THE WATER CRISIS IN THE GULF AREA: SEAWATER DESALINATION A PATH TO A PARTIAL SOLUTION.

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Acknowledgment To Eng. AbduHameed Al- Mansour (Director Manager Saudi Tabreed)
CONTENT

- Introduction
- The Water Situation in The Gulf States
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It has been estimated that the annual worldwide freshwater supply per capita in the year 2025 will be 62% of what was available in the year 1990.

- The GCC countries have a renewable freshwater supply less than 400 m³ per Capita

- If rainfall is used as a source of fresh water, the rainfall in the GCC is less than 250 mm/year which is considered to be very low

- The main source of freshwater available comes from the ground water wells, which is not considered to be a renewable water resource (Consumption values are high compared to the recharging values)

- All the Gulf States are considered to be high income countries
HIGH INCOME COUNTRIES WATER DISTRIBUTION

- Domestic: 11%
- Industrial: 59%
- Agricultural: 30%
# The Water Situation in the Gulf States in the Year 2003

<table>
<thead>
<tr>
<th>Ranking Out of 182</th>
<th>Country</th>
<th>Total Internal Renewable Water Resources (m³/year)</th>
<th>Ground Water Produced Internally (m³/year)</th>
<th>Surface Water Produced Internally (m³/year)</th>
<th>Overlap Surface And Groundwater (m³/year)</th>
<th>Water resources Total Renewable (m³/year)</th>
<th>Water resources Total Renewable Per Capita (m³/capita)</th>
<th>Dependency Ratio (%)</th>
<th>Land Area (km²)</th>
<th>Population in 2000 (1000 inh)</th>
<th>Population Density in 2000 (inh/km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>165</td>
<td>Oman</td>
<td>0.99</td>
<td>0.96</td>
<td>0.93</td>
<td>0.9</td>
<td>0.99</td>
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<td>0.004</td>
<td>0</td>
<td>0.12</td>
<td>181</td>
<td>97</td>
<td>690</td>
<td>640</td>
<td>928</td>
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<td>2.2</td>
<td>2.2</td>
<td>2</td>
<td>2.4</td>
<td>118</td>
<td>0</td>
<td>2149690</td>
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<td>9</td>
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<td>0.05</td>
<td>0.001</td>
<td>0</td>
<td>0.05</td>
<td>94</td>
<td>4</td>
<td>11000</td>
<td>565</td>
<td>51</td>
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<tr>
<td>178</td>
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<td>0.12</td>
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<td>0</td>
<td>0</td>
<td>0.2</td>
<td>10</td>
<td>100</td>
<td>17820</td>
<td>1914</td>
<td>107</td>
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</table>
### The Water Situation in the Gulf States in the Year 2006

<table>
<thead>
<tr>
<th>Country</th>
<th>Population (1,000,000s)</th>
<th>Precip Rate1 (mm/yr)</th>
<th>TARWR Per Capita 2000 (m³/yr)</th>
<th>TARWR Per Capita 2005 (m³/yr)</th>
<th>Surface water TARWR</th>
<th>Ground-water TARWR*</th>
<th>Overlap2 TARWR*</th>
<th>Incoming Waters TARWR</th>
<th>Outgoing Waters TARWR</th>
<th>Total use % TARWR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bahrain</td>
<td>.739</td>
<td>100</td>
<td>181</td>
<td>157</td>
<td>3%</td>
<td>0%</td>
<td>0%</td>
<td>97%</td>
<td>0%</td>
<td>258%</td>
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<tr>
<td>Kuwait</td>
<td>2.60</td>
<td>100</td>
<td>10</td>
<td>8</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
<td>0%</td>
<td>2.227%</td>
</tr>
<tr>
<td>Oman</td>
<td>2.94</td>
<td>100</td>
<td>388</td>
<td>340</td>
<td>94%</td>
<td>97%</td>
<td>91%</td>
<td>0%</td>
<td>0%</td>
<td>137%</td>
</tr>
<tr>
<td>Qatar</td>
<td>.619</td>
<td>100</td>
<td>94</td>
<td>86</td>
<td>2%</td>
<td>94%</td>
<td>0%</td>
<td>4%</td>
<td>0%</td>
<td>554%</td>
</tr>
<tr>
<td>Saudi Arabia</td>
<td>24.9</td>
<td>100</td>
<td>118</td>
<td>96</td>
<td>92%</td>
<td>92%</td>
<td>83%</td>
<td>0%</td>
<td>6%</td>
<td>722%</td>
</tr>
<tr>
<td>UAE</td>
<td>3.05</td>
<td>100</td>
<td>58</td>
<td>49</td>
<td>100%</td>
<td>80%</td>
<td>80%</td>
<td>0%</td>
<td>0%</td>
<td>1.538%</td>
</tr>
</tbody>
</table>
THE EXPECTED WATER DEMAND UNDER THE CONDITION OF 1000 M³/CAPITA/YEAR FOR THE TOTAL POPULATION PREDICTED IN THE GULF STATES IN BILLION M³/YEAR
The average freshwater available m³/capita/year from renewable resources in the Gulf States up to the year 2050.
TO SUSTAIN PRESENT ACTUAL WATER SUPPLY PER CAPITA IN BILLIONS OF M³/YEAR FOR THE GULF STATES WITH RESPECT ACTUAL FRESHWATER CONSUMPTION RATE IN THE YEAR 2005
The Gulf States are considered to be leaders in sea water Desalination.

The Yearly production of the gulf states is 37% of the total water desalinated freshwater produced in the world.

More than 50% of freshwater produced from Seawater Desalination is been produced in the Gulf States.

Starting from the 1950’s to date The installed capacity in the Gulf States is more than 17 Million M³ /Day.

Seawater Desalination Can be assumed to be a nonconventional Renewable freshwater Resource.
Desalination Capacity in the Gulf States

- Bahrain: 2%
- Kuwait: 13%
- Oman: 3%
- Qatar: 7%
- Saudi Arabia: 42%
- UAE: 33%
SEA WATER DESALINATION CAPACITY IN THE GULF STATES

- UAE: 37%
- Saudi Arabia: 37%
- Kuwait: 12%
- Qatar: 8%
- Bahrain: 3%
- Oman: 3%
THE DESALINATION CAPACITY IN THE GULF STATES TO SUSTAIN PRESENT /CAPITA/YEAR SUPPLY

- Available Renewable Freshwater
- Make Up Using Desalination
- 1000 M3
TOTAL DESALINATION COST (MSF MODEL) IN BILLION US$ NEEDED FOR SUPPLY MAKE UP (1$/M$^3$)

- To Sustain Present Condition
- To reach 1000 M3/Capita
TOTAL DESALINATION COST (RO MODEL) IN BILLION US$ NEEDED FOR SUPPLY MAKE UP (.5$/M³)

To Sustain Present Condition
To reach 1000 M³/Capita
TOTAL DESALINATION COST (DREAM MODEL) IN BILLION US$ NEEDED FOR SUPPLY MAKE UP (.1$/M$^3$)

- To Sustain Present Condition
- To reach 1000 M$^3$/Capita
TOTAL DESALINATION COST (ONLY DOMESTIC, INDUSTRIAL USE) IN BILLION US$ NEEDED FOR SUPPLY MAKE UP (.75$/M³)
The Demand Issue:

Domestic Use:
- Sydney of Australia has per Capita daily consumption rate of 123 liters/Capita/Day
- Along with The development of effect Awareness Campaigns The development of an [effective a award/penalty legal System] is of the up most importance
- A legal frame work on the usage of the freshwater supply is needed
- Reduction of Distribution Network Leaks (5%)
- Rational Use of water for (Car Wash, Landscaping, ..etc)
- Water Crisis Management techniques ( Water Shortage Legislation, Water Emergency planning)
USING AN EFFECTIVE IWRM

The Demand Issue
Agricultural Use:

- Long term Planning For the Agricultural Sector Taking to consideration available water sources (renewable and non renewable)
- Food security Vs Self sufficiency (Cost/benefit analysis)
- Maintain the Balanced Dietary Energy Supply (DES) Threshold (2800 Kcal/person/day)
- Using high efficiency irrigation systems in place of traditional irrigation systems.
- Investment in the food processing industry
- Water requirements for the establishment and expansion of available farm land
USING AN EFFECTIVE IWRM

The Demand Issue

Industrial Use:

- Planning the industrial sector growth while taking in consideration water quality and freshwater requirements
- Environment protection of coastal area as the may be used in seawater desalination
- Minimizing the usage of freshwater in the industry
- Using freshwater recirculation methods as a part of the industrial plant specifications
- The construction of industrial plants may be associated with construction of desalination plants and electrical power plants
USING AN EFFECTIVE IWRM

The Supply issue:
- Usage of water aquifers while taking into consideration recharge rates
- Minimizing the overall cost of Seawater Desalination
- Investment in The Waste Water treatment plants
- Using water reuse methods
- The establishment of research centers on the Gulf States Level with the strategic goal of minimizing the production and construction of Seawater Desalination plants
- Rehabilitation of existing seawater Desalination plants
- The manufacturing of Desalination Plant equipment within the Gulf States
- The prospect in new Seawater Desalination technologies that may prove to be Cheaper than existing traditional methods
- The use of Solar energy and nuclear energy in Seawater desalination if proven to be more efficient and cheaper
As a part of the IWRM scheme it is important to introduce by lateral research centers that will address the water supply and demand issues throughout the Gulf states.

In Seawater desalination these research centers have to address issues like:
+ The investment in new method of desalination
+ Increasing of the desalination Unit capacity
+ Reduction of Construction and production costs for Desalination (e.g. Chemicals costs, Lower material costs, better unit performance, Lower fuel costs… etc)

Research in Wastewater treatment plants
Research in Water reuse methods
Research to increase the efficiency of Irrigation systems
Research in water recirculation methods, also reduction of freshwater usage in the industrial sector
IWRM AND THE PRIVATE SECTOR

- Enforcing the Continuation of Production
- Using Balanced Legal framework
- Using Balanced Billing systems that take into consideration rational freshwater supply
- The establishment of the IWRM controlling Organization
- The private sector research funding
- The role of the Private sector in the manufacturing of freshwater production equipment locally
It is the balance between water supply and water demand taking into consideration the time dimension.
FACTORS TO BE CONSIDERED IN THE MODELS

Supply Side:
+ Available Surface Water resources (Dam water, evaporation control).
+ Under Ground water (Quality, Depth, Quantity, efficiency of consumption, Pollution, S/W intrusion, Charging rate).
+ Desalination Plants (IWPP, Technology, Lowering costs, R&D, Energy Co-Generation, Seasonal Fluctuation, Blending, Subsidization of the Industry, Local intensity)
+ WWT Plants (Reclamation, Aquifer Re-Charging, Livestock, Agriculture Irrigation)
+ Rain (Collection Systems, Clouds Harvesting)
+ Water Storage (Quality, Underground storage, Seepage).
+ Imported Water (Pipe Lines, Tankers....)
**FACTORS TO BE CONSIDERED IN THE MODELS**

- **Demand Side:**
  - **Awareness Campaigns** (Water Availability, Conservation Incentives, Population growth).
  - **Distribution Networks Control** (Design, Materials & construction Control, leak detection & repairs, Pressures, Control, Training, Trucking, Water Shedding).
  - **Emergency Plan**
  - **Conservation Implementation** (Facet Aerators, Leak Detection, Water Boxes)
  - **Agriculture Consumption** (Irrigation Optimization, Fining, Crops Type).
  - **Live Stock Consumption** (Review on Economics Basis).
  - **Industrial Uses** (Type of industry, Water Injection Control, efficiency monitoring).
  - **Water Chemistry Monitoring** (Control, Salinity,....)
CONCLUSION

- It is evident that the Gulf States have to adopt a number of controlling measures that will help the public and private sectors in the proper development of the water supply schemes, with respect to domestic, industrial, and agricultural uses of the supplied freshwater. The cost/benefit feasibility of different freshwater supply schemes will be influential on the overall development of the Gulf States.

- The strategic planning of the available conventional and nonconventional freshwater supply schemes is a mandatory requirement to sustain and improve the overall development of the Gulf States.

- Seawater desalination is considered to be one of the mean pillars in solving the water crisis in the Gulf area, but on its own it is not considered as a complete solution.