

DETERIORATION OF QUALITY OF GROUNDWATER FROM SUANI WELLFIELD, TRIPOLI, LIBYA 1976-93

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ABSTRACT: The Suani wellfield, consisting of 52 pumping wells, is located about six kilometers south of Tripoli and is continuously pumped to supply the city of Tripoli with public supplies. In 1976, total dissolved-solids content ranged from 265-675 mg/l; however, sea water has moved inland as a result of heavy exploitation of the Miocene-Quaternary aquifer in order to meet the increasing water demand. Dissolved-solids content now exceeds 10,000 mg/l.

RÉSUMÉ: Le champ captant de Suani, composé de 52 puits de pompage, est situé à environ 6 km au sud de Tripoli; le pompage continu est destiné à l'adduction d'eau potable de Tripoli. En 1976, la minéralisation de l'eau variait entre 265 et 675 mg/l. La surexploitation de l'aquifère mio-quaternaire a provoqué une intrusion de l'eau de mer, du fait de l'accroissement de la consommation. La minéralisation de l'eau atteint maintenant 10 g/l.

RESUMEN: El campo de pozos de Suani, situado a unos 6 kilómetros al sur de Trípoli, presenta 52 pozos de extracción que son bombeados de forma continua para el abastecimiento de dicha ciudad. En 1976, el contenido total de sólidos disueltos oscilaba entre 265-675 mg/l. Sin embargo, se ha producido un proceso de intrusión de agua marina como resultado de la sobreexplotación del acuífero Miocénico-Cuaternario para absorber la creciente demanda de agua. El contenido de sólidos disueltos alcanza ahora un valor superior a los 10000 mg/l.

INTRODUCTION

The municipality of Tripoli is in the northwestern part of Libya, bounded in the north by the Mediterranean Sea (fig. 1). The population is approximately 1.4 million, with a total daily water requirement of about 330,000 m³ (120.5 mil m³/year). This quantity is supplied by more than 550 wells in wellfields or as scattered community wells.

The Suani wellfield is one of the oldest well fields designed to supply Tripoli with potable water. The wellfield is about six km south of Tripoli (fig. 1) and consists of 52 pumping wells, 42 of which were drilled between 1975 and 1978; the other 10 were drilled in 1988 and 1990. Their depths range from 85 to 147 m, and they are designed to tap the Miocene-Quaternary aquifer. Their discharge rate ranges from 25 to 128

m³/hour, with a corresponding drawdown of 2 to 15 m. Water extracted from these wells is collected into two main reservoirs and consequently supplied to consumers through a distribution network.

HYDROGEOLOGY

The Miocene-Quaternary deposits consist mainly of calcarenite, sandstone, and limestone intercalated with silt and clay. They are the main water-bearing formations in the study area. This aquifer is unconfined and is locally known as the shallow aquifer; its thickness ranges from 100 to 140 m. Transmissivity of this aquifer ranges from 2×10^{-3} to 3×10^1 m²/s, and its specific yield ranges from 4 to 10 percent. Depth to water level is 30 to 50 m below ground surface.

Table 1. Chemistry of groundwater, 1976 and 1993.

Well no.	Conductivity ($\mu\text{mhos/cm}$)		Dissolved solids (mg/l)		Cations (mg/l)								Anions (mg/l)					
					Ca		Mg		Na		K		HCO ₃		SO ₄		Cl	
	76	93	76	93	76	93	76	93	76	93	76	93	76	93	76	93	76	93
56	578	9,530	340	5,848	43	272	4	214	58	1,750	3	21	165	146	72	427	74	3,400
52	604	16,530	390	11,042	42	384	21	408	73	3,300	--	40	173	140	40	1,234	106	6,000
58	489	1,104	300	612	35	32	6	41	48	105	2	4	171	146	57	52	50	218
2A	574	8,980	415	5,546	60	272	15	194	65	1,550	--	20	175	142	78	240	85	3,200
4A	777	3,940	467	2,393	48	200	26	101	78	510	--	9	179	138	96	250	52	1,160
3B	819	9,360	594	5,980	49	256	29	194	118	1,750	--	23	185	142	124	412	138	3,400
7A	--	962	380	583	56	72	15	27	67	94	--	3	189	152	--	163	77	142
13A	539	16,150	330	10,788	41	416	6	370	57	3,200	3	72	183	148	82	993	53	6,000
75	785	4,980	540	3,142	57	166	34	124	--	820	--	9	194	136	--	278	107	1,600
77	867	3,960	520	2,421	51	128	10	49	80	660	3	10	204	154	105	89	117	1,240

Groundwater exploitation in and around Tripoli exceeds natural recharge, thereby causing a water-level lowering in the southern parts of the area and resulting in movement of the saline front farther inland. The water-level decline, as observed in a wellfield piezometer, is about 0.3 to 0.6 m/year.

WATER QUALITY

Water quality of the Suani wellfield is periodically monitored and water samples are collected for chemical analysis. Initially, water pumped from this wellfield was classified as fresh water. Total dissolved-solids content ranged from 265 to 675 mg/l in 1976. Dissolved-solids content has increased rapidly during the last few years and is now more than 10,000 mg/l. Figure 2 shows the increase of salinity and chloride concentration of samples from selected wells with time.

Table 1 shows the quality of some water samples from Suani wellfield in 1976 and 1993, respectively.

The results of chemical analyses are represented as salinity maps (fig. 3) and trilinear diagrams (fig. 4). Both figures show that the water of Suani wellfield is contaminated with sea water and that most of the wells are now pumping saline water.

CONCLUSION AND RECOMMENDATION

The over-exploitation of groundwater from the shallow aquifer (Miocene-Quaternary aquifer) to meet water demands in the vicinity of Tripoli is causing a continuous deterioration in water quality as a result of sea-water intrusion. Reduction of groundwater withdrawals from the shallow aquifer in the Suani wellfield and surrounding areas is recommended. The deficit in water supply can be made up either by construction of large-capacity sea-water desalination plants or by transporting fresh water from groundwater basins farther south.

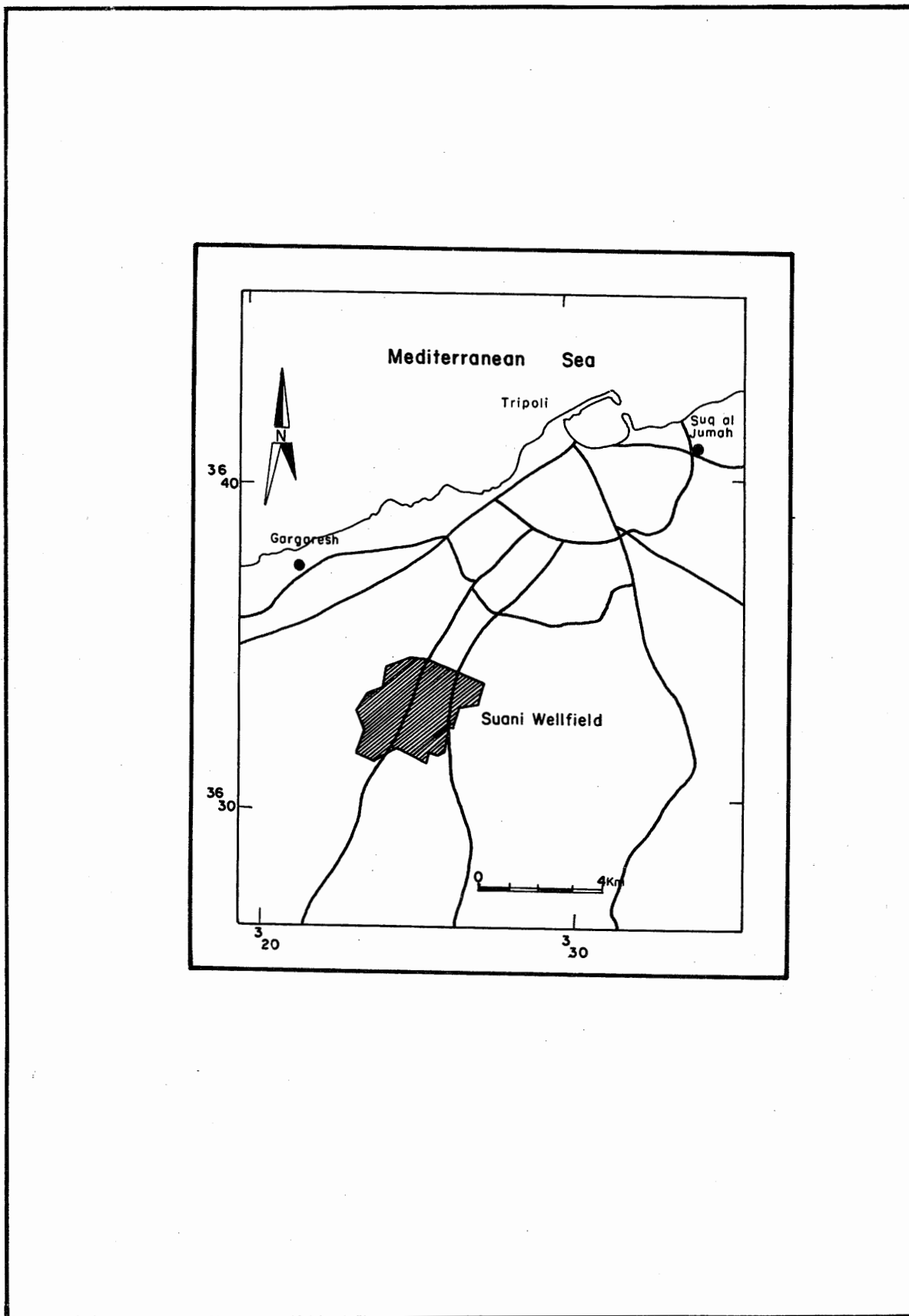


Figure 1. Location map of Suani wellfield, Libya.

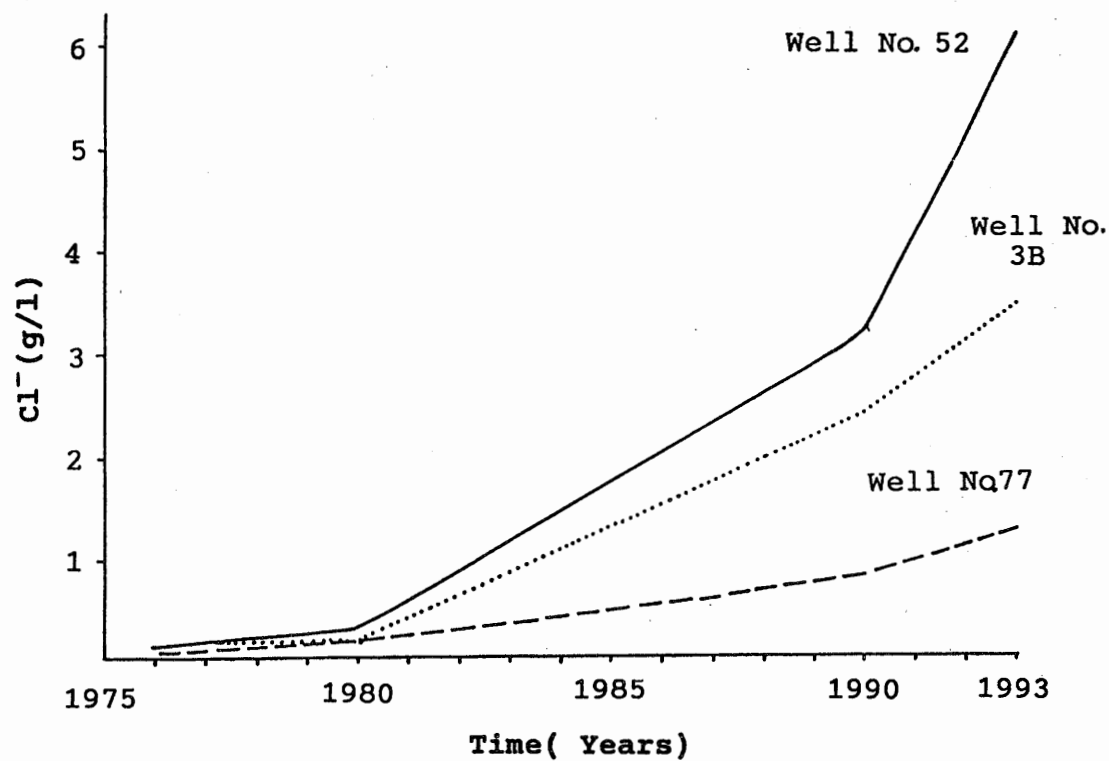
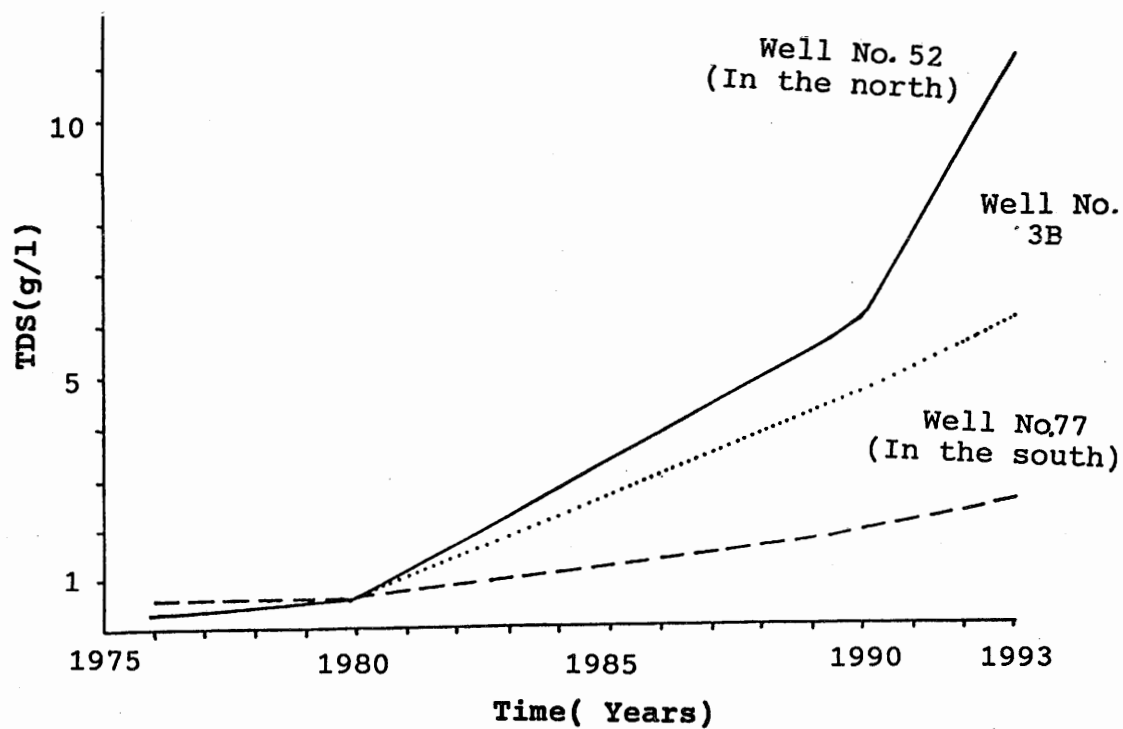


Figure 2. Increase of salinity (TDS, Total Dissolved Solids), and chloride (Cl) concentration with time. Well locations shown in figure 3.

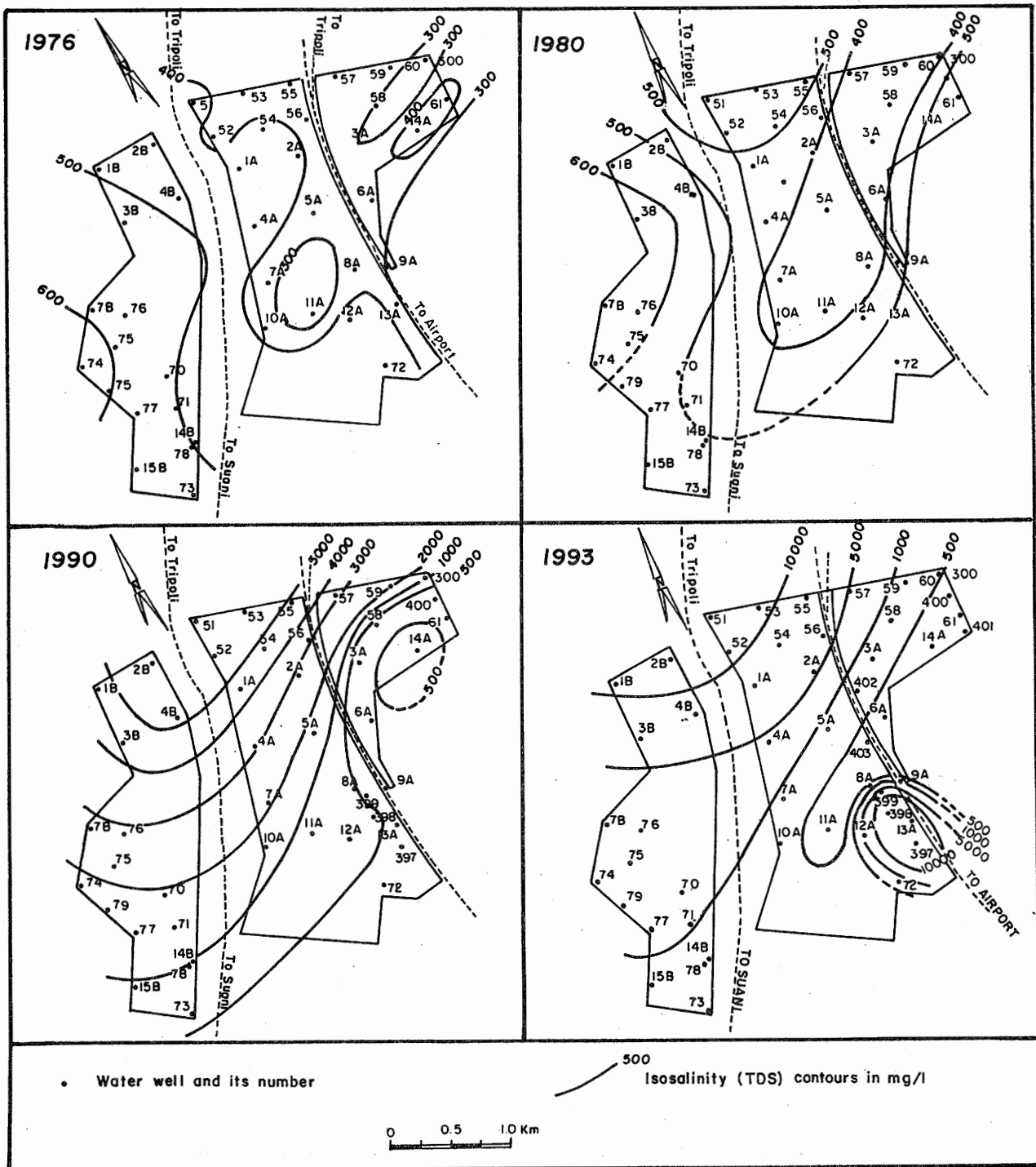


Figure 3. Salinity distribution, 1976-93.

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REFERENCES

- El-Baruni, S., and Hensher, H., 1993, Hydrogeological conditions of the Suani wellfield: General Water Authority, Tripoli (in Arabic).
- Floegel, H., 1979. Seawater intrusion study (Field Report), Gefara Plain Water Management Project: Unpublished report, General Water Authority, Tripoli.