University of Tabriz

Journal of Civil and Environmental Engineering
Volume 52 (2022), Issue 1 (Spring), 185-201

EXTENDED ABSTRACT

The Investigation of Groundwater Reducing and Geotechnical Parameters of Soil Impacts on Land-Subsidence by GIS (Case Study: Tabriz City)

Ramin Naboureh [a], Amir Hassan Rezaei Farei [a,*], Bakhtiyar Feyzizadeh [b]

[a] *Faculty of Engineering, Azarbaijan Shahid Madani University, Tabriz, Iran*
[b] *Faculty of Planning and Environmental Sciences, University of Tabriz, Tabriz, Iran*

Received: 08 January 2020; **Accepted:** 08 June 2020

Keywords:
FAHP, Groundwater level reduction, GIS, land subsidence, Interpolation, InSAR, Tabriz's geotechnical data.

1. Introduction

Land subsidence can be counted as a vital concern for human beings due to its harmful effects. The impacts of land subsidence can be seen in several forms, such as cracks in buildings, damage of infrastructures (roads and bridges), tilting and damaged houses, and increases in flooding inundation areas (Gumilar et al., 2015). Overusing of water and soil resources, which can threaten nature and human life, is considered as one of the main reasons for some natural hazards like land subsidence.

2. Methodology

Regarding the land subsidence risk as well as the fact that the reduction of groundwater level and soil geotechnical parameters are the main factors of land subsidence occurrence, in the present study, the impact of underground water level reduction and soil geotechnical parameters on land subsidence in Tabriz city were analyzed using Geographic Information System (GIS). In this regard, Fuzzy Analytical Hierarchy Process (FAHP) and Interferometric Synthetic Aperture Radar (InSAR) were used between 2006 and 2016. InSAR could be applied to derive land subsidence information with high spatial and temporal resolution and has been successfully applied to measure ground surface deformation in many countries such as the USA, Germany, Mexico, Italy and China (Chen et al., 2019). Five of the most important factors on land subsidence include underground water level fluctuations, volumetric density, SPT test results, land use type, and soil types applied in the FAHP model. First, land subsidence risk maps for Tabriz city for the years 2006 and 2016 were generated using radar data and the InSAR method. In the next stage, using reliable data, interpolation maps for every single factor were produced. After producing and standardizing all layers, Criteria weights were yielded and then the layers overlaid obtaining the final risk map of land subsidence.

3. Results and discussion

The findings of the present study illustrated that the West, South-west, and some parts of South and East of Tabriz had the higher risk whereas the North and North-west part of the city had the lower risk of land subsidence. The obtained result from the InSAR method also confirmed the FAHP's result and showed that the west, South-West, and some parts of East and South of the case study area had higher risk between 2006 and 2016. These two maps had some small differences in recognizing areas with low risk or very low risk in the

* Corresponding Author
E-mail addresses: nabore.ramin@gmail.com (Ramin Naboureh), rezaei.ah@azaruniv.ac.ir (Amir Hassan Rezaei), feizizadeh@tabrizu.ac.ir (Bakhtiyar Feizizadeh).

North-west and Central parts. The results of this research are of great importance for regional authorities and decision-makers in strategic land subsidence issues.

4. Conclusions

The results revealed that between 2006 and 2016, 5% of the city had very high subsidence, 17% with high subsidence, 25% with moderate subsidence, 23% with low subsidence, and 30% with very low subsidence also results revealed that the underground water level has an undeniable role on the land subsidence. Furthermore, soil parameters and characteristics showed their significant effects on the final maps; for instance, despite the notable decrease of underground water level in some areas of South and East of the study area land subsidence did not occur while it happened in the same places with favorable geotechnical parameters. On the other hand, according to the final map, although there were some areas that were favorable for land subsidence in terms of geotechnical parameters in the North of Tabriz, land subsidence didn't happen because of having low groundwater reduction.

5. References

Chen B, Gong H, Lei K, Li J, Zhou C, GAO M, Lv W, "Land subsidence lagging quantification in the main exploration aquifer layers in beijing plain, China", International Journal of Applied Earth Observation and Geoinformation, 2019, 75, 54-67.

Gumilar I, Abidin HZ, Hutasoit LM, Hakim DM, Sidiq TP, Andreas H, "Land subsidence in Bandung Basin and its possible caused factors", Procedia Earth and Planetary Science, 2015, 12, 47-62.