Land subsidence caused by groundwater exploitation in Quetta valley, Pakistan

Najeebullah Kakar[1]; Din Mohammad Kakar[2]; Abdul S. Khan[3] and Shuhab D. Khan[4]
[1]Irrigation Department, Government of Balochistan, Pakistan
[2]Department of Geology, University of Balochistan, Quetta, Pakistan
[3]Centre of Excellence in Mineralogy, University of Balochistan, Quetta, Pakistan
[4]Department of Earth and Atmospheric sciences, University of Houston, Houston, USA
najeebullahkakar991@gmail.com

Abstract

Land subsidence is effecting several metropolis in the developing as well as develop countries around the world such as Nagoya (Japan), Shanghai (China), Venice (Italy) and San Joaquin valley (United States). This phenomenon is attributed to natural as well as anthropogenic activities that include extensive groundwater withdrawals. Quetta is the largest city of Balochistan province in Pakistan. This valley is mostly dry and ground water is the major source for domestic and agricultural utilization. The unplanned use of ground water resources has led to the deterioration of water quality and water quantity in the Quetta valley. Water shortages in the region was further aggravated by the drought that hit the area forcing people to migrate from rural to urban areas. Refugees from the war torn neighboring Afghanistan also contributed to rapid increase in population of the Quetta valley. The population increased from 0.26 million in 1975 to 3.0 million in 2016. The objective of this study was to measure the land subsidence in Quetta valley and identify the effects of groundwater withdrawals on land subsidence. To achieve this goal, data from five Global Positioning System (GPS) stations were acquired and processed. Furthermore the groundwater decline data from 41 observation wells during 2010 to 2015 were calculated and compared with the land deformation. The results of this study revealed that the land of Quetta valley is subsiding from 20mm/y on the eastern flank to 120 mm/y in the central part. The level of groundwater drops at a rate of 1.5-5.0 m/y in the area where the rate of subsidence is highest. So the extensive groundwater withdrawals in Quetta valley is considered to be the driving force behind land subsidence.