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"Working towards a water resources management strategy for the Emirate of Abu Dhabi, United Arab Emirates"

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Working towards a water resources management strategy for the Emirate of Abu Dhabi, United Arab Emirates.

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Abstract Abu Dhabi Emirate has 75 times less available water per capita than USA and currently uses nearly seven times its natural renewable water resource. Consequently, there is an ever increasing reliance on unconventional water resources.

The Emirate is still in an accelerated development mode; the region has some of the largest population growth rates in the world. It is imperative that an overall, integrated Water Resources Management Plan is followed; the blue print for such a strategy is currently being finalized by the competent Abu Dhabi Government Agency, the Environmental Research & Wildlife Development Agency (ERWDA) and the main water resources issues and the phased development program for the formulation and implementation of the Water Resources Management Strategy is the focus of this paper.

Key words Abu Dhabi Emirate, database development, ambient monitoring, unconventional water resources, water resources management strategy, stakeholders.

INTRODUCTION

Abu Dhabi, one of seven Emirates that constitute the United Arab Emirates (UAE) is located in the Arabian Gulf (Fig.1) and has an arid to semi-arid climate with less than 100 mm/yr.

rainfall, 2000-3000 mm annual evaporation and no permanent, reliable surface water sources. It occupies an area of 67,000 Km², 86% of the total area of UAE and has the second highest per capita water consumption after USA. Population growth rates are currently about 4% /yr. and are forecast to rise to 6%/yr., giving a projected 2010 population for Abu Dhabi Emirate of about 2¼ million. Table 1 (Khouri, 2002) shows that UAE currently uses nearly seven times its renewable water resource. Consequently, there is an ever increasing reliance on unconventional water resources e.g. UAE is now the second largest user of desalinated water in the Gulf Cooperation Council countries (GCC) after Saudi Arabia.

The Environmental Strategic Plan for Abu Dhabi Emirate (2000-2004), developed and to be implemented by ERWDA, includes the development of a Water Resources Management Strategy Plan. The main water resources issues of the Emirate are described herein, along with the various steps which are to be followed in developing and implementing the strategy. For the plan to be successful, each step must be conducted with maximum collaboration and co-operation between all stakeholders in the project, both public and private.

WATER RESOURCES DEVELOPMENT

With the advent of the discovery and subsequent development of oil & gas resources in the 1960's, Abu Dhabi Emirate has developed in leaps and bounds. Only 30 years ago, less than 70,000 people relied on traditional water sources from a few hundred shallow dug wells and "aflaj" (gravity fed traditional water canals) and rain harvesting by means of collection in "cisterns". A population growth rate of >4%/yr. now gives a present day population of 1.08 million which uses over a billion m³/yr. of water. Fig. 2 shows that the Emirate's GDP is heavily dependent on revenues from oil & gas exports, but despite lower GDP between 1983-

1990, due to depressed international crude oil prices, the per capita consumption of domestic water continued to rise to the present level of nearly 1200/l/c/d.

Fig. 3 shows water sources for the Emirate from 1985 to 2000. Deleterious effects from over-abstraction from groundwater, from the two main aquifer types, alluvial gravels and aeolianite, has meant that the development & use of non-traditional water sources have increased significantly e.g. desalination production has increased from about 100 Mm³/yr. in 1985 to >400 Mm³/yr. in 2000. Within the UAE and Abu Dhabi Emirate there are now only 30 and 10 aflaj respectively, the latter being almost now totally supported by pumping from groundwater. Nevertheless groundwater still accounts for > 60% of all water used (Fig.4), with desalination & recycled water comprising the balance. About 85% of all water sources in the Emirate are used for agriculture (Joudeh, O, 2001). There are now over 20,000 farms and 1.7 million date palms, 13.8 million other productive trees and 19.6 million non-productive trees (257,000 ha. forestry) and over 300 ha under green-house cultivation. Over the last 20 years, the total number or irrigation wells has increased from 5667 to 59124, but the percentage of unproductive wells has also increased from about 10% to now over 25% of the total, reflecting the depletion of aquifer reserves.

WATER RESOURCES ISSUES & DIFFICULTIES

In order for water supply to keep abreast of domestic demands, the capacity of desalination plants has been carefully planned with more than adequate excess. Plants at four different site locations will have a combined capacity of >680 Mm³/yr. by the end of 2002. Coping with demands from agriculture and forestry development has proved more problematical with over-abstraction from groundwater causing rapidly declining water tables, water quality degradation, saline intrusion and upconing and Salinization of land leading to the

abandonment of farms. Groundwater pollution, through uncontrolled use of fertilizers, is also seen with significant Nitrate (N) levels in places reaching > 300 mg/l (Alsharhan, A et al, 2001).

There are presently numerous government bodies involved in the management and use of water resources in the Emirate, seventeen alone in the Eastern Region; the absence of a single, central authorized public authority for water hinders the development of a water resources management strategy. Within the GCC, the Emirate is not alone in this aspect. All GCC countries, with the exception of Oman, have never had a Public Authority or Ministry entirely dedicated to Water Resources. In the case of Oman, the Ministry of Water Resources existed between 1989-2001, but was dissolved in mid-2001 when it was amalgamated with the Municipalities and Environment Ministry. Similarly, there is no single, central water resources database developed for the Emirate; this is a goal of ERWDA. Other issues which largely affect the development and use of water resources in the Emirate are: a large and subsidized agricultural extension policy, a rapidly developing forestation program, need for strengthening groundwater protection and other water resources legislation, priority use of water, a recognition of the true economic cost of water supply and trans-boundary water resources issues - Abu Dhabi Emirate has a common 630 km International border with Saudi Arabia and Oman and is largely a down-stream water user. Large scale groundwater fed water supply schemes, presently being developed in Oman, for example, (Brook, M.C, 2001) and which are on or close to the border, need to be considered in any water resources management strategy.

Redressing the balance between supply and demand cannot be achieved by additional groundwater development alone and will need to incorporate unconventional water sources - development and research has been ongoing into the following fields: brackish/saline groundwater use, interception of groundwater losses, oil production water use, urban run-off

capture, reduction in urban distribution leakages, re-cycling wastewater, water import by bulk carrier/pipeline, virtual water policies, artificial recharge by way of dams (UAE currently has 64 dams with a combined capacity of 140 Mm^3) and aquifer storage and recovery and last, but not least, adoption of a conservative strategy through demand management.

WATER RESOURCES MANAGEMENT STRATEGY

One of ERWDA's six strategic environmental goals is the development and implementation of the first water resources management strategy for the Emirate. The objective of the strategy is to "manage the overall water resources of the Emirate of Abu Dhabi in a sustainable, economically viable and environmentally sound way that will allow the long-term socio-economic development of the Emirate of Abu Dhabi" (ERWDA, 2000).

The strategy development has been modeled on that described by the World Bank. (Le Moigne, G. et al.,1994). The project implementation plan is given in Table 2. The fist step of any management strategy is to assess the current situation; a comprehensive water resources assessment of the entire Emirate is programmed for the first two years, and will be assisted through external consultancy. The main deliverables will be database development, water resources balances and evaluation, interactive predictive modeling and a review of the existing water resources monitoring network. Step 2 in year two will follow with the detailed evaluation of management scenarios and proposed options of management for decision makers. During this stage, it is vital that all public and private stakeholders in the development of the strategy be given full responsibility according to their various capabilities and resources and that the process be totally collaborative and transparent in nature.

Step 3 involves choice of options provided in step 2. It is important that sufficient time be allocated for debate by government, with the involvement of all relevant stakeholders. The

final step is to implement and monitor the efficacy of the strategy. This will require the appointment of an Enforcement Agency, still to be nominated. The whole process is expected to take 5 years with completion in mid – 2008.

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Table 1 Water Use Sustainability in the GCC Countries

Country	Renewable Water Resource (TR)	Total Demand (TD)		TD/TR (%)	
	Year	2000	2025	2000	2025
U.A.E	315	2180	3200	692	1016
Qatar	51.4	347	485	670	943
Kuwait	160.1	590	1400	369	874
Saudi Arabia	6080	17765	24200	292	398
Bahrain	100.2	282	609	282	608
Oman	1468	1847	2430	126	169

Table 2 Water Resources Strategy Implementation Plan

Year	Step	Activities
1 & 2	Baseline Information & Database Development	1. Studies review, compilation & analysis of data. 2. Well inventory & Database Development 3. Water Balances and Groundwater Resources Evaluation 4. Predictive modeling, monitoring network review & In – house capacity training
2	Management Scenarios & Options	1. Technical arrangements to meet physical development of Water Resources 2. Institutional & human resources 3. Regulations for enforcement 4. Demand management sector use 5. International Agreements e.g. Trans-boundary water resources 6. Environmental & Heath Protection 7. Comparison of options
3	Management Strategy	1. Strategy developed from choice of most suitable options analyzed 2. Time allocated for debate by Government 3. Involvement of all stakeholders
4 & 5	Implementation & Monitoring	1. Program schedule for all tasks with stakeholder responsibilities 2. Monitoring & Enforcement of Strategy 3. Appointment of Enforcement Agency

Fig. 1 Location of Abu Dhabi Emirate

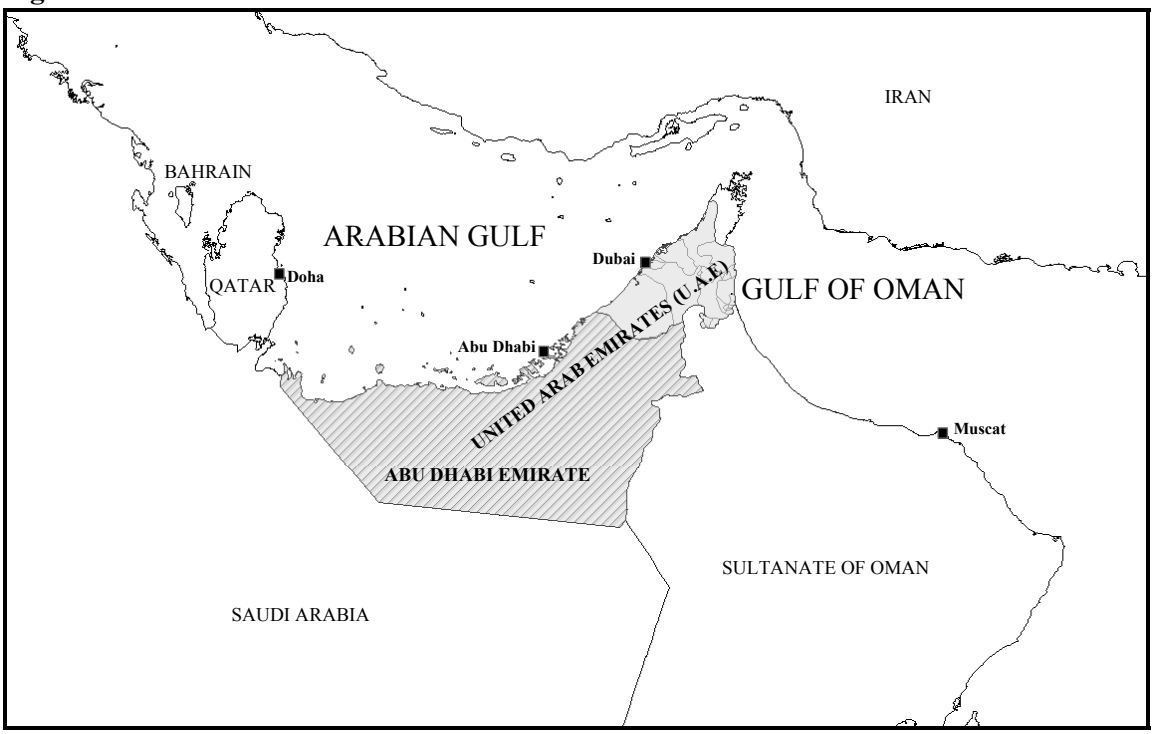

Fig. 2 Gross Domestic Product & Per Capita Domestic Water Use in Abu Dhabi

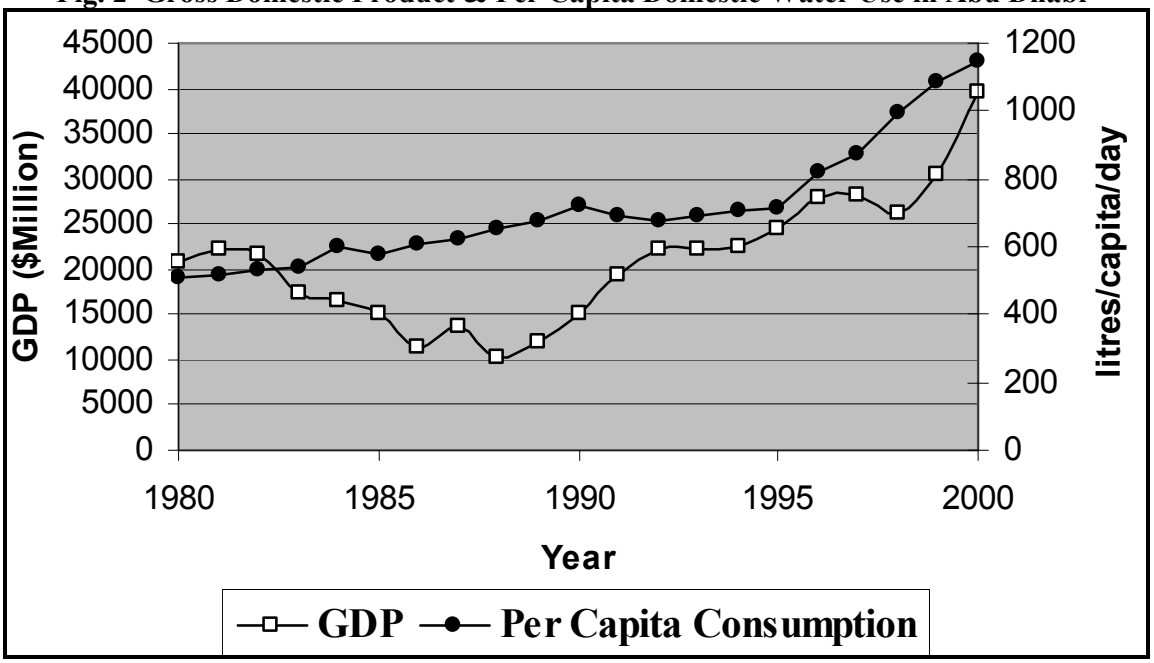

Fig. 3 Abu Dhabi Water Sources 1985 -2000

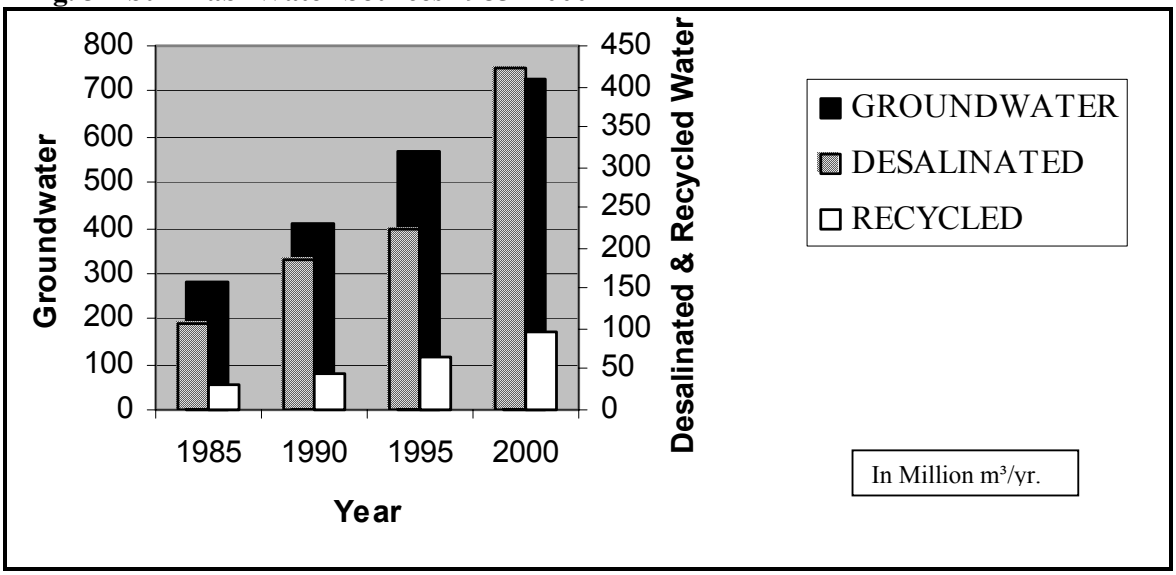

Fig. 4 Abu Dhabi Emirate Water Sources (2000)