

SUMMARY

Since the discovery of oil in the United Arab Emirates, the country's population has risen constantly. This has put considerable pressure on the natural resources and the infrastructure of the country, which has had to provide water, food and facilities for millions of new residents. This policy brief focuses on one natural resource in particular—water. The paper explores how economic boom and population growth triggered increased demand for water, and considers the question of whether population growth necessarily implies water shortages. The issues of water stress and water crisis at both the global and UAE levels are discussed. The paper also highlights the main challenges faced by the UAE in the water sector, and describes the remedies already being applied by the Government in order to tackle the water shortage. Finally, the brief provides several concrete policy suggestions on how to optimize water use.

The Water Challenge in the UAE

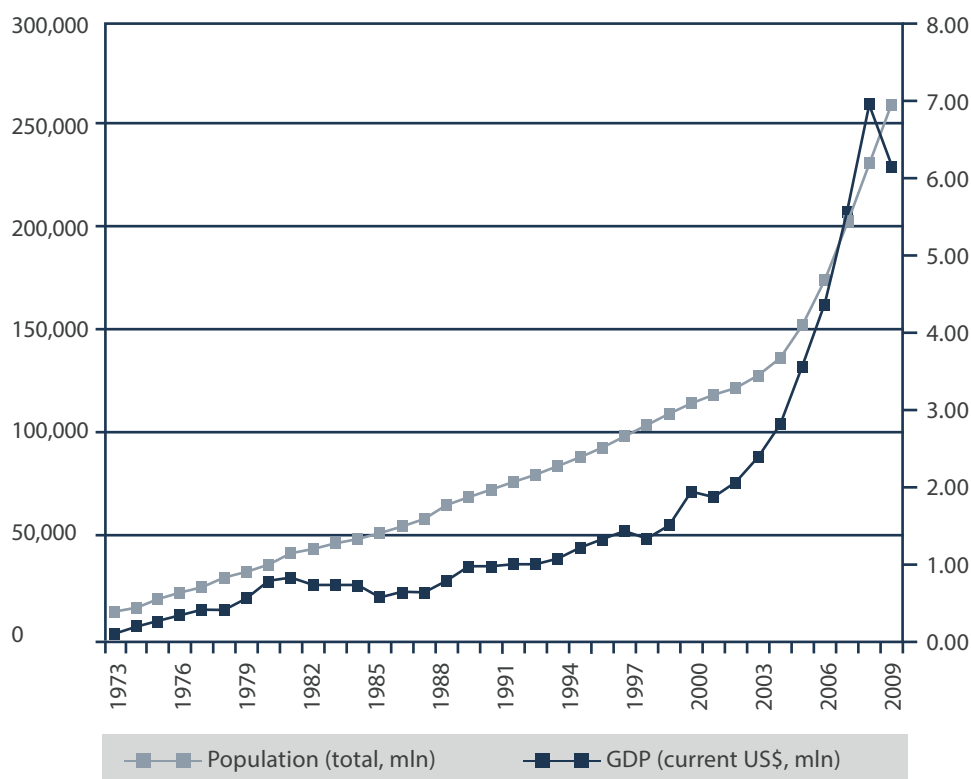
*"Water is life's mater and matrix, mother and medium. There is no life without water."*¹

By Sylvia Szabo

The Population Boom in the United Arab Emirates

The commercial exploitation of oil in Abu Dhabi began in 1962, bringing with it wealth and an increased demand for foreign labor. The UAE's GDP and purchasing power now rank it among the wealthiest nations in the world. Since its first census, conducted in 1968, the population has increased more than 40-fold.

Table 1: Population and GDP growth in the UAE



Source: Author's calculations based on World Bank indicators

At the regional level, The *Abu Dhabi Statistical Yearbook 2010* points out that in 2009 the population of the Emirate had grown to 1.643 million. This implies an average annual population growth rate² of 6.3% since 1975. During the last decade, Dubai's population more than doubled. It now exceeds 1.9 million, as compared to 826,000 in 2000 (AME 2001, Dubai Statistics Center 2011). The majority of the UAE's population



¹ Albert Szent-Gyorgy, Hungarian biochemist and 1937 Nobel prize winner for Medicine (1983-1986)

² The UN defines population growth rate as "average exponential rate of growth of the population over a given period. It is calculated as $\ln(P_t/P_0)/t$, where t is the length of the period. It is expressed as a percentage." <http://esa.un.org/unpd/wpp/Documentation/glossary.htm>

are expatriate residents, mainly from South Asia, but also from other Arab and Middle Eastern countries, Europe and North America, tempted by the country's job opportunities and accompanying salaries. In 2009, 70 percent of the UAE residents were foreigners (UN 2009), both highly skilled professionals and manual laborers.

While lack of space may not be a problem in the Emirates, meeting the demand for water and electricity remains an issue. In a country where arable land accounts for 0.1 percent of the total area, scarcity of natural resources combined with high consumption lifestyles triggers concern about the future. According to the recently published 2010 WWF report *Living Planet*, the per capita "Ecological Footprint" of the average UAE resident was the highest in the world. At over 10.7 global hectares, the indicator was four times larger than the global average, and at least 10 times higher than the ecological budget locally available (less than one global hectare per capita). Whether the UAE is overpopulated in relation to its resource capacity, and the country's "optimal population" remains to be estimated through in-depth analysis. It is nonetheless crucial to ensure, regardless of the number of residents in a certain territory, that resources are managed optimally in order to prevent their depletion. Water in particular is a key natural resource, and its availability and quality has received much attention at the global level and in the UAE.

Water Management as a Global Issue

Around 70 percent of the Earth's surface consists of water; however, 96 percent of the planet's water is saline. Of the remaining four percent, about 69 percent is trapped in ice caps and glaciers, while the remainder is mainly groundwater (US Geological Survey 2011). Thus, the amount of water readily available for human use is less than one percent of total water resources in the world.

Adequate supplies of clean and safe water are essential for socioeconomic development, and for the health and security of human populations. Some drastic consequences of a lack of water, or of bad water quality, include the spread of water-related diseases such as cholera, diarrhea or malaria, as well as transnational conflicts. As most rivers are shared

between countries, tensions may arise, especially between neighboring countries, over borders and riparian water rights.

The term "water crisis" has been used widely in academia and by international organizations. Jain and Singh argue that the term water crisis "denotes an overall scarcity of usable water of good quality as compared with the demand of the society to meet its domestic needs, to grow crops, to run industries, to generate energy, to maintain environment and ecology, for recreation and so on" (Jain and Singh 2010, 216).

Another term widely used when discussing water scarcity is "water stress," defined as "a condition where an imbalance occurs between water demand/need and water availability consumed for meeting the need" (Ali 2010). The relationship between these two parameters is measured using the Water Stress Index (WSI). Initially developed by the Swedish water expert Falkenmark in 1989, the WSI has since been widely used by the United Nations and other research organizations. The United Nations' map "Water Stress Level of Major River Basins" (UN 2009, 92) divides the world into nine areas based on their WSI (lowest WSI < 0.3; highest WSI ≥ 1.0). The UAE falls within the highest range, with a WSI of ≥ 1.0 . However, one of the limitations of the Water Stress Index is that it does not take into account the water potentially available from non-conventional sources, such as desalination or reuse.

It is interesting to notice the links between migration and water analyzed in "The 3rd United Nations World Water Development Report: Water in a Changing World" (2009). While it may seem obvious that population growth may cause stress on water and other natural resources, the report highlights a two-way relationship between the variables—while water stress drives migration, migration also contributes to water stress. The report states that "Water stressors, such as water scarcity and flooding, can trigger migration decisions," and points out that "If the natural environment becomes inhospitable, people are motivated to move to areas where their locally specific knowledge may no longer apply. Once people move, their places of destination must provide them with water resources, which can lead to further environmental stresses." (UN 2009, 32)

Water in the United Arab Emirates

The UAE climate is characterized by high temperatures, humidity and low precipitation levels. In the summer (May-October), average temperatures fluctuate around 40°C, whereas during winter they average around 23°C. The UN Food and Agriculture Organization (FAO) has reported that the UAE's long-term average precipitation rates are around 78 mm per year, as compared to 715 mm/year in the United States, 1274 mm/year in the Republic of Korea, or 207 mm/year in Tunisia. While the country experiences high temperatures and low rainfall rates, its rapid growth and urbanization have triggered an unprecedented demand for water. In addition, the luxury lifestyle and lack of conservation measures amongst residents has resulted in high levels of water usage and waste. It has been reported that in the UAE, per capita water usage is 550 liters per person per day, as compared to a global national average of 250 liters per person each day (Gulf News 2010).

The Dubai Electricity and Water Authority has been quoted saying that water supply increased by 4.58 percent between the first quarter of 2009 and the first quarter of 2010 (AMEInfo 2010). A recent report published by the Italian Trade Commission (ITC) entitled "Water, Energy, Technology and Environment Exhibition" (2011) states that "as per 2006 data, the UAE has, as most other countries, the biggest consumption for water in the agricultural sector, accounting for 67%. The UAE's water consumption by private households accounts for 24%, while only 9% is used by industry." However, in Dubai, private households account for around 60% of water consumption (ITC 2011, 12).

While demand for water in the UAE is growing, the country's resources are limited. Moreover, it is estimated that by 2050, per capita water availability in the MENA region will fall by half, with serious consequences for the region's already stressed aquifers and natural hydrological systems (World Bank 2007). Water used in the country comes mainly from groundwater and desalination. As per a presentation by the Environment Agency -Abu Dhabi, 72 percent of water used in the UAE comes from groundwater, 21 percent comes from desalination, while seven percent is retreated water (Environment Agency - Abu Dhabi). There are almost no surface water resources in the UAE.

In addition, it is feared that climate change may aggravate the situation. The UNDP's *Arab Human Development Report 2010* predicts that temperatures will increase by between 1.6° - 2.9°C by 2050, and by 2.3° - 5.9°C by 2100. Rainfall predictions, however, are less clear—it is estimated that rainfall level could vary anywhere between a 20 percent decrease and a 10 percent increase, as compared to average precipitation levels between 1961 and 1990. The potential impact of climate change in the UAE could include "severe shortage of water resources, increasing soil and water salinity in some coastal aquifers through direct salt water intrusion, and salinization of soil and water used for irrigation, [which] would threaten agricultural and food production" (UNDP 2010).

At a conference launching a report by the Environment Agency -Abu Dhabi (EAD), HE Majid Al Mansouri, Secretary General of the EAD, stated that "We are a country that already faces extreme climatic conditions and has precious natural resources, so long-term variations in temperature and precipitation will produce adverse impacts" (EAD 2010). It is interesting to note however, that the report itself asserts that the effects of climate change on water demand and supply are rather limited. Using several scenarios to project future water needs and availability, it predicts that climate change will have marginal effects on water demand (less than 5 percent), and that the relative impact of climate change on groundwater storage is "quite small." Rather, future water stress might be caused by continuous increase of water demand due to population growth, higher domestic water use, and policy decisions regarding irrigation of the agricultural and landscape amenity sectors. Water resource management, and technology innovations, are likely to continue to be key to sustainable development.

How is the UAE Addressing its Water Shortage?

The United Arab Emirates has been long aware of its water problem, and has so far responded to its rapidly growing water needs and dwindling reserves with a policy of increased reliance on desalination. Indeed, despite their considerable cost and related environmental issues, desalination plants are

becoming increasingly numerous throughout the Gulf States. It has been reported that GCC countries account for almost 41 percent of total global desalinated water output (Emirates 24/7, 2010). The UAE currently possesses 70 desalination plants, of which two-thirds are located in Abu Dhabi, with 18 percent in Dubai and the rest in the remaining emirates. Recently, Abu Dhabi launched a project for the largest underground reservoir in the world, which will contain 26 million cubic meters of desalinated water, to be used only in case of emergency.

The decreasing costs and greater availability of relevant technologies for desalinating water have contributed to this trend, although annual costs are still estimated at AED 11.8 billion (US\$ 3.21 billion). The World Bank claims that “breakthroughs in desalination technologies are responsible for a decline in the cost of desalinated water to a range of \$0.50 to \$0.80 per cubic meter, compared to more than \$1.00 per cubic meter five years ago” (World Bank 2011).

However, in addition to increasing supply through desalination, there is widespread realization at the political level that water management is required for further successful development of the country. A key milestone was the establishment of the Ministry of Environment and Water in 2005. In the last decade, the importance of water resource management and the reduction of water demand have been highlighted on numerous occasions, with awareness campaigns launched at both the local and national levels.

For example, in October 2007 the Ministry of Environment and Water launched the National Ecological Footprint Initiative (*Al Basma Al Beeiya*), which aims for a more “resource-conscious and resource-efficient Government and society” (UAE Interact 2007). The initiative is a joint project of the Ministry of Environment and Water, the Abu Dhabi Global Environmental Data Initiative (AGEDI), the Emirates Wildlife Society—World Wide Fund for Nature (EWS-WWF), and the Global Footprint Network (GFN). One of the main activities of the Ecological Footprint Initiative is an extensive nationwide data collection program across all sectors in the UAE, including fisheries, agriculture, water, energy, and urban planning.

Another way of curbing demand for water is through increased fees for water usage. In January 2011, DEWA introduced new water and electricity tariffs; however UAE nationals are exempt from the new tariffs for their houses and farms. Interestingly, in August of the same year, the Dubai Supreme Council of Energy announced that there would be no further increases of water and electricity charges over the next years. The whole tariff system is quite complex and part of a larger debate over the level of charges paid by expatriates and UAE nationals.

Legal aspects are becoming increasingly important when it comes to environmental regulation. The UAE has been working on water conservation law, which aims at laying out legal mechanisms for the management and use of water in the country. At the regional level, Abu Dhabi established a law requiring drilling contractors working in Abu Dhabi to have a drilling license. The Emirate also issued a number of other environmental regulations pertaining to water, including executive decisions on groundwater utilization and an administrative order regulating drinking water.

In agriculture, the Government introduced subsidies for farmers who reduce their production of water-intensive crops. Efforts have also been undertaken to explore alternative production techniques, including the use of sea water. There has been growing concern about reliance on foreign products and issues of food safety. Currently, the majority of agricultural produce in the UAE is imported. The country has been also securing fertile land in sub-Saharan Africa, including Ethiopia and Sudan.³

The Abu Dhabi Food Control Authority has recently launched the *Zera’atona* (“our agriculture”) campaign, which aims at mainstreaming agricultural policies, including enhancement of the legal framework and provision of support to farmers.

Finally, building platforms for the creation and exchange of knowledge contributes to tackling water scarcity. One of the key initiatives in this area has been the creation of the Arab Water Academy (AWA) in 2008 in Abu Dhabi. The Academy was established precisely with the aim of addressing the issue of water shortages in the Arab countries. The institution is building capacity in the region by bringing together

³ More on this fascinating issue at <http://www.guardian.co.uk/environment/2009/jul/03/africa-land-grab>

different aspects of water management, including training and connecting experts.

Future Population Trends in the UAE

As mentioned in the beginning of this paper, over the last four decades the United Arab Emirates has experienced unprecedented growth in both wealth and population. As the country’s economy has boomed, migrants from throughout the world have come to take advantage of job opportunities. Consequently, rapid increase in population has placed considerable stress on the UAE’s natural resources, with the most significant impact on the country’s water supply.

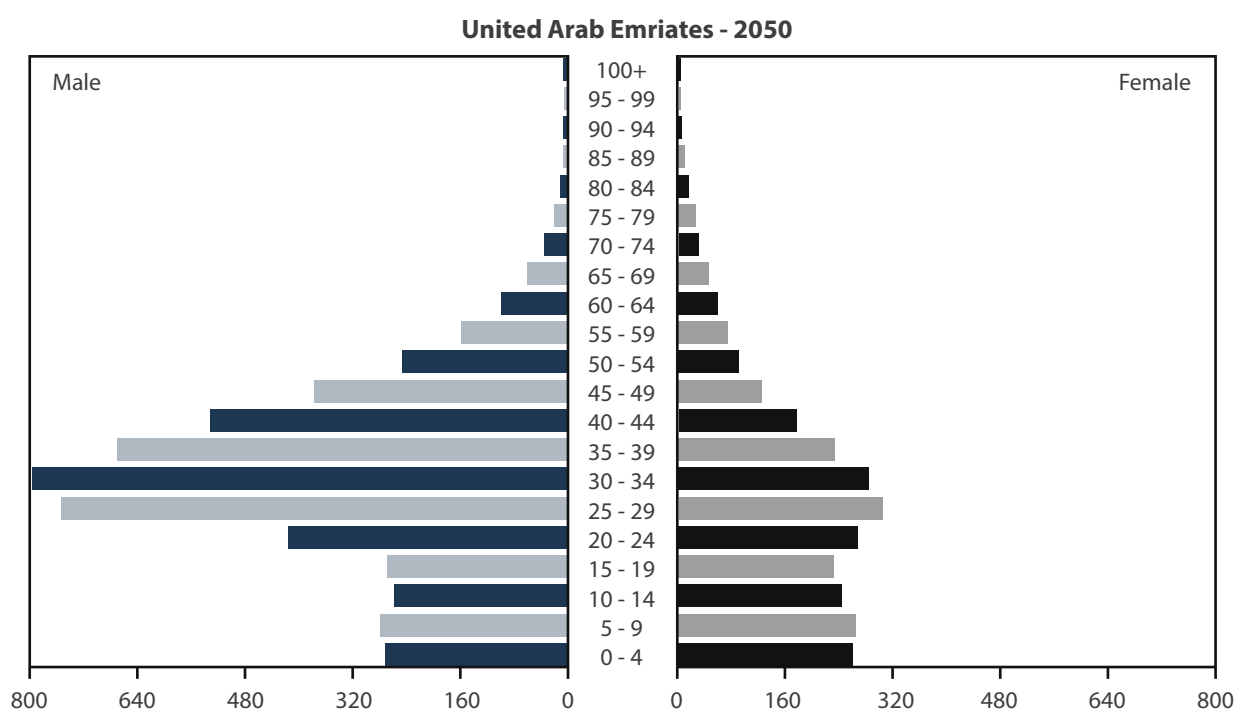
We have seen at the beginning of this paper that the population rates in the country have grown rapidly. The current net migration rate⁴ is estimated to be at around 106 (2005-2010), but is projected to decline (UN, *World Population Prospects, 2010 revision*).

While the UAE’s population is projected to continue to grow, it is likely that the growth rate will be much lower in comparison to historical trends. Immigration is most likely to continue to be the primary source of population increase,

complemented by the relatively high fertility rates of the citizens. It is important to point out that although total fertility rates have recently been reported to drop by half, aggregate fertility rates in the UAE may be misleading. This is due to the fact that the majority of the population are non-nationals and, therefore, their children may either reside outside the country or have been born outside of it. This skews the overall data.

In addition, when talking about population growth and its impact on resource management, one should not neglect the effects of technological advances. One example of technological progress is in the area of water desalination, where work is progressing toward lowering the costs and negative environmental impact of this process. In fact, the UAE has already started ecologically friendly desalination plants, and the cost of the operation is reported to have gone down. Technological progress in other domains, such as transport and communications, will also have a positive impact on natural resource management. International trade in an ever more globalized world, sharing of information and know how, and innovations in agriculture and manufacturing will all go a long way towards efficient resource allocation.

Table 2: 2050 Population Pyramid for UAE (projected)



Source: US Census Bureau, International Data Base

⁴The UN defines net migration rate as “The number of immigrants minus the number of emigrants over a period, divided by the person-years lived by the population of the receiving country over that period. It is expressed as net number of migrants per 1,000 population.” <http://esa.un.org/unpd/wpp/Documentation/glossary.htm>

Policy Implications

There are two areas of policies which should be considered when assessing population's impact on water resources. The first area falls within population policies, and the second one deals with water management strategies. First, let us consider population. Because of the high net migration rate in the UAE migration management in the country should be a key element of population policies. We will not consider here fertility, as aggregate fertility rates in the country (for both UAE nationals and foreigners) are low (estimated at 1.9), and as such they are not a major factor in population increase.

As a result of the need for both cheap labor and skills, the UAE has had a fairly open policy towards migration. While in 1976 the UAE considered its level of international migration as satisfactory, the Government has since expressed the view that it is too high, and the official policy aim is to lower immigration. As Shah points out, "a focused strategy on the part of several GCC countries is to pinpoint the occupations where phasing out of expatriates will be done on a priority basis" (Shah 2006, 9). In the UAE, the banking and PR sectors are given as examples of such occupations. Recently, employers in Dubai are subject to a new work permit quota system and are required to obtain pre-approval in order to sponsor individuals for work permits. Similar regulation has also been introduced in Abu Dhabi. Different administrative and other fees are on the rise, including new healthcare provisions where foreigners are required to have a medical insurance or health card in order to obtain work permits and growing charges for attestations confirming foreign degrees.

While migration policies are often sensitive, if not controversial, it is hardly arguable that effective migration management is required as part of population control strategy. Development of holistic migration policies at the national level is necessary in order for the country to be able to estimate the needs of its residents and provide required services. A top down system rather than a disperse scheme of private sponsors, possibly similar to those in Canada, Australia or UK, could therefore be adapted in the future. By eliminating intermediaries/sponsors, a comprehensive national system would also help curb "visa trading."

The second aspect of the issue of population growth's impact on natural resources is natural resource management itself. Earlier in this paper, it was pointed out that water consumption in the UAE has increased consistently, due to population growth and high per capita private water usage. Pressure on agricultural produce has been a direct consequence of population boom. It was highlighted that the authorities, both at the national and regional levels have been increasingly aware of the potential "water crisis" and, consequently, a number of actions have been undertaken to prevent water shortage. These include awareness campaigns, further enhancing policy frameworks, looking for innovative solutions in the agricultural sector, and investing in know-how.

Importantly, desalination is breaking ground with new eco-friendly technologies. Such eco-friendly large-scale water production processes will be crucial in the future decades, and therefore further investments in research and innovation are needed.

In the agricultural sector, technology research, as well as further enhancements in the regulatory framework, are key. Support to local farmers, focus on water-saving irrigation technologies and use of wastewater will all need to be part of an overall agricultural policy framework. These are already being developed, in particular in Abu Dhabi. When it comes to imported food, continued tight controls of the quality of imported produce as well as stockpiling of key crops (as with water reservoirs) needs to be further developed. Transnational cooperation, already taking place, is also important.

At the individual level, public awareness campaigns should be expanded in order to reach large audiences. Conservation should be encouraged, not only through awareness campaigns but also through high tariffs for exceeding certain ceilings for both Emirati nationals and foreigners. Immigration authorities could include water and electricity awareness raising in the standard visa application process. Integration courses could be designed for non-nationals, including guidelines on water saving.

The system of existing water subsidies should be reconsidered. It has been reported that water is currently sold at 25 percent below its cost price (Global Water Intelligence 2009-2010). Subsidies could be only given to those who have made an

adequate saving of water over a given year, or to low-income families.

Decision makers at all levels need to be involved in water management strategy. Water resources should be evaluated and monitored, and both trans-regional and transnational cooperation should be made a priority. Water issues should be included in cross-sectoral policy agendas covering other areas affecting water, such as trade, manufacturing, agriculture, or migration. Indeed, the UAE could become a leader in advocating for water and sanitation issues at the global fora, such as the UN.

On the supply side, further investments in clean, eco-friendly desalination are recommended, together with investments in storage facilities. Cooperation with “water rich countries” and other states facing similar problems, including neighboring countries, but also such states as Singapore or Australia, is important. It is only through technological advances, an adequate regulatory framework, and close cooperation with others that population growth will not constitute a threat to the UAE’s water resources, but an opportunity for further socio-economic development of the country.

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