جامعة الخليج العربي
Arabian Gulf University

Sustainable Water Management System in the GCC Countries

Major Challenges and Opportunities

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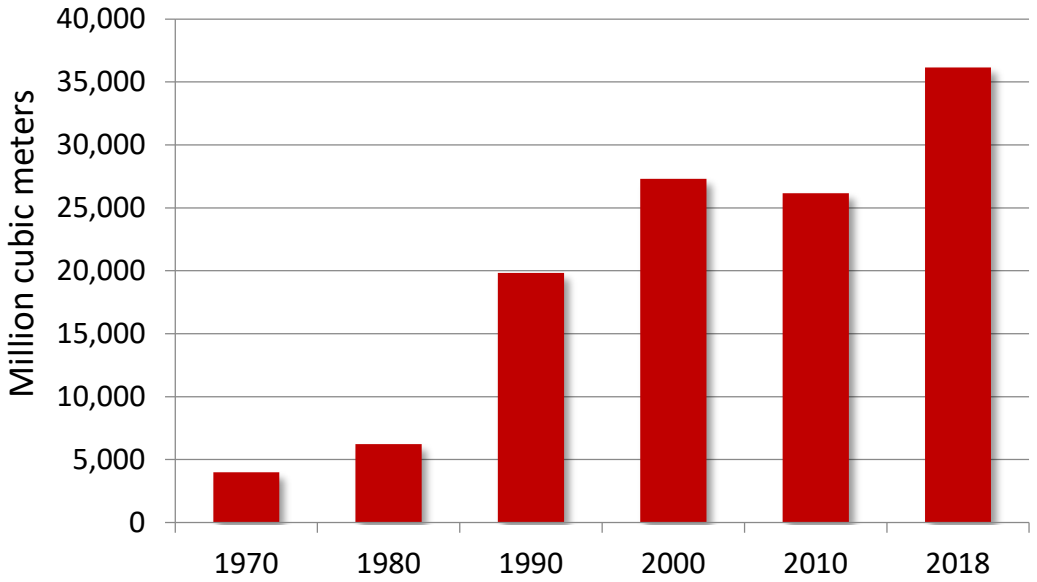
Overview

- Main Water Sector Challenges in the GCC
  - Groundwater Over-exploitation and Rapid Mining
  - Inadequate Utilization of Treated Wastewater
  - Climate Change Impacts on Water Sector
- Agricultural Sector Challenges & Proposed Sustainability Policies
- Conclusion and Recommendations

Main Water Challenges in the GCC

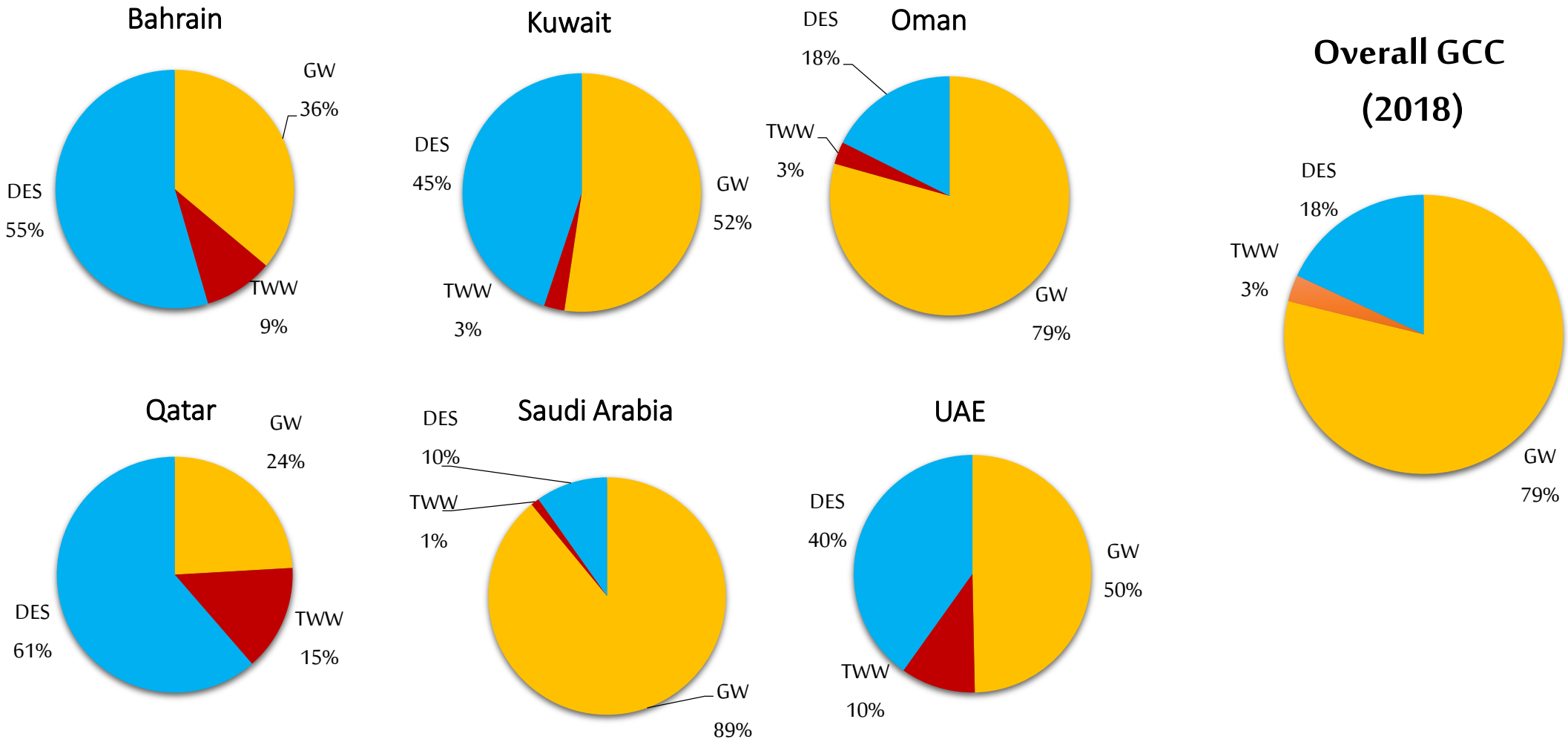
- Overall Challenges
  - Increase in water scarcity
  - Increasing costs of water supply
- Groundwater Over-exploitation and Rapid Mining (conflict and risks between Water and Food Securities)
- Inadequate Utilization of Wastewater
- Meeting Municipal Water Demand & Increasing Associated Costs
- High Vulnerability of Desalination Plants & Water Supply System
- Climate Change Impacts on Water Sector

Trends in Total water consumption in GCC Countries, MCM



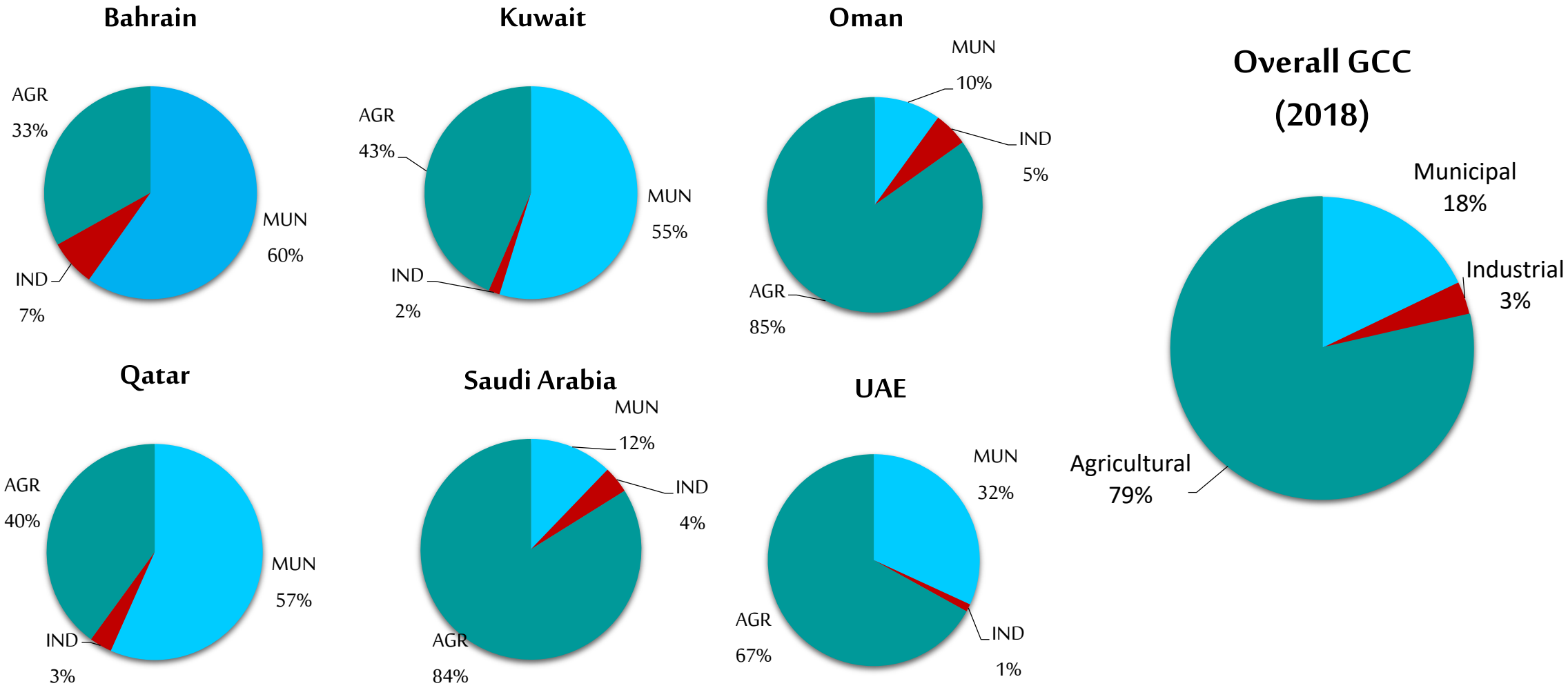
1. Groundwater Over-exploitation & Rapid Mining

Water Resources Utilization in the GCC Countries



(GCC/UNEP, 2022)

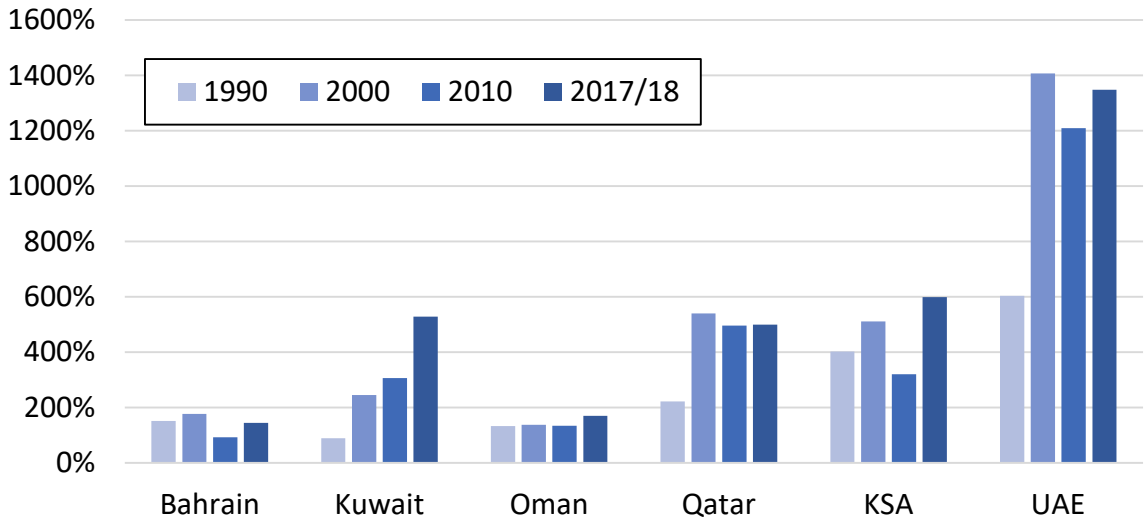
Main Water Use Sectors in the GCC Countries



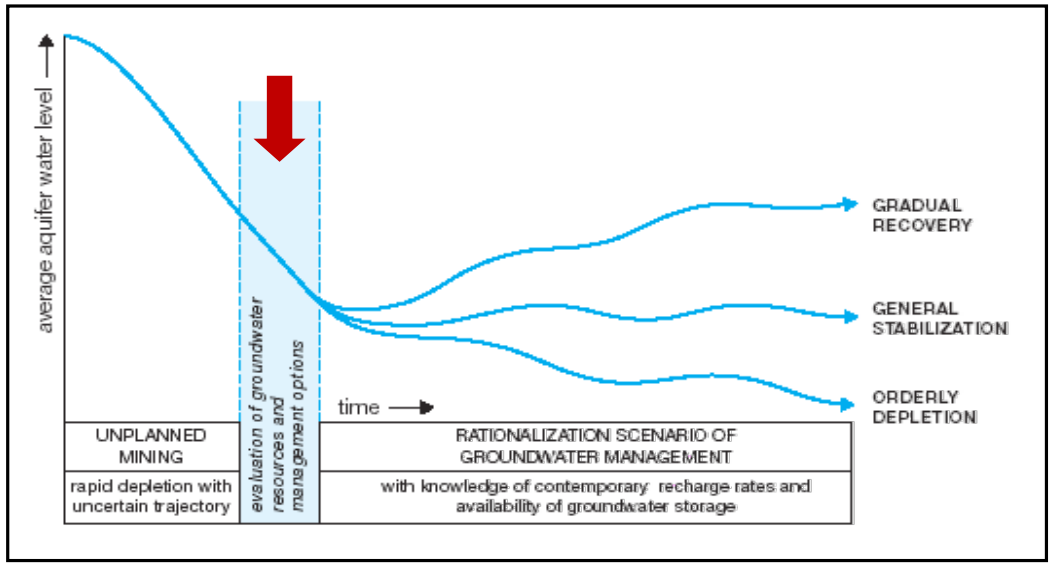
(GCC/UNEP, 2022)

- **Renewable Groundwater**:
  - Overexploited, decline in water levels and salinization by saltwater intrusion
  - Pollution by anthropogenic activities
- **Non-Renewable Groundwater**
  - Rapid mining mainly by agriculture
  - Immediate gains vs. long term benefits, Exit Strategy? Replacement water source?
- **Consequences of Groundwater Loss:**
  - Increasing water scarcity & cost of water supply, Loss of strategic reserves for emergency, desertification of agricultural lands & loss of productivity, and loss of agricultural activities

Percentage Groundwater Abstraction from Recharge in the GCC countries, 1990-2018

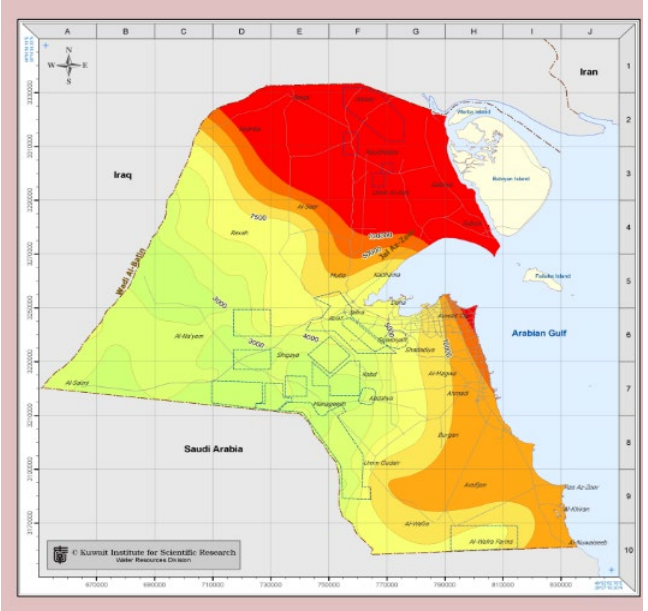


Non-Renewable Groundwater Management

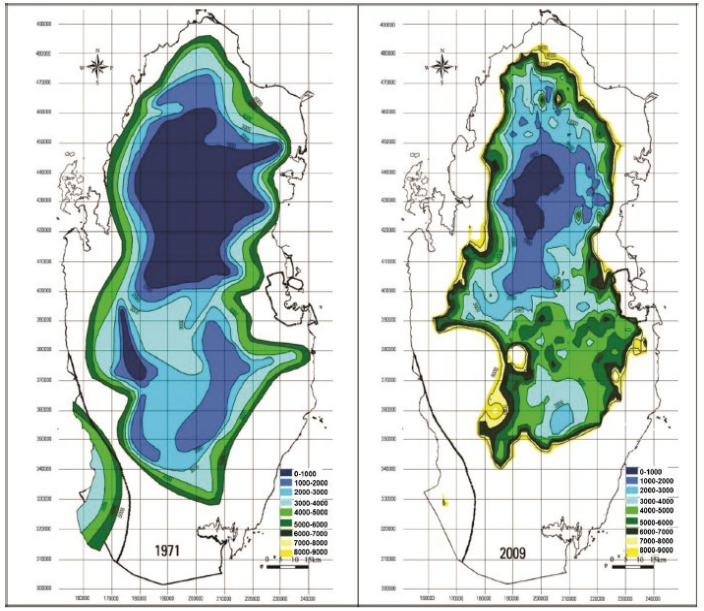


Cont., 1. Over-exploitation & Mining of Groundwater Resources

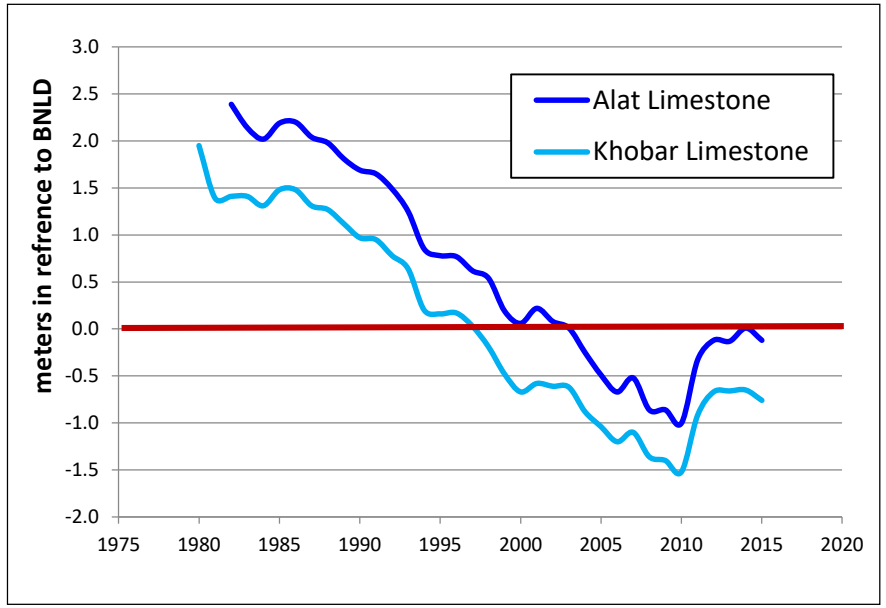
Saltwater intrusion in groundwater in Kuwait (KISR, 2000)



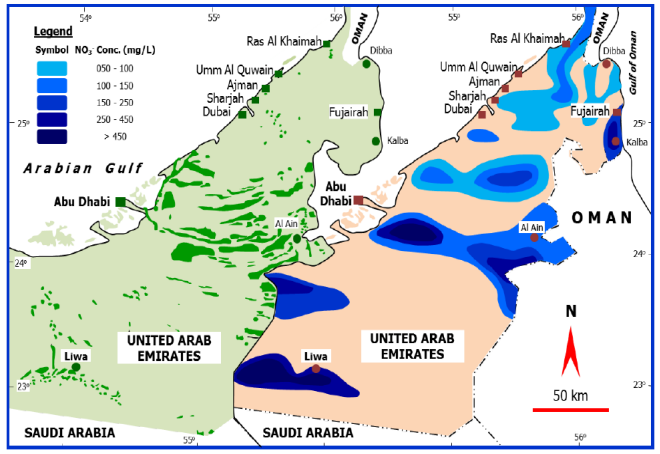
Freshwater groundwater Shrinkage in Qatar, 1971 and 2009 (Baaloush, 2006)



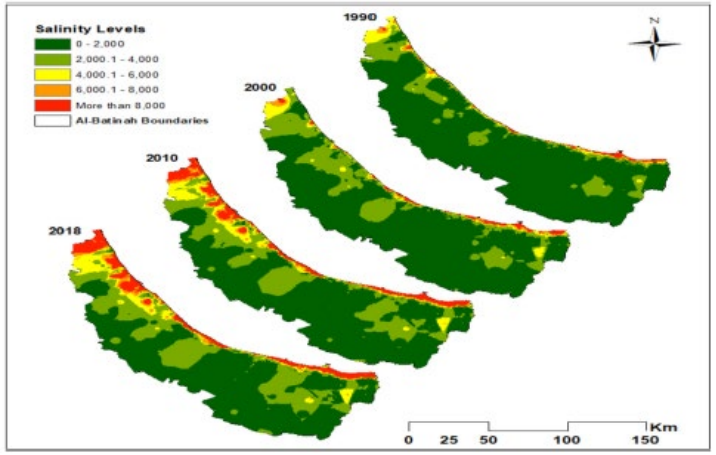
Average water levels in Dammam Aquifer zones in Bahrain (Al-Zubari, 2018)



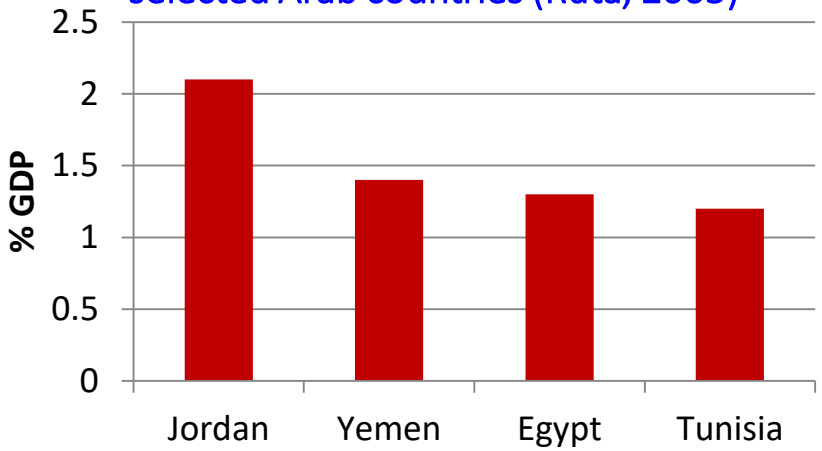
Nitrate pollution to groundwater in UAE (Rizk, 2014)



Salinity increase in groundwater in Albatinah in Oman (Abulibdeh, et al. 2021)

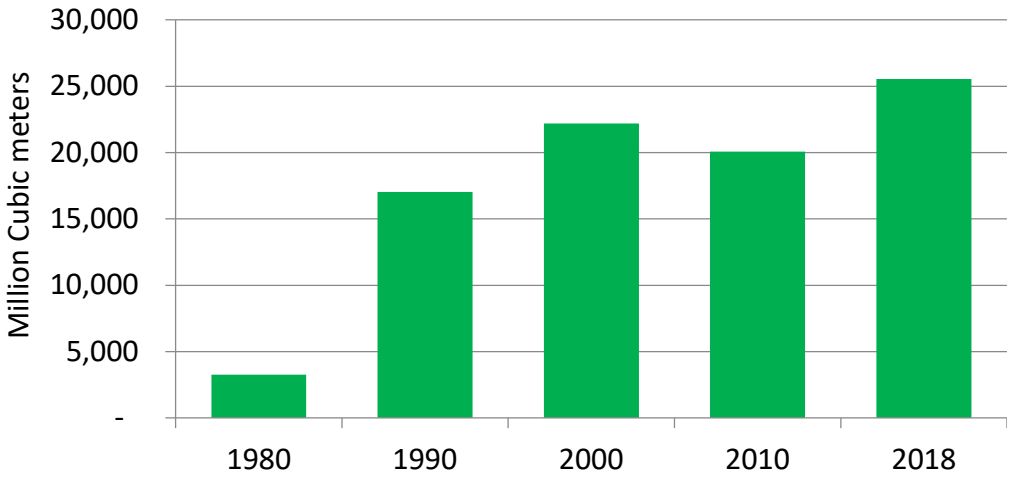


Value of groundwater depletion in selected Arab countries (Ruta, 2005)

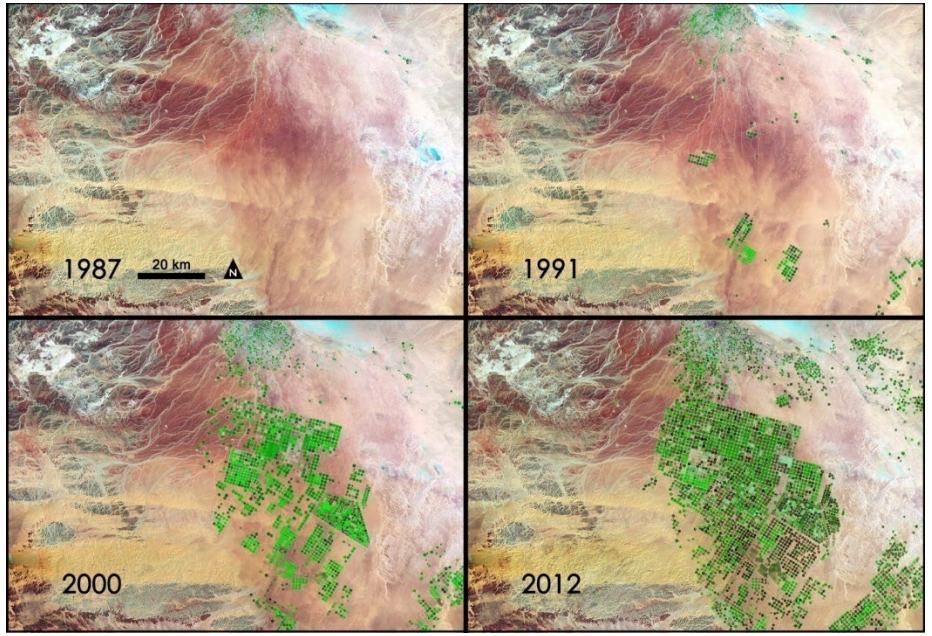


- # Uncontrolled Agricultural Water Consumption
  - Drivers: food demand/security and/or socio-economic policies, major subsidies (including water) & incentives programs for agricultural expansion and food production
  - Consumption exaggerated by:
    - Traditional irrigation methods (low Irrigation efficiencies: 25-40%);
    - Cultivation of high water consuming crops (e.g., alfalfa as a cash crop);
    - Privately-owned groundwater rights (unlimited abstraction)
    - Absence of well metering/monitoring
    - Absence of groundwater tariffs for agricultural water use

Trends in Agricultural Water Demands in GCC



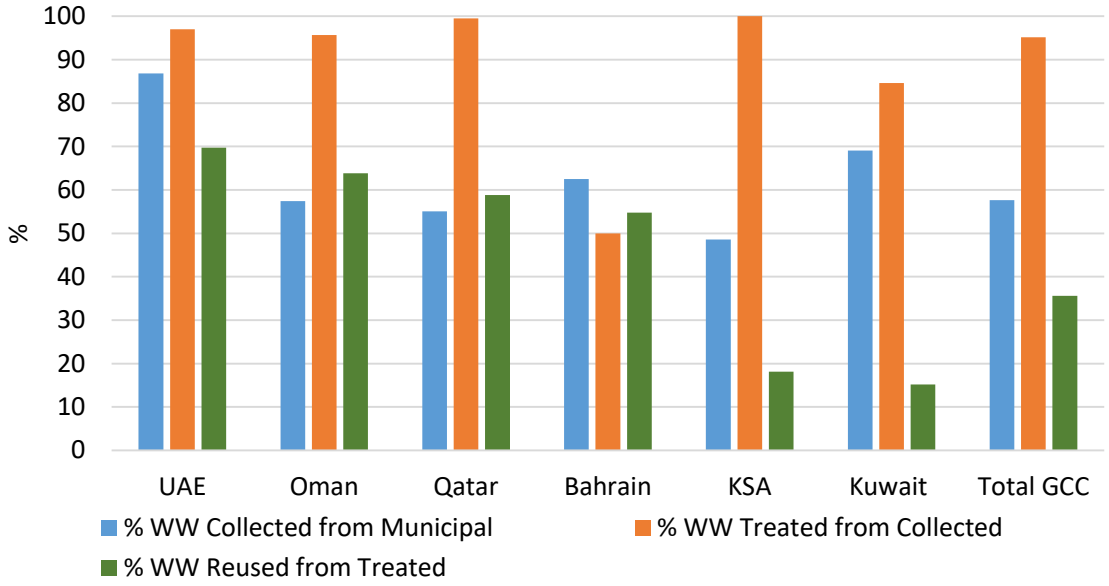
Expansion in agriculture, e.g., Wadi Al-Sarhan, KSA

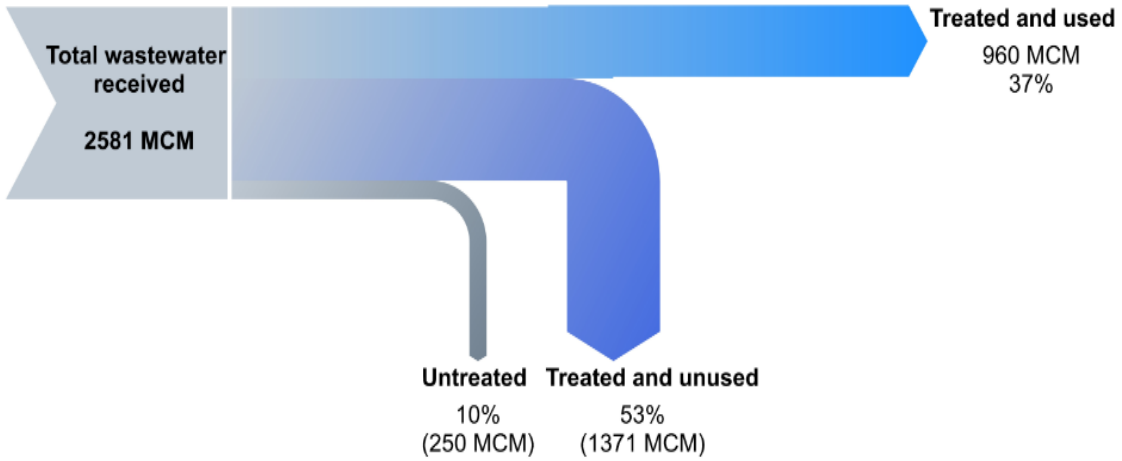


2. Inadequate Utilization of Wastewater

- **Large volumes of tertiary treated wastewater are not used**
  - Many constraints (social, technical and infrastructure)
  - Lack of integrated reuse plans (as part of the overall water management plan)
- **Major lost opportunity** under GCC water scarcity conditions
- **Frequent Hydraulic loading (carryovers)**
  - Rapid urbanization and lack of integrated planning with water supply
  - Environmental pollution to the marine environment (carryover)
  - Impacting quality of treated wastewater & reuse

Wastewater Dynamic in the GCC countries (2018)



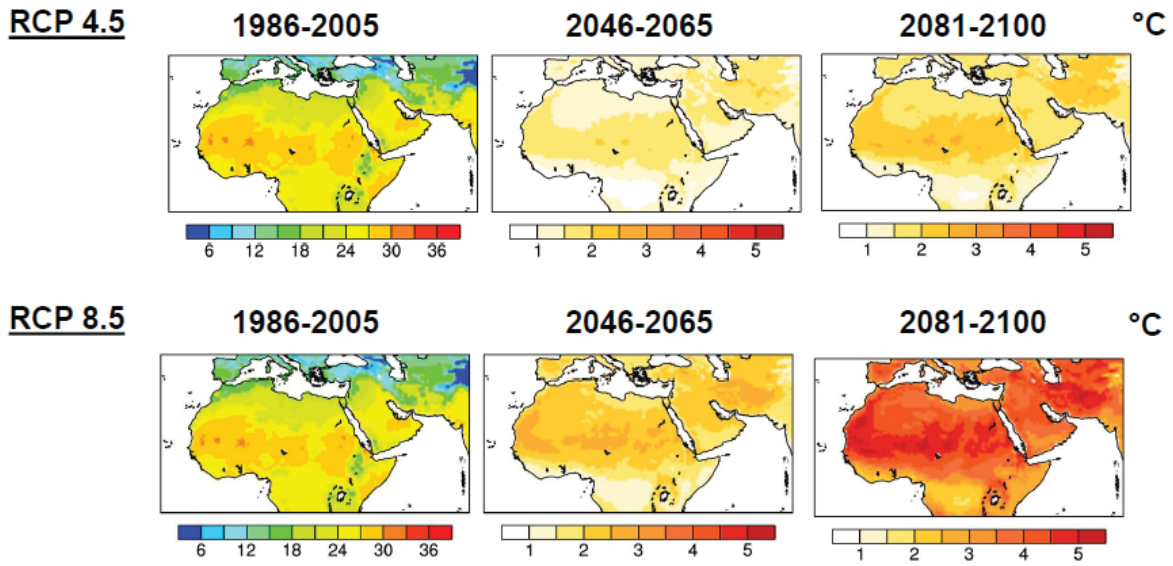


3. Climate Change Impacts on Water Sector

- Additional stressor on the GCC water system
  - Reduction in overall precipitation
  - Sea level rise
  - Temperature increase
  - Increasing frequency of extreme events

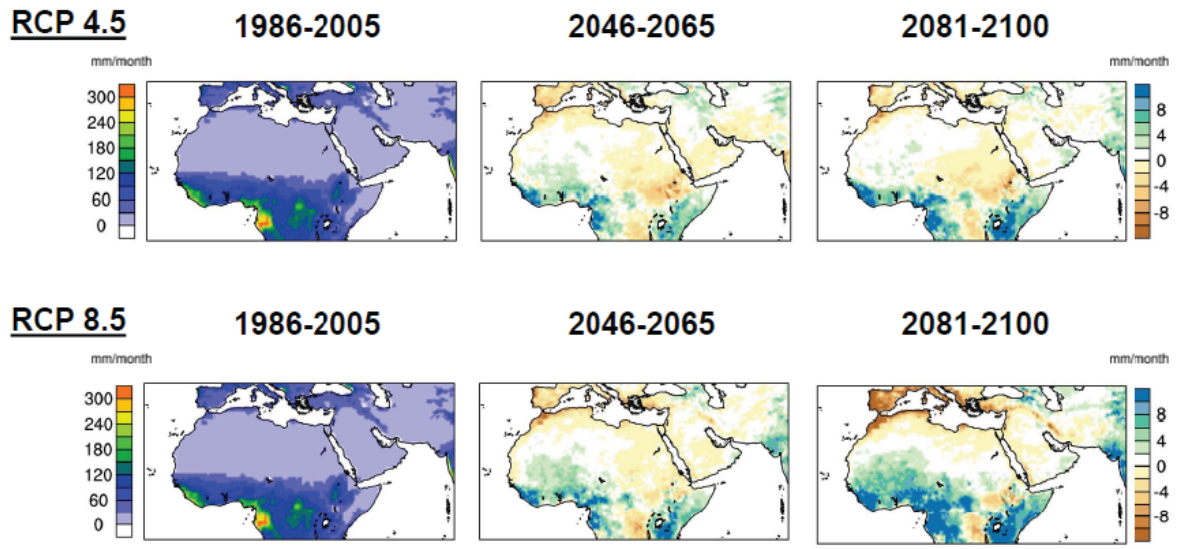
Projected Climate Change Variables by RICCAR Arab CORDEX

Figure 5. Change in mean annual temperature for the time periods 2046-2065 and 2081-2100 compared to the reference period 1986-2005 for RCP4.5 and RCP8.5



Source: RICCAR,2017.

Figure 6. Change in mean annual precipitation for the time periods 2046-2065 and 2081-2100 compared to the reference period 1986-2005 for RCP4.5 and RCP8.5



Source: RICCAR,2017.

(www.riccar.org)

Agricultural Sector Challenges & Proposed Sustainability Policies

- **To grow or not to grow?**
  - Critical and important complementary and buffer strategy for other food strategies (i.e., food imports and Agro-investments)
- **Need to be implemented under policies of**:
  - Compatible with available water resources
  - Improving irrigation efficiency
  - Shifting to modern agricultural system to increase water productivity
  - Maximizing reuse of treated wastewater, under strict health and safety regulations; directly or indirectly (e.g., MAR)
  - Discouraging/limiting cultivation of high water-consuming crops
  - Reducing post-harvest food losses and food waste
  - …

Conclusion & Recommendations

- **Water/Groundwater is undervalued** in the agricultural sector in the GCC Countries
- Loss of groundwater will undermine the future sustainability of the agricultural sector itself and its contribution to local food production/security
- Need to shift from focus on "**sustainability of supply**" to "**sustainability of consumption**" by using appropriate policy instruments for the agricultural sector
- Implementing **demand management policies** and shifting to **modern agricultural system** will provide higher degrees of sustainability for both water and agricultural sectors

Thank You!