

## THE NEGATIVE IMPACT OF SINKHOLES IN AGRICULTURE LAND: THE CASE OF KONYA

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### **Abstract**

*Sinkholes, one of the carstic geographical formations, come into existence as meltable rocks underground, such as limestone create holes in time and as ceilings of those holes collapse. Sinkhole formations have occurred with convenient lithological and ground water effect in Konya area for a long time. Dry or wet, there are almost 100 sinkholes in Konya, which they are called as sinkholes. As a result of overuse of groundwater in the district of Konya, existence of sinkhole has been increased recently. Since appearances of aforementioned sinkholes are located in agriculture land has been carried issues because those aforementioned sinkholes are covered improperly and used as a farm area by property owners. The covered process is extremely dangerous and it sometimes causes the sinkhole area to collapse again. In this study, it is aimed to discuss some sample of aforementioned sinkholes in the agriculture lands in Konya.*

**Key words:** Sinkholes, Konya, agriculture land, Turkey.

### **INTRODUCTION**

Formations of sinkhole have occurred in Konya area for a long time with the effect of convenient lithologic structure and groundwater. However, there has recently been an increase in formation of sinkhole with the effect of the change in level of groundwater, chemical features of groundwater, lithologic structure, climate features and human beings. That's why, sinkhole formations can be categorized as old-occurring and new-occurring. As new-occurring sinkholes have begun to occur in settlements and agricultural lands, they've begun to directly affect humanity. Many people have begun to fulfill some plains with excavation in order to prevent aforementioned impacts. This situation, in fact, presents vital danger for people, because the fulfilled plains attract attention as a potential to harm people by collapsing again.

Researchers who studied around Konya suggested many ideas (*Lahn 1940, Güldalı and Şaroğlu 1983, Erol 1990, Selçukbiricik 1992, Çörekeçioğlu 1994, Canik 1997, Pekkan 2004, Türk et 2010, Göçmez 2011*) about description, formation and features of sinkholes.

### **MATERIALS AND METHODS**

In this study, the formation of sinkholes in and around Konya, it is aimed to present the effects of the sinkholes that have formed in past and present on human activities. In order to achieve this goal, firstly field studies take an important place. Through the field studies both the areas in which there are sinkholes and the settlements around the sinkholes in the determined land will be examined on the spot. In order to document the studies in the field, it will be photographed on the spot. It will be tried to measure the wide and depth of the sinkholes. The heights and the relationships of sinkholes with each other will be examined. By being evaluated of both data that will be gathered through study of field (photographs, statistical information and the notes of interview with local people) and related literature, the formation of sinkholes and the evolution of sinkholes their effects on activities of the people living around will be evaluated.

### **SINKHOLES IN KONYA**

Sinkholes in Konya exist in middle and southern parts of Central Anatolia.

These sinkholes can be particularly found in Karapınar, Çumra, Karatay, Akören, and Ereğli and Kadınhanı districts. We separate the

sinkholes in Konya into two groups, as old and newly formed (Figure 1).

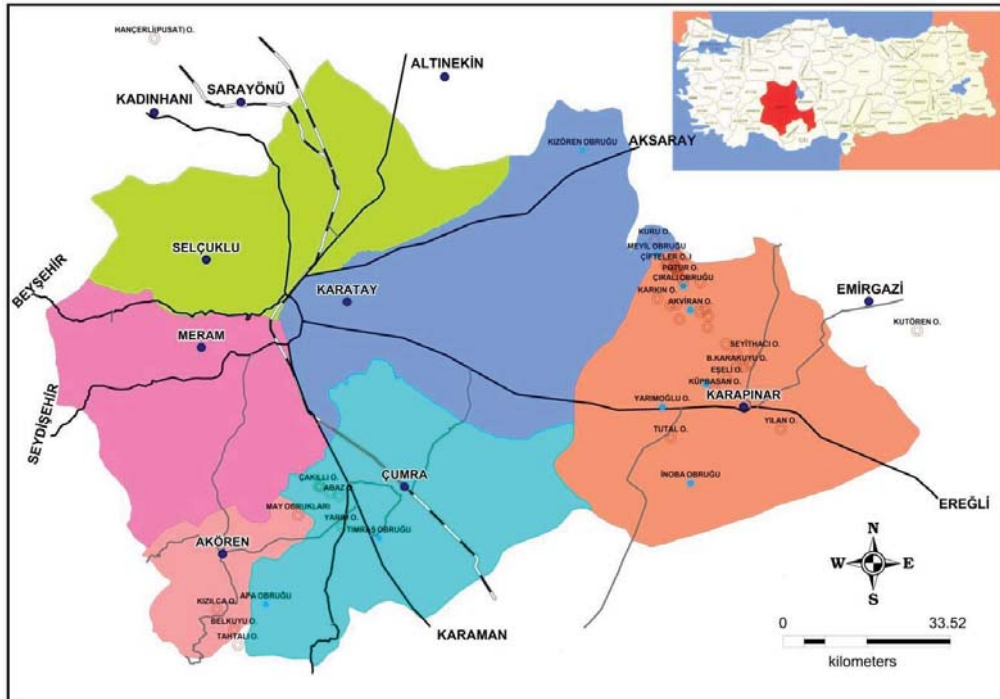


Figure 1. Distribution of the sinkholes in Konya

## SINKHOLES IN TERMS OF FORMATION

In Konya, there are sinkholes that were formed in old era and attract attention in terms of morphologic and their formation characteristics. In view of place and depth, the sinkholes which are old formed such as Kızören, Meyil, Çıralı, Timraş and Apa, Zincancı, Akobruk, Fincan, Yarımobruk, Potur, Karain, Hamam, Çifteler, Derinobruk, Kızılobruk, Celal, Kurk, Cehennem, Yeniopan, Karkın, Niğdeboğazı, Kuruobruk, Küpbasan, Meke, Bereketini, Belkuyu are the ones which mostly attract attention.

**Kızören Sinkhole:** It exists in the east of Konya centrum, on the highway between Konya and Aksaray, in the 4 kilometers north of Kızören Town (Figure 2). The sinkhole had emerged in Upper Paleozoic old crystalized limestones and Upper Miocene-Pliocene old lacustrine formations. Upper elevation of the

sinkhole seen in circular shape is 1004 meters in average; its water surface elevation is 973 meters. Long axis of the sinkhole in east-west direction was determined as 341 meters, and its short axis in north-south direction was determined as 182 meters. Although Selçukbiricik (1992:103) remarked the lake depth of the sinkhole as 145 meters, today, this depth has slightly decreased due to the ebbing of underground water. Kızören Sinkhole and the area of 127 hectares around it were involved in contract list as Ramsar Convention in 2005.

**Meyil Sinkhole:** It's located in the Meyil Plateau in the 40 kilometers northwest of Karapınar (Figure 3). The sinkhole had emerged Upper Miocene-Bavention old different layers. The elliptic sinkhole's upper elevation is 1044 meters; its water surface elevation is 980 meters. Long axis of the sinkhole in east-west direction is 660 meters, and its short axis in north-south direction is 590 meters. The measurement in September, 2014 shows that

various fish live in the sinkhole whose lake depth is 40 meters.

**Çıralı Sinkhole:** It's located in the Çıralı Plateau in the northwest of Karapınar (Figure 4). The sinkhole had emerged in Upper Miocene-Pliocene old limestone, clayey limestone, marl, travertine limestones. Circular shaped sinkhole's upper surface axis is 354 meters, short one is 303 meters, its lake surface's long axis is 135 meters and short one is 120 meters. Its upper elevation is 1070 meters, its lake surface elevation is 966 meters



Figure 2. Kızören Sinkhole from south



Figure 3. Meyil Sinkhole from North



Figure 4. Çıralı Sinkhole Lake from north



Figure 5. Timraş Sinkhole Lake from South

**Timraş Sinkhole:** It's in the southeast of Village Gökhüyük in Çumra (Figure 5). The ellipse sinkhole's upper surface long axis' caliber in north-south direction is sketchy 325 meters, its short axis in east-west direction is 245 meters, lake surface's long axis is 242 meters, its short axis is 197 meters. Its upper elevation is 1035 meters, its lake surface elevation is 1005 meters and there's a range of about 25 meters between upper surface and Lake Surface. Water depth of the sinkhole is 40 meters. The sinkhole had emerged in Upper Miocene-Pliocene old limestone, marl and sandy-clayey formations.

and there's a range of about 90 meters between upper surface and Lake Surface. Today (October, 2013), the depth of the lake has decreased so much that the branches of an old tree has appeared. It was seen that it decreased up to 12 meters as of the date of October, 2013. Cave habitations' existence spaces of 10 to 12 meters emerging on the slopes in the north, east and southwest parts of the sinkhole. The fact that the tools and coins found in these caves were dated to Rome and early Christian eras proves that this place had been used with aim of locating since old ages.

There are horizontal limestone cornices on its slopes and melting spaces between the cornice and marly surface. As the water of the lake is fresh, various fish kinds exist.

#### RECENTLY FORMED SINKHOLES

There are many sinkholes in Konya province which has recently emerged and are going on emerging today. Significant amount of recently formed sinkholes have emerged in Karapınar district (Figure 1). While sinkholes today sometimes slightly show indications, sometimes they collapse without any indications.

**İnoba Sinkhole:** It's located in the southwest of Karapınar district center and 40 meters west of İnoba plateau habitation (Figure 6). The sinkhole emerged in 2008 in limestone, clay and marly formations. Its upper elevation is 1010 meters. While the sinkhole was in 25 meters caliber and 33 meters depth when it first emerged, today (October, 2013), it has a caliber of 29 meters and depth of 42 meters. The fact that the sinkhole is close to plateau habitation presents a great danger. Families around here stated that they had immigrated to Karapınar district center. The sinkhole formation is regarded as a significant danger for people who make a living from sheep-goat farming.

**Yarımöğlü Sinkhole:** It's located in the Akkuyu Plateau in the west of Karapınar

district center. Sinkhole is occurred in the agriculture lands. When sinkhole was occurred corn was field land. The sinkhole emerged in 2009 in soil, clay and marly alluvion formations. Its upper elevation is 1010 meters. While the sinkhole had a caliber of 25 meters when it first emerged, the caliber has raised up to 28 meters in present day. Water exists at the part after almost 49 meters of sinkhole (Figure 7). Yarımöğlü Sinkhole attracts tourists as it is highly close to Konya-Adana highway. Edge of the sinkhole has been covered with simple barb wires. There's a serious danger for people visiting the sinkhole. Currently 350 m<sup>2</sup> there agriculture land were destroyed by sinkhole.



Figure 6. İnoba Sinkhole

**Yavşançukuru Sinkhole:** It's located in the northwest of Karapınar, 1 kilometer east of Yavşançukuru Plateau. In the measurement performed in December, 2000, it was determined that the northeast-southwest section of sinkhole's caliber increased to 17.5 meters and northwest-southeast section increased 16.5 meters (Göçmez et al, 2001). According to the measurement performed in October, 2013, the caliber of the sinkhole is 21 meters, its girth is 70 meters and its depth is 56 meters.

**Nebili Sinkhole:** It's located in the north of Büyükkarakuyu Plateau. Its upper elevation is 1092 meters; its depth is 70 meters. The

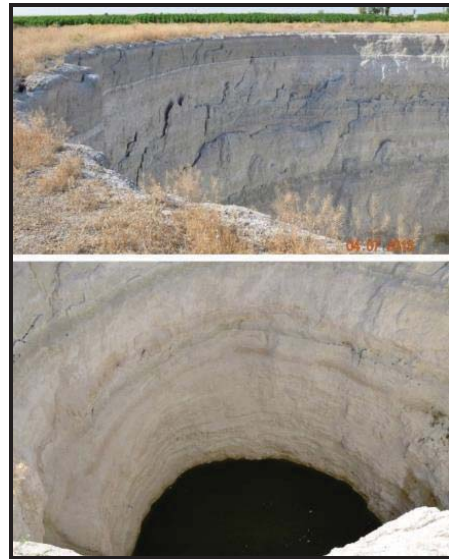


Figure 7. Yarımöğlü Sinkhole

sinkhole which had been wet since its emerging has become a dry sinkhole as underground water level went deeper 21. Sketchy ellipse shaped sinkhole's long axis is 18 meters, short axis is 16 meters (Figure 8). This makes it possible for pigeons to house.

**Akviran Sinkhole:** It's located in the northwest of Karapınar and north of Akviran Plateau. The sinkhole emerged in May, 1977 in Upper Miocene-Pliocene formations (Figure 9). Its upper elevation is 1046 meters, its depth is 80 meters and its calibre is 24 meters. There's 26 meters of range of ridge between the sinkhole's

upper surface and water level. It's observed that the shielless sinkhole presents a danger for



Figure 8. Nebili Sinkhole

living beings. Currently 190 m<sup>2</sup> there agriculture land were destroyed by sinkhole.

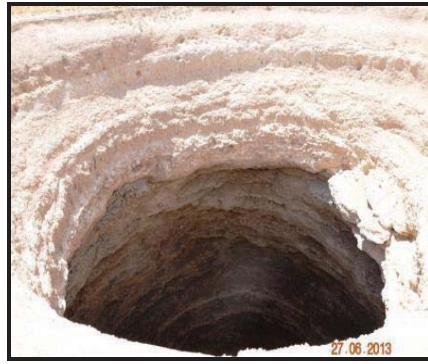


Figure 9. Akviran Sinkhole

**İçeriçumra Çakillar Sinkholes:** 3 sinkholes emerged in different dates in İçeriçumra Çakillar Location. First of them emerged in 2005, the second one emerged in 2008, and the third one emerged in 2009. Each one of these sinkholes was plugged by landowners. First of them emerged in November, 2005 in İçeriçumra Çakillar Location. In our measurement in 2008, the caliber of circular sinkhole was determined as 5 meters, its depth was determined as 9 meters. During that period,

limestone, clay and marley layers on the slopes of the sinkhole could be prominently seen (Figure 10). Moreover, although the sinkhole hadn't been named yet, we stated that it would be proper to name it Çakıllı Sinkhole as the location where it had emerged was Çakillar (Bozyiğit-Tapur, 2009:149). However, when we went there to make a more detailed research, it was observed that the sinkhole had totally been plugged.



Figure 10. İçeriçumra Çakillar Sinkhole-I plugged in present day (Photo taken in 2008)



Figure 11. İçeriçumra Abaz Sinkhole plugged following its emergence

The other two sinkholes emerged in the south of 8<sup>th</sup> kilometer of İçeriçumra-Seçme highway on the same. For information about the sinkholes, research was made on the location shown by Hasan Görmez, who plows the farm. Hasan Görmez stated that they had made measurements themselves when the sinkholes had occurred, the sinkhole emerging in 2008

had had a caliber of 4 meters and depth of 7 meters, and the one emerging in 2009 had had a caliber of 2 meters and depth of 4 meters. He stated that they had plugged the sinkholes in order to cultivate the farm (Tapur-Bozyiğit, 2013). However, little signs of collapsing and cracks can be observed on one of the plugged sinkholes.

***İçeriçumra Abaz Sinkhole:*** It's located in the borehole fields in the west of İçeriçumra Town (Abaz Road). The sinkhole emerged in Quaternary old alluvion layers. Its upper elevation is 1027 meters; its depth is 8 meters. The calibre of sketchy circular sinkhole was measured as 10 meters. The sinkhole emerging in July, 2012 has been plugged with excavation materials (Figure 11).

***Kadınhanı Hançerli Sinkhole:*** It emerged in Pusat Village in Kadınhanı district.

The sinkhole emerged in Upper Miocene-Pliocene old lacustrine cover formation (Figure 12). Its elevation is 1004 meters; its depth is 7 meters. Its long axis in the direction of east-west is 18 meters; its short axis in the direction of north-south is 13 meters. The escarpments are more in the north and east slopes of the sinkhole. There are block collapses and deep cracks in the west slope and piles of debris in the south slope. As the sinkhole is highly new, its process of formation is going on.



Figure 12. Kadınhanı Hançerli Sinkhole

Later on, found out that the sinkhole had been plugged with excavation by the farm owner 4 months after its emergence, it was seen that the sinkhole had been plugged when we performed a research on the sinkhole field in April, 2014. It can be seen that the sinkhole had collapsed about 1 meter and cracks occurred on the edges of the sinkhole although we researched 2

months after it was plugged (Figure 13). Plugging it increases the possibility of a bigger collapse as the sinkhole hasn't totally collapsed. Although the owner of the farm where sinkhole emerged was informed about this danger, he didn't give up his insistence. He carries on his agricultural activities by plugging the sinkhole emerging on his farm.



Figure 13. The closed display of Kadınhanı Hançerli Sinkhole after 6 months

## CONCLUSIONS

The sinkholes in Konya province emerged in Miocene-Pliocene and Quaternary old formations. These formations consist of rocks such as limestone convenient to karstification, marl, claystone. It can be seen that sinkhole emerging frequency has recently increased in and around Konya. The fact that people overuse underground water is effective in that increase. The rapid decrease of underground water in recent years can be detected from change of levels in Akgöl, Meke Tuzlası, Kızören, Meyil, Çıralı, Timraş and Apa sinkhole lakes. During underground water movement from Konya Plain toward Lake Tuz, underground water abstracts the carstic rocks it engages and this creates underground spaces. These spaces collapses due to both decrease in underground water level and false landuse of humanity and carstic formations which we call sinkholes emerge.

Recently emerging sinkholes affect both habitation areas and agricultural activities in and around Karapınar, Çumra, and Kadınhanı. Either plateaus are deserted or agricultural activities are interrupted in farming fields because of danger of collapsing on the locations where sinkholes have emerged. However, it's been observed that some of the recently emerging sinkholes were immediately plugged by landowners. However, the plugged sinkholes transform into covered traps, this might cause lose of priorities and lives. That's why, the public should be informed about not plugging newly emerging sinkhole areas and plugging sinkhole formations should be prevented.

The sinkhole fields should be evaluated in economic activity branches mainly in tourism different from utilizing in agricultural land, because the old and newly formed sinkholes in Konya could become ecological attraction centres by putting under protection because of their morphological figure, climatic features and aquatic value. Sinkholes forming habitats of species such as hawks, falcons, eagles, partridges and pigeons and existence of living

beings in wet sinkholes having lake characteristics are important ecotourism destinations.

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