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Reserach Article

The Effect of Geographical Factors on Agricultural Activities in Altınekin District

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Abstract

Agriculture is still the most populous sector among the areas of economic activity in the world. Nearly 60% of the world's population can maintain their lives thanks to the agricultural economy. Agriculture is the most closely associated and compatible sector with nature among manufacturing activities. Agriculture, the first of economic activity, can be shaped by geographical factors. Human environmental factors are highly effective on agricultural activities as well as natural environmental factors. This study reveals the natural and human environmental factors that influence agricultural activities in the Altınekin district and examines the relationship between agricultural production and the future of these factors. Much of the data obtained in this study is based on field observations. In light of field observations and agricultural statistics, the ArcGIS10 program produced maps of the work area.

Altınekin district, which is unfavorable for climatic features and superficial water resources, is abundant in groundwater resources. With the rise of groundwater wells throughout the county, which have been dry agriculture in the past, there have been large increases in the cultivation and production of plants that require more water such as sugar beets, sunflowers, corn and carrots, and the agricultural structure of the region has completely changed. The lack of annual average rainfall and surface water resources in the county, the irrigation of much larger farmland by year, and the continued cultivation of excess water supply poses significant threats to the future of groundwater resources.

Keywords: Agrarian geography, Altınekin, Ground water, Agricultural production.

Altınekin İlçesinde Coğrafi Faktörlerin Tarımsal Faaliyetler Üzerine Etkisi

Öz

Dünya genelinde ekonomik faaliyet alanları arasında nüfusun halen en fazla olduğu sektör tarımdır. Dünya nüfusunun yaklaşık %60'a yakını geçimini tarım ekonomisine bağlı olarak sağlamaktadır. Üretim faaliyetleri arasında doğayla en sıkı ilişkili ve uyumlu sektör tarımdır. Ekonomik faaliyetlerin ilki olan tarım, coğrafi faktörlere bağlı olarak şekillenmektedir. Tarımsal faaliyetler üzerinde doğal çevre faktörlerinin yanı sıra beşerî çevre faktörleri de oldukça etkilidir. Bu çalışmada Altınekin ilçesinde tarımsal faaliyetler üzerinde etkili olan doğal ve beşerî çevre faktörleri ortaya koymak ve bu faktörlerin tarımsal üretimle arasındaki ilişkiyi inceleyerek geleceğe yönelik çıkarımda bulunmak amaçlanmıştır. Bu çalışmada elde edilen verilerin büyük bir bölümü saha gözlemlerine dayanmaktadır. Saha gözlemlerinden elde edilen veriler ve tarımsal istatistikler ışığında ArcGIS10 programında çalışma sahasına ait haritalamalar üretilmiştir.

Klimatik özellikler ve yüzeysel su kaynakları açısından elverişsiz olan Altınekin ilçesi, yeraltı su kaynakları bakımından oldukça zengindir. Geçmişte kuru tarım yapılan ilçe genelinde yeraltı su kuyularının artış göstermesiyle birlikte su isteği fazla olan şeker pancarı, ayçiçeği, mısır ve havuç gibi ürünlerin ekim alanları ve üretim miktarlarında büyük artışlar olmuş ve bölgenin tarımsal yapısı tamamen değişmiştir. İlçede düşük yıllık ortalama yağış miktarının ve yüzeysel su kaynaklarının yetersiz oluşu yıldan yıla çok daha geniş tarım alanlarının sulanması ve su ihtiyacı fazla olan ürünlerin ekiminin devam etmesi yeraltı su kaynaklarının geleceğine yönelik ciddi tehditler oluşturmaktadır.

Anahtar Kelimeler: Tarım coğrafyası, Altınekin, Yer altı suyu, Tarımsal üretim.

Introduction

Agriculture occupies a prominent position among the branches of economic activities. An economic activity, enterprise space, and a way of life are the first stages of civilization. Agriculture is a plant-based cultivation and animal husbandry to meet the needs of people in conditions of different socio-economic and physical environments. It's seen that making the most extended definiton by saying cultivating soil to produce goods is not adequate. Agriculture has been transitioned to good agricultural and organic agriculture with agricultural activities such as hunting, forestry, aquatic production, beekeeping, bonding, cultural mushrooming, silk insecticide as well as plant production and livestock raising (Thoman, 1962; Grigg, 1995; Symons, 1967; Aliağaoğlu, 2019; Bulut, 2006; Demir, 2021).

Agricultural activities have continually maintained their importance from the past to the present. Agriculture will always be on the agenda as the basic need for physiologic nutrition will continue (Balcı Akova, 2002). Agriculture is still the most populous sector among the areas of economic activity worldwide. Nearly 60% of the world's population live off the agricultural economy (FAO, 2020). Agriculture is an important manufacturing area that supports other sectors such as industry and trade and contributes to the development of these sectors. In this way, many of the world's production areas have evolved due to inputs and the provision of raw materials, dependent on agriculture (Sertkaya Doğan, 2008; Demir, 2021).

Differences occur in the branch of agricultural operation in order to meet the growing and diversifying needs of the people every day. Although, for agricultural activities, advances in the scientific and technical spheres have increased, natural environmental aspects overall has a decisive role. That’s why the effect of the natural environment (geology, topography, soil, water resources, climate, and weather) should not be ignored when both agricultural and agricultural geography issues are examined because agriculture is the most closely connected and compatible sector with nature of all production activities in the world. Agriculture, the first economic activity, is shaped by geographical factors. Human environmental factors are highly effective on agricultural activities as well as natural environmental factors. Changes resulting from global climate change due to urbanization and industrialization (drought, misuse of soil and water resources) disturb the ecological balance. So it's very important to get optimal utilization of the agricultural land without damaging the environment and disturbing the ecological balance, and to make plans for that (Özdemir ve Tonbul, 1995; Bulut, 2006; Elmastaş, 2008; Doğanay, 2011). Planning implementation studies can be done on a micro-scale, such as a village, neighborhood, and on a macro scale, such as city, region, basin and country. Producing increased yields in agricultural activities, doing agriculture compatibly with the farmland and reducing the problems due to agricultural activities to a minimum can only be made by going through the consideration of the geographical characteristics of farming basins. In this respect, it is important to consider geographic conditions, both in the process of preparing and implementing development plans and in the process of establishing agricultural policies (Garipağaoğlu ve Uzun, 2019; Sertkaya Doğan, 2008; Çavuş ve Kırmızı Erdal, 2020).

For Turkey, based on an assessment, although the topographical conditions particularly of the agricultural production areas, water supplies are poor in many places which affects agricultural activites negatively. But this problem has been partly overcome, depending on the technology evolving in fields of hydrogeologically suitable potential. This situation has led to various problems in the short or medium term. Altınekin county, designated as a research area, is an area where topographical conditions are suitable for agricultural activities, but the annual average rainfall in the basin and the surface water supply are low. Rapid advances in technology have increased the use of rich groundwater on the basin floor in recent years. The usage of groundwater has increased the amount of crops and diversified the crop pattern. This has resulted in the remigration to rural areas for agricultural production and increased agricultural labor.

Altınekin district, which is administered by Konya province, is surrounded by Cihanbeyli from the north, Eskil from the east (Aksaray), Sarayönü from the west, Karatay from the southeast and Selçuklu district from the south and southwest (Figure 1). The surface area of the district is 1165 km².

In the plain bases on the east and west of the county center, large amounts of agricultural production are produced, particularly due to the fitness of geological, geomorphological and hydrological conditions. Located on the plain to the east of the county center: Mantar, Oguuzeli, Topraklık, and Yenikuyu neighborhoods, and the area west of the county center, Dedeler, Yeniyayla, Ölmez and Sarnıç neighborhoods are the main areas of agricultural activity. In these areas, irrigated

farming is intensively conducted, mainly due to the presence of groundwater wells. There are also dry farming or insufficient irrigated farming in the neighborhoods of Koçaş, Hacınuman, Akıncılar and Ayışığı. Outside of these areas, the agricultural activities in the neighborhood of Akçaşar, Karakaya and Koçyaka, which are typically located in areas where elevation and slope are high, are found to be inadequate compared to the plain bases. In these areas, pasture livestock is likely to be produced more since water wells are less in these areas or the water flow in wells is not sufficient.

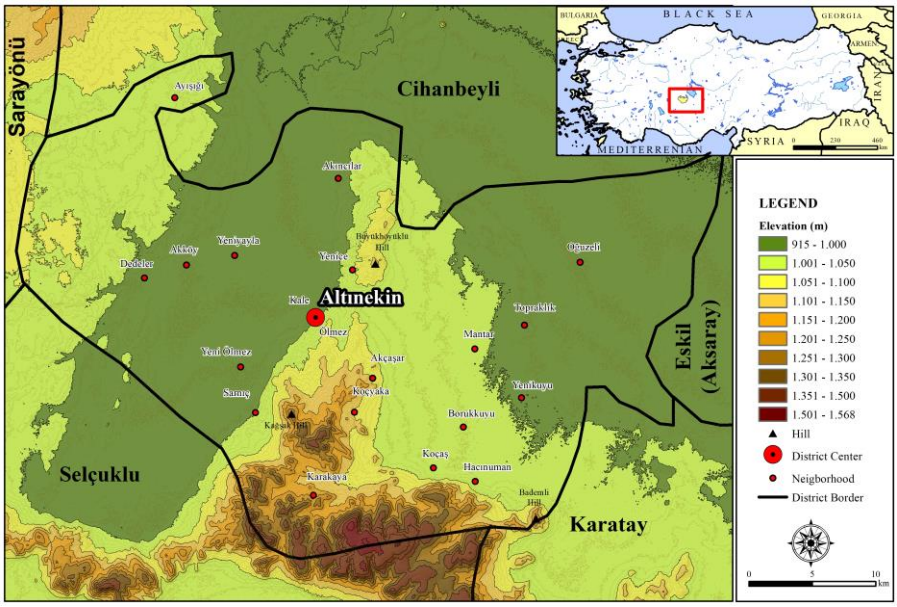

Figure 1. Location Map of Altınekin District

Materials and Methods

The main purpose of this study is to present the natural and human environmental factors that influence agricultural activities in the Altınekin district and to examine their relationship with agricultural production to draw conclusions for the future. In this work, a mixed research pattern is used. The primary reason why a mixed research pattern is preferred is to make a holistic assessment of the work space, with sufficient use of both qualitative and quantitative data. In the qualitative research technique, descriptive charts, shapes, graphics and maps are made using statistical data from public institutions of local or national scale. In quantitative research technique, deep discussions (20 mins on average) were conducted with the subjects in the field to support field observations. The data collected in accordance with the qualitative and quantitative research technique has been combined to provide a holistic assessment using field studies and statistical data.

In light of field observations and agricultural statistics, maps edited with the base plates were produced and data was obtained through these maps using the ArcGIS 10.6 package programs. Furthermore, the study of monographical studies of the site has been thoroughly analyzed and literature review has been made. All of the photographs in the study were taken by the authors during field observations in different time periods. Data from different public institutions was used during the analysis of the geographical characteristics of the county. Data on climate properties has been taken from the General Directorate of State Meteorology, the amount of agricultural production and agricultural structure data have been taken from the Altınekin District Directorate of Agriculture, data on the population of rural neighborhoods has been taken from the Turkish Statistical Institute (Turkish Statistical Institute, 2021).

Results and Discussion

Geology

Geologic factors are an important place among the geographical factors that have an impact on agricultural activities. Geological factors affect agriculture, not directly, but indirectly, such as soil, slope, elevation, water resources, and climate properties. The processes of geological formation in a region, and the mineral structure of rocks and rocks that come out at the end of these processes, have

an effect on soil type, significantly affecting agricultural activities. There is a greater potential of plant development and agricultural production on mineral-rich soil resulted of geologic processes.

The most important aspect of the geological structure, apart from the soil process, is to pave the way for the formation of groundwater. The litological elements below the soil cover on the surface are very important for the groundwater. Lithological units, such as limestone and dolomitic lime beneath the soil cover, are areas rich in groundwater, where water that seeps from the surface creates aquifers. The ground water is trapped in this area by impermeable blocks like marble and granite on the ground of these elements. Elements of the limestone group, which has a large capacity to hold groundwater throughout the Altınekin district, are proportionally large (Table 1)

Table 1. Areal and Proportional State of Geological Units in Altınekin County

Geologic Units	Elements	Area (km²)	Rate (%)
Holocene	Slope wash, alluvion	25	2.2
Plio-Quaternary	Carbonated clay, pebble stone	601	51.1
Upper Miocene-Pliocene	Lacustrine limestone, clay	168	14.3
Upper Miocene	Limestone, pebble stone	222	18.9
Jura	Peridotite, gabbro, antigorite	2	0.2
Upper Cretaceous	Metamorphic ophiolite	37	3.2
Lower Cretaceous	Peridotite, antigorite	32	2.6
Mid Trias	Dolomitic limestone	89	7.5
Total		**1165**	**100**

Source: MTA 1/500,000 geological maps

Altınekin county does not contain any surface water, such as streams or lakes. In addition, the county's location in Turkey's least rainfall basin illustrates the vital condition of agricultural groundwater. Atmospheric waters were stored within lithological elements from the Neogene period, creating a rich underground water presence. Throughout the county there are thick layers of limestone in areas where agricultural production is concentrated, and there is a wealth of groundwater within these layers. In this regard, the groundwater system is heavily influenced by geological-agricultural, soil-agriculture and groundwater-agriculture interactions.

Lithological elements of the limestone group are found to be concentrated in the Altınekin district in two separate plain areas of the east and west block (Figure 2).

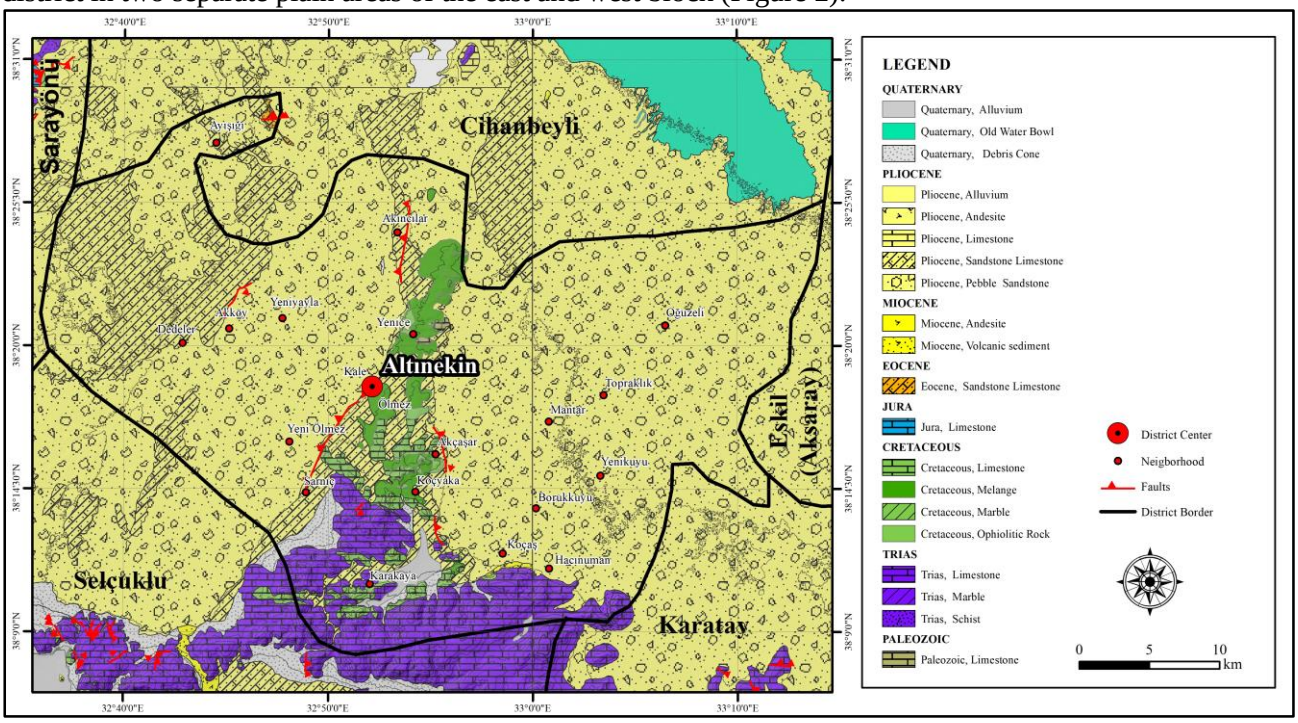

Figure 2. Altınekin County: Geological Map

Geomorphology

Geomorphological factors have a defining effect in a variety of ways on agricultural activites. These factors, which are divided into four main groups: height, slope, pressure, and the direction of the mountains, directly or indirectly affect agriculture. Particularly elevation and slope from these factors are effective in the Altınekin district, where the ground shapes do not vary much.

The defining effect on climate conditions also reveals the effect of the elevation factor indirectly on agriculture. Temperature, precipitation, and pressure are affected by the elevation, while also having an impact on agricultural activities. Agricultural production is also adversely affected by the fact that in areas where the elevation is high, temperatures drop below the favorable level for plant development. Therefore, areas that have low elevation have more agricultural favorable conditions.

The average elevation is in the range of 950-1000 meters in the Altınekin district, which has a geomorphologically simple appearance. Nuras hill at 1566 meters near the Karakaya countryside and the areas at 949 meters in the northeast of the rural neighborhood of Oğuzeli are regions with the most and least elevation within the county limits. The majority of the Altınekin's land consists of slightly wavy plains in the elevation range of 950-1000 meters (Figure 3). In the eastern part of the county, the rural neighborhoods of Mantar, Oğuzeli, Topraklık, and Yenikuyu, and the rural neighborhoods in the western part of the county, Akıncılar, Yeniyayla, Dedeler, Sarnıç and Yeniölmez constitute areas where the elevation of agricultural activity is low.

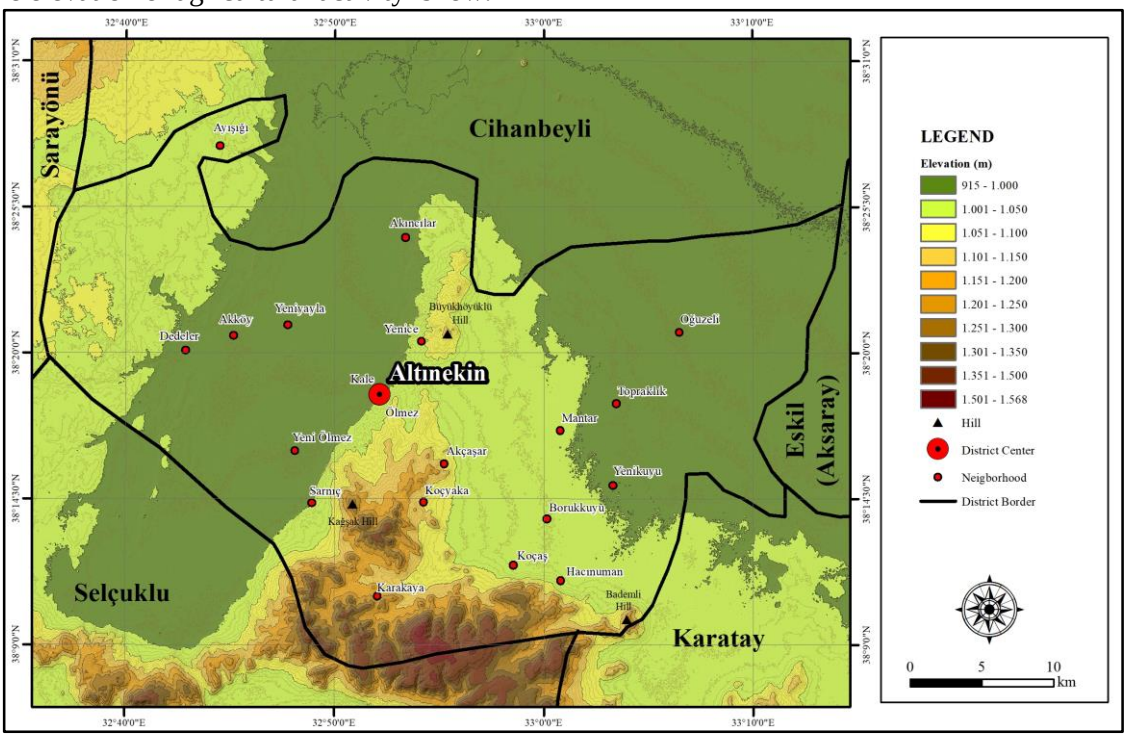

Figure 3. Altınekin County: Morphology Map

Slope is important for determining factors such as soil thickness, erosion intensity, and machine use over agricultural activities. Machine farming is more convenient in places where the slope is high. Furthermore, where the slope is high, the risk of water erosion is increased due to climate and morphological factors, negatively impacting soil formation and development. Agricultural activities have also been affected.

In the town of Altınekin, the slope is relatively increasing in the mountainous area, which lies on a north-south axis, and is an extension of the mass of the Bozdağlar mountains, forming two separate plains in the east and west. 85% of the land area of the Altınekin, which has a simple terrain structure, has slope values of 3° and below (Table 2). The slope over the mountainous mass extending from the rural neighborhoods of Karakaya, Koçyaka, Koças and Hacınuman to the northern neighborhoods of Ölmez, Kale and Yenice, has increased relatively but is seen in a relatively narrow region of area. Outside of these areas, agricultural activities appear to be concentrated and modern agriculture has developed further than in other areas.

Table 2. Area and Rate of Land Curvature Units in Altınekin

Slope Units	**Area (km²)**	**Rate (%)**
0°-3°	989.9	85.0
3°-10°	111.2	9.5
10°-20°	51.1	4.4
20°+	12.8	1.1
Total	**1165**	**100**

Source: The HGK 1/25,000-scale sheets were digitized.

Throughout Altınekin, the effects of geomorphological factors on agricultural activities are evidently felt. Bozdağlar mountains divides the slightly elevated county area into east and west, while the area to the west is called Altınekin Plain, and the area to the east is called Aşağıköyler Plain. These are the areas where agricultural activities are most concentrated. In Aşağıköyler Plain in east, agricultural products of high economic value are produced by fertile soil with the rich underground water presence. In Altınekin district, areas on the mountainous mass such as Koçaş, Akçaşar, Koçyaka, Karakaya and Yenice are found to have sheep and goat farming as well as plantation activities. Dry agricultural activities are preferred in these areas due to poor groundwater. Thus, the agricultural product range and agricultural gain are lower than the rural areas of the plain. The conditions described in these areas are the basis for the development of livestock as a core or side-economic activity.

Climate

Climate has an important decisiveness on agricultural activities in terms of affecting temperature and precipitation factors. Many factors, such as soil structure, hummus wealth, water resources, and plant development, are impacted by the climate. Although technical improvements have somewhat decreased climate decisiveness on agriculture, agricultural activity is strictly dependent on climate conditions at all times.

The influence of climate factors on agricultural activities in Altınekin district is significant as well. In this area, where no marine effect exists, there seems to be a continentality. The effects of the overall climate character in central Anatolia are seen. The average annual temperature in Altınekin is 11.2 °C, and the average annual rainfall rate is 343 mm. In Altınekin, the wettest season is found to be spring, and the driest season is summer. The monthly pattern of rainfall is shown to be uneven. In the spring, Altınekin, one of the areas characterized by "*kırkikindi precipitation*" *(forty-afternoon precipitation)*, was determined that the precipitation did not fall each year, and that in some years it was shifting towards summer (Figure 4). After spring, the rainiest season is autumn, but in recent years rainfalls in november have also been below average. In Altınekin, while it's latitude plays a primarily important role in climate values (38°N), also it's continentality due to it's average elevation and the inability of marine masses to inland due to mountain ranges in the north and south of Central Anatolia are effective. Along with areas around the Salt Lake, it forms one of Turkey's least rainy areas.

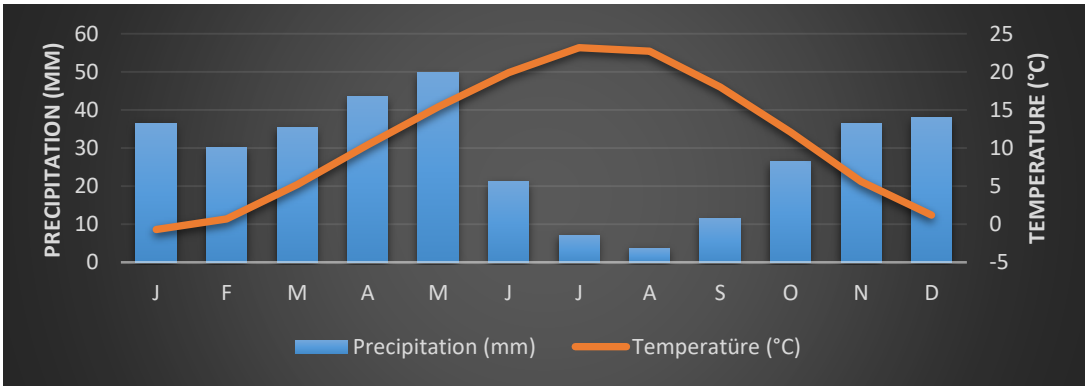

Figure 4. Average Temperature and Precipitation Graph in Altınekin County (1964-2020)

There is no significant difference in the propagation of temperature and precipitation due to the simple structure of morphology in Altınekin. Around the Karakaya countryside, there are several degrees of reduction in temperature values due to the rise in the elevation, while there is a slight increase in rainfall. However, this is not at the level of creating climate differentiation throughout the county. (Figure 5).

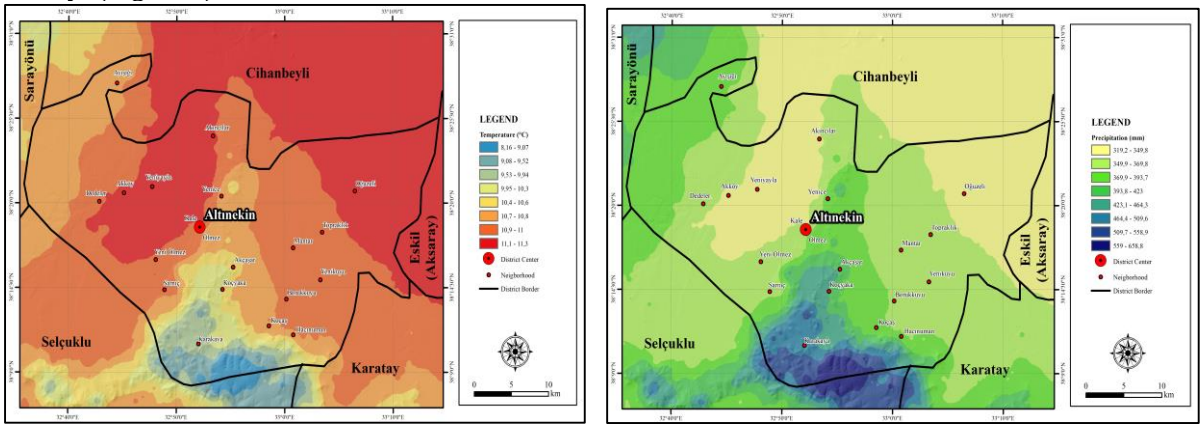

Figure 5. Average Temperature and Precipitation Map in Altınekin County (1964-2020)

Altınekin's climate has been identified as semi-arid (BSk) in the Köppen climate model, step (semi-arid) in the De Martonne-Gottman climate model, and semi-arid climate in the Erinç's annual model. According to De Martonne, the monthly ruler shows there are differences between months (Table 3).

Table 3. Monthly Drought Indices by Martonne Model in Altınekin County

Month	Application of the Formula				Results	Climatic Type
January	I=	(39.6x12)	/	(-0.7 + 10)	51.09	Humid
February	I=	(30.2x12)	/	(0.7 + 10)	33.86	Humid
March	I=	(35.4x12)	/	(5.2 + 10)	27.94	Semi-humid
April	I=	(43.5x12)	/	(10.4 + 10)	25.58	Semi-humid
May	I=	(49.8x12)	/	(15.4 + 10)	23.52	Semi-humid
June	I=	(21.2x12)	/	(19.9 + 10)	8.50	Arid
July	I=	(7.1x12)	/	(23.2 + 10)	2.56	Arid
August	I=	(3.7x12)	/	(22.7 + 10)	1.35	Arid
September	I=	(11.5x12)	/	(18 + 10)	4.92	Arid
October	I=	(26.5x12)	/	(12.1 + 10)	14.38	Semi-arid
November	I=	(36.6x12)	/	(5.6 + 10)	28.15	Semi-humid
December	I=	(37.9x12)	/	(1.2 + 10)	40.60	Humid

Source: Calculated using data from MGM (1964-2020)

According to Erinç model, there are also drought differences in the table of monthly drought indices in Altınekin district (Table 4).

Table 4. Monthly Drought Indices by Erinç Model in Altınekin District

Months	Avg. Max. Tmp. (°C)	Precipitation (mm)	Index Value	Rainfall Effectiveness
January	3.2	39.6	148	Per-humid
February	5.5	30.2	65.8	Per-humid
March	11.2	35.4	37.9	Semi-humid
April	16.9	43.5	30.8	Semi-humid
May	21.5	49.8	27.7	Semi-humid
June	26.3	21.2	9.6	Desert-steppe
July	29.5	7.1	2.9	Desert
August	29.1	3.7	1.5	Desert
September	25.8	11.5	5.3	Desert
October	19.2	26.5	16.5	Semi-arid
November	11.4	36.6	38.5	Semi-humid
December	5.1	37.9	89.1	Semi-humid
Annual	17.1	343	20.05	Steppe

Source: MGM (1964-2020) data was used.

The semi-arid climate conditions that have been effective in Altınekin district have had an impact on the variety and growing conditions of agricultural crops. Grains have been highlighted as natural agricultural products in the steppe climate during the summer, when it is hot and dry, winters are warm and wet, and the wettest season is spring. These products, which can adapt to low temperatures in winter and low rainfall conditions during their vegetation period, are the primary source of livelihoods and are the source of inspiration (altın-ekin / gold-crop) for the name of the county. In recents years however, the cultivation of traditional crops such as wheat and barley has been severely constircted and the the cultivation of much more water hungry crops such as corn, sunflower, pumpkin seeds, sugar beets has become common.

The traditional agricultural model in Altınekin is shaped according to climate. The traditional agricultural model at Altınekin began in the 1970s, accelerated in the 1990s, and has transformed into modern agriculture over the last 20 years based on excessive consumption of groundwater. Along with this transformation, the traditional crop pattern in Altınekin, one of the least rainy areas of our country with no surface water sources, has been replaced by products that need much more water and want water during this dry period, including sugar beets, corn, sunflower, pumpkin seeds, carrots, potatoes, cloves. Of course, new products don't grow independently of climate factor. However, these new products fulfill their total water consumption in the summer months when almost no rainfall falls. Water shortage is entirely provided from underground water. While the new crop pattern is constantly growing in plantation, water consumption is covered by groundwater, the reserves for groundwater are decreased each year due to the inability of these water sources to replenish themselves. New crop patterns are also more limited in these areas due to the greater limitation of underground water reserves in mountainous neighborhoods and surrounding areas throughout Altınekin, and dry farming and pasture livestock is more common. Neighborhoods like Mantar, Oğuzeli, Topraklık and Yenikuyu in the eastern part of the county are densely populated by modern farming with new crop patterns due to the wealth of groundwater. In the western part of the county, the area where the Konya-Ankara road is located, the reserves are depleted substantially and a mixed pattern of watery-dry agriculture is carried out using limited underground water supply.

Soil

Soil properties are one of the major factors affecting agricultural activities. In areas with high soil yields, vegetative production and crop patterns are affected by this condition in a positive way. But because the soil factor is affected by other factors, it's not adequate for soil to be efficient itself. It needs to be addressed together with water resources, climate properties, and morphological conditions. Even as improvements occur in soil-free agricultural practices on a global and national scale, the soil is still more valuable for agricultural production. Vegetative production is also influenced by the soil formation affected by the climate and topographic-lithological structure of the region.

It is found that the soil found throughout Altınekin is consistent with the general structure of the land of steppe climate. The plains in the eastern and western part of the county are covered with brown prairie soil (Figure 6).

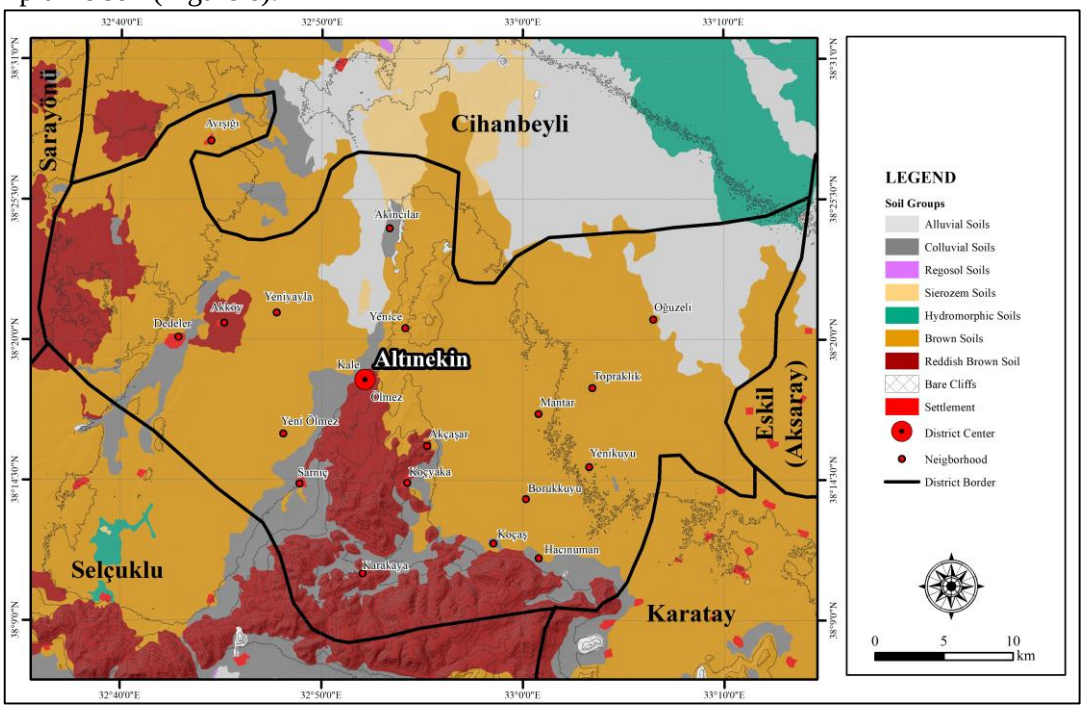

Figure 6. Altınekin County Territorial Map

Of the land found throughout Altınekin, 64% is made up of brown soil and 18% is made up of reddish brown soil (Table 5). The use of fertilizers is important in order for plant production to occur in this soil, where the amount of hummus and mineral wealth are low. However, in recent years, there has been a slight increase in the ammount of hummus due to the decomposition of vegetative waste from plant production due to extensive agricultural practices on brown soil. The area of aluvial soil, covering 8.2% of the county land, is in fact the area where productivity is low. In these areas of old lacustrine sediments, the soil is thiner and the clay rate is very high.

Table 5. Areal and Proportional State of Territorial Units in Altınekin County

Soil Types	**Area (km²)**	**Rate (%)**
Brown Soil	752.6	64
Red Brown Soil	213.7	18.1
Colluvial Soil	107	9.1
Alluvial Soil	96.35	8.2
Sierozem Soil	6.35	0.6
Total	1165	100

Source: Konya Province Land Presence (1992)

Heavy agricultural production is established in areas of the brown soil that lie within the borders of Altınekin. It's only natural that the soil type has an effect on agricultural production in these areas. However, because the areas where the brown soil is found correspond to areas where the rich aquifers of the groundwater are located in most places, the concentration of agricultural production on these areas is seen to be effected by the groundwater far more than the soil factor. In addition, agricultural activities are more limited in areas where rich groundwater aquifers exist, but where there are no brown or aluvial types of soil. There have also been an increase in washes of soil and irrigated agriculture in recent years, and there have been positive developments in agricultural production in the salt and lime ratio of soil. However, the general presence of limestone rocks on the ground of the areas where this soil type is located poses a significant threat. With the Southeastern Anatolia Project (GAP)

getting involved, the *'capillarity'* event, a significant concern for the Southeast Anatolia Region, poses a serious risk to this region as well. During the summer months, when the land is dehydrated, water seeps underground from the irrigation by farmers. Depending on the region's high temperature in the same period, the soil may dissolve the salt and lime minerals on the bottom after a while, and move them up, resulting in the accumulation of the caliche layer on the surface of the soil and creating a negative condition for agriculture. In order to avoid this problem, the drainage system must be placed in areas where irrigated agriculture is performed.

Population and Settlement

As on all economic sectors, there is also a significant influence of population power on agricultural activities. While population can be a driving force in areas with high economic acceleration, it can become a burden in areas with limited work branches and work areas. The district has a total area of 1165 km², with a population of 14289 people (Table 6).

Table 6. Population Quantities of the Neighborhoods in Altınekin District (2022)

Neighborhood	Population	Neighborhood	Population
Akçaşar	178	Mantar	469
Akıncılar	3255	Hacınuman	218
Akköy	191	Oğuzeli	1625
Ayışığı	84	Ölmez	2310
Borukkuyu	120	Sarnıç	585
Dedeler	1700	Topraklık	308
Kale	911	Yeni Ölmez	423
Karakaya	126	Yenice	643
Koçaş	67	Yenikuyu	459
Koçyaka	371	Yeniyayla	246
		Total	**14289**

Source: Turkish Statistical Institute -2022

Overall, there are 20 neighborhoods, including 18 in rural areas and 2 in urban neighborhoods that form the county seat. The population of these neighborhoods varies. There are also many sub-villages attached to these rural neighborhoods. Some of these locations, locally called tablelands, (they are not geographically tablelands), are linked together administratively to form neighborhood status. All across Altınekin, Akıncılar, Ölmez, Dedeler and Oğuzeli are the most populated rural neighborhoods. Karakaya, Koçaş and Ayışığı are the least populated rural neighborhoods. In Altınekin there is 12 people per square kilometer across the county. The density of the arithmetic population is about 9 times lower than the average for Turkey. In terms of the county's economic income level, it is well above the average in Turkey. Immigration for many years has been a huge factor on the low population of the county. In the traditional agricultural period, modern agriculture has accelerated resulting in the cease of migration and the beginning of remigration. In the economically good district, the workers employed in agricultural activities are mostly undocumented foreign workers. In rural areas where farmland is heavily processed and irrigated agriculture is dense such as Mantar, Oğuzeli, Topraklık, Dedeler, population density is relatively low. In these areas, farmland is very large, and in agriculture, machinery is very high, so the population has remained low. In addition, since the sectors other than agriculture and animal husbandry have not developed in these areas, they have not improved and their population has remained stable.

Land Use

Land use, which depends on human factors as well as natural factors, is highly important for agricultural activities. The excess of area and proportional space of agricultural land in land use directly affects agricultural activities. The total area of Altınekin district is 1165 km², accounting for 2.88% of Konya land and 0.15% of Turkey land. The area of 77966 hectares of the county are used for agricultural production. The ratio of agricultural areas in the district to the district surface area is 66%. In this case it is found that agricultural production can be executed in most of the town.

Agricultural activities are concentrated in two separate plains in the eastern and western part of the county. In the eastern part of the county, rural neighborhoods like Oğuzeli, Mantar, Topraklık, Yenikuyu are among the major areas of irrigated agriculture. And to the west of the county, irrigated

farming is also seen between the areas of rural neighborhoods of Dedeler, Sarnıç and Ölmez. In addition to mountainous areas of the district, its wavy plains and barren areas are used as pasture (Figure 7).

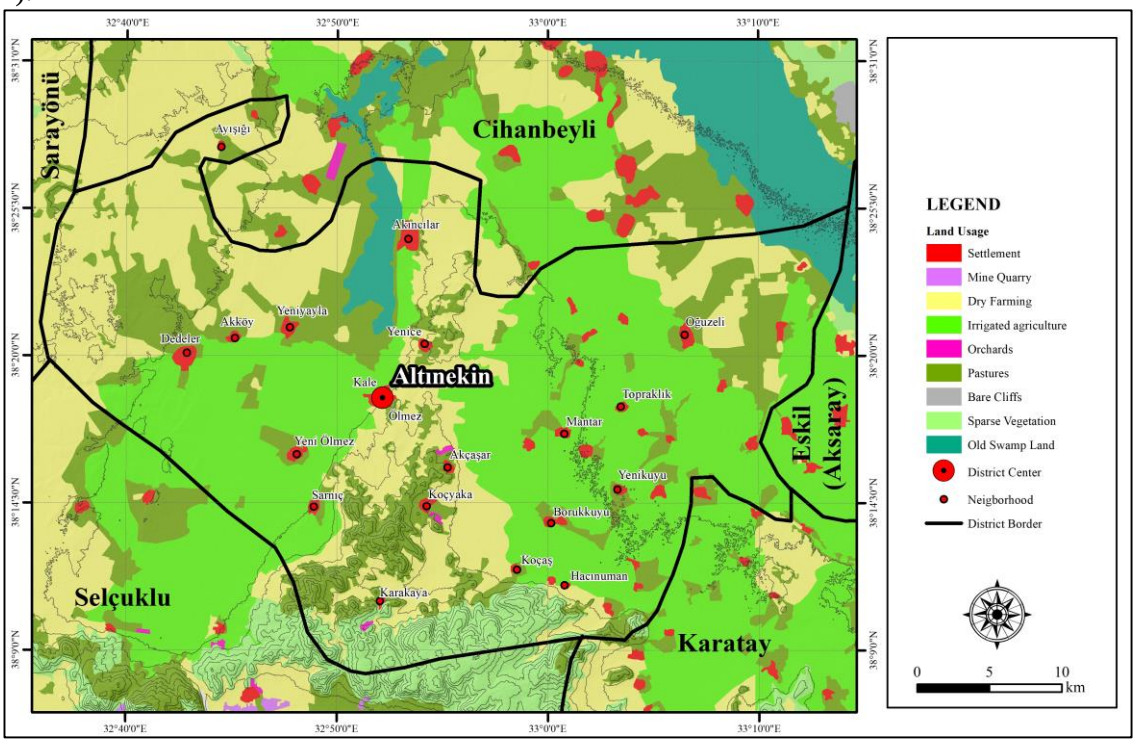

Figure 7. Altınekin County Land Usage Map

In recent years, one of the major developments in land use has been land consalidation projects. In rural neighborhoods such as Mantar, Oğuzeli, Topraklık, Yenikuyu, Akçaşar, Borukkuyu, Koçyaka, land consalidation projects were completed in 2015-2018. This has resulted in significant improvements in the size and shape of agricultural enterprises as in some idle areas has been put to good use. Land consalidation projects contributed to the development of a more modern agricultural activity (Figure 8).

Figure 8. View of Land After Land Consalidation in Yenikuyu Surroundings (Source: EkiciFen Farm)

Underground Water Wells

As with all creatures, water is vital to plants. So water is very important for agricultural activities. Plants germinate, grow, and develop with water. Where there's enough rain, plants provide this water from precipitation, while where there's not enough rainfall, water is provided from other sources such as streams, lakes and dams. Although the agricultural potential is very high, vegetative production cannot be made in areas where water resources are not sufficient. Therefore, when

technological and economic opportunities are viable, water is transported from over 400 km away to provide water for agricultural activities as seen in California and Libya examples. With GAP getting involved in our country, the need for water in the Southeastern Anatolia Region is greatly satisfied via canals. It will provide relief in meeting the need for water in some parts of Konya (around Çumra) with the Konya Plain Project (KOP). The method that is frequently used in the inner regions for water supply is the use of groundwater.

There is no surface water in Altınekin. There is no river, lake or dam in the county, where the average annual rainfall is very low (343 mm). Until the 2000s, there were small carstic source outputs called *pınar* (springs) in certain areas of the mountainous part of the county, but these sources are now completely dry. However, the county is luckier in groundwater. Fossil underground waters accumulated within the carstic rocks that formed the ancient lake sediments that began to be stocked in the Neogene have become the lifespring of the district's economic and social life. In the 1970s, with wells opened to benefit from agricultural irrigation, it took more and more utilization of groundwater. In the 1970s, the number of low-flow underground water wells extracted by diesel engines was around 400, but with today's electric motors, the flow is much higher and their total number throughout the county is close to 5000.

In Altınekin district, underground water wells used for agricultural purposes are found to be concentrated around the eastern rural neighborhoods of Oğuzeli, Güvercinlik, Mantar, Topraklık, Yenikuyu, and the western rural neighborhoods of Dedeler, Ölmez, Sarnıç. These areas where water wells are concentrated indicate areas where agricultural production is concentrated. In these areas, it has been found that the public's income level is higher than in other areas, as high-income products are cultivated.

The western part of Dedeler rural area and the mountainous part of the county are weaker in groundwater, so the wells are not densely populated in these areas. As a result of this, dry farming is executed which brings in low income.

In the Altınekin district, agricultural production is entirely dependent on groundwater wells, and with increasing acceleration each year, the use of this water poses significant risks to the future of agricultural activities in the county and the basin. Over millions of years, water reserves that have reached the present day by clinging to the rocks have been constantly losing reserves as a result of over half a century of excess consumption. The annual loss of groundwater cannot be compensated by rain or surface water. This is why the level of the underground water decreases every year by between 2 and 10 meters. In the eastern part of Altınekin, it is seen that the water level of well-1 near the rural district of Güvercinlik is higher, and the water level of well-2, located in the western part near the neighborhood of Sarnıç, is lower. However, the decrease in water level over the years in both wells shows parallelism (Figure 9). This causes increased water extraction costs every year and also signals danger that in the near future, the total consumption of groundwater may lead to a change of economic structure and social fabric in the county, particularly agriculture. While the economic extraction of the groundwater is not possible, especially in the line in the western parts of the county such as Sarnıç, Dedeler, and Akıncılar, it is likely to last for some time in the eastern plains and then suffer the same fate. Thus it is very important for the future of water and agriculture to undertake agricultural policies and measures, especially in the whole basin.

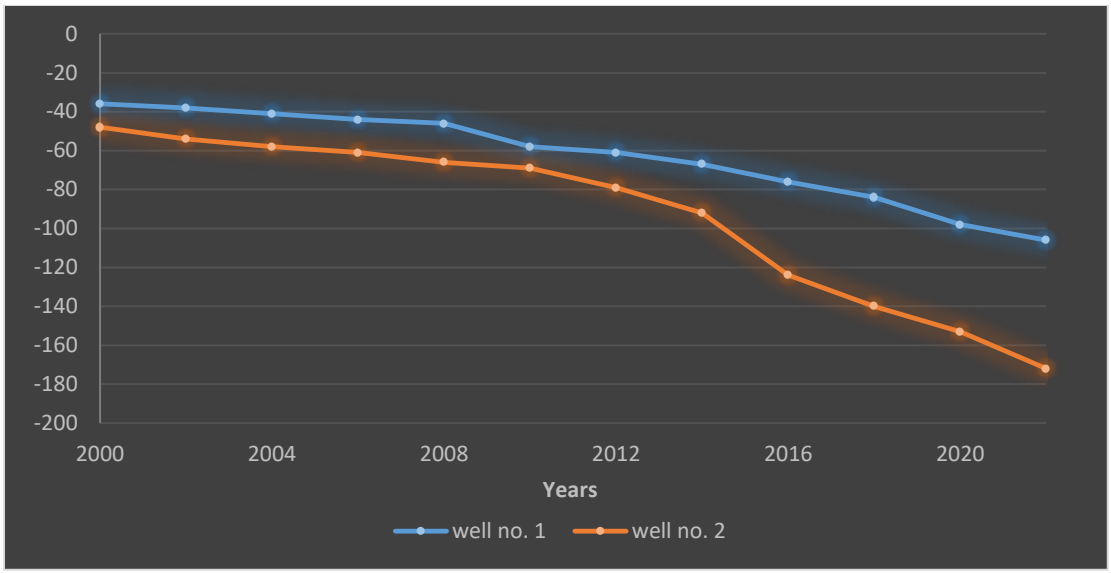

Figure 9. Changes in the Levels of Underground Water Wells in Altınekin (Irrigation Cooperative Records-2022).

Product Pattern

The pattern of agricultural products on agricultural activities is also very important in Altınekin district. Wheat and barley, which are compatible with the region's climate, was at the forefront of the most important products. However, the cultivation area and production of wheat has declined in recent years, while the barley has fluctuated (Table 7). There have been large increases in the production and planting of products such as sugar beets, sunflower, corn, and carrots, which consume more water in the new crop pattern. This indicates that the agricultural structure of the region has changed.

Table 7. Planting and Production Status of Agricultural Products by Years in Altınekin District

	Planting Area (da)			**Current Output (tons)**		
	Years			Years		
Product	**2000**	**2010**	**2020**	**2000**	**2010**	**2020**
Wheat	564325	378989	147567	182965	107381	75726
Barley	79560	81482	85954	38721	41300	45000
Sugar beet	21323	79963	85376	165000	569534	615000
Corn	85	4200	121520	142	24500	257600
Sunflower	11120	53254	55215	4740	32652	33750
Carrot	0	134	560	0	1200	4500

Source: Provincial Agriculture Directorate of Konya

With the beginning of irrigation in Altınekin, traditional grain products such as wheat and barley began to be watered and there has been an increase in production. However, over time, alternative products began to be tested, and by the 1990s, sugar beets became a major additional product. High income from sugar beets has played an important role in modernizing the agricultural vehicle park and supplies of farmers in the region. As the sugar beet also reveals the use of wet pulps, livestock activities in the region have also developed with agricultural activities. This process of shifting in the agriculture of Altınekin up to the 2000s occurred earlier in the rural areas of the western parts of the city such as Yeni Ölmez, Kale, Yenice, Dedeler, Sarnıç, Ölmez and the economic development of these areas progressed faster than the eastern neighborhoods of the county. By the 2000s, the western region was becoming a problem for groundwater shortages, while the access of richer underground waters were being increased in the eastern areas. With a more efficient and thicker soil structure in eastern rural neighborhoods such as Mantar, Oğuzeli, Topraklık, and Yenikuyu, agriculture started to move faster in these areas. In this process, agricultural products such as sugar beets, sunflowers, dried beans, gourd seeds and potatoes became common. After 2010, more corn is

cultivated and produced annually, especially in rural neighborhoods in the eastern part of the county. This more economically efficient product was also seen as a convenience for drip irrigation, transforming into the new face of agriculture in Altınekin with less labor (Figure 10).

Figure 10. Corn Farming in Altınekin District

It was found that irrigated agriculture, especially corn farming, was unsustainable due to the extensive use of groundwater in Altınekin. Today, this agricultural model is changing the face of the town, especially economically, with water supplies rapidly disappearing and the reflects of this will be felt in all areas in the near future.

Conclusions

Altınekin is located in Turkey's least rainy region of Konya closed Basin. Altınekin's climate has been identified as semi-arid (BSk) in Köppen climate model, steppe (semi-arid) in De Martonne-Gottman climate model, and semi-arid climate in the Erinç's annual model. The district is extremely unfavorable in terms of climatic characteristics affecting agricultural activities, with an average annual temperature of 11.2° C and an average annual rainfall of 343 mm. In the town of Altınekin, the surface water sources are extremely low and there are no streams, lakes, or dams. From this aspect, agricultural activities in the county were generally carried out by the mid-1970s, mostly with dry farming activities with limited product pattern (wheat, barley, etc.).

The district of Altınekin, which is unsuitable for climatic properties and surface water sources, is extremely rich in underground water sources. From the Neogene period to the present day, atmospheric waters leaking from the surface have been stored among limestone layers, creating a rich underground water presence. In the county, which is extremely poor in surface water resources, groundwater has vital importance in agriculture. The common feature of the regions where agricultural activities are concentrated and production is the highest in Altınekin is the thick limestone layers on the ground of these areas and the presence of rich underground waters in these layers. More and more use was made of groundwater, which was started to be extracted from the wells drilled in the 1970s in order to benefit from agricultural irrigation. In the 1970s, the number of low-flow underground water wells extracted by diesel engines was around 400, but with the development of today's electric motors, the flow is much higher and their total number throughout the county is reaching to 5000.

With the increase in underground water wells throughout the county where dry farming was practiced in the past, there has been a great increase in the cultivation areas and production amounts of products which need more water such as sugar beet, sunflower, corn and carrot, and the agricultural structure of the region has completely changed. With the advances in technology, the number of groundwater wells throughout the county has steadily increased, and diversity in the product pattern has begun to increase. Starting in 2010, cultivation areas of crops bringing in more economic income, especially corn, began to expand. Corns cultivation area, which was 85 decares in 2000, increased from 4200 to 121520 decares from 2010 to 2020. During the traditional agricultural period, the migration ceased, as modern agriculture and remigration gained momentum in recent years. Locals throughout the county live in socio-economically golden years thanks to their income from agricultural activities.

The lack of annual average rainfall and surface water resources in the county, the irrigation of much larger farmland by year, and the continued cultivation of products which need more water poses significant threats to the future of groundwater resources. Fossil underground water supplies that

accumulated in a closed basin for millions of years have been unconsciously overused in recent years for agricultural irrigation. In order for the agricultural activities carried out in the district to continue for many years in a sustainable way, groundwater should be used consciously. Depletion of underground water resources will not only end agricultural activity throughout the county, but will also adversely affect all branches of economic activity in the field of agriculture-based industry and trade. It would also lead to sociological unemployment, significant loss of income, and consequently the emigration of people from the district.

A number of measures need to be taken immediately to avoid geographical factors that could endanger the future of agricultural activities in the town of Altınekin. To prevent unconscious use of underground water resources by the local population, it is first necessary to make audits on wells which are drilled illegally, to install a meter on existing water wells that are drilled with legal permission, to provide information on the agrarian irrigation and irrigation methods in the way that farmers can understand and participate in. Taking restrictive precautions against water-hungry crop varieties (corn, sugar beets, sunflower, carrots and potatoes) are of paramount importance. In the product support program provided by the state, the supports given per kilogram to the products with high water demand should be removed and the products with low water demand should be supported. Although it does not seem possible in the short term, it should be included in the program within the framework of a plan to export water from outside to the basin in the long term.

Authors' Contributions

All authors contributed equally to the article.

Conflicts of Interest Statement

The authors declare that they have no conflicts of interest.

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