Land Utilization in the Transitional Zone between Central and Northern Anatolia in Bolu District

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Bolu and its immediate surroundings, which constitute our study area, is located at the western part of the Black Sea region. This study area extends over part of the western fringes of the Ilgaz Bolu Mountains and the summit of the Mt. Köroğlu, also comprising longitudinal valleys of the Gerede and Bolu creeks in between and include such depressions as Bolu, Çağa, and Gerede. This is a transition area between more arid Central Anatolia and humid Black Sea regions. Thus higher terrain and the northern parts are humid whereas depressions and the southern parts are relatively dry. Although the higher parts of this region has undergone a high degree of forest destruction especially during the present century, it still has an important forest cover. Transportation routes have developed only in directions corresponding to some definite axes. The most important road is the E-5 highway that links Ankara to İstanbul, which enters the study area from the Adapazarı direction at the west, and passes through Düzce—Bolu—Yeniçağa—Gerede. Side roads that depart from Yeniçağa and Gerede link Zonguldak, Bartın and Karabük, Kastamonu to this highway. The main city in this district is Bolu. This city, at 700m, is located within a plain which carries some steppic characteristics and is surrounded by forests and it is the provincial center also. Although the town has a long historical past, its population growth has been slow, now reaching only 38, 300.

Smaller towns located in the interior parts have been unable to develop due to the absence of wider plains. Among them the most developed towns are the ones situated at the sides of the secondary roads linking İstanbul to Ankara. Mudurnu (5,600), Göynük (3,800), and Gerede (9,600) are such settlements also serving as small administrative centers.

District is located on a very important and still active tectonic line that traverses whole of the Northern Anatolia. In fact, tectonic activities have played a major part in formation of present drainage pattern. Although waters of the basin are drained by the southwest-northeast directed Bolusuyu creek to the Black Sea at the west, Çağa creek, outlet of the Çağa lake, and Gerede creek drains waters at the west.

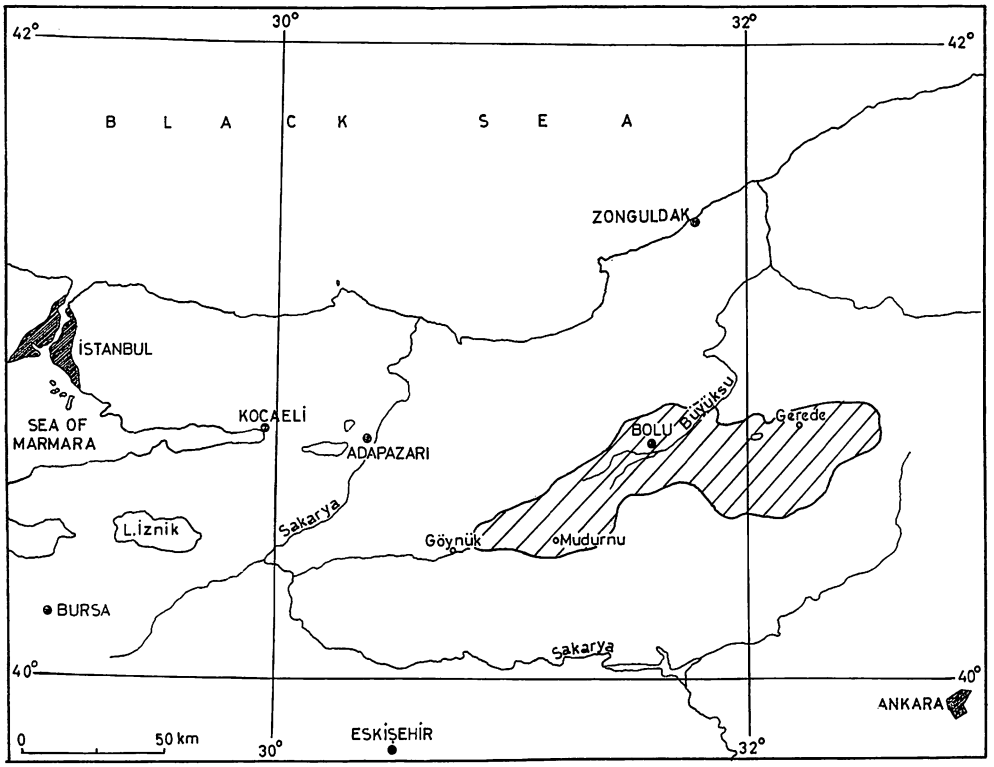

Fig. 1 Location of the study area.

The study area could be divided into two units which differ from each other in landforms and geographical features. These two units are lowlands and the higher lands including the slopes. The lowlands located almost at the center of the district are composed of the Göynük, Mudurnu, and Bolu plains at the western section, and the Çağa lake and its surrounding parts at the eastern section. Almost flat lands around Gerede are actually high plateau surfaces. Old and recent alluvial deposits are common on the plain floor. Lower parts of the surrounding highland slopes are made of flysches and limestones, whereas the higher parts at the back are composed of volcanic rocks. The higher parts encircling the basin are generally covered with older formations. Limestone and flysch series that begin from the western and northern parts of the Bolu basin continue up to Gerede at the northeast of Çağa. Differences in the vegetation cover on volcanic formations and limestone—flysch series are clearly discernable. Although deciduous types are dominant on flysches and limestones, coniferous species are more common on volcanic rocks.

From climatological viewpoint, the study area is under the influence of the more continental Central Anatolian climate from its south and more humid Western Black Sea climate from its north due to its location. However, its climatological features clearly differ

from its neighbouring areas because of elevation, relief features and distance to the sea.

Due to their orographic features, marine influences from the north and continental influences from the Central Anatolia can not penetrate easily to this basin surrounded by high mountainous masses. For this reason, according to the records of the Bolu Meteorological Station located just at the middle of the basin, average annual temperature of Bolu (10.2°C) is lower than the temperatures recorded at the Black Sea coast (Zonguldak 13.5°C) and Central Anatolia (Ankara 11.8°C, and Konya 11.5°C).

Bolu's temperature being lower than Zonguldak's could be attributed to the elevation differences that exist in between these two places. However, when compared with Central Anatolian stations, lower average temperatures of Bolu can not be explained only by elevational differences. In fact, Ankara and Konya, both are at higher elevations than Bolu. In our opinion, this temperature difference is due to Bolu's location within a basin. As a result of its topographical features, Bolu gets less warmer than Konya and Ankara during the summer season and probably this lower summer temperatures affect annual averages, lowering it too. As a matter of fact, although average summer temperatures can not reach up to 20°C at Bolu, it reaches 23–24°C at Ankara and Konya. On the other hand, there are almost no differences between Ankara, Konya and Bolu in regards to winter temperatures (coldest month being January in all of them; average values for January are 0.0°C in Bolu, −0.1°C in Ankara, and −0.2°C in Konya). It is obvious that lower temperature values of Bolu are associated with summer temperatures more than winter temperatures. This is due to Bolu's slightly higher humidity rates and lesser continentality degree in comparison with the other two.

Lowlands and surrounding higher lands also differ both in precipitation amounts and regimes. Although coastal areas at the north receive ample amount of precipitation in all seasons with maximums at winters and minimums towards the end of spring and beginning of summer; within the Bolu basin the rainiest season is winter (distribution of precipitation in the basin is as follows: winter: 32.17%; spring: 28.38%; autumn: 21.0%, and summer: 18.31% of the total). This does not conform with the continental character of the Central Anatolia at the south and the Kastamonu district at the east of the basin. In fact, precipitation maximum at Kastamonu is towards the end of spring and beginning of summer, and minimum in winter (percentage of summer and winter precipitation rates are 26.5% and 18.5% respectively). Whereas in Central Anatolia spring is with the most and summer with the least precipitation.

According to thirty-year average figures of the Bolu meteorological station, annual precipitation amount is 529.5mm. Its seasonal distribution is as follows: winter 32.17% (168.2mm), spring 28.98% (150.7mm), autumn 21.12% (113.6mm), and summer 18.33% (96.6mm). The month with the most precipitation is January with 57.7mm. August, with 18.0mm, is the month with least precipitation.

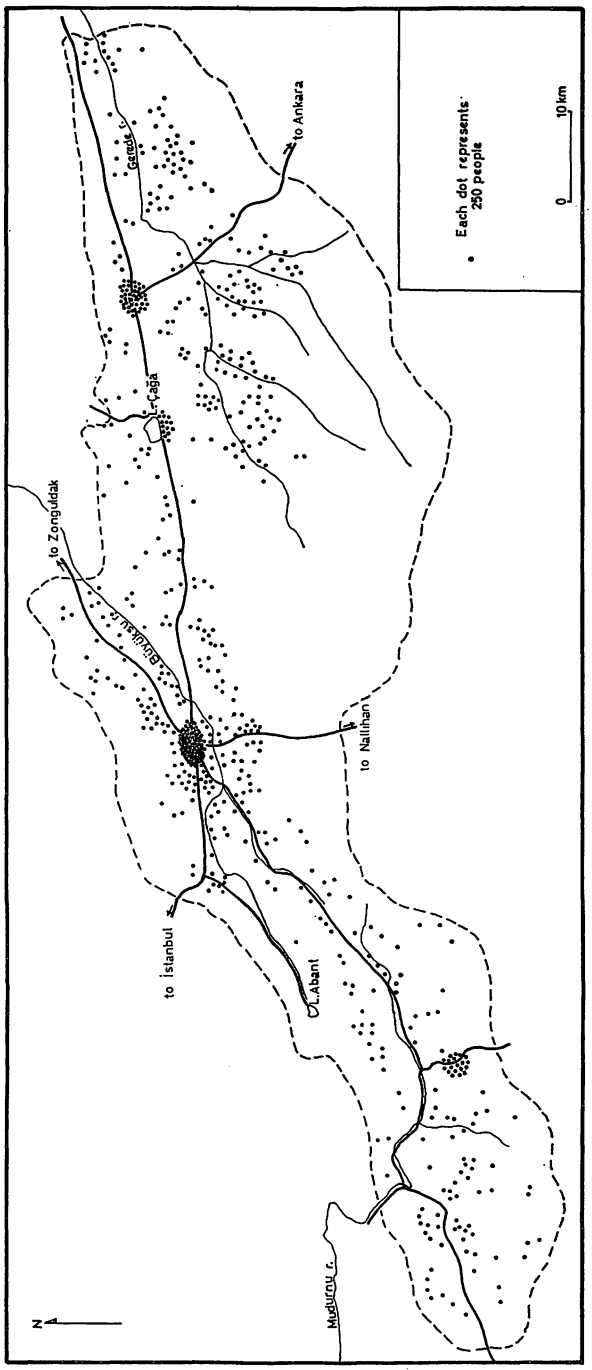

Fig. 2 Population distribution in Bolu district.

Although precipitation amounts are higher than 50mm in December, January, and February, they fall below this amount in March and April, but get higher again in May and June, which is another important feature observed in the monthly sequence of precipitation distribution which must not be overlooked. There is a precipitation deficiency in July. This deficiency occuring in July and August at the basin especially has negative effects on crops such as potatoes and sugar beet seeds. As these months are also hottest with high evapotranspiration rates within the vegetative period in the basin, negative effects are further enhanced, that is, in other words, aridity indices are lowest during these months. Thus, irrigation of potato and sugar beet crops is a must during July and August.

On the other hand, number of rainy days in the basin has a mean value of 138.4 days. To put it in another way, 37% of the year is rainy. When its monthly distribution is taken into hand, January leads with 15.6 days. February and March follows with 15.4 and 14.3 days respectively. The lowest figure belongs to August with 4.2 days. Such a situation shows clearly the need for irrigation as already indicated, of potato and sugar beet crops, which are in the field during this time of the year. Number of rainy days about different years do not deviate from the mean too much. According to our calculations, a minimum of 101 days and a maximum of 169 days occur in every ten years. However, a minimum of 74 days and a maximum of 196 days are probable over a hundred year time span.

Maximum precipitation amount recorded during observation period is 690.4mm which fell in 1951. The least annual precipitation rate is 412.0mm recorded in 1957.

On the other hand, annual mean temperatures in other lowlands in the vicinity such as Mudurnu and Göynük only differ slightly (Mudurnu 10.1°C, and Göynük 10.8°C). Annual precipitation amounts in both are higher than Bolu (Göynük 596mm, and Mudurnu 559mm).

According to de Martonne's aridity index,[1] the basin with a value of 21.0 is very near the limits of the semi-arid regions. It even falls below this limit every 2 or 3 years. However, frequency of much smaller index numbers is very low. Nevertheless, there is the possibility of falling below 10 once in 71.4 years. In general, an index value of 14.5 occurs every 10 years. Also, the area has an index value of 31.8 according to Erinç's aridity indices.[2] Thus a semi-arid character persists in precipitation effectiveness in Bolu.

The following conclusions could be drawn from an analysis of the direction and frequency of winds in the basin and its immediate surroundings. The most frequent directions are south and west. By the application of Rubinstein's formula, the dominant wind direction has been estimated as S 67.5° W with an overall frequency of 70.8%.

Westerly and southerly winds usually blow during winters and are moist, so they cause rainfall. Winds of northerly sector blow mostly during the summer season bringing a lot of moisture at the beginning of the season, thus they are of great help to the sugar beet and potato cultivation on the floor of the basin carried out with irrigation in a wide area.

After stating all these facts we can say that the dominant climatic type in our study area is, according to Thornthwaite's classification[3] "$C_1B'_1sb'_4$", that is, "dry, semi-humid, mesothermal with moderate water surplus in winter and, in a way, oceanic in character". Whereas, in Köppen's classification it is "Csck" which means, warm, temperate, wet winters with dry, hot summers, a climatic type peculiar to middle latitudes. However, a different type of climate exists in higherlands indicating to the presence of two different local climatic types in the district. These two areas of differing climates also form two different units from the points of natural vegetation, soil types, agricultural activities and settlement characteristics.

The higher parts could be differentiated from the lower lands by their lower temperatures, longer frost periods and snow cover durations and higher rainfall. If 1500 m is taken as the mean elevation of the surrounding higher lands, then annual temperatures, their monthly values, average maximums and minimums, and absolute maximums and minimums will differ considerably. Annual precipitation totals should also get higher, reaching 850 mm.

Similarly, rainfall decreases during the summer season in the higher parts. According to Thornthwaite's climatic classification "$B_2C'_1sb'_3$" type of a climate, that is, humid-microthermal, prevails in the higher lands. On the other hand, number of days with snowfall is 70 and duration of snow cover 86 days at the Aladağ forests according to the records made during 1966–67.

All of these features lead to the fact that from the point of land use, two different units as higher and lower lands exist in the study area.

Soil characteristics also differ considerably. Three types of soils exist in the basin and its surrounding areas. First of these is alluvial soils of the "azonal" group. The second, brown forest soils of the "zonal" group, and third, "intrazonal" soils. As a result of degree of inclination, alluvium that forms the azonal soils is usually found in the lower parts. Zonal and intrazonal soils cover the surrounding higher areas. Thus, floor and the surrounding higher parts of the depression differ markedly in the type of soils each possess. In this region, brown forest soils could be regarded as zonal soils. Although Oakes has included the brown forest soils within the intrazonal group in his study, their consideration within the zonal soils is more appropriate as Erinç also states.[4] Intrazonal soils mostly cover surrounding slopes where the bedrock is limestone. Alluvial material that takes place within the "azonal soils" group is so slightly inclined that it can be considered as flat surface. According to their texture these are sandy-clayey soils with sand percentage around 50. Their rate of percolation is $8.6 mhr^{-1}$. These soils are divided into two subgroups according to their organic material and carbonate content. First of these two contain 13 to 14% carbonate and is rich in organic material. They are generally found in lower levels, covering the area lying between the Büyüksu and Mudurnusuyu creeks.

Cultivation of sugar beet seeds, vegetables and fruits is done especially on these soils. The second group is found mostly on the fringes of the depression and areas around the slopes. Their organic material and carbonate contents are less than the first groug so that field type cultivation of grain is done on these soils.

Intrazonal soils constitute the second main group. They are rendzina soils found on hilly area around alluvial soils and on slightly uneven ground. Their inclination varies between 8 and 15 in a hundred. They have developed on limestone bedrock and material of flysch series. Horizons of these soils have a thickness of 25 to 40 cm and contain a lot of large, unbroken limestone particles. Their carbonate content is around 50% and have pH values around 6, 50 to 7, 50. They are poor in organic material content and have 17–18% water capacity. These soils are covered with forests composed of small trees and mixed semi-deciduous types. On land topographically suitable, grain cultivation and pastoral farming are practiced.

"Brown forest soils" constitute the zonal types in our study area. These are pedalfers. According to Erinç and Irmak's determinations, these zonal soils are found on very rough and highly inclined (25–40%) land.[5] These are shallow soils with an average depth of 15 to 30 cm. They have moderately acidic reactions with pH values varying in between 4, 6–5, 5. Generally developed under a cover of forest series composed of fir trees, these soils are very stony. Such a character permits a good drainage up to a certain depth. The organic materials are mostly concentrated on the upper zones of these soils on andesites in the southern parts, conforming with the general characteristics of the forest soils, hence, making the upper 20–30 cm layer the most suitable. Vegetation structure of the lowerlands differ from the surrounding areas. Bottom parts are used for cultivation purposes and in general outlook the land has the character of a steppe with trees and bushes. But most probably this is an anthropogene steppe. Apart from the remnants of the above mentioned forests, some grass formations are also found on the floor of the basin. Various species of Dianthus, Linum, Colchium, Agropyrum, Galium, Ergyngium, Tecicricum, Bromus, Draba gerannium form the principal elements of these grass formations.

In contrast, the higher lands around the basin support a strong and humid forest vegetation. In fact, this region that takes place within the North Anatolian forests zone is considered, as İnandık has also stated, as one of the richest and valuable forest areas of Turkey, and outstands with its beech, fir, and scotch pine trees.[6] Beech trees begin from a low altitude as 200 m, climbing to considerable heights at the North Sea coasts, especially at the northern section where they are found at altitudes in between 950 to 1600 m; however, after passing this height, fir trees replace them, taking place up to 1800 m. In fact, this altitude could be considered as the upper limit of the forests in our study area. Number of pinus nigra trees increase on south facing slopes at elevations in between 1000–1500 m, whereas, in lower levels down to 750 m, oaks and hornbeams dominate. South facing

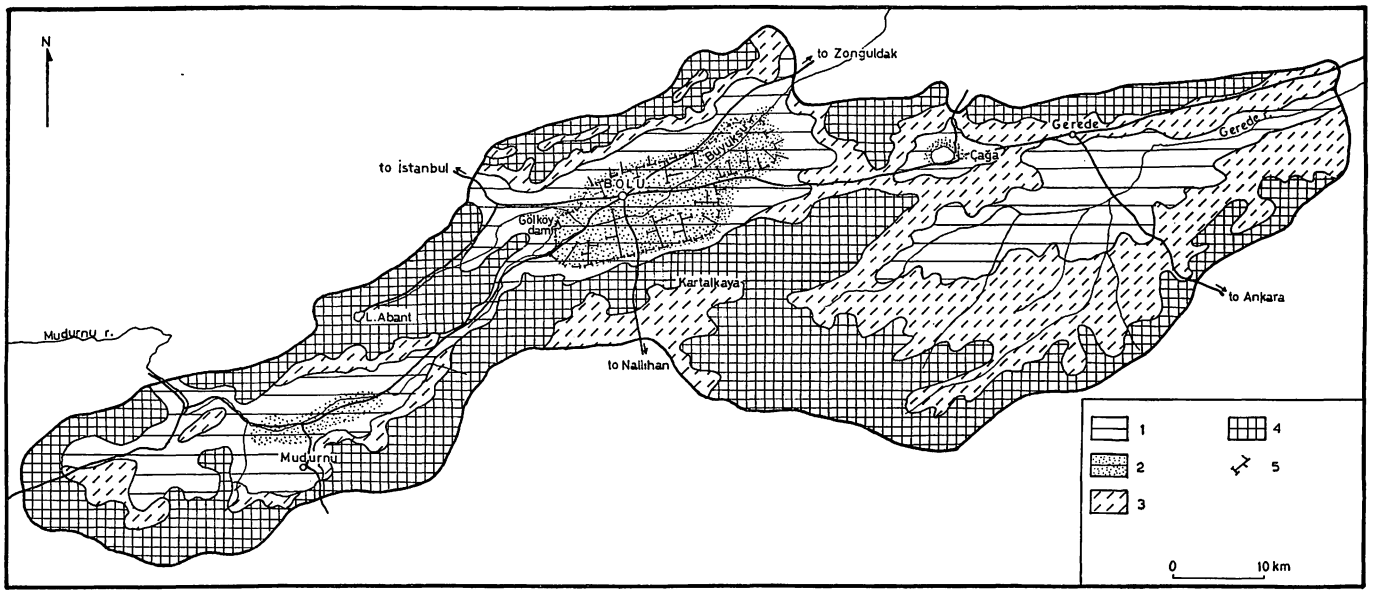

Fig. 3 Land-utilization distribution in Bolu district. (1: non irrigated agricultural areas, 2: irrigated agricultural areas, 3: pastures and meadows, 4: forests, 5: irrigation channels.)

slopes of the massifs at the south of the depression and the Aladağ plateau environs strike the eye as pinus silvestris areas.

Some periods could be differentiated when humane and economic activities and land use characteristics in the district are taken in their historical perspective. Settlement history in the district is as old as bronze age. Our initial knowledge about the district belongs to the Kingdom of Bithynia which was established in this place right after the death of the Alexander the Great. At that time and afterwards, during the Roman and Byzanthian periods, pastoral farming came foreward in this area. Animals and their products were the most important economic activity of the people living in this district. After the reign of the Seldjuk Turks in the 11th Century, during the Ottoman period the nomadic people became settled and founded many villages. According to the land ownership records arranged by the emperor Yavuz Selim, the land was divided into such units as "has", "tımar", "zeamet", "çiftlik", and "arpalık". At that time, grain became the most important crop.

As Katip Çelebi states, due to dense forest cover of the district, forestry was also present among economic activities besides agriculture and pastoral farming in this basin and its surrounding parts during the 17th Century.[7] Although some traces about land use of those past times could be detected even now, present landscape, both at the low alluvial floor and the higher land around have altered because of technological progress. Thus, there are land use differences between the floor which is almost level with slightly inclined alluvial fill, and the steeper slopes surrounding this floor, and the mountainous land at the back. As can also be seen on the land use map of the region, alluvial floor and its immediate surroundings are reserved for cultivation activities. On the other hand, the higher land surrounding the floor and lower terraces are places where field type agricultural activities fall behind forestry and pastoral farming activities. The following facts come about when a comparison is made between agricultural products of this essentially agricultural district. Grain products, with wheat leading, cover some 55% of the land under cultivation. Sugar beet seeds, sugar beet and potato cultivation areas with 30% and legumes and fodder crop with 10% come second and third. Vegetable and fruit production areas are considerably small with 5% altogether. As can also clearly be seen from these facts, crops of the district differ and are more varied than in many other parts of Turkey. However, here we must state that apart from general characteristics, the same agricultural features do not hold true for whole of the district. In fact, due to differing agricultural practices, physical conditions (soil, exposure, inclination, drainage), and socio-economic conditions, some smaller units with a variety of crops could be discriminated. For example, in the Bolu plain, especially around the Büyüksu channel, the land used for cultivation of sugar beet seeds and potatoes is much larger than the land used for grain and legumes. This is especially associated with soil conditions. Clayey, wet and less porous soils of this area, especially near Büyüksu

Table 1 Crop production and areal distribution in Bolu district

CROPS	BOLU "Central"		GEREDE		GÖYNÜK		MUDURNU	
	Area Cultivated (Hectar)	Production (Ton)	Area Cultivated (Hectar)	Production (Ton)	Area Cultivated (Hectar)	Production (Ton)	Area Cultivated (Hectar)	Production (Ton)
Wheat	16,500	44,375	28,200	55,000	17,000	30,600	9,850	17,500
Barley	4,000	9,200	6,500	11,700	2,505	6,080	5,250	3,225
Rye	—	—	180	255	—	—	—	—
Oat	50	80	350	400	400	480	350	400
Paddy (Rice)	—	—	—	—	—	—	—	—
Maize	—	—	—	—	30	75	150	350
Sunflower	—	—	—	—	80	9	—	—
Potato	1,000	15,000	1,750	7,000	160	2,300	1,100	12,000
Sugar beat/seeds	1,100	2,000	140	5,000	15	5,250	400	16,000
Bean	50	55	—	—	200	700	150	375
Pea	20	20	—	—	40	60	900	720
Broad bean	—	—	—	—	—	—	—	—
Lentil	—	—	—	—	—	—	—	—
Wild vetch	400	7,000	1,650	28,000	302	450	1,250	22,000
Clover	400	1,000	215	2,300	105	2,100	400	7,200
Animal feed	600	3,000	170	60	80	300	1,500	6,500
Millet	—	—	—	—	—	—	—	—
Onion	50	300	50	100	40	400	75	240
Garlic	20	50	10	3	5	2	—	—
Various vegetables	50		50		20		15	

are ideal for sugar beet seed cultivation, whereas, sandy loams are also ideal for potato cultivation. Also, the banks of the Büyüksu creek are topographically very suitable for irrigation purposes. As a matter of fact, with the development of the flanks of Büyüksu from the one hand, and with the construction of the Gölköy dam and its irrigation system in 1970 with an expenditure of 300 million liras from the other hand, this part of the depression attained complete irigation. The Gölköy irrigational system constructed with the purpose of irrigating the agricultural land within the basin, consists of two main channels, one 29km long in the left direction with an auxiliary channel 42km long. The system has an irrigational capacity of 11, 500 hectares. Nevertheless, we must assert that the change in the land use pattern at this part of the basin has happened only most recently. This change has especially occured following the introduction of the sugar beet seed cultivation in 1959. Hence, almost all of the agricultural activities in this part are adjusted according to the sugar beet cultivation. Sugar beet seed cultivation around Büyüksu was introduced in 1959, as already stated. A company whose more than half of the capital came from the Federal Republic of Germany was founded mainly for this purpose. Cultivation of the seeds, which are plants of two-year duration, is done by mapping procedures. Each year 2 to 9 thousand hectares of cultivable land is planted and returns per areal unit are important and high. Average yield per acre is around 200kg.

On the other hand, the other important crop is potato, especially at Göynük, Mudurnu, and Gerede. For the past twenty years, the potato cultivation has been done for economic purposes. There are four kinds of potatoes in the basin of which only three has economic significance. Names of these four kinds in the order of area that they occupy are as follows: "ari", "cosima" which is of German origin, "sarıkız", and "Trabzonpaşa". Potato is especially planted to wheat fields following their harvest, in lump form, after three tillings, made first in October when the autumn rains begin to fall, second in November or December, and third in February or March. Harvest is done in September and yield per acre is around 4 tonnes. Apart from the low basin floor, grain is an important crop in our study area, especially at Gerede, Göynük and Mudurnu. In these places almost all of the other agricultural activities are adjusted according to grain production. Wheat outstands among the grain types. Wheat seeds are planted in the first week or at most 15th of October. These seeds bloom in 15 days but as snowfall begins at this time of the year, they remain under the snow cover. Following the melting of the snow and its disappearance towards spring, farmers make an extermination of the fields. Seedlings begin to rise towards the end of March and become erect in April. Wheat-ears become visible during the first week of May. These ears turn yellow toward 25th of June and are harvested at the end of July.

The areas we have so-called as higher lands are actually plateaux having elevations in between 1200 to 1500m. Western parts of these vast flatlands are surrounded by dense

forests. At the northern parts of these plateaux, pastoral farming and cultivation are practiced together during certain months, whereas, the only agricultural activity at southern parts is pastoral farming. Although a great number of women workers are employed in preparation of animal products, men mostly work in forests as timberman. Almost all of the villages have land in the plateaux. Thus, we can say that plateaux constitute a secondary livelihood area for these villagers. Moving to the lands in plateaux takes place right after the third week of May. They return back to their villages towards the end of September.

The mountainous higher land in the district forms one of the richest forest areas of the country. Wood obtained from these forests are processed at the Karacasu factory, which comes second after the one at Ayancık as the largest foreat products processing factory in Turkey, and laminated artificial wood planks factory at Doğancı.

Recently founded skiing and winter sports grounds at Kartalkaya near Kartaltepe located at the eastern fringes of the Aladağ plateau which is the western extension of the Köroğlu mountains, is an interesting feature. This establishment at Kartalkaya comes second after Uludağ in Turkey as one of the most modern winter sports centers and consists of hotels, motels, skiing pists, telesiege systems, altogether covering an area of some 2,000 m^2. By making proper advertisements within and outside the country, this recently inaugurated place will, without doubt, attract tourists from here and abroad, to the southern parts of these plateaux.

notes

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