

## Groundwater pollution in the city of Zahedan, Eastern Iran

G. R. Lashkaripour

Department of Geology, University of Sistan and Baluchestan, Zahedan, Iran

### ABSTRACT

Zahedan, with a population of about 500,000, lies in the most arid area of Eastern Iran, close to Pakistan border. This city has shown the highest rate of population growth among the big cities of the country in the last two decades. Groundwater is the sole water source for the city. It is provided from an aquifer with an area of 120 km<sup>2</sup>. Groundwater pollution and problems in water supply appear to be the main factors preventing the sustainable economic development of the city. The quality of groundwater has deteriorated sharply since last several years owing to the following main factors.

- (1) Groundwater pumping has exceeded natural recharge in the Zahedan watershed since 1980, and groundwater level in the city has been declining because of low yearly rainfall (Precipitation in the Zahedan watershed averages 95 mm per year, mainly in the winter).
- (2) The city population is growing fast, especially after 1980, and the aquifer pollution by human activities is serious.
- (3) Uncontrolled and unplanned development of the city in the western part over the aquifer that is providing fresh water has led to the problem of overexploitation and further groundwater pollution.

At present, a massive federal project for the construction of 191 km long pipeline is in progress. It will fulfil the public demand of drinking water by bringing water from the Chahnimah Reservoir that is fed by the Hirmand River.

### INTRODUCTION

Zahedan is one of the newest cities among big ones in Iran. In the past, it was called Dozdab. Its official establishment began in 1923, i.e. about 8 years after the completion of the Zahedan-Koweiteh (Pakistan) railway. The fast development of the city was due to special geographical situation. Many settlers came from suburbs to this city and neighbouring Baluchs also moved in gradually. Consequently, the city's population increased from 38976 in 1966 to 419518 in 1996.

A rapid growth of the city in the last few decades, low yearly rainfall, and irrational use as well as pollution of groundwater caused severe drinking water problems in the city. At present, the impoverishment of water sources and low quality of water are known as the most important obstacles in the way of social and economical development of Zahedan.

### ZAHEDAN WATERSHED

The Zahedan watershed extends from Qatar Khanjak and Khash in the south to the Lar River in the north. It has an area of 1675 km<sup>2</sup>. The watershed is drained by the Lar River, and Zahedan is near to it. The watershed is surrounded by flysch from the east and north, and granites and granodiorites from the south and west. Flysch is composed mainly of sandstone and shale (Plate 1).

The aquifer with an area of about 120 km<sup>2</sup> occupies the northern portion of the Zahedan watershed. The thickness of aquifer varies from 20 to 100 m with the average thickness of about 45 m. The mean annual precipitation in the Zahedan watershed is 95 mm. It mainly occurs in winter, and potential evaporation averages approximately 2800 mm. The natural recharge of the aquifer is not known clearly. As noted by Lerner et al. (1990), one of the key difficulties associated with the assessment of groundwater resources is the estimation of the natural recharge.

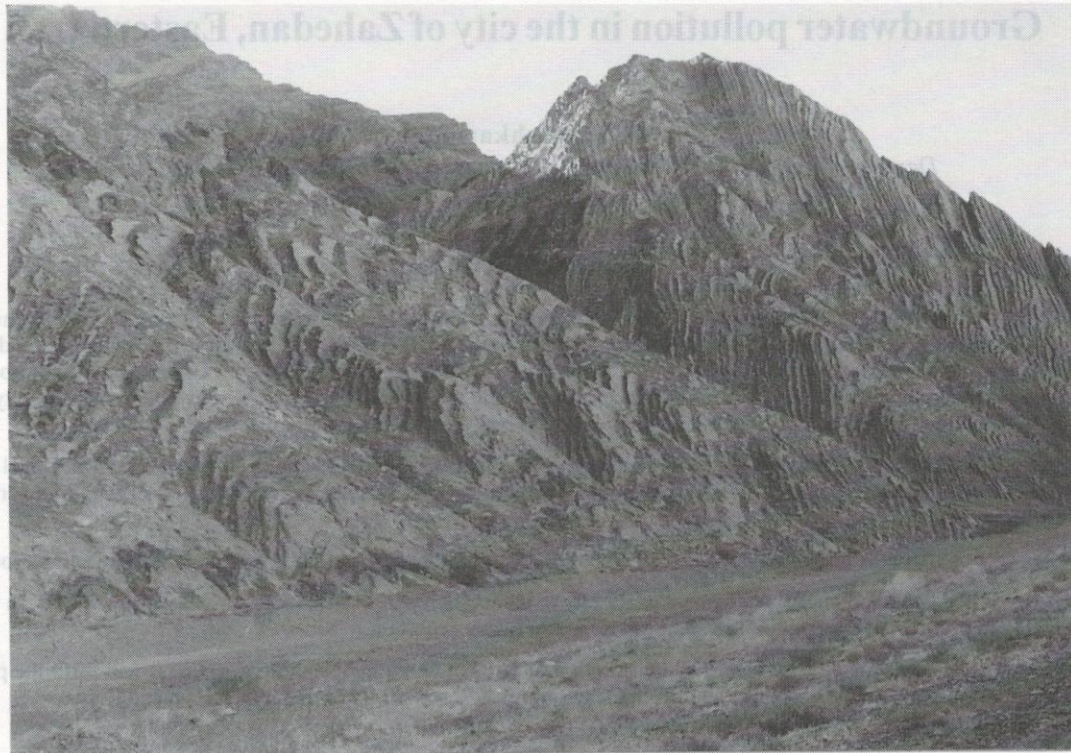
### GROUNDWATER POLLUTING FACTORS

The information on groundwater contamination in the city is poor. The traditional focus has been on estimation of water quantity, rather than its quality.

The quality of ground water has been deteriorating since 1966, and at present, the water supplied in the city is undrinkable. For example, in 1998, the values of total dissolved solids (TDS) reached 3635 mg/l from 2299 mg/l in 1966 and electrical conductivity (EC) reached 5370  $\mu$ mhos/cm from 3537  $\mu$ mhos/cm in 1966.

In recent years some factors caused the quality of groundwater to come down sharply and to become unusable gradually. Some of the factors are described below.

The city is expanding towards the western and southwestern parts of the aquifer, just over the groundwater



**Plate 1: Outcrops of flysch in the north of the Zahedan watershed**

sources. It has caused the pollution of water wells at the source. Many installations such as hospital, jail, university, gas station, and school are being constructed. The effluents from these installations will further pollute the groundwater in the near future.

There is no city sewerage system in Zahedan. It is one of the main factors leading to groundwater pollution, since the effluents can enter into the ground either directly through the deep wells or indirectly by percolation. Owing to carelessness of the citizens, the collection of polluted water can be seen in some places and it is also another factor that increases ground water contamination (Plate 2).

Groundwater pumping has exceeded natural recharge in the western part of the aquifer and the groundwater level has declined since 1980. It has caused the contamination of the fresh water by salty water from east and southeast. The occurrence of salty water in the eastern part of the aquifer is due to presence of evaporite deposits in the vicinity of flysch.

Another groundwater polluting factor is the location of city waste dump in the eastern part of the city, along the edge of the Zahedan-Pakistan Highway. The leachates from it contaminate the water entering into the ground.

The above factors have caused the water supply to become undrinkable in recent years. If this trend continues,

the pollution will cause the groundwater to become unusable even for non-drinking and agricultural uses in the near future.

### **WATER SUPPLY IN THE CITY**

The city water supply is not suitable for drinking purposes. At present the water supply from groundwater sources is about 18 lit/s and it does not meet the demands. Therefore, from 1998 forty tankers are allocated for supplying water from about 80 km east of the city (from the Ladiz village close to the Taftan mountains). Actually, the potable water is available in 13 stations located at various parts of the city. Plate 3 shows one of such stations. There are some people that take the drinking water by themselves from these stations. Moreover, about 200 private tankers and 500 vendors with handy carts also sell the water (Rahdari 1998).

Keeping in view the above situation, a massive federal project for the construction of 191 km long pipeline is in progress. The project is funded by the Ministry of Power and will be completed by the end of 2000. It will fulfil the public demand of drinking water by bringing water to Zahedan from the Chahnimah Reservoir that is fed by the Hirmand River. The Hirmand River originates in the Hindu-Kush Mountains in the east of Afghanistan.

*Groundwater pollution in the city of Zahedan*



**Plate 2: The polluted water accumulation in the northwestern part of the city**



**Plate 3: One of the public drinking water stations in Western Zahedan**

### CONCLUSIONS AND RECOMMENDATION

The available water sources of Zahedan do not meet the ever-increasing demands of the city. Zahedan is the social and political centre of the province and has a great importance. Therefore, it is necessary to do a comprehensive research for supplying drinking water for a long term in addition the Chahnimah project.

Uncontrolled and unplanned development of the city in western and southwestern parts over the aquifer zone has led to overexploitation and groundwater pollution. The location of the city waste dump should be transferred to the Kacheh-Rood watershed, which is a few km away from the

present location. The Kacheh-Rood watershed is not suitable for settlement and even if the groundwater is polluted, there will not be environmental problems. It is also necessary to establish a sewerage system to collect the waste and to prevent leaching into the groundwater.

### REFERENCES

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- Rahdari, A., 1998, Zahedan and its health problems (in Persian). Osvah Jour., No. 6, pp. 30-31 .

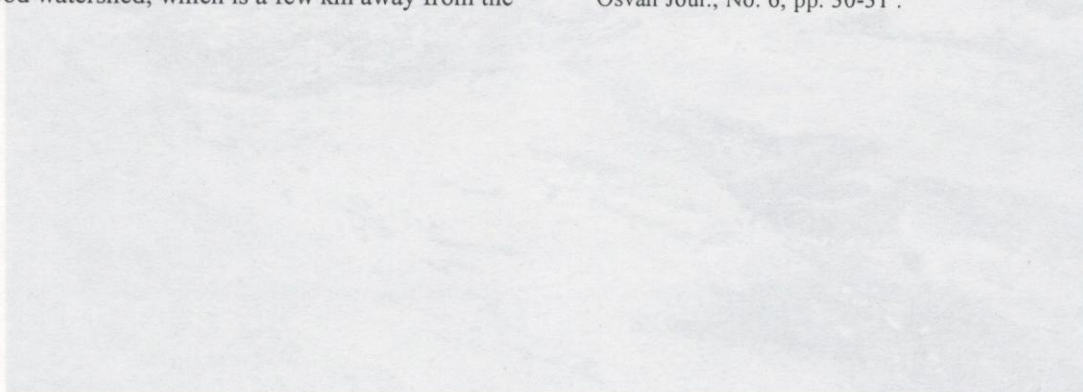


Plate 2: The polluted water accumulation in the northwestern part of the city



Plate 3: One of the public drinking water stations in Western Zahedan