160,000

Silage Maize:

In Turkey, the maize is mainly grown for grain production; however the area of silage maize has steadily increased over the last ten years. In silage making, maize has become a favorite crop in all regions. In Black Sea Region the maize stand planted after barley harvest as a second crop produced 6-8 tons/ha dry-matter yield, or 25-30 tons/ha green foliage (Acar and Tosun, 1988). In Central Anatolia as a second crop after barley harvest, 20-50 tons/ha of green maize should be considered an average yield (Açıkgöz, 2001). The maize silage production substantially accelerated from 229,162 tons in 1990 to 600,000 tons in 2004 (Table 10.).

6. OPPORTUNITIES FOR IMPROVEMENT OF PASTURE RESOURCES

6.1. Adjustment of range legislation

In 1998, the new Range Law Number 4342 was ratified in the National Assembly. Within the framework of this act- to enforce the range law and to improve range conditions -a range fund was established. The utilization rights of rangelands (*Mera*), summer-hill pastures (*Yaylak*) and winter-pastures (*Kışlak*) belong to the local village(s) and municipality(s). But, these lands are in public ownership and under the authority and possession of the government. At present, for the enforcement of the Range Act the sub-structural and administrative systems have been established.

The purposes of the Range Act can be summarized as follows; *(1)* the allotment of range areas, *(2)* the exploitation of pastures in compliance with rules and regulations, *(3)* improvement of pasture condition and sustainable use, *(4)* supervision of usage and protection, *(5)* if necessary, amending of its exploitation type to tourism, mining, industrial production or other purposes. According to the Agriculture Production Development General Directorate (APDGD)'s records in 2005 between 1998 and 2004, the determination and delineation of pasturelands has been accomplished for 15,579 villages covering 5 million ha and in 6,500 municipalities, totaling to 2.9 million ha, respectively (Personal Communication with Ms. Emine İncediken). The village leader (*Muhtar*) or mayor (*Belediye Başkanı*) is responsible for the protection and appropriate usage of public pastures in their respective administrative units. With the purpose of supervising all management practices, the Pasture Management Body is set up in each entity (village or municipality). This unit is formed by electing a five member board among the livestock growers dwelling in the vicinity of the village or municipality area. So far, a total of the 706 Pasture Management Bodies have been established in 95 districts of 40 provinces (Personal Communication with Ms.Emine İncediken).

6.2. Developmental Projects

6.2.1. National Rangeland Restoration Project:

The Agricultural Production Development General Director (APDGD) and Agricultural Research General Directorate (ARGD), Universities and the Provincial Agriculture Directorates have collaboratively conducted the range rehabilitation project. This is the most ambition project of its kind in Turkish history in terms of people and areas involved. In 2004 and 2005, the restoration projects were initiated in a total of 158,800 ha of pasturelands all over the country. A village is considered a unit with its pastureland, livestock inventory and crop production. First, range condition classes are determined and accordingly a restoration project is planned. To balance livestock inventory and feed production the forage crop production is encouraged by providing forage seeds such as alfalfa, vetches and sainfoin, and silage maize. In general, deferment of grazing is recommended, i.e., while half of the pasture area is rested during spring the other half is grazed and in autumn vise-versa.

6.2.2 National Pasture and Forage Crop Production Development Project:

In both the Eight and Ninth Five-year Development Programs of the State Planning Organization forage cultivation area has been targeted, aiming at increasing forage production and some projects have been implemented. This project was first initiated in a total of 18 provinces. In 1996, it was promoted to the National level and it was subsequently extended in a second term from 2000 to 2005 and further in a third term from 2006 to 2010. Up to present, 116,898 ha area of range rehabilitation and planted pastures have been realized, 293,598 ha of forage cultivated, and as a result 13,356,821 tons of silage have been produced. With the aim of expanding use of agricultural machinery, a total of the 410 agricultural implements were purchased and delivered to the Provincial Directories (Personal Communication with Mr. Musa Kozan). Short training courses were organized on the subjects of silage making, range management and forage crop agronomy.

6.3. The subsidization of forage crop production

With the aim of eradicating feed shortages, forage crop cultivations have been subsidized since 2000. The Livestock Subsidization Decree Number-2000/467 was issued by the Council of Ministers in 2000. According to this by-law, a given portion of capital and production expenses for forage crop production was disbursed to the growers. Forage crops such as alfalfa, sainfoin, common and Hungarian vetches, silage maize, sorghum, feed beet, feed turnip, triticale -- as pure stands or in mixtures – were included in the subsidy program. For the establishment year for perennial species, excluding the costs of freight, fertilizer and chemical, 35 percent of the capital and operational expenses, and 30 percent of agricultural machinery that is well-suited to the planted areas are provided to the farmers. For annual forage crops, 20 percent of operational expenses and machinery well-matched to the sown area are subsidized. The number of projects, sown area and funds disbursed in the subsidy program conducted between 2000 and 2004 are given in Table 11. The cultivated area and disbursements have substantially from 53,855 ha and 2.4 million YTL (1.6 mil. USA $) in 2000 to the 362,641 ha and 73.5 million YTL (49 Mil USA $) in 2004 (Table 11) (Personal Communication with Mr. Musa Kozan).

Table 11. Table. Number of projects, sown area and disbursed in the subsidizing program between 2000 and 2004 (source: APDGO records)

Years	Number of the projects	Sown area (Ha)	Funding (Million YTL)
2000	10,741	53,855	2.4
2001	28,769	127,513	17.4
2002	51,383	215,854	35.6
2003	67,034	269,875	62.3
2004	143,033	361,641	73.5
Total	300,960	1,028,738	191.2

6.4. Potentiality of the roughage production enhancement

Despite an expansion in forage crop cultivation, the natural pastures are still the main feed resources in Turkey. Principally, the rehabilitation of these grazing resources is first designed to foster roughage production, and the introduction of forage species into crop rotations is to ameliorate feed resources. However, with the large livestock inventory and a wide reliability of natural pasture production makes range rehabilitation almost impractical. Therefore, improving forage cultivation in cropping systems is very crucial.

According to research results, the expansion of forage production area without any decline in the area of the main crops such as cereals, industrial crops and oil seeds can be achieved in crop rotations. The perennial crops such as alfalfa and sainfoin are suitable for long-term rotations, while annual forages such as vetches and field pea are well-matched to short-term rotations. Research studies indicate that common vetch (*Vicia sativa*), Hungarian vetch (*V. pannonica*), hairy vetch (*V. villosa*), narbon vetch (*V. narbonensis*), and field pea (*Pisum sativum*) can be grown as pure stands or in a mixture with cereals such as barley, oats, rye and triticale. The planted mixtures can be harvested for hay or used for grazing. Use of forages in two areas will now be discussed.

a) Rainfed Areas (inland regions).

In dry-land farming systems, the cereal-fallow cropping pattern is widely practiced. In the first year wheat, barley or oats are grown and harvested for grain, and in the following year the field is left empty as fallow. In place of fallow, in Central Anatolia Hungarian vetch is grown as a winter crop, whereas common vetch as a summer crop, and also in mixtures with cereals they can produce a good quality hay. In Ankara, in a six year-long experiment designed to study fallow replacement, the annual forage legume as a pure stand or in mixture with cereal did significantly decrease yields of the subsequent wheat crop (Kurt and Tan, 1984). Similarly, various experiments conducted in the Ankara and Çorum Provinces of the Central Anatolian Region revealed that annual forage legumes can be successfully grown alone or in mixtures with a companion cereal crop (Tan, 1984a; Tan, 1984b). In Eskişehir Province, annual forage legumes, when grown for herbage, did not cause any yield losses of the following wheat, whereas for seed production it cause some losses in subsequent cereal grain yields, which was explained by the lower accumulation of nitrogen in the soil and reduced amounts of water in the soil profile (Gerek, 1987; Kalaycı, 1981).

b) Humid and sub-humid areas (coastal regions)

Studies revealed that beneficial effects of forages in rotations have been unarguably proven in wet areas or under irrigation. In coastal areas the forages can be well-matched to rotations as a second crop in (a) winter from November to April and (b) summer from May to October. In the humid-coastal areas, the main crops for winter and summer growing are wheat, barley, oats and rye, and maize, sunflower, tobacco, soybean, sugar beet, cotton and potato, respectively. If the cereals are grown as the main winter crop, then after their harvest, silage maize or sorghum for hay can be grown during summer. In the Black Sea Region after winter-barley harvest the silage maize produces 6,850 kg/ha dry-matter yield (Acar and Tosun, 1988). In a traditional cotton-cotton rotation the field is empty for a period of five to six months from November to April; so during that period of time short-lived annual forage crops can be grown. In Adana Province of Southern Turkey, the introduction of various forage species into rotations affected the subsequent cotton yield in a positive way (Aydemir, 1982).

The irrigated and well watered rainfed areas cover approximately 14 million ha. Sixty percent and 40 percent of these areas are allocated to winter and the summer cropping respectively; hence 5.6 million ha of land is readily available for the planting of annual forage legumes alone or in mixtures with cereals in winter (Tosun, 1996).

In the Çukurova Basin, as a winter-crop from November to March, common vetch and field pea in mixture with cereals (especially with triticale) can be grown for hay production, and as a summer-crop silage maize or sorghum can be grown in mixture with kidney bean (Personal Communication with Dr. Celal Yücal).

In the Aegean Region, the cropping pattern is cotton-cotton or wheat-cotton; the winter crop can be pure vetch or vetch in a mixture with a companion cereal, which produces 5-7 tons/ha dry-matter yield. If silage maize is grown as a summer crop, after its harvest Persian clover (*Trifolium resupinatum*) or annual ryegrass are recommended as winter crops (Personal Communication with Dr. Hüseyin Özpınar).

7.CONCLUSION

An affirmative effect on forage production has clearly been evident as a consequence of the implementation of the subsidiary incentives over the last six years. And, the forage cultivation has significantly enlarged. Currently, there is a huge demand for forage seed, and the seed imports of alfalfa, vetch and sainfoin have sharply increased in the last two years. And, I believe, that unless government policies change, the forage crop growing area will continue to expand in near future. In addition there are always interactions between the livestock sector and forage cultivation, so as a matter of fact, the genuine determinant in forage production is its reliance on the demand from livestock sector.

Pasture restoration and its sustainable use are more social and environmental issues rather than economic and technical ones. The release of overgrazing pressure on communally used village pastures has always been problematic because of the excessive number of livestock on the pasture land. However, the conclusive results from the range rehabilitation attempts could be expected in the areas where grazing is controllable, fostering to the proper management.

As a conclusion, although Turkey has a great potential for forage and pasture production, it has not reached the desired level yet.

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REFERENCES

Acar, Z., F. Tosun. 1988. Comparisons of the herbage productions of the four silage maize cultivars sown in the four different row spacing, planted after winter cereal (barley), OMU, Agriculture Faculty, Agriculture Journal, 3(2): 121-128.

Açıkgöz, E. 2001 Forage Crops, Uludağ University, Agriculture Faculty, Department of Field Crops, Reinforcement Foundation Publication Number: 58, Bursa.

Akman, N., M. Ertuğrul, M. Türkoğlu. 2001. In the Centenary of Republic Livestock Sector of Turkey. IN: The Proceedings of the Centenary of Republic Symposium on the Agricultural Targets. 30 April to 01 May 2001. A publication of the Turkish Agriculture Engineers Union, p. 215-235)

Alınoğlu, N. 1971. A research on the effects of the continuous grazing and the incrementally resting on the range vegetation, Grassland and Animal Husbandry Research Institute, Ankara, Publication No: 16.

Alpay, O. 1970. The planted pasture investigations in the vicinity of Çamkoru and Aladağ areas. Forestry Research Institute, Technical Bulletin, Serial number: 43.

Altın, M. 1975. An investigation on the effects of nitrogen, phosphorous and potassium fertilization on the herbage yield, the crude protein and ash contents of herbage and botanical compositions in the meadows and native pastures under the Erzurum conditions. Atatürk University Publication No: 326, Agricultural Faculty Publication No: 159, Research Serial Number: 95-141.

Altın, M., A. Gökkuş, A. Koç. 2005. Meadow and Rangeland Rehabilitation. The Ministry of Agriculture and Rural Affairs. The department of The Meadow-Rangeland and Forage Crops, Publication ISBN 975-407-188-8.

Anonymous 1980. "Soil-water Statistical Bulletin" The General Directorate of Soil-Water, Ankara

Anonymous, 1987. General Soil Management Planning of Turkey, The Soil Protection Master Plan, the Ministry of Agriculture Forestry and Rural Affairs, The General Directorate of Rural Affairs, the Department of Watershed Rehabilitation and Ponds, Ankara.

Anonymous, 2004a. Amendments and Developments in the Agricultural Structure. IN: The Proceedings of the second Agriculture Convention, p. 71-134.

Anonymous, 2004b. Plant Husbandry Plant Protection and Environmental Health. IN: the Proceedings of the second Agriculture Convention, p.135-198.

Anonymous 2004 d. Agricultural input and Subsidies. IN: The Proceedings of the second Agriculture Convention, p. 365-424.

Anonymous, 2004c. Livestock, Marine Product Husbandry and Health. IN: The Proceedings of the second Agriculture Convention, p. 199-281.

Avcıoğlu, R. 1986. The properties and examinations of the plant communities of the meadow and rangelands. Aegean University, Agricultural Faculty, Publication Number: 466, İzmir.

Aydemir, M. 1982. Breeding, husbandry techniques and fibrous properties of the cotton. The Ministry of Agriculture and Forestry. Nazilli Cotton Research Institute, Publication number: 33.

Bakır, Ö. 1971. Range Management in Turkey. IN: The proceedings of the development of feed resources and improvement of animal feeding methods in the CENTO region countries. p:69-78.

Bakır Ö. 1985. Meadow-Rangeland Rehabilitation: Principals and Applications. Ankara University. Agriculture Faculty. Publication: 947, Text Book: 272, p.226 Ankara.

Bakır Ö.1987**.** Meadow-Rangeland Management Ankara University. Agriculture Faculty. Publication: 992, Ankara.

Balabanlı, C. 1999. The effects of phosphor dose applications and the mowing at different maturity stages on some agronomic traits of the sainfoin (*Onobrychis sativa* L.) grown under the Isparta ecological conditions. SÜ, Journal of Agriculture Faculty, 13: 86-94.

Büyükburç, U. 1983a. The Characteristics and Restoration Possibilities of the Central Anatolian Rangelands. Grassland and Animal Research Institute, Publication Number: 80, Ankara.

Büyükburç, U. 1983b. An investigation on the rehabilitation possibilities of Yavrucak village rangelands of Ankara through fertilization and resting applications. Grassland and Animal Research Institute, Publication Number: 79, Ankara.

Çakmakçı, S. and E. Açıkgöz. 1987. The effects of planting date, row spacing and mowing periods on the herbage yield and quality of the common vetch (*Vicia sativa*). The Scientific and Technological Research Council of Turkey, Nature 1: p. 179-185.

Elçi, Ş. 2005. Grass and Legume Forage Crops. The Ministry of Agriculture and Rural Affairs. The General Directorate of Agricultural Production, Publication: ISBN 975-407-189-6, Ankara.

Fırıncıoğlu, H.K., D. Uncuer, S. Ünal, F. Aydın. 1996. An investigation on the agronomic traits of some vetch (*Vicia* sp.) and grass pea species (*Lathyrus* sp.). IN: The Proceedings of Turkey third National Pasture and Forage Crops Congress. 17-19 June 1996, p. 685-691, Erzurum.

Fırıncıoğlu, H.K., S. Christiansen, E.J. Lamont, S. Ünal, M. Peşkircioğlu and S.P.S. Beniwal. 1997. Village, Farm, and Pasture Resources Assessment in Planning a forage, livestock and range improvement project for the Central Highlands of Turkey. in the proceedings of Regional Symposium on Integrated Crop-Livestock Systems in the Dry areas of West Asia and North Africa, 6-8 November, 1995, Amman, Jordan. Editors: Nasri Haddat, Richard Tutwiler and Euan Thomson, ICARDA, Aleppo, Syria.

Fırıncıoğlu, H.K., 2005. Agricultural Research Master Plan Revision; Meadow-rangeland and forage crops. The data evaluation reports and matrices for Research Opportunity Areas (ROA). The Ministry of Agriculture and Rural Affairs. The General Directorate of Agricultural Research Publication, p.183-190, Ankara.

Gençkan, M.S. 1970. Investigations on the legume vegetation in the native pastures of the coastal strip area of Aegean Region. Aegean University, Agriculture University, Publication Number: 467, İzmir.

Gerek, R., 1987. In the fallow agricultural system of the Central Anatolia, the possibilities of the removal or decrease of the fallow ratio. IN: The proceedings of Turkey Cereal Symposium, p. 9-15.

Gökkuş, A., A. Koç. 2001. Range and Meadow Management. Atatürk University, Agriculture Faculty, Text Book Publication Number: 228, Atatürk University Agriculture Faculty, Erzurum.

Gökkuş, A., A. Bakoğlu, A. Koç 1996.A research on the adaptation of some common vetch (*Vicia sativa*) lines and cultivars under the irrigated conditions of Erzurum. IN: The Proceedings of Turkey the third National Pasture and Forage Crops Congress. 17-19 June 1996, p. 674-678, Erzurum.

Gökkuş, 1987. An investigation on the effects of the different rehabilitation methods and over-sowing on the dry-matter yield, crude protein and botanical composition of the rangelands. Journal of the Turkish Agriculture and Forestry; Nature, 11: 348-361.

Kalaycı, M., 1981. The fallow reduction studies conducted hitherto by the Eskişehir Agricultural Research Institute. In The Proceedings of the Symposium on the utilization of the fallow lands in the rainfed areas. The Scientific and Technological Research Council of Turkey, TOAG, Serial number: 119, p. 195-2006.

Keskin, S. 2001. Head of Data Collection and Analysis Department of Soil & Water Resources National Information Centre, General Directorate of Rural Services last updated: 28 June 2001. http://www.fao.org/ag/agl/swlwpnr/reports/y_nr/z_tr/tr.htm

Kılıç, A. 2001. Roughages and concentrate feedstuffs, IN: The Proceedings of The Symposium on Targets of the Agriculture in the Centenary of Republic, p. 236-245., Ankara.

Konak, C., A.E. Çelen, İ. Turgut and R. Yılmaz 1997. The studies on the herbage yield and some other characteristics of the vetch sown as a pure stand and in a mixture with barley, oat and triticale. IN: the Proceedings of The Second Field Crop Congress, 22-25 September 1997, Samsun, p. 446-449.

Kurt, Ö., A. Tan. 1984. The studies on the feed production from the fallow lands through autumn and late-autumn planting under rainfed conditions. Grassland and Animal Husbandry Research Institute, publication number: 93, Ankara.

Munzur, M., 1989. Fodder Development and Rangeland Rehabilitation and Improvement. General Number : 3, the Central Research Institute for The Field Crops, Ankara

Ögel, B. 1991. Introduction to the Turkish Cultural History. Volume:1, The Ministry of Culture Publication number: 638, Culture Work Series: 46, p. 495. Ankara.

Polat, ,T., Şılbır, Y., Baytekin, H., Okant, M., 1996. An investigation on the effects of the different restoration techniques on the yield potentials of the Tektek mountains in the Şanlıurfa province. IN: The Proceedings of Turkey third National Pasture and Forage Crops Congress. 17-19 June 1996, p. Erzurum.

Serin, Y., A. Gökkuş. 1997. The effects of the sowing rate, row spacing and phosphorous fertilization on herbage and crude protein yields and crude protein ratios of sainfoin. IN: The Proceedings of Turkey II. Field Crops Congress, 22-25 September, 1997, Samsun, p. 416-420.

SIS. 1991. General Census. State Statistic Institute, Ankara

SIS 1998. Statistical Yearbook of State Statistic Institute, Ankara

SIS 2000. General Census. State Statistic Institute, Ankara

SIS 2005. Summary of agricultural statistics. State Statistic Institute, Ankara

SIS, 2001. General Agriculture Census. State Statistic Institute, Ankara.

Tan, A. 1984a. Hay production of the barley and annual legume mixtures through the autumn planting method under the rainfed conditions of Ankara. Grassland and Animal Husbandry Research Institute, Publication Number: 88, Ankara.

Tan, A. 1984b. Hay production through the autumn and summer crop rotation from the intercropped legume mixtures in the fallow-wheat rotation under the rainfed conditions of Çorum. Grassland and Animal Husbandry Research Institute, Publication no: 91, Ankara.

Tosun F., İ. Manga, A. Altın, Y. Serin. 1977. A study of the improvement of dry-land ranges developed under the ecological conditions of Erzurum (Eastern Anatolia). IN: The Proceedings of XIII. International Grassland Congress, 18-27 May 1977, Leipzig, p.607-611.

Tosun, F. and M. Altın 1981. A crop rotation experiment under the rainfed conditions of Erzurum. IN: The Proceedings of The Symposium on the utilization of the fallow lands in the rainfed agricultural areas, 28-30 September, 1981, Ankara.

Tosun, F. 1996. In the roughage production the past, present and future of the pasture and forage cultivation in Turkey. IN: The Proceedings of Turkey III. Pasture and Forage Congress, 17-19 June, 1996, Erzurum.

Turan, O., 1965. Seljuk History and Turk-Islam Civilization. Turk Culture Research Institute, publication no: 7, Seri: III, Number: A, l, 265-277, Ankara

Tükel T. 1988. Meadow-Rangeland Rehabilitation, Çukurova University, Agriculture Faculty, and General Publication Number: 191, Text Book Publication Number: A-59, p.152., Adana