Wealth generated by oil revenues:

- Drastic changes in population size:
  - x 16 in the last 30 years
  - in 2000: 3% population growth
    (World average= 1.3%)

- Drastic changes in the environment:
  roads, housing, forestry, agriculture...

Ex: The total cultivated area has increased by 26 % per year since 1989 in Abu Dhabi.

Brook et al. (2006), Dawoud (2007), EAD
• UAE arid climate with:
  - < 100 mm/year average rainfall,
  - high evaporation rate (2-3m/year),
  - low groundwater recharge rate (<4% of total annual water used)

• Traditional systems: falaj in mountains & hand-dug well in desert

➢ Increase of demand: dams in mountains, drillings in desert, desalination plants on the coast

<table>
<thead>
<tr>
<th>Country</th>
<th>Litres per person</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abu Dhabi Emirate</td>
<td>525 – 600</td>
<td>overall</td>
</tr>
<tr>
<td></td>
<td>160 – 220</td>
<td>flats only</td>
</tr>
<tr>
<td>Australia</td>
<td>268</td>
<td>urban residential only</td>
</tr>
<tr>
<td>USA</td>
<td>305</td>
<td>figure for 1980</td>
</tr>
<tr>
<td>UK</td>
<td>141</td>
<td>metered</td>
</tr>
<tr>
<td></td>
<td>153</td>
<td>unmetered</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>113</td>
<td></td>
</tr>
<tr>
<td>Hungary</td>
<td>102</td>
<td></td>
</tr>
</tbody>
</table>

Source: Bureau calculations for Abu Dhabi, and OECD (1999), the price of water: trends in OECD countries
In GCC, groundwater abstractions to total demand: 68% (Kuwait) to > 90% (Bahrain)

In Abu Dhabi Emirate, in 2005:

• ca 79% of all water sources (ca 2.5 billion cubic meters/year abstracted)

• 75% of the water taken by agriculture, forestry and amenity plantations

Brook et al. (2006), Dawoud (2007), EAD
A tremendous pressure on arid ecosystems…

- **level loss of 93 m in 10 years in Al Ain region**
- **pollution by fertilizers**

*Brooke et al. (2006), EAD, SOE*
Dams and mountain water resources

140 dams in UAE mountains, of which, 9 mains:

- Capacity: 300,000 to 18.5 million m³
- Aim: Groundwater Recharge and Flood Protection

“UAE to build 68 dams in five years”
Kippreport (13 August 2008)
Damming...

+ natural causes (drought)
+ overhunting/poaching
+ overgrazing by livestock (goats)
+ quarrying and crushers
  ➢ irreversible loss of habitat
  ➢ a supplementary stress on remnant wildlife populations
Solution: desalination plants?

• 99% of Kuwait needs

• 50% of KSA needs in water and 20% of energy needs

• > 20% of water used in UAE (ca 100% of drinking water)

GCC countries hold about 45% of the total global desalination capacity!

Dawoud (2007)
But desalination = energy consuming
 + concentration of desalination plants on the Arabian Gulf (= closed sea):

- Environment impacts (dredging, hot water and brine effluents, heavy metals, cleaning agents) on sensitive marine habitats (coral reefs, seagrass beds)
- High oil industry activity (refineries, transport) = high risk of oil pollution for intake
- Diplomatic tensions with Iran...

[Diagram: Persian Gulf Oil Exports by Route -- 2003]

<table>
<thead>
<tr>
<th>Route</th>
<th>2003 (MMBD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strait of Hormuz</td>
<td>16.0</td>
</tr>
<tr>
<td>E-W Pipeline/Yanbu</td>
<td>0.0</td>
</tr>
<tr>
<td>Turkey/Ceyhan</td>
<td>0.0</td>
</tr>
<tr>
<td>Other</td>
<td>0.0</td>
</tr>
</tbody>
</table>
New threats for water resources:

Climate change / global warming

Introduced invasive species
Sea level rise due to global warming

Sea level rise: 1m

1m only = Abu Dhabi, Dubai cities underwater
Expected: 7m (Greenland’s icecap melting)

- Impact on desalination plants + coastal infrastructure
- Saline intrusions in groundwater table

2008 REPORT OF THE ARAB FORUM FOR ENVIRONMENT AND DEVELOPMENT
Changes in precipitations patterns due to global warming

- Rainfall in Eastern emirates and Oman influenced by El Niño-Southern Oscillation / La Niña (ENSO)

![Rainfall for Surrounding Area](image)

La Niña / El Niño cycle depends on Pacific Decadal Oscillation (PDO).

- Climate change disturbs PDO cycle...

- Impact on unique fauna and flora
- Impact on groundwater recharge
- Impact on infrastructure and population

A growing threat: introduced invasive species

Ex: *Prosopis juliflora* (beautification)

- Competition with local species for water
- Supplementary stress on groundwater resources

Ex: *Cochlodinium sp.* (ballast waters)

- red tide for 7 months now in UAE
- cloth of intake filters of desalination plants
Measures

- Local (Emirate) level:
  - 2005: Administrative order 4 regulating drinking water in Abu Dhabi
  - 2007: MASDAR initiative in Abu Dhabi
  - 2007: Master of Science “Groundwater Engineering and Management”, Ajman University
  - 2008: Arab Water Academy in Abu Dhabi
  - 2008: Water saving campaigns in Dubai, Sharjah
  - 2008: Rise of water tariffs in Dubai
  - 2008: Green building codes in Abu Dhabi, Dubai
  - 2009: Protected Area for conservation of freshwater resources in Fujairah
Federal level:

- 1992: Federal Laws 39 and 41 concerning importation and handling of agricultural pesticides and fertilizers
- 1999: Federal Law 24 for protection of environment
- 1999: Creation of Water Resources Master Program of UAE University
- 2005: Creation of Ministry of Environment and Water of UAE
- 2007: Ecological Footprint Initiative (MoEW, EAD, EWS-WWF, GFN)
- 2009: National water and energy saving campaign (MoE, MoEW, MASDAR, ADWEA, EAD, EWS-WWF)

Soon to come: Federal Legislation on water conservation and protection...
### International level

<table>
<thead>
<tr>
<th>Convention/Protocol</th>
<th>Date Ratification</th>
<th>Website</th>
</tr>
</thead>
</table>
Challenges

• Set-up of sound data monitoring (standardisation)
• Implementation (+ standardisation) of laws, decrees and international agreements / conventions
• Integrate the environment, its resources and their preservation in the development planning
• Invest in technology and research & alternatives (ex: artificial recharge stations in AD, Middle East Desalination Research Centre in Oman…)
• Trans-boundaries collaborations within UAE, and GCC

Change habits!!!
Need to connect the dots!

“...1.4 billion square feet of empty desert and sea into an international community for an estimated population of 1.5 million people that is twice the size of Hong Kong Island...”

Nakheel

"Our five-year strategy indicates the increase of expected tourists arrivals to 2.7 million visitors by the year 2012,...”

ADTA

With already > 4 millions people, water and electricity shortages, and one of the highest footprint in the world:

Can the UAE really afford it?