Quality of Groundwater, Proceedings of an International Symposium, Noordwijkerhout, The Netherlands, 23—27 March 1981, W. van Duijvenbooden, P. Glasbergen and H. van Lelyveld (Eds.), *Studies in Environmental Science*, Volume 17

© Elsevier Scientific Publishing Company — Printed in The Netherlands

GROUND WATER QUALITY IN NORTHERN IRAQ

Tariq A. Mahmoud
College of Engineering, University of Mosul, Iraq.

HISTORICAL BACKGROUND

The history of ground water utilization in Northern Iraq begins in the qntiquity (about 7000 years B.C.). In the mountain regions springs were explicited for water supply, irrigation or orchards and for animals. Wells, 10 to 20 m deep were scattered all over the plain. These wells were mainly utilized for water supply and at times used as a strategic war tool. Underground tunnels locally called Kahreez (Fig. 1) were also developed to fulfill the needs of water, the remains of which are still found in the region.

During Assyrian rule northern Iraq was at the pinacle of civilization. Most of the development activity was centralized in this region because the capital cities of the empire namely, Ninevah, and Khorasabad were located here. The focal point of the development activity was proper water resource utilization. In the history, Assyrians are remembered as great warriors, but at the same time they made a mark as Water Engineers. They built canals, aqueducts, dams and flow regulating structures for controlling and utilizing water for the benefit of the people. While they took pains to provide water in sufficient quantity, at the same time they did not neglect water quality. In fact the water quality played an important role in the implementation of their water projects. The Tigris river on which Ninevah was located and even today is located, was considered too turbid for human consumption. For this reason and because of the drop inwater elevation in the Tigris river during low flows, Assyrian King Sencharib decided to transport good quality water from springs and rivers located high up in the mountains about 80 Km. North East of Ninevah. He built a canal and a giant aqueduct (Fig. 2) partly lined with stone that outweighed in total volume of what was used in the Pyramids.

STATUS OF GROUND WATER USE

Shallow dug wells were common household feature of Iraqi homes for water supply up to 1930 and even later. At times people apparently suffered from the poor well water quality due to the high sulfate and chloride content. As a matter of fact the use of wells having salinities in the range of 2000 mg/l for drinking were very common due to the shortage of water sources in some localities. In emergency, people use to drink much more saline water. Water with salinities up to 15000 or 16000 mg/l have been used for cattles in some north western regions of the country without definitely determined adverse effects. As a result of this people were forced to seek drinking water from other sources, thus limiting the use of such well water for other domestic needs.

However, the idea of exploiting the ground water for the well being of the region was never abandoned. According to Ingra (3) the first effort for developing water resources was started in 1953 with the investigation taken up by M/S Ralph H. Parsons Co. In 1954 M/S H. T. Smith Inc. undertook the drilling of 160 wells in the northern region. From 1959 to 1967 Ingra Consulting Department of Zagrab-Yugoslavia took up large scale program for ground water resource evolution all over Iraq. The programme included drilling of 346 wells out of which 114 were located in Northern Iraq. In 1976 and 1977 Coyne and Partners (4) investigated the north eastern region of Iraq. Part of their investigation included the chemical composition of 16 drilled wells, 13 dug wells and five springs,(Table 1). This study concluded that ground water in the area is suitable for irrigation as well as for drinking purposes. Presently, more extensive program for ground water development is taken up to cope with the all round rapid development in the country.

Previous studies did not rule out the possibility of utilizing the ground water source for irrigation at the same time stressing the need and importance of analysis and study before making large scale investment in implementing such agricultural projects. But the need for water and the ground water source being a convenient one, resulted into drilling of hundreds of wells in the last few years without proper consideration of water quality degradation or fast depletion of the ground water source. Presently, such projects are suspended awaiting for feasibility studies. However, Northern region of Iraq is more promising than that of the rest of the country for ground water utilization

Table 1 Areal-Variation of Ground Water Chemical Composition over the Project Area.

	Chemical Test	PH	EC $X10^6$	TSS ppm	Ca	Cations mg/l Mg	Na	K	Anions mg/l Cl	So_4	HCo_3	Co_3	No_3
Dug Wells	Range	7.5-8.2	348-677	310-626	32.96	16-30	4.5-26	0.7-20	14-105	tr.-105	164-305	0-19	0-18
	Average	7.84	488	420	58.9	25.9	12	3.86	34.2	20	243	5.93	8.14
Springs	Range	7.9-8.2	300-400	251-399	44-60	12-22	5-9	0.8-1.6	25-53	tr.-33.5	146-250	9 - 19	3 - 7
	Average	7.96	376	325	59.2	15.4	7	1.12	33.6	15.3	191.6	13	3.8

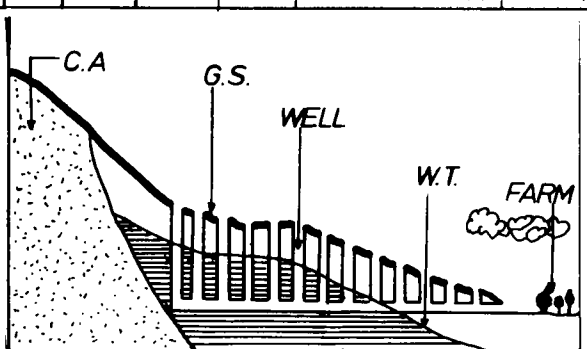

Fig. 1 Under Ground Tunnel (Kahreez) in Northern Iraq (after Malaika (1))

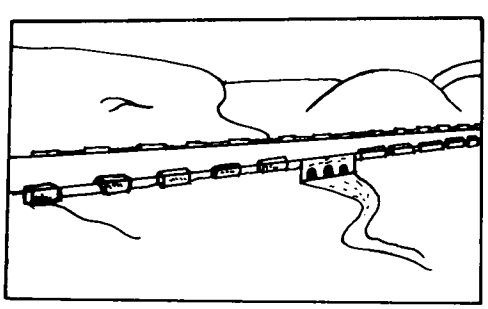

Fig. 2 The Giant aqueduct of Serwana built by Kind Sencharib 691 B.C. (after Maner (2))

specially for regions close to mountain areas where rainfall is higher than the average rainfall in the country ($\sim$ 300 mm/year).

DISCUSSION

The problem of underground water quality exists in Iraq. Therefore a well planned program for well location is important in addition to other protection techniques for drilled wells so as to safeguard the water quality. However, water mining concept should be avoided in such well location planning.

In general water quality of a good percentage of existing wells is considered satisfactory for domestic purposes specially in the background of limited alternatives of other water sources. High salinity of same wells is not considered a problem because of the limited industrial use of the water. However, high salinity of some of the wells is considered critical for agricultural use since salinity in fair percentage of wells exceeds the tolerance plant levels.

The impact of artificial pollution whether it is agricultural, industrial or domestic is still insignificant. But with the increase in the use of fertilizers, pesticides and other chemicals for increasing the agricultural yield the ground water quality could get adversely affected. In fact, high concentration of nitrates (40 - 200 mg/l) was observed in some wells located in areas where nitrates concentration normally ranges between 1 - 20 mg/l. Such situation could not be explained whether from hydrogeological or hydrochemical point of view.

Construction of Mosul Dam in the future and with that the development of 700 Km^2 of impounded reservoir in addition to the several hundred kilometers of channels will recharge the ground water, thus affecting its quality positively or negatively depending upon the original conditions of ground water.

Such changes have to be watched carefully and consequently ground water exploitation should be carried out keeping in view all of the aspects mentioned above.

REFERENCES

1. J.Malaika, Afak Arabia,Vol. 1,1979,Baghdad.
2. A.W.Maner,Public Works in Ancient Mesopotamia,Civil Eng.ASCE Vol.36, 1966.
3. Ingra Consult.Div.,Final Report on 100+14 Wells Programme,Mosul,1967
4. Coyne & Bellier,Final Report on Khazir-Komel Project,1978.