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Ürünlü (Çumra-Konya) Çevresinde Yeraltısuyu Seviye Değişimleri ve Obruk Oluşumları

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Özet

Konya Kapalı Havzası içerisinde yer alan Ürünlü (Çumra-Konya) Mahallesi ve çevresi tarımsal üretim bakımından havzanın en önemli bölgelerinden biridir. Çumra İlçesinin yaklaşık 9 km doğusunda bulunan Ürünlü mahallesi ve çevresinde Geç Miyosen-Pliyosen yaşlı İnsuyu formasyonu temeli oluşturmaktadır. Çumra bölgesinde 43 adet sondaj kuyusundan seviye ölçümü yapılmıştır. Kuyuların derinlikleri 20-200 m, debileri 5-40 l/s, beslenim dönemindeki statik seviyesi 13.9-110.26 m, boşalım dönemindeki statik seviyesi 22 m-101.2 m'dir. Bu dönemler arasında kuyularda 0.1 m ile 29 m arasında düşüm olmuştur. İnceleme alanında Konya Fay Zonu'na paralel fayların yanı sıra yaklaşık D-B doğrultulu faylar da yer almaktadır. Obrukların Konya Fay Zonu doğrultusuna paralel oldukları tespit edilmiş olup bölgedeki obruk oluşumlarının faylarla ilişkili olduklarını göstermektedir. İnceleme alanındaki obruklar İnsuyu formasyonu ve üzerine çökelmiş genç birimler içerisinde oluşmaktadır. Obrukların tamamı 1000-1010 m kotları arasındadır. Obrukların bir kısmının çevresinde konsantrik yarık ve çatlaklar bulunmakta ve obruklar derine doğru daralan bir yapı sunmakta ve obrukların gelişimi devam etmektedir. Ürünlü Mahallesinin kuzey kesiminde yaklaşık 1.4 x 1.0 km boyutlu alan içinde 23 adedinin derinliği 1-3 m arasında, 342 adedinin derinliği 1 m'den daha sığ olmak üzere toplam 365 adet obruk tespit edilmiştir. Obrukların uzun eksenleri 0.7 m ile 88.5 m, kısa eksenleri ise 0.7-44.0 m arasında değişmektedir. Yerleşim bölgelerine ve bazı tarımsal sanayi üretim tesislerine oldukça yakın olan bu bölgede obruk alanları 0.38 m^2 ile 2674.69 m^2 arasındadır. Bölgede çok su isteyen mısır, ayçiçeği vb. bitkilerin ekilmesi, kuyulardan yapılan aşırı su çekimi yeraltısuyu seviyesinin düşmesine neden olmakta ve obruk oluşumunu hızlandırmaktadır. Akiferlerden olan çekim beslenimden oldukça fazladır. Her geçen gün artan kaçak kuyular, uygun olmayan bitki deseni, aşırı çekim yeraltı su seviyesinin düşmesine neden olmakta ve obruk, yarık ve çatlakların oluşumunu hızlandırmaktadır. Bölgedeki obruklar yerleşim yerleri ve tarımsal sanayi üretim tesisleri için tehlike arz etmektedir.

Groundwater Level Changes and Sinkhole Formation of Ürünlü (Çumra-Konya)

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Abstract

Located in the Konya Closed Basin, the Ürünlü Neighborhood of Çumra district is one of the most important regions of the basin in terms of agricultural production. The Late Miocene-Pliocene aged İnsuyu formation forms the basis of the Ürünlü neighborhood, which is approximately 9 km east of the Çumra District, and its surroundings. Water level measurements were made from 43 wells in the Çumra region. The depths of the wells are 20-200 m, their flow rates are 5-40 l/s. Its static level during the recharge period is 13.9-110.26 m, and its static level during the discharge period is 22 m-101.2 m. Between these two periods, there was a decrease between 0.1 meters and 29 meters in the wells. In the study area, there are faults parallel to the Konya Fault Zone as well as approximately E-W oriented faults. It has been determined that the sinkholes are parallel to the Konya Fault Zone direction, indicating that the sinkhole formations in the region are related to the faults. The sinkholes in the study area are formed within the İnsuyu formation and young units deposited on it. All of the sinkholes are between 1000-1010 m elevations. There are concentric fissures and fractures around some of the sinkholes, and the sinkholes present a structure that narrows downwards, and the development of the sinkholes is continuing. A total of 365 sinkholes have been identified, 23 of which are between 1-3 m in depth and 342 are shallower than 1 m in depth, within an area of approximately 1.4 x 1.0 km in the immediate northern part of Ürünlü Neighborhood. The long axes of the sinkholes vary between 0.7 m and 88.5 m, and the short axes vary between 0.7-44.0 m. In this region, which is very close to residential areas and some agricultural industry production facilities, the sinkhole areas are between 0.38 m^2 and 2674.69 m^2. Corn, sunflower, etc. that require a lot of water in the region. The over-drawing from the wells causes the groundwater level to decrease and accelerates the formation of sinkholes. The withdrawal from the aquifers is much higher than the recharge. Increasingly, illegal wells, unsuitable plant patterns, excessive draft cause the groundwater level to decrease and accelerate the formation of sinkholes, fissures, and fractures. The sinkholes in the region are dangerous for both settlements and agricultural industry production facilities.

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1. Introduction

Konya Closed Basin is in the Central Anatolia region. It is the largest basin in Turkey and is fed by precipitation. Located in the Konya Closed Basin, the Ürünlü Neighborhood of Çumra district is one of the important regions in terms of agricultural production. In the region where surface waters are very scarce, groundwater is the most important source for water supply (Figure 1).

In 2021, the monthly average temperature is 13.5 °C and the total precipitation is 134.2 mm. The decreases in groundwater levels have increased due to the increase in temperature and evaporation, decrease in precipitation value and excessive groundwater withdrawal. In recent years, the scarcity of precipitation and excessive evaporation as well as excessive consumption of groundwater resources for agricultural sinkholes cause the groundwater level to decrease. The sinkholes, which were formed in higher areas topographically due to the high groundwater level in the past, are formed at lower elevations due to the decrease in the groundwater level in recent years. In this study, the decrease in groundwater level, sinkhole formations, causes and solution proposals due to the excessive withdrawal of groundwater in the vicinity of Ürünlü (Konya-Çumra) were tried to be revealed.

Climatic factors (temperature, precipitation, evaporation, relative humidity) in the formation of sinkholes, geological and lithological features of the region, tectonic features, volcanism in the region, flow direction of groundwater, chemical composition of groundwater, excessive extraction of groundwater, plant pattern, agricultural activities. tremors are effective [1, 2, 3].

In the study area, the lowest monthly average temperature in 2020 is 0.8 ^{o}C in January, the highest monthly average temperature is 24.5 ^{o} C in July, and the monthly average temperature is 13.2 ^{o}C. Temperature values have increased in 2021, the lowest monthly average temperature is 3.5 ^{o}C in January, and the highest monthly average temperature is 24.2 ^{o}C in July. For many years, the monthly average temperature value is 16.5 °C. Precipitation is effective from January to June and there is no precipitation in July, August and September. Precipitation values in 2020 are 23.4 mm, which is quite low. Total precipitation is 367.2 mm in 2019, 134.2 mm until July 2021, and 299.44 mm according to the long-term average. According to Thornthwaite (1948) correlated moisture balance, actual evaporation (Etpr) is 365 mm, Potential evaporation transpiration (Etp) is 651.2 mm, and evaporation transpiration corresponds to 65.3% of precipitation.

The basement of the study area is formed by the Upper Miocene-Lower Pliocene İnsuyu formation. It is generally represented by carbonate rocks such as white, light gray, beige colored, pink and yellowish in places, thin-medium bedded fossiliferous limestone, marl, sandy limestone, clayey limestone, carbonate claystone.

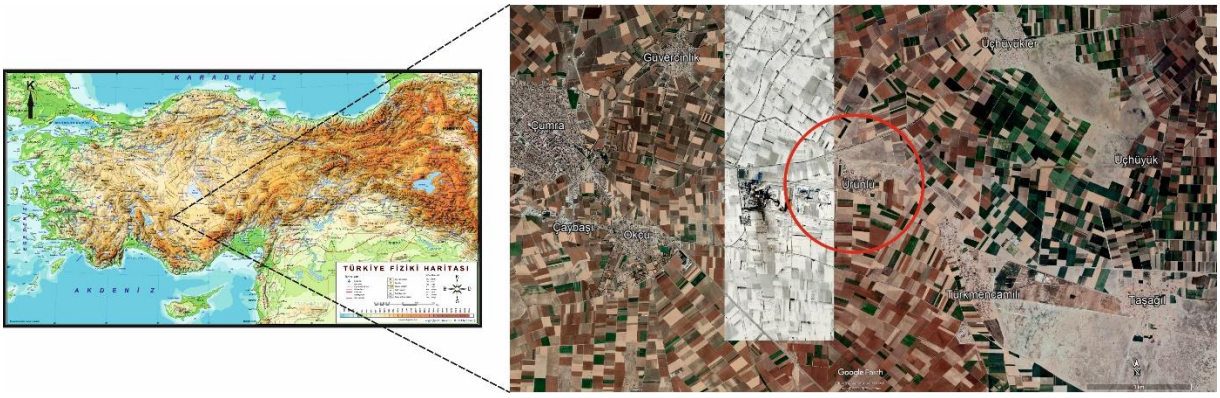

Figure 1. Location map of the study area.

This unit is overlain by the Pleistocene aged Çumra formation consisting of yellowish brown pebbly, sandy siltstone and limestone. The Çumra formation is overlain by the Pliocene-Pleistocene aged

Eğilmez formation consisting of sand, silt and carbonate clays, and the Pleistocene aged Türkmencamili formation overlies it. It forms white and gray colored carbonate clay-silt and sandy marls consisting of clastics at the base of the unit. This is followed by the Börücekyayla member of the Pleistocene aged Hotamış formation, which consists of thick gravel, cross-bedded sand, and mud. All these units overlap each other discordantly [4, 5, 6]. These units are unconformably overlain by the Çarşamba formation consisting of Holocene aged unconsolidated sand, silt, and pebbles (Figure 2). In addition to faults parallel to the Konya Fault Zone, there are approximately E-W oriented faults in the region.

2. Climate, Geology, Sinkhole Formations and Groundwater

Climatic factors (temperature, precipitation, evaporation, relative humidity) in the formation of sinkholes, geological and lithological features of the region, tectonic features, volcanism in the region, flow direction of groundwater, chemical composition of groundwater, excessive extraction of groundwater, plant pattern, agricultural activities. tremors are effective [1, 2, 3].

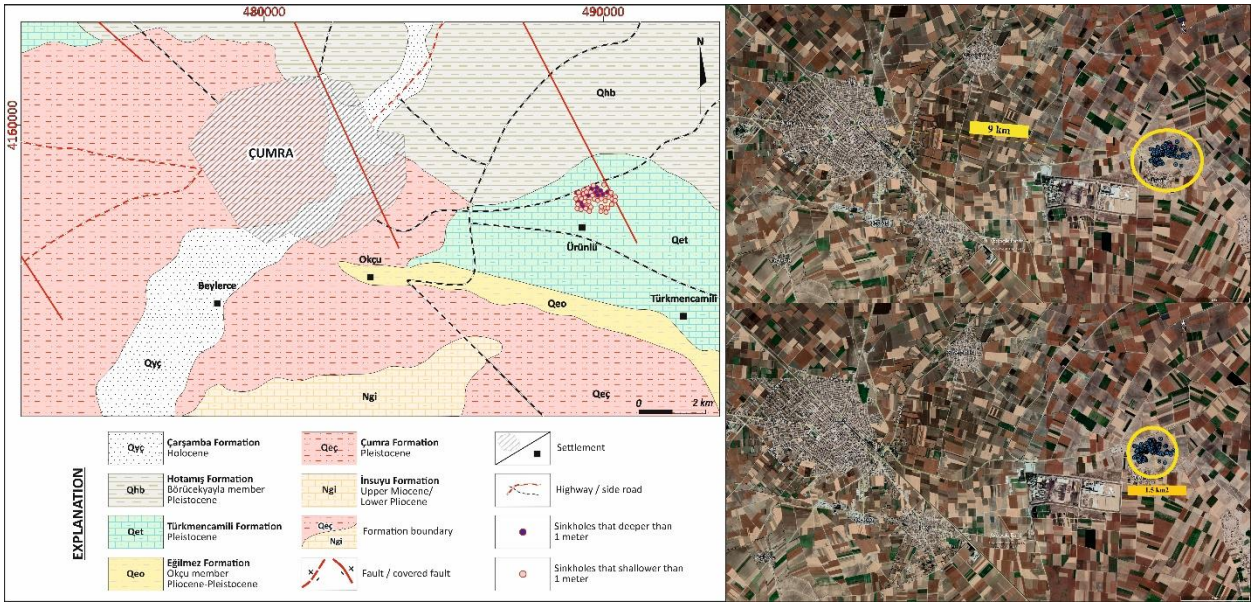

Figure 2. Geological map of the study area and Google Earth images.

While the İnsuyu formation, where sinkholes formations are most common in the study area, is generally composed of carbonate rocks, soluble minerals such as gypsum, anhydrite, halite, boron salts, which have much higher solubility than carbonates, are common in younger sediments, as well as carbonate. For the formation of the sinkholes by Ford and Williams; Three types of sinkhole formation mechanisms are suggested as (1) solution from the top, 2) erosion from the bottom, and 3) suffusion (Figure 3) [7]. The sinkholes in the study area contain carbonic acid-rich groundwater limestones belonging to the İnsuyu Formation. As a result of dissolution in the internal karstification zone, caverns and cavities are formed at the bottom and these cavities approaching the surface over time collapse by not being able to carry the alluvial cover on the top. The Ürünlü and its surroundings are dry sinkholes, and their depths are low [8,9,10,11,12,13].

A total of 365 sinkholes have been identified, 23 of which are between 1-3 m in depth and 342 are shallower than 1 m in depth, within an area of approximately 1.4 x 1.0 km in the immediate northern part of Ürünlü Neighborhood. All the sinkholes are between 1000-1010 m elevations. The long axes of the sinkholes vary between 0.7 m and 88.5 m, and the short axes vary between 0.7-44.0 m. In this region, which is very close to residential areas and some agricultural industry production facilities, the sinkhole areas are

between 0.38 m^2 and 2674.69 m^2. The rose diagram prepared according to the long axes of the determined sinkholes shows that the long-axis positions of the sinkholes are oriented in the N 10^o-20^o E direction. When the distribution of the sinkholes is examined, it has been determined that they are parallel to the direction of the Konya Fault Zone, and it shows that the sinkholes formations in the region are related to the faults. In the geophysical surveys carried out in the region, covered fracture lines developing parallel to the main fault of the Konya Fault Zone were determined.

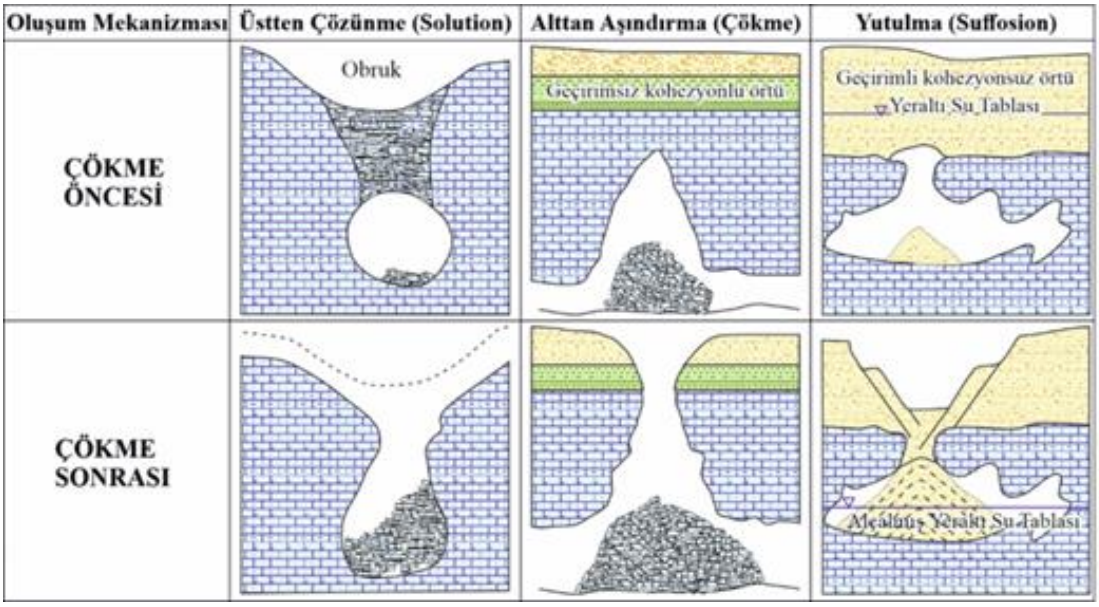

Figure 3. Types of collapse, [7].

The sinkholes in the study area are observed in young units deposited on the İnsuyu formation. There are concentric fissures and cracks around some of the sinkholes and the sinkholes present a structure that narrows to downward.

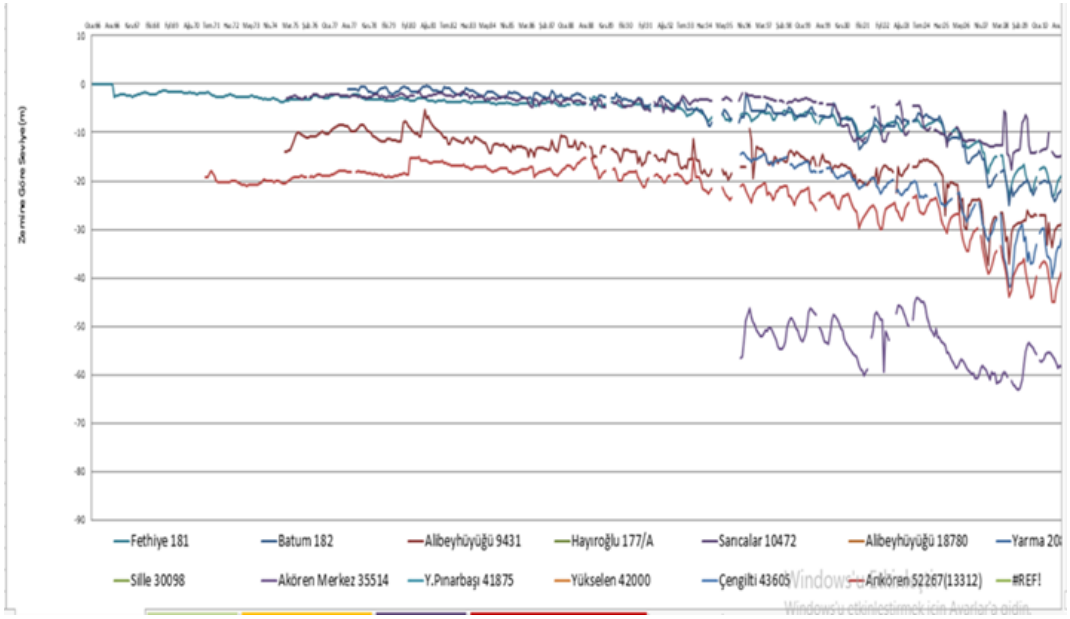

Figure 4. Monthly groundwater level in Çumra Karapınar sub-basin graphic year 1975 to 2020.

Level measurements were made from 43 drill wells in the Çumra region. The depths of the wells are 20-200 m, their flow rate is 5 to 40 l/s, the static level in the recharge period is 13.9 to 110.26 m, the static level in the discharge period is 22 to 101.2 meters. Between these two periods, underground water level differences are 0.1 m to 29 m. There was a decrease 2 to 35 m in the underground water level in the observation wells of the State Hydraulic Works (DSİ) (Figure 4). Excessive withdrawal from wells causes the groundwater level to drop and lowering the groundwater level removes the carrier load of the water and accelerates the formation of sinkholes. [14,15,16].

3. Conclusions

1-Sinkholes formations have been going on for thousands of years depending on natural geological, tectonic, lithological, and hydrogeological conditions.
2-Climate change, lack of precipitation, and most importantly, excessive, and uncontrolled use of groundwater accelerate the formation of sinkholes
3-The sinkholes have now become a threat to the local people, living life, settlement, industry, investment and agricultural areas, public investment lines (electricity, water, oil and natural gas), transportation networks (in-field roads, roads, highways, railways, high-speed train, etc)
4- We do not have the opportunity to control the lithological features, structural geology, climate change, drought, hydrogeological features, which are among the natural geological factors that cause the formation of the sinkholes. The most critical issue that can be controlled is anthropological factors, namely water use.

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