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# Investigation of nitrogen contamination of important subterranean water in the plain

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**Abstract**

Subterranean is the most important method for exploiting groundwater in arid and semi-arid regions. There are 26 subterranean strings in Gonabad plain which 19.5 million cubic meters of underground water are drained from them annually. Low rainfall causes to the absence of permanent river in this districts, and the only living way in this arid area is the use of underground water by the subterranean. Some of the subterranean of this plain date back to 2700 years ago. Currently, subterranean water is used for agriculture, but the subterranean are still used as drinking water by direct harvesting from the subterranean crater. From the past to now, the water of Khoshvyy subterranean is also stored in water cisterns and used as drinking water. Because of very rarely amount of nitrogen compound in geology formations, the level of nitrate in underground water is normally low so that, except in pollution situation, the concentration of nitrogen ion does not exceed to 20 mg/l. The presence of nitrate in groundwater can indicate contamination of water due to contact with polluting sources such as municipal sewage, rural areas and landfills or irrigated agriculture. Due to increased urban activity and the production of more sewage, pollution of nitrate water resources is increasing. In this research, nitrate and nitrite levels of six important subterranean strings in Gonabad plain have been studied. The results show that Nitrogen content of groundwater in six subterranean strings is less than the World Health Organization Standard (50 mg/l). The highest amounts of nitrogen are 20 and 23 mg/l in the Rahn and Bidokht subterranean that both of them pass through the residential context due to leakage of domestic wastewater. High levels of nitrate (20 mg/l) in these two subterranean is indicator of beginning of contamination. The lowest levels of nitrate are in the Khoshvyy subterranean around about 10 mg/l. Nitrite content of subterranean water have also been analyzed which all of them were less than the permitted levels of the World Health Organization (WHO) (3 mg/l).

**Keywords:** Subterranean; Contamination; Nitrate; Nitrite, Standard Level

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## 1. Introduction

The largest amount of groundwater harvesting takes place through the subterranean in the Gonabad area, so that the amount of groundwater harvesting by 300 subterranean string is 30 million cubic meters annually, and by wells is around 11.8 million cubic meters in this region. There are 77 springs in the highlands of this region with an annual drain of 3.4 million cubic meters. Among the 300 subterranean strings in the Gonabad Basin, there are 26 strings in the plain with an annual drain of 19 million cubic meters. The rapid growth of the population, the expansion of polluting industries and the unconventional development of cities have caused to a critical state of water resources. The water contaminating factors in urban environments include industrial and domestic pollutants. The best way to keep the quality of groundwater resources is to identify

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sources of pollution and prevent water pollution. Urban polluting agents in the Gonabad plain include wastewaters from hospitals and health centers, slaughterhouses, small and large workshops, repair shops, petrol stations, utility units such as residences, baths and sewage of residential buildings and residential complexes which have contributed to the pollution of surface water and underground water. In addition, agricultural and livestock activities in this plain and the drainage of agricultural waters can also lead to pollution of groundwater.

Among the most important sources of groundwater contamination in urban areas are absorbent household and workshop wells. The most important factors that can contribute to the pollution of groundwater in urban areas include inappropriate design, location and position of absorbent wells, groundwater depth, geological formations, density or abundance of absorbed wells and their distance from water resources [16]. The large number of absorbed wells contributing to the pollution of groundwater in the alluvial aquifer of the cities can lead to pollution of the water so that in urban areas in alluvial plains, groundwater nitrate concentrations can increase up to more than 100 mg/l [9].

## 2. Experimental section

In order to investigate the amount of nitrogen compounds in groundwater of 6 main subterranean string of Gonabad plain, in May 2018, 6 water samples were taken from the fountain of the subterranean. Samples were stored in a cold container to reach the laboratory site and after 24 hours they were analyzed at the Hydrology Laboratory of the Faculty of Earth Sciences, Shahrood University of Technology.

## 3. Results and discussion

The results of water analysis of samples of the 6 main Ghanabad plain subterranean for nitrogen compounds are presented in Table 1. Two main nitrogen ingredient in groundwater is nitrate and nitrogen, which is discussed below.

**Table 1.** Nitrogen content in groundwater of Gonabad plain subterranean (in mg/l)

| No. | Subterranean name | Nitrate | Nitrite |
|---|---|---|---|
| 1 | Bahabad | 13 | 0 |
| 2 | Bidokht | 23.2 | 0 |
| 3 | Dizagh | 11.6 | 0.17 |
| 4 | Khoshvyy | 10.5 | 0.44 |
| 5 | Rahn | 20 | 0.44 |
| 6 | Ghasabeh | 14.9 | 0.5 |

### *3.1 Nitrate*

Nitrate, as the most extensive and common pollutant of groundwater, originates from human and urban activities [7]. Because nitrogen compounds are very rare in geological formations, so the amount of nitrate in groundwater is low, so that nitrogen ion concentration does not exceed more than 20 mg/l [8]. Existence of nitrate in groundwater can indicate soil contamination by contact with contaminating sources such as urban, rural and livestock exhaust wastewater or agricultural returns. Nitrate pollution is increasing due to increased urban activity and greater production of the wastewater [6]. Nitrate is water soluble and is not absorbed by clay-rich soils. As a result, after entering the nitrate to groundwater, it moves to the more and more depths in flow direction as a mass [10]. But the aquifer permeability and granularity of its constituent materials can play a role in the diffusion process of contamination. Typically, nitrate concentration is higher on the stop level of the water in the plant and decreases with depth increment and movement toward downstream area due to the diffusion, mixing and dilution with low nitrate water [13].

According to the WHO standard, the permitted amount of nitrate ion in drinking water is 50 mg/l. Generally, nitrogen in water may be exist in the form of nitrate, nitrite, ammonium and nitrogen in organic materials. High levels of nitrate ion in drinking water sources cause methemoglobinemia disease in a neonate. As a result of the disease, the color of the face is bruised and therefore also called blue baby. In adults, nitrates in the body become a carcinogen compound called nitrosamines and increase the incidence of gastrointestinal and bladder cancers. In addition, excessive amounts of nitrate in drinking water can cause goiter diseases, birth defects, gastric cancer and metaglobin in humans [11]. Nitrate causes the conversion of hemoglobin to metaglobin by intestinal bacteria, which its process is still unknown [12,14].

In order to study and survey the potential of contamination of the studied subterranean and to initial investigate the potential vulnerability of them, the water samples were analyzed for nitrate and nitrite ions in May 2018. The obtained values indicate that the amount of groundwater nitrate in the subterranean is less than the standard for drinking water (50 mg/l), so that the maximum amount of nitrate ion which observed in Bidokht and Rahn subterranean are 23.2 and 20 mg/l, respectively. And the lowest amount of nitrate ion is found in Khoshvyy subterranean is 10.5 mg/l. The passage of Bidokht and Rahn subterranean from rural and urban areas has led to the entry of household wastewater and nitrate contamination in water. Higher levels of nitrate from the baseline amount (20 mg/l) indicate that contamination has been started in these two subterranean. While nitrate levels are less than 15 mg/l in other subterranean. According to that the feeding of the

subterranean is carried out from highlands of Gonabad and from rural areas such as Sanu, Zabad, Kalat, Khanyik and Dysfan, the penetration of wastewater as well as agricultural activities in the villages causes to increase the amount of nitrate ions in the subterranean to 10 mg/l, and additional amounts is added due to the subterranean canal in the drought within residential areas. According to the World Health Organization, the maximum permitted amount of nitrate in drinking water in subterranean is 50 mg per liter which in the studied plain, measured of nitrate levels is less than the maximum allowable amount.

*3.2 Nitrite*

Nitrite anion has a brief stability (meta-stable) and is naturally found in waters because of the presence of organic nitrogen compound in the soil. In addition, absorbed wells can supply groundwater nitrite ions in the presence of free oxygen in the surrounding environment. But chemical fertilizers can increase the nitrite concentration in groundwater. Because that nitrite has a greater negative effect on the health of humans and animals, so its maximum concentration in drinking water is 3 mg/l which is recommended by the World Health Organization.

In addition to nitrate, the nitrite ion has also been analyzed to verify the vulnerability of the subterranean. Accordingly, the concentration of nitrite ions in the studied subterranean is lower than the permissible limit recommended by the World Health Organization and its maximum value is 0.5 mg/l in Qasat subterranean. In two subterranean of Bahabad and Bidokht, the amount of nitrite was very low and less than the detection limit of apparatus. Investigating the distribution of nitrite ions in the subterranean indicates a decrease in the concentration of nitrite ions in the groundwater of the studied subterranean. The denitrification process is one of the factors that increase the nitrite ion in the underground waters of the studied subterranean.

## 4. Conclusion

1. Subterranean is the most important method for exploitation of underground waters in the Gonabad arid area. There are 26 subterranean in the Gonabad plain, which 19.5 million cubic meters of underground water is extracted from them, annually. The study of nitrate and nitrite in groundwater of 6 main Gonabad plain subterranean indicates that the concentrations of these compounds in subterranean are less than the permissible limits recommended by the World Health Organization for drinking water standards. The amount of nitrate in two Rahn and Bidokht subterranean that they pass through the residential areas is at 20 mg/l, indicating the onset of contamination of these subterranean. The amount of nitrite in the subterranean is low and the highest nitrite content is measured at 0.5 mg/l in Qasat subterranean.

## Reference


2. Appelo, C. A. J. and D. Postma. 2005. Geochemistry, Groundwater and Pollution, Brookfield, Vermont Balkema, pp. 646.
3. Beatriz, A. H., M. Vega, E. Barrado, R. Pardo and L. Fernandez. 1998. A case study of hydrochemical characteristics of an alluvium aquifer influenced by human activities. *Air Water and Soil Pollution Bulletin*, 112: 365-387.
4. Cohen, S., S. Creeger, R. Carsel and C. Enfiel. 1984. *Potential for pesticide contamination of groundwater resulting from agriculture use*, in Krueger, R.R., and Seiber, J.N., eds., Treatment and Disposals of Pesticides Wastes, American Chemical Society, No. 259 ACS, Washington, DC, pp. 297-325.
5. Datta, P.S., D. L. Dab and S. K. Tyagi. 1997. Assessment of groundwater contamination from fertilizers in Delhi area based on $^{18}O$, $NO_3^-$ and $K^+$ composition. *Journal of Contaminant Hydrology*, 27: 249-262.
6. Fetter, C. W. 1999. *Contaminant Hydrogeology*. 2th Ed, Prentic Hall Inc., NJ, pp. 500.
7. Freeze, R. A. and J. A. Cherry. 1976. *Groundwater* Prentice Hall. Pp. 603.
8. Goulding, K. 2000. Nitrate from arable and horticultural land. *Soil and Management* 16: 145-151.
9. Hounslow, A. W. 1995. *Water quality data: analysis and interpretation*, CRC Press, pp. 397.
10. Jin, Z., Y. Chen, F. Wang and N. Ogura. 2004. Detection of nitrate sources in urban groundwater by isotopic and chemical indicators, Hangzhou City, China. *Environment Geology*, 45: 1017-1024.
11. Keeney, D. R. 1986. Source of nitrate to groundwater. *CRC critical reviews in environment control*, 6: 257-304.
12. Majudar, D. and N. Gupta. 2000. Nitrate pollution of groundwater and associated Human health disprders, Indian. *Journal Environment Health*, 42: 28-39.
13. Maila, Y. N., I. El-Nahal and M. R. Al-Agha. 2004. Seasonal variation and mechanisms of groundwater nitrate pollution in the Gaza Strip. *Environment Geology*, 47: 84-90.
14. Pawar, N. J. and I. J. Shaikh. 1995. Nitrate pollution of groundwater from shallow basaltic aquifers, Deccan Trap Hydrologic Province, India. *Environment Geology*, 25: 197-204.
15. Petakove, N. I. and A. V. Ivanove. 1970. Investigation of certain psycho physiological reaction in children suffering from metheamglobinaemia, *Hyg Sanit* 35: 29-32.
16. World health organization. 2017. *Guidlines for drinking-water quality*, pp. 631.
17. Yates, M. V. 1985. Septic tank density and groundwater contamination. *Groundwater*, 23: 586-591.