

# Transboundary Groundwater Management: A Case Study for the Eastern Border of Egypt

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## 1. INTRODUCTION:

Groundwater resources are unique water supply in arid regions such as Sinai Desert and Negev Desert that locates along the eastern border of Egypt. The Eastern Mediterranean Aquifer (EMA) is crossing the border between Egypt and Gaza Strip. It is located in the coastal plain, along the eastern shore of the Mediterranean Sea. It is delineated on the World Map of Transboundary Aquifer Systems and depicted with number 502 (Struckmeier et al., 2006). It is defined on the world map as priority aquifer for water stress areas (Fig. 1). It is locally known as Kurkar Group (Calcareous sandstone, Sandy clay, Calcareous, clayey sandstone, Sandy limestone). Groundwater is recharged by precipitation at an average volume of 372 MCM/yr and generally flows westward toward the Mediterranean Sea. Groundwater is withdrawn primarily from sand, gravel, and Calcareous sandstone of Quaternary age (USGS, 1998). Groundwater levels are influenced by precipitation and pumping and generally fluctuate about 1–2 meters per year. Groundwater is generally of fresh water quality, with chloride concentrations between 50 and 250 mg/L. The EMA in Egypt has been greatly affected by pollution across the boundaries (Geriesh et al., 2004). The political situation is not stable and residents along both sides have continues emerging and unstable socio-economic conditions. The local inhabitants are greatly affected by deterioration of groundwater resources and spoiling soil environment. The EMA has been greatly deteriorated due to the continuous bombing for the border line. These aggressive activities may exaggerate the pollution of this aquifer that is used in Egypt for supplying drinking water and for irrigation.

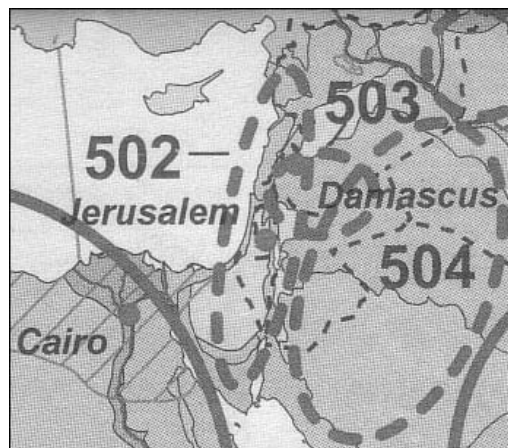


Figure 1: Distribution of EMA (no. 502) on the World Map of Transboundary Aquifer Systems (Struckmeier et al., 2006)

## 2. OBJECTIVES:

The specific objectives of this study include the following:

- Investigate the EMA aquifer (delineate aquifer hydrogeology, identify problems: pollution, bombing, issue of heterogeneity and governance issues)
- Review international practice in transboundary aquifer management and how it relates to the EMA case (emphasize on financial mechanisms such as benefit sharing and polluters pay)
- Formalize proposals for moving forward on the EMA management and possibly some generic recommendations for zones at war?

### 3. CHARACTERISTICS OF THE EAST MEDITERANIAN AQUIFER

The EMA Aquifer along the border between Egypt and Gaza strip is consists primarily of Pleistocene deposits (mainly calcareous sandstones). The total thickness of the aquifer is about 100m at the border zone (USGS 1998). The border zone receives an average annual rainfall about 300mm/y. Groundwater is mainly recharged by the rainwater. About 10% of the rainwater feeds the Quaternary aquifers in the study area (RIWR, 1988). The groundwater level is about 20 m below land surface, and average well yield is about 100 m<sup>3</sup>/h. Groundwater constitutes the main source of water supply for drinking, domestic and irrigation purposes. Groundwater is generally flows westward toward the Mediterranean Sea (Fig. 2) . Drinking well fields near the international border are suffering from pollution. Almost 90% of the groundwater wells of the Gaza Strip showed nitrate concentrations two to eight times higher than the WHO standards (Shomer et al 2008).

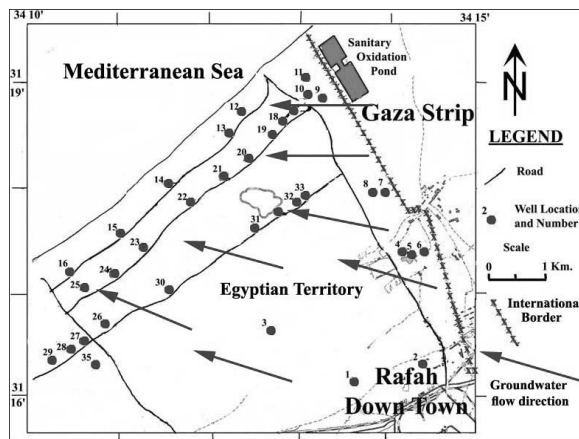


Figure 2: Distribution of wells, general groundwater flow direction and potential sources of pollution in Rafah environs.

The huge exploitation in both sides and subsurface activities along the border has facilitated the migration of contaminants towards the Egyptian territory. The physical nature of the EMA (calcareous and cavernous nature) facilitates migration of pollution across borders. The continuous Israeli invasions along the borders greatly threat sustainability of the aquifer. Aquifer vulnerability increases along the areas covered by sand dunes belts. The political setting is not stable and there is no water resources management institutions working regular in Gaza Strip. Egypt has strong institutions for water resources management but they do not give attention to water issues along their eastern border.

### 4. INTERNATIONAL CONVENTIONS GOVERNING SHARED GEOUNDWATER

Groundwater is first identified in Article II of the Helsinki Rules (ILA 1966). The United Nations' 1997 Convention on the Non-Navigational Uses of International Watercourses (UN 1997) is regarding the use, protection, preservation, and management of international watercourses for purposes other than navigation. It sets the principle of "equitable and reasonable utilization and participation in Article 5. Environmental considerations are injected into equitable utilization by internalizing the often competing values of development and conservation in the definition of the principle. Other principles of the Convention include the obligation not to cause significant harm (Article 7), the general obligation to cooperate (Article 8), and the duty of notification concerning planned measures with possible adverse effects (Article 12). Article V of the Bellagio Draft Treaty charges the international Commission assigned to implement the treaty with "the creation and maintenance of a comprehensive and unified database" that collects and catalogues information pertaining to transboundary groundwater, and is made available in the languages of the Parties (International Transboundary Resources Center, 1989). The Seoul Rules also dealt with protection of groundwater and urged the riparian states to consider the integrated management of their international groundwater, including conjunctive use with surface waters (Salman, 2007). There is confusion over the relationship between the principle of equitable utilization and the obligation not to cause harm.

Throughout history governments have found innovative and cooperative solutions to transboundary water management tensions, even in the most difficult political environments and conflicts (UNDP, 2006). Conflict among the Arab countries and Israel on sharing Jordan River in 1955 has urged third party (USA) to introduce plan for developing the region irrespective of the political issues and constrain the plan in economic context (Haddaden M., 2004). This plan has suggested unbiased Engineering Council for monitoring and execution of the development plan and commitment. This council consists of professional engineers selected by concerned parties from list prepared by the Secretary General of the United Nation. It is expected from the selected engineers to work as professionals and not as representative for the parties that have selected them. The members of this council should not be from the citizens or beneficiaries from the shared parties. There is international obligation of not to cause harm for water resources even during wars.

## 6. CONCLUSION

Groundwater supplies in the environs of Egypt-Palestine border are under severe stress due to severe exploitation and extensive air strikes and bombing. The specific hydrogeological characteristics of the Eastern Mediterranean Aquifer have facilitated the migration of pollution across borders. The water management institutions in both sides have failed to protect groundwater and have not the capacity and motivation to raise the issue. There is confusion over the obligation of not to cause harm for water resources and enforcement. It is necessary to have third party that can stop Israeli invasion and enable local inhabitants to have their groundwater environment clean. The potential mechanisms for addressing the transboundary groundwater issues along the border zone include: emphasize cooperation, setting independent groundwater management association, applying principle of polluter pay, enabling local inhabitants to sue parties causing harm to their water environment irrespective of their government help. It is necessary to run jointly funded research to assess transboundary aquifer problems, spread education and outreach and establishing aquifer management association.

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