Survey of Land Subsidence, Perspective and Geomorphology
Developments in the Denser Plains, Case study: Neyshabour Plain

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Extended Abstract

Introduction
In terms of definition, gradual and sudden subsidence of land surface are two phenomena which take place by both natural & synthetic and the damages caused by this kind of subsidence can sometimes be catastrophic. Man has increased the severity and number of these hazards by exploiting unconstitutional and irrational natural resources. Although the main cause of land subsidence, according to studies in the Iranian plains, which is susceptible to this phenomenon, is reported as indicative of downturns of underground fluids, dissolution of subsurface formation, and collapse of karstic caves but other human activities such as land use change, construction, exploitation, or loading of engineering structures, organic soil drainage, subsurface mining or oil pumping are among the reasons for subsidence.

The first identified descendant is due to the unusual exploitation and extraction of groundwater for agricultural purposes in the State of California and in the Santa Clara area. One of the best examples of land subsidence due to the abnormal extraction of groundwater in the world is in the San Jacinto Valley region of California, where a 9-meter subsidence has been reported at its maximum point between 1925 and 1975.

Today, land subsidence events have been reported in more than 150 major cities in the world including Mashhad, and in many places, such as Mexico, Australia, Colombia, China, the United States, Thailand, India, Japan, Iran, Italy, the Netherlands, Venezuela, Egypt, Saudi Arabia, Britain, France, Occupied Palestine, Poland and Sweden.

Currently, among the 43 well-known geological hazards in the world, there are 32 cases in Iran, which can be said that among them, five major geological hazards include earthquakes, floods, landslides, droughts and land subsidence which seriously threatened our country.

Materials and Methods
This research has been carried out through historic method of descriptive analytical kind. Field measurements were used to collect data and to use satellite maps and images, and finally to analyze data and field observations based on the method of work. First, by studying aerial photos and satellite imagery over time, the trend of plain changes has been investigated and ArcGIS software has been used to create a database and analyze data, and the Surfer 11 software has been used to draw up maps of groundwater levels over five-year intervals from 1986 to 2014. Then, by integrating the water table and the groundwater levels of the Neyshabour plain and the groundwater abstraction site with the cracks created in different parts of the plain, the changes and the trend of the expansion of these cracks were all analyzed.

Discussion and Results

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Determining the depth of groundwater for exploitation development, calculating evaporation from groundwater, studying its quality and identifying salinity factors, subsidence studies and agriculture are very important. The subsidence mainly results from groundwater extraction more than the abundance of aquifers, and any increase or decrease in groundwater abstraction is reflected in the fluctuations in groundwater depth. In this section, the analysis of the maps of the fall of the groundwater level and the level curves of the station in the plain, the condition of landing and cracks occurring in areas of the plain is investigated.

With the outflow of water from the aquifer of the Neyshabour plain, which is mainly done by drilling wells, the depth of water gradually decreases and this causes an increase in effective stress. Increasing effective stress in water-bearing fine-grained beds known as aquitard, which are not consolidated or are semi-consolidated, will cause the drainage of these layers and eventually decreases its volume and land cover. Underground water level maps in the area of Neyshabour plain using observation wells data from the regional water organization of Khorasan Razavi have been intersected after the necessary corrections by Surfer 11 software. These maps are shown in Figures 2 to 5 for a period of 10 years and between 1986 and 2014 years. These maps also confirm the reduction of groundwater levels.

According to the state of the curve on the level of the station in the aquifer of Neyshabour plain, it has been observed that from the year 1986 to the present, the fall of the level of the station has continued gradually and suddenly.

Investigating the above maps shows the decline in groundwater level in Neyshabour plain as follows:
- From 1986-1996=15m in average
- From 1986-1996=18m in average
- From 1986-1996=10m in average

The annual decline average of water level = 1.4 m

It can be seen that the decline in the underground level in this plain over a period of 30 years is 43 meters, indicating that each year the Neyshabur Plain has a ground floor slope of 1.4 meters on average per year.

Conclusions

The findings of this research confirm the reduction of groundwater level and, consequently, the subsidence of the land and its role in the formation of cracks in the Neyshabur Plain. An analysis of groundwater levels maps over the past 28 years indicates an average annual decline of 0.25 meters in the plain. Underground decline has led to a decrease in the size of the aquifer and emergence of holes and cracks in parts of the Neyshabur plain.

The most important geomorphic outcomes and the forms caused by these subsidences, especially in the northwest, south and south-east of the plain, are classified into five groups, which include longitudinal gaps, discontinuous slits, circular cavities, large holes and hollows. The destruction of agricultural land and irrigation canals has also led to a change in the slope of the land in some areas.

Water transmission networks and oil and gas transmission lines and other civil engineering projects, including the Tehran International Railways to Mashhad in areas of the plain, are in serious danger of land sinking and the resulting gaps. Reducing the volume and storage of water is another consequence of subsidence in denser plains.

Keywords: Ground land subsidence, cracks & fissures geomorphologic changes, Neyshabour Plain.
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