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EXTENDED ABSTRACT

Inferring Damage Effects of Subsurface Water Level Local Uplifting on Water and Wastewatwr Systems Using Analytical Hierarchy Process (Casy Study: Kerman City)

H. Riahi-Madvar[1*] and A. Seifi[2]

1*- Corresponding Author, Assistant Professor, Water Engineering Department, Faculty of Agricultural Engineering, Vali-e-Asr University of Rafsanjan, Iran. *(h.riahi@vru.ac.ir)*

2- Assistant Professor, Water Engineering Department, Faculty of Agricultural Engineering, Vali-e-Asr University of Rafsanjan, Iran.

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Introduction

With urban developments and the aging of urban water distribution pipes their demand for repair and maintenance is rapidly grown. There are several factors that affect the performance and leakage in water and wastewater distribution networks (Ameyaw and Chan, 2016). By increasing the water leakage from pipes and wastewater depletion from houses to the injection wells, water level under the city ground is rising and saturation condition will be created near the underground infrastructures. In recent years, local uplifting of subsurface water level in metropolises created different challenges over water and wastewater systems with multiple damage effects (Baah et al., 2015;Qiu et al., 2016).İn recent two decades, the rising of groundwater table in Kerman city have caused several challanges over the water and wasetwaer infrustructures. İn the ancint zone of the Kerman city, water level come up to 3 meter under the groundsurface and is interacted with several underground structures and basment flooding. The rising water table have several destructive effects over the urban infrastructures. The main purpose of the present study is to investigate the effects of rising subsurface water level in Kerman city by using an AHP based damage prioritization to depict the relative importance or urgency of a damages of water level rising over infrastructures.

Methodology

The City of Kerman as the case study of the present paper is located in the southeastern of Iran. It has an elevation of 1760 m from the sea level as the average altitude of the city. It has dry and relatively hot climate that suffers from water shortage and drought effects over the past decade. The city's water supply system is based on the groundwater transfer from nibeghour aquifers to the city. The city aquifer is composed of a soft clay and sand alluvial layers. The balancing parameters of water budghet in the city are mean annual precipitation: 140-mm, mean annual evaporation: 2050 mm, present population: 550,000, annual water usage: 40 MCM.. Currently, there are 75 water wells with average discharge of 1430 liter per second, two Qanats with 1550 litere per second, and a conveyance system of near regions having 80 km lenght with 600 liter per second discharge. These are three main sources of water supply for the urban demand. By water to wsetwaer conversion fraction of 0.8, there is a 2864 litere per second sewer dishcarge that infiltrats to the groundwater and causes the groundwater level rising .

As mentiond, The main purpose of this study is to identify, infer and weight the damage effects in Kerman city using analytical hierarchy process. Therefore, based on the analysis of subsurface

ground water level in Kerman city and investigating standards, regulations, guidelines in current references and expert opinions, damage indices ahead in 4 levels with 18 damage inferred are illustrated (Fig. 1). Ranking of damage preferences based on pairwise matrix and geometrical averaging of weights used for building group matrices. Inconsistency is controlled by I<0.1 and weight ratio and priority derived by AHP.

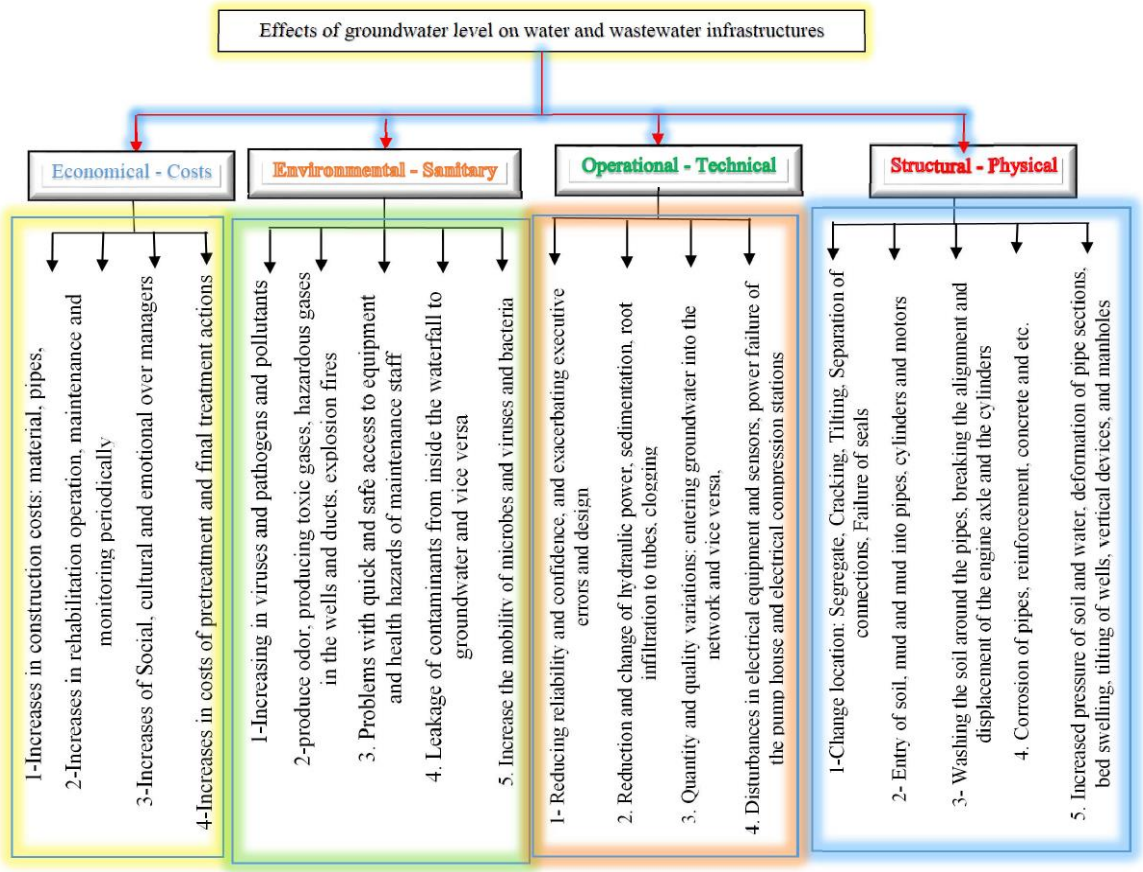
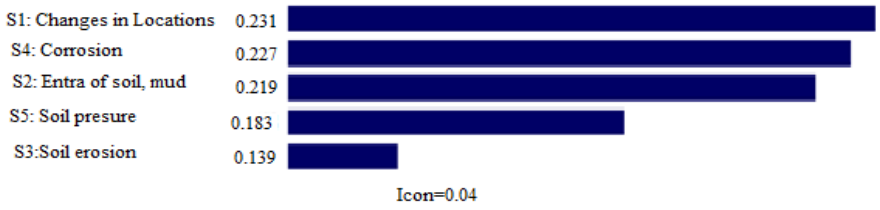


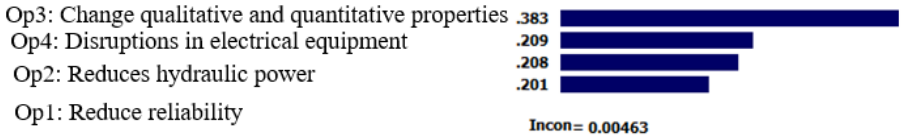
Fig. 1- Hierarchy process framework of subsurface level rising effects on water infrustructures

Results and Discussion

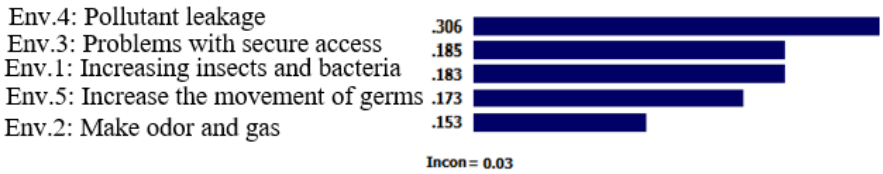
Based on the results that are provided for the model components in Fig. 2 it is decleared that, heath-environmental damages with a weight of 0.480, engineering-operational with a weight of 0.265, physical-structural with a weight of 0.145 and economics with a weight of 0.108 were ranked respectively. Sub-factors of structures displacement: subsidence, slope changes, junction and joint separation with a weight of 23.1 %, changes in quality and quantity of water and wastewater into network a with weight of 38.3, pollutant leakage from wastewater networks to the groundwater and reverse with a weight of 30.6%, primary and secondary treatment costs increasing with a weight of 32.1% were ranked as the highest damage inferences. Finally, sensitivity analysis of damages' weights and intensity was performed.



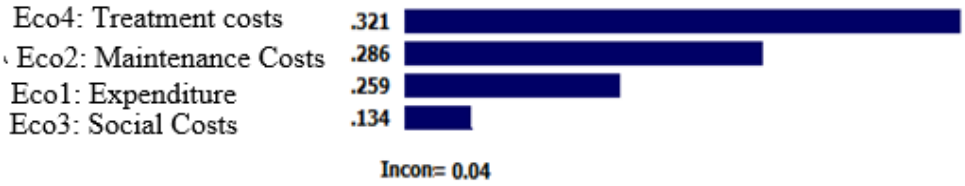
A) Structural - Physical damages



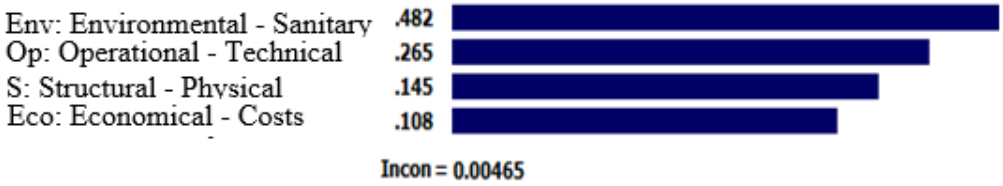
B) Operational - Technical damages



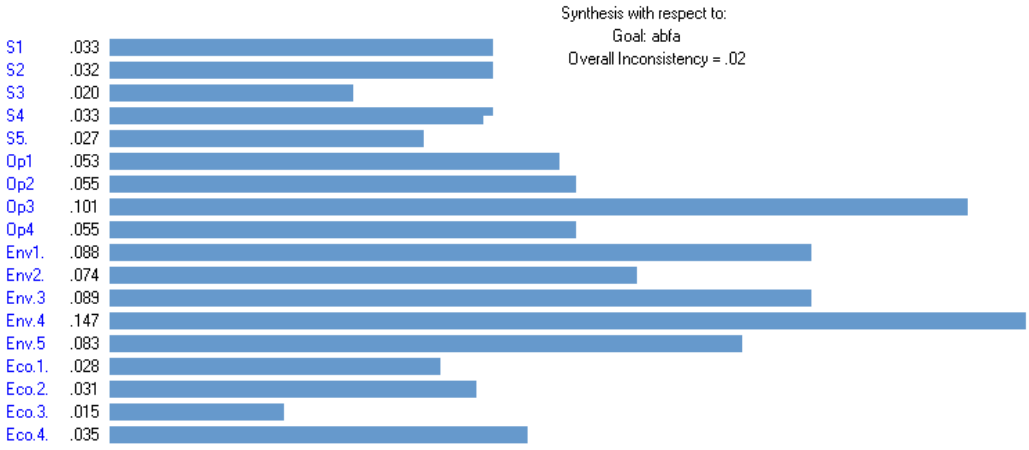
C) Environmental -Sanitary damages



D) Economical - Costs damages



E) Basic main level damages



F) Overall weights importance of damages based on the AHP framework

Fig. 2- Importance of each damage separately (A-E) and overall relative weights of subsurface rising damages on infrastructures

Conclusions

This paper showed that the AHP analysis is suitable to deal with complex decision-making problems, such as identification of the most severe damage threats contributing to better understand and decrease high groundwater level in urban areas. The environmental damages with 0.482 weight is the most important challenge, in second rank is the operational and technical damage with a weight of 0.265, the third one is structural damages with 0.145 weight and the final one is economic effects having a weight of 0.108.

Results of the study declared that retardation in developments of urban sewer networks simultaneous with the urban growth, especially in Kerman city that is located over an upper finer soil layer, will results in creation of several destroying factors of water and wastewater infrastructures.

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