



Groundwater Management in IWRM

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World Water Day 2022: Groundwater: Making the Invisible Visible!

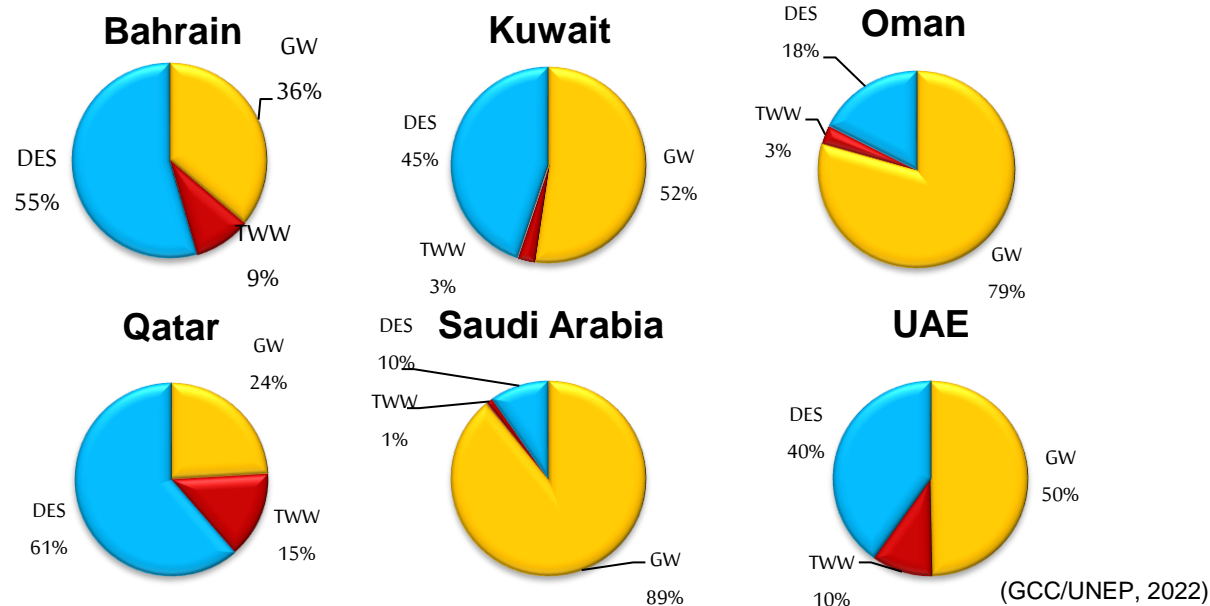
- **Invisible** (decision makers, users, and the public at large) leading to wrong perceptions
- **Complex to assess** (heterogeneities, moving boundaries, hydraulic interactions)
- **Hard to manage** (spatially distributed users, socio-economic and political factors; slow processes)
- **Relatively costly to monitor** (water levels, quality, abstraction)
- **Difficult to rehabilitate when polluted** (takes long time and costly)



Groundwater in the GCC Countries

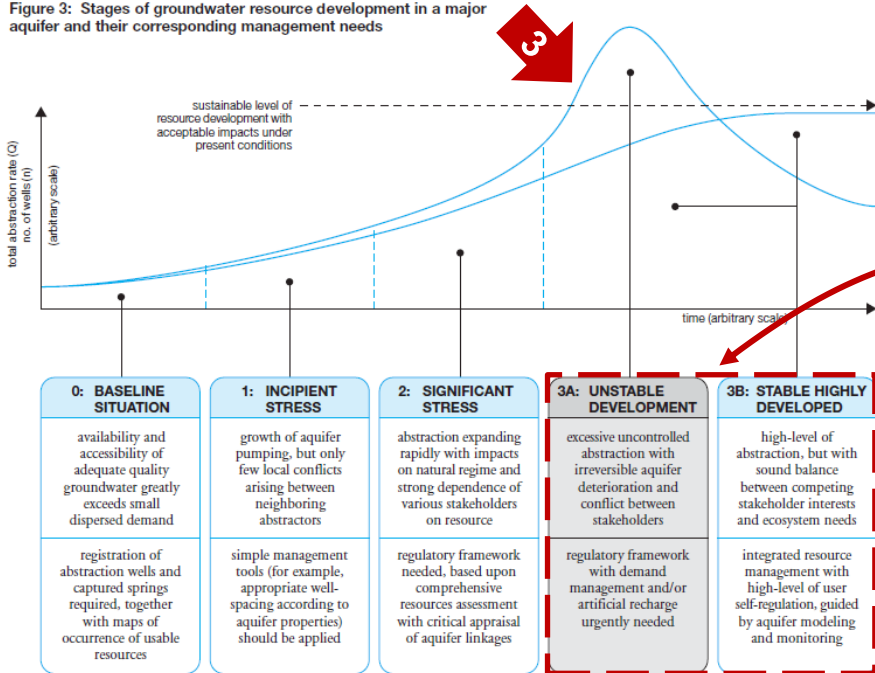
Water Resources Utilization in the GCC Countries

- **Renewable Groundwater:** overexploited, saltwater intrusion, and pollution by anthropogenic activities (**focus of this talk**)
- **Non-Renewable Groundwater:** rapid mining (to fulfill agricultural water demands mainly)
- **Loss of groundwater consequences:** increasing water scarcity, increasing cost of water supply, loss of strategic reserves for emergency, loss of agriculture, ...

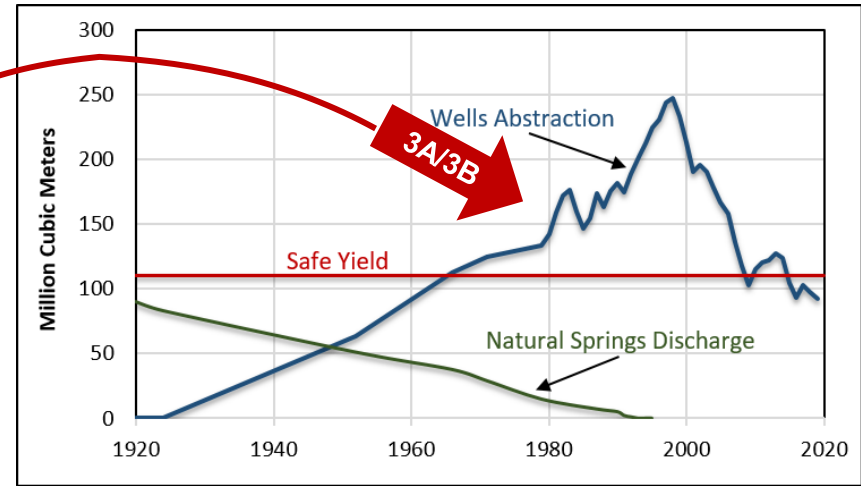


Analysis of the Status of Groundwater Management in the GCC

Figure 3: Stages of groundwater resource development in a major aquifer and their corresponding management needs



Case Study Bahrain Groundwater Exploitation in the Kingdom of Bahrain, 1925-2020



GROUNDWATER MANAGEMENT TOOLS & INSTRUMENTS	LEVEL OF DEVELOPMENT OF CORRESPONDING TOOL OR INSTRUMENT			
	0: BASELINE SITUATION	1: INCIPIENT STRESS	2: SIGNIFICANT STRESS	3: UNSTABLE DEVELOPMENT
TECHNICAL TOOLS				
Resource Assessment	basic knowledge of aquifer	conceptual model based on field data	numerical models operational with simulation of different abstraction.	models linked to decision-support and used for planning and management
Quality Evaluation	no quality constraints experienced	quality variability is issue in allocation	water quality processes understood	quality integrated in allocation plans
Aquifer Monitoring	no regular monitoring program	monitoring, ad-hoc data exchange	monitoring routines established	monitoring programs used for D Support
INSTITUTIONAL INSTRUMENTS				
Water Rights	customary water rights	occasional local clarification of water rights (via court cases)	recognition that societal changes override customary water rights	dynamic rights based on management plans
Regulatory Provisions	only social regulation	restricted regulation (e.g. licensing of new wells, restrictions on drilling)	active regulation and enforcement by dedicated agency	facilitation and control of stakeholder self-regulation
Water Legislation	no water legislation	preparation of groundwater resource law discussed	legal provision for organization of groundwater users	full legal framework for aquifer management
Stakeholder Participation	little interaction between regulator and water users	reactive participation and development of user organizations	Stakeholder organizations co-opted into management structure	stakeholders and regulator share responsibility for aquifer management
Awareness and Education	groundwater is considered an infinite and free resource	finite resource (campaigns for water conservation and protection)	economic good and part of an integrated system	effective interaction and communication between stakeholders
Economic Instruments	economic externalities hardly recognized (subsidized)	only symbolic charges for water abstraction	recognition of economic value (reduction & targeting fuel subsidies)	economic value recognized (adequate charging and possibility of reallocation)
MANAGEMENT ACTIONS				
Prevention of Side Effects	little concerns for side effects	recognition of (short- and long-term) side effects	preventive measures in recognition of <i>in-situ</i> value	mechanism to balance extractive uses and <i>in-situ</i> values
Resources Allocation	limited allocation constraints	competition between users	priorities defined for extractive use	equitable allocation and <i>in-situ</i> values
Pollution Control	few controls over land use and waste disposal	land surface zoning but no proactive controls	control over new point source pollution	control of all point and diffuse sources of pollution; mitigation of existing contam.

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TECHNICAL TOOLS				
Resource Assessment				
Quality Evaluation				
Aquifer Monitoring				
INSTITUTIONAL INSTRUMENTS				
Water Rights			Identified Major Management Deficiency Areas	Need to be here!
Regulatory Provisions				
Water Legislation				
Stakeholder Participation				
Awareness and Education				
Economic Instruments				
MANAGEMENT ACTIONS				
Prevention of Side Effects				
Resources Allocation				
Pollution Control				

Concluding Remark

- Groundwater challenges are **Governance & Management challenges** first (i.e., institutions, legislations, participation, economic value of water, data, ...), and **Technical challenges** second
- groundwater-related academic programs need to **include social, economic and political** topics in their curriculums to prepare GCC national cadre to address these challenges in groundwater resources management
- **Groundwater models are tools** (not objectives) and should be used in the decision-making process, planning, and management of groundwater resources

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Governor of Riyadh Region

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Water Sustainability.. A Responsibility for All

THANK YOU



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