

THE IMPACT OF THE HIGH DAM ON THE QUALITY OF GROUNDWATER UNDER THE NILE DELTA,
EGYPT WITH EMPHASIS ON GREATER CAIRO PROVINCE

M.Sh. DIAB and I.H. HIMIDA, M.F. SALEH

Menoufia University, Egypt and the Desert Institute, Cairo, Egypt

ABSTRACT

The regulation of water quantities entering the Nile and its branches in the Egyptian territories after the High Dam construction affected the groundwater levels and quality under the Nile Delta region, this is the result of cancelling of flood effect and alteration of hydrologic relations after the High Dam.

INTRODUCTION

The Nile Delta region occupies a part of the northern extremities of Egypt. The hydrogeology and hydrogeochemistry of the Nile Delta is of importance, especially after the construction of the High Dam, as the regulation of surface water quantities entering the Egyptian part of the Nile basin directly affected groundwater levels and quality.

The study of the hydrogeochemistry of groundwater of the Nile Delta depends on the data of chemical analyses of the adjacent Quaternary aquifer of Deltaic origin directly recharging on behalf of the river Nile and its branches.

RESULTS

1- The deltaic deposits belonging to the Quaternary compose the main aquifer of the Nile Delta region, the total thickness of which ranges between 200 to 700 m from south to north, groundwater of Quaternary exists almost under partially confined conditions. The main replenishment of this water is from the Nile water.

2- The nature of the Nile course and its branches and the lithology of the Quaternary rocks permit direct interconnection between surface water of the Nile and canals from one side and the groundwater of the quaternary aquifer on the other side.

3- The examination of the constructed salinity maps of the Quaternary aquifer in 1970 before the effect of the High Dam had manifested itself, indicates that the salinity ranges between 300 - 500 ppm at the southern localities of the Delta region and greater Cairo locality. However, a slight increase in salinity values were detected towards the north. At the latitude of Tanta city the water salinity

amounts to about 1000 ppm. Immediately to the north of this latitude an abrupt increase in salinity was detected and salinity ranges between 5000 ppm to 4000 ppm near the shores of the Mediterranean Sea and adjacent lakes. (Fig. 1)

The examination of the constructed iso-salinity map of 1974, i.e. after the effect of the High Dam had become known, indicates that groundwater salinity of the Quaternary aquifer ranges between 300 ppm and 150.000 ppm from south going towards the north. The line of 1000 ppm salinity moved to the south of Tanta latitude, i.e. it creeps inland, which may be due to the lowering of the groundwater level permitting the interference of salt water from the sea.

4- The salinity of surface water of the branches and canals is increasing from south to north 8250 - 450 ppm). The salinity of the Damietta branch is slightly lower than that of the Rosetta branch, because the Damietta branch is always losing stream, while the Rosetta branch is now gaining stream along most of its course. Generally, the salinity and water quality of drain water are higher than that of the canals, due to the processes involved during the irrigation cycle.

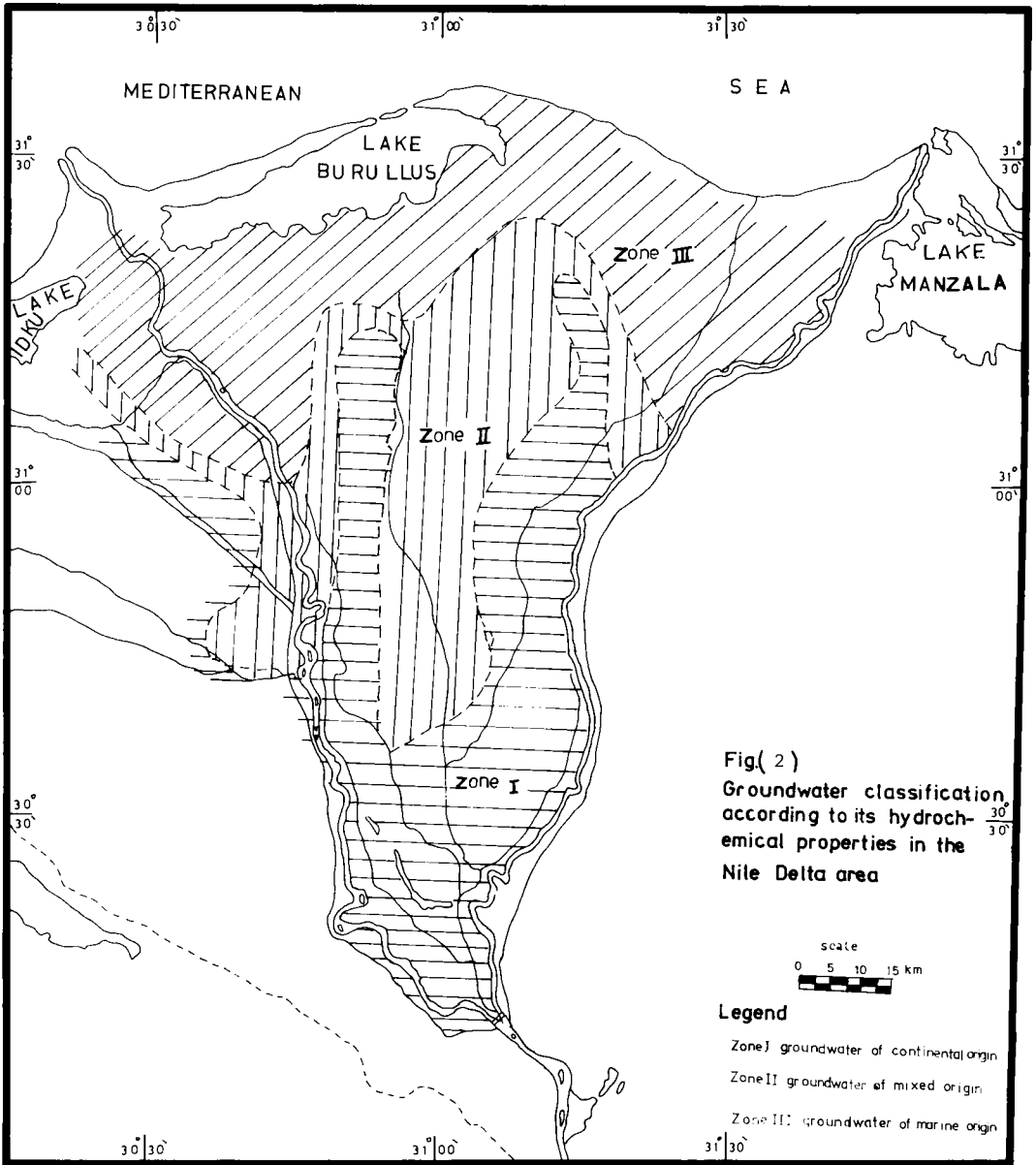
5- Before the High Dam construction there was a slight variation in the chemical composition of the groundwater in winter and of that in summer. These variations include salinity, type of salts and concentration of these salts. After the High Dam there are no significant variations in the chemical composition of both surface water and groundwater, because of the cancelling of the flood effect after the construction of the High Dam. (Fig. 2)

6- In the southern part of the Quaternary aquifer under the Nile Delta groundwater mainly contains dissolved bicarbonate salts $\text{Ca}(\text{HCO}_3)_2$, $\text{Mg}(\text{HCO}_3)_2$, NaHCO_3 , salts, whereas chloride salts predominate in the northern part of the same aquifer, with a gradational increase of sulphate salts. This salt distribution mostly continues after the High Dam, but with different ratios.

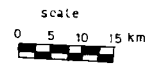
7- The hydrochemical ionoc ratios of the groundwater of the Quaternary aquifer exhibit a wide range, especially between the southern part and the northern part. In the southern part the ratios are greatly similar to those of river water, while in the northern part of the aquifer they are of a salt water nature, sometimes even exceeding the typical sea water. This may be due to a number of factors, the most important of which are the palaeohydrogeological conditions, in addition to those of the mixing of sea water, evaporation and solubility.

8- The quaternary water bearing formations, which dominate the area under greater Cairo, contain groundwater with a salinity ranging between 380 - 12.000 ppm. Groundwater chemical types are $\text{HCO}_3^- - \text{Ca}^{2+}$, $\text{HCO}_3^- - \text{Na}^+$, $\text{SO}_4^{2-} - \text{Na}$ and $\text{Cl}^- - \text{Na}^+$.

9- The number of viable bacteria per ml range between 9250 to 160 organisms at 22°C , and between 2750 to 32 organisms at 37°C . The number of viable bacteria in groundwater samples from the Quaternary aquifer under Cairo range from 400 to 2200 at 22°C , and 32 to 1400 at 37°C . The quantitative faecal coli test results are negative, i.e., groundwater of quaternary is satisfactory.



Fig(2)
 Groundwater classification,
 according to its hydroch-
 emical properties in the
 Nile Delta area



Legend

- Zone I groundwater of continental origin
- Zone II groundwater of mixed origin
- Zone III: groundwater of marine origin

Hydrochemical ionic ratios of the groundwater of the Quaternary aquifer compared to sea and river water

Hydrochemical Coefficients	Surface Water		Ground Water	
	Sea water	River water	From	To
$\text{Ca}^{2+} / \text{Cl}^{-}$	0.03	2.20	0.02	2.20
$\text{Na}^{+} / \text{Cl}^{-}$	0.85	1.79	0.58	>1.79
$\text{SO}_4^{2-} / \text{Cl}^{-}$	0.10	0.10	0.04	>0.82
$\text{Cl}^{-} / \text{CO}_3^{2-} + \text{HCO}_3^{-}$	>200	0.35	0.6	5231

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