



# Advancing Water Sustainability in Bahrain through Water Resource Management Knowledge Platforms



**Water Resource  
Management Unit**

(on behalf of National oil and gas Authority)



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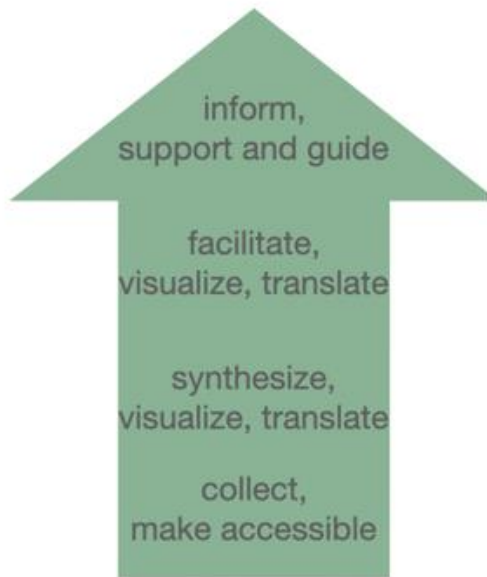
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# Overview

- Water Poses a Critical Challenge for Bahrain
- National Oil and Gas Authority (NOGA) is working to achieve sustainability goals
- Develop *Integrated Water Resource Management* Tools and Strategies
- Standardization and Coordination of Water Data
- Common Collaborative space.
- Outcome -“Water and Climate Knowledge Platform” or WCKP in support of IWRM

# A Water and Climate Knowledge Platform for Bahrain



- **Wisdom:** Enable well-informed decisions based on Knowledge that is judged and balanced against different policy needs
- **Knowledge:** Environment where decision-relevant information can be further explored towards specific decisions, developing insight into risks and benefits; scenario exploration; calculation of cost - benefit
- **Information:** Aggregated products for specific applications, links between basic data products
- **Data:** Observations, Technical Studies, etc that offer in-depth and foundational building blocks and concepts

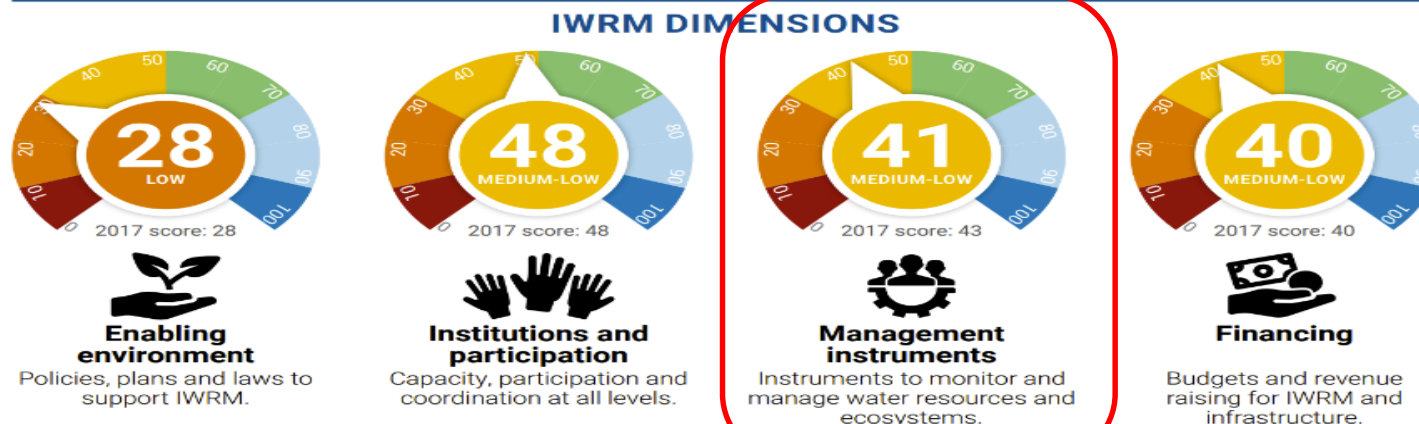
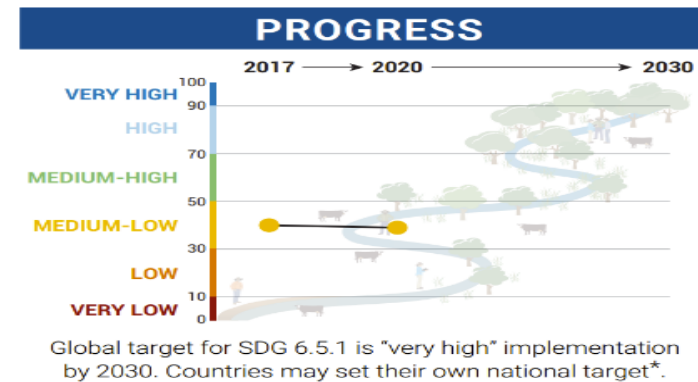
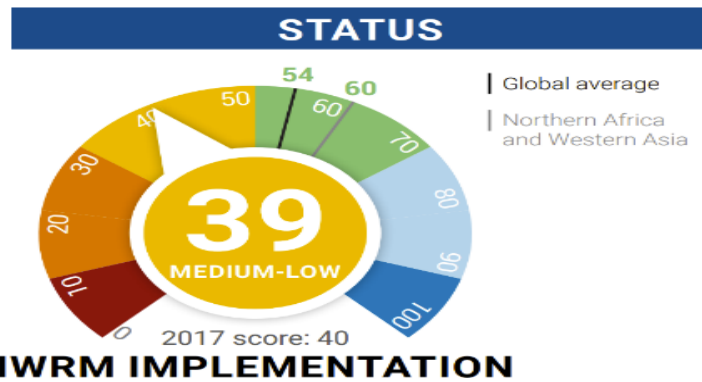
# Sustainable Development Goal on water and sanitation (SDG 6)

SDG 6 seeks to ensure safe drinking water and sanitation for all, focusing on the sustainable management of water resources, wastewater and ecosystems, and acknowledging the importance of an enabling environment. In the 2030 Agenda for Sustainable Development, countries have committed to engage in systematic follow-up and review of progress towards the Goals and targets, using a set of global indicators.

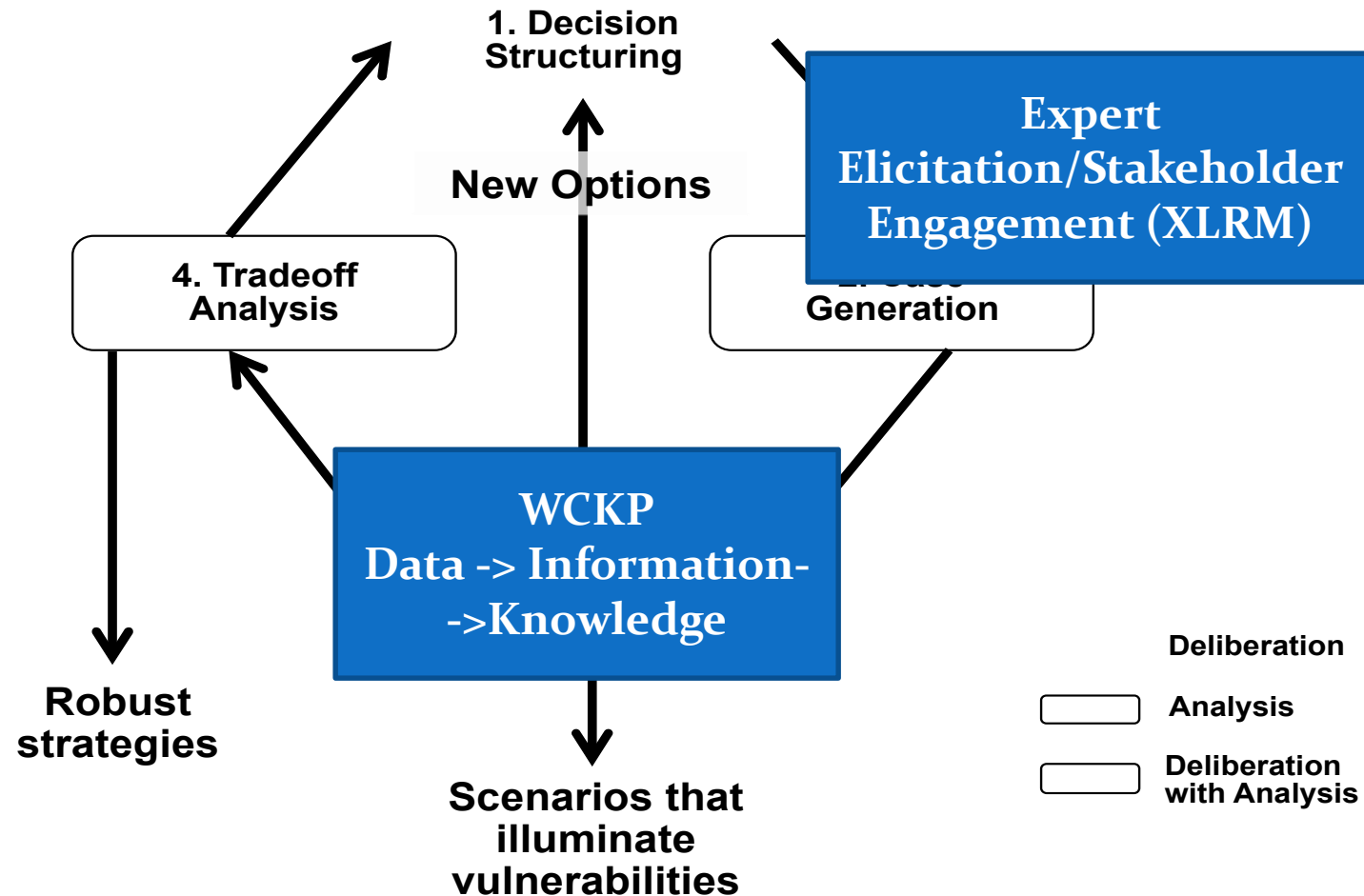


## Bahrain

REGION: Northern Africa and Western Asia



# Robust Decision Making



# Stakeholder Driven: Elicitation of Needs and Expectation: The XLRM Problem Formulation Framework

Exogenous Factors /Uncertainties (X)	Management Levers/Strategies (L)
<p>Uncertain factors that are outside of the control of water managers but which have the potential to impact the decisions being made. <i>e.g. population change; climate change; new regulation ...</i></p>	<p>Options under consideration by water managers to improve the performance of a water system under consideration. <i>e.g. new desal plants, conservation programs, recycled water, rainwater harvesting, strategic groundwater reserves, TSE use, etc.</i></p>
Relationships/Models (R)	Performance Metrics (M)
<p>Models that are constructed to capture the relationship between uncertain factors, management strategies, and system performance. <i>e.g. WEAP Modeling; expert opinion, WCKP ...</i></p>	<p>Measures that will be used to evaluate the potential performance of the selected strategies in the face of identified uncertainties. <i>e.g. Unmet Demand, Groundwater Storage, Water Costs; compliance with regulation</i></p>

# Hydroinformatics- The Water Evaluation and Planning Decision Support System

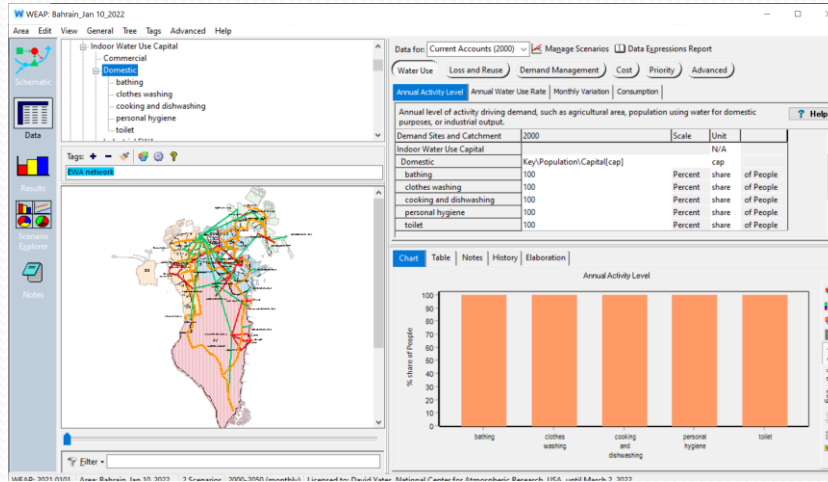
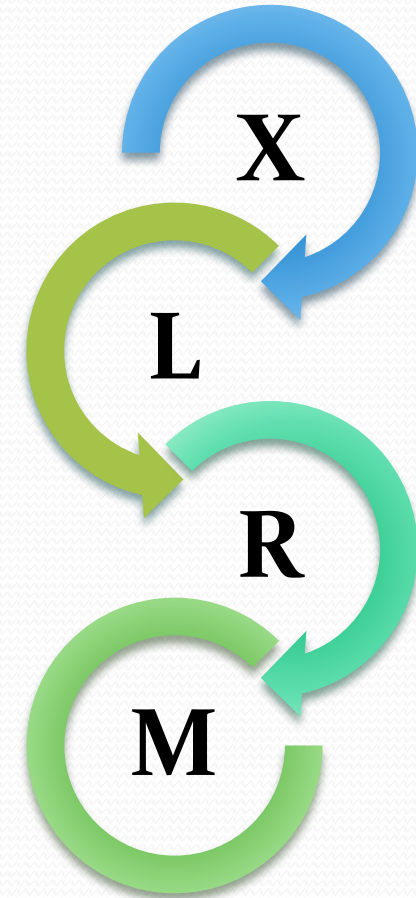


<https://WEAP21.org>

Windows Application

Web-enable

40,000+ registered users



- **Policy levers (L)** actions that decision makers can consider
- **Exogenous uncertainties (X)** are factors outside decision makers' control, such as climate change, demographics, demand for water and energy;
- **Metrics (M)** are the performance standards used to explore if choices achieve goals;
- **Relationships (R)**, simulation models that describe how the policy levers perform, as measured by the metrics, under the various uncertainties.

# The WEAP IWRM Model



## Water Supplies

- Water Supply Network
- Electricity and Water Authority Network
- Desalinization Supplies
- Groundwater Supplies

## Water Demand

- Domestic
- Commercial and Domestic
- Irrigation (Agriculture & Amenity)



# IWRM Model - WEAP

WEAP: Bahrain\_Jan 6\_2022

Area Edit View General Tree Tags Advanced Help

Data for: TSE master plan demand projections (2015-2050) Manage Scenarios

Land Use Climate Irrigation Flooding Yield Cost Priority Advanced

Runoff Resistance Factor Root Zone Conductivity Deep Conductivity Preferred Flow Direction

Area Kc Soil Water Capacity Deep Water Capacity

Enter the land area for branch, or branch's share of land area from branch above. Help

Range: 0 and higher

Demand Sites and Catchment	2014	2015-2050	Scale	Unit
Irrigation south				N/A
Ag farms	16	ReadFromFile(input data\TSE areas.csv, "s...		ha
Road landscaping	0.1	ReadFromFile(input data\TSE areas.csv, "s...		ha
Residential gardens	0	ReadFromFile(input data\TSE areas.csv, "s...		ha
Public parks and recreation	0	ReadFromFile(input data\TSE areas.csv, "s...		ha
Community Services	0	ReadFromFile(input data\TSE areas.csv, "s...		ha
Mixed special projects	0	ReadFromFile(input data\TSE areas.csv, "s...		ha

Chart Table Notes History Elaboration

Area

ha

1,800  
1,600  
1,400  
1,200  
1,000  
800  
600  
400  
200  
0

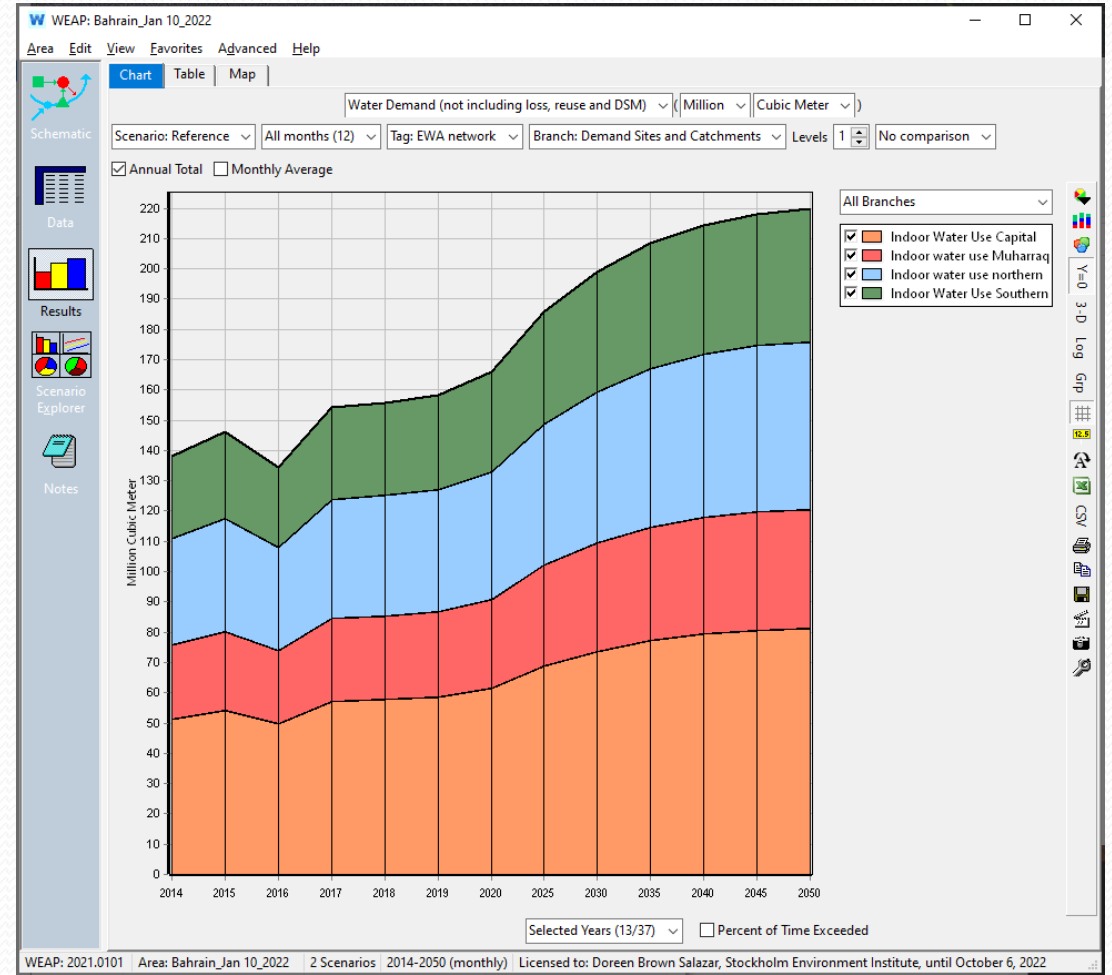
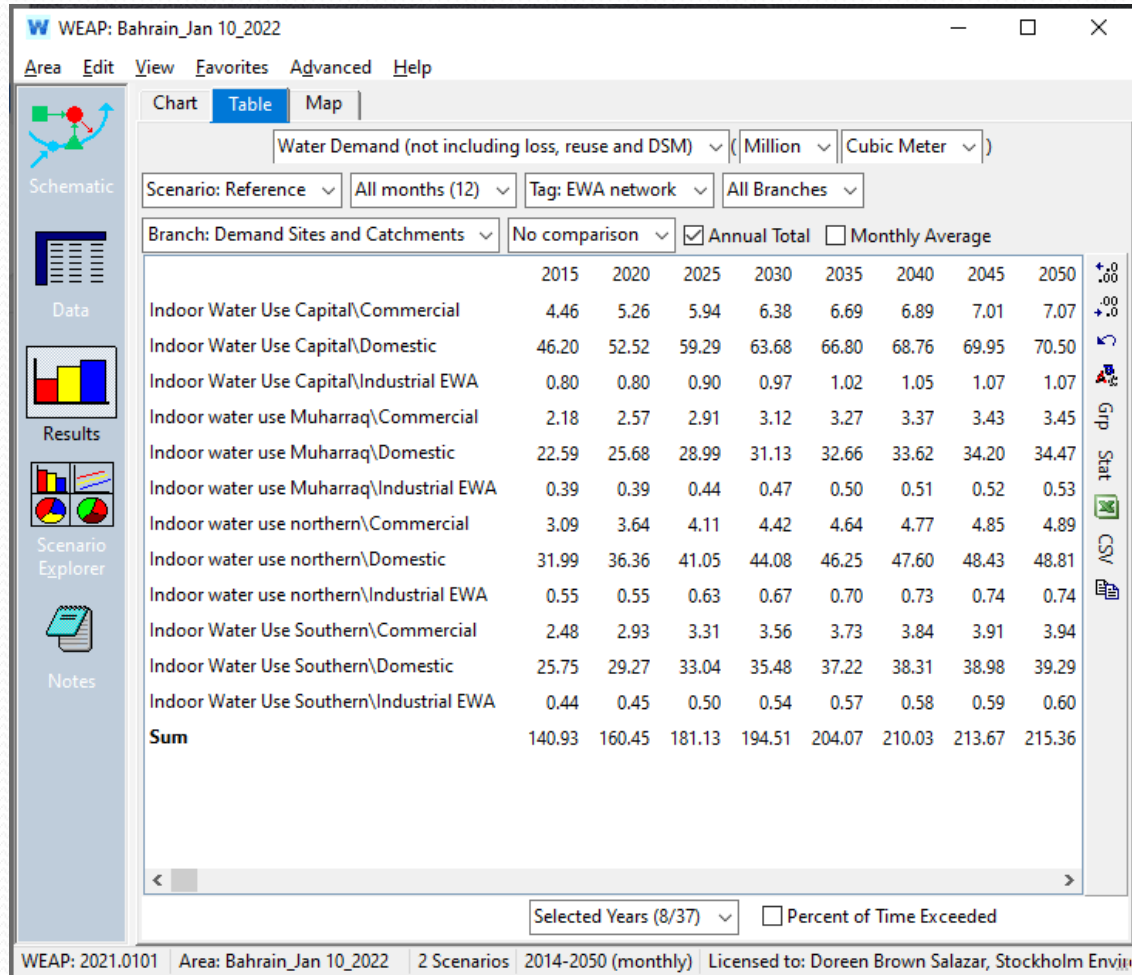
2014 2018 2023 2027 2031 2036 2040 2045 2049

- Ag farms
- Road landscaping
- Residential gardens
- Public parks and recreation
- Community Services
- Mixed special projects
- Forestation

Y=0 3-D

Tags: + - TSE network

# IWRM Model – Performance Metric



# IWRM – The Water-Climate Knowledge Platform

crme.rap.ucar.edu/WCKPortal/en

WRF Dust Model Vi... Vu Gia Thu Bon RBIS Complex networks... IBM Global High-Re... National Hydrology... Flood Modeller PAGASA 25-Forecas... TELEMAC-2D - Two... Workbook: Water\_B... SPSE ESP Ministry o...



WCKPortal

Climate

Water Supply

Water Demand

Water Management

Sign In

English العربية

## Data and Information

### Country and Time Period Selector

The pull-downs allow the user to select a different country and / or different 20-year time period for exploring the projected changes

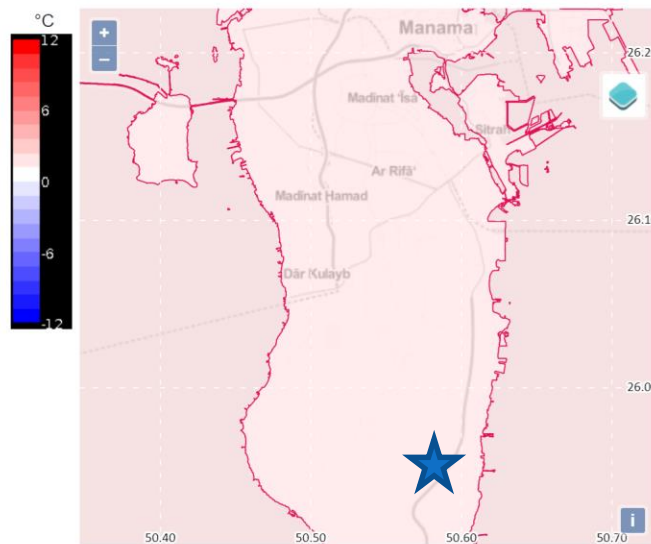
Bahrain 2020-2039

### Projected Change 2020-2039 in Spatial Variation

Reference Period:1986-2005. Country: Bahrain

Please explore different climate variables, aggregation period, climate scenario relevant for climate-induced hazards through the drop-down menu. Some information is available from Individual models, but it is recommended to primarily focus on the Multi-Model Ensemble

Variable: Average Temperature Agg. Period: Annual Scenario: RCP 8.5 Model Source: Multi-Model Ensemble



DOWNLOAD DATA

DOWNLOAD MAP

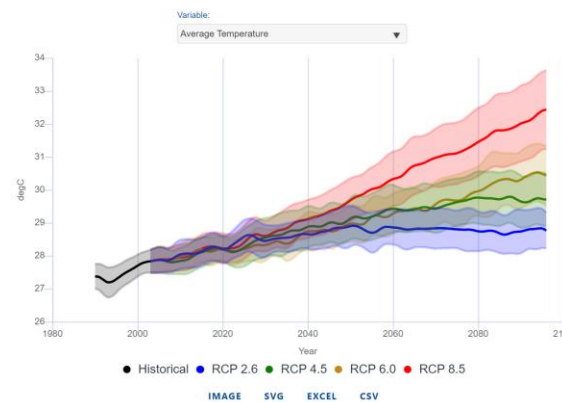
Add Data

### Projected Trends as a Time Series

Country: Bahrain

Graph shows ensemble average and country aggregation.

Please explore different climate variables relevant for climate-induced hazards through the drop-down



# IWRM – The Water-Climate Knowledge Platform



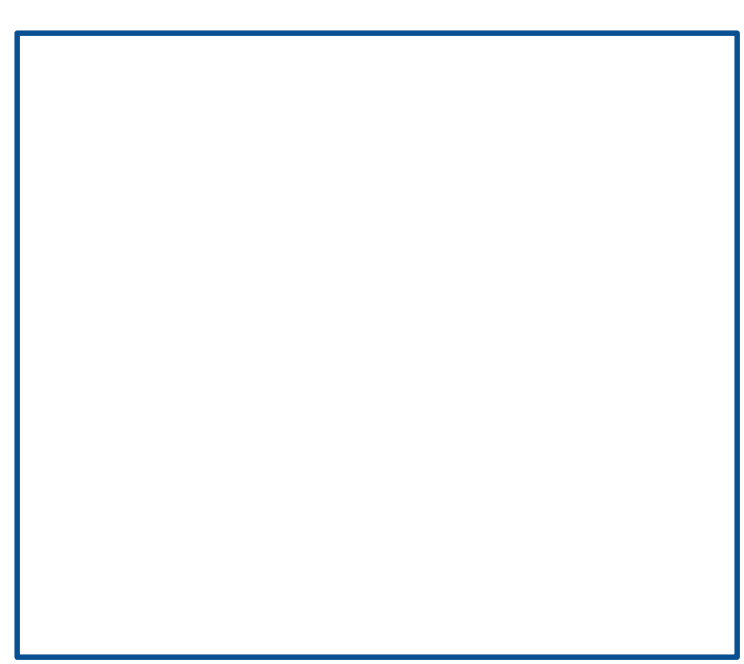
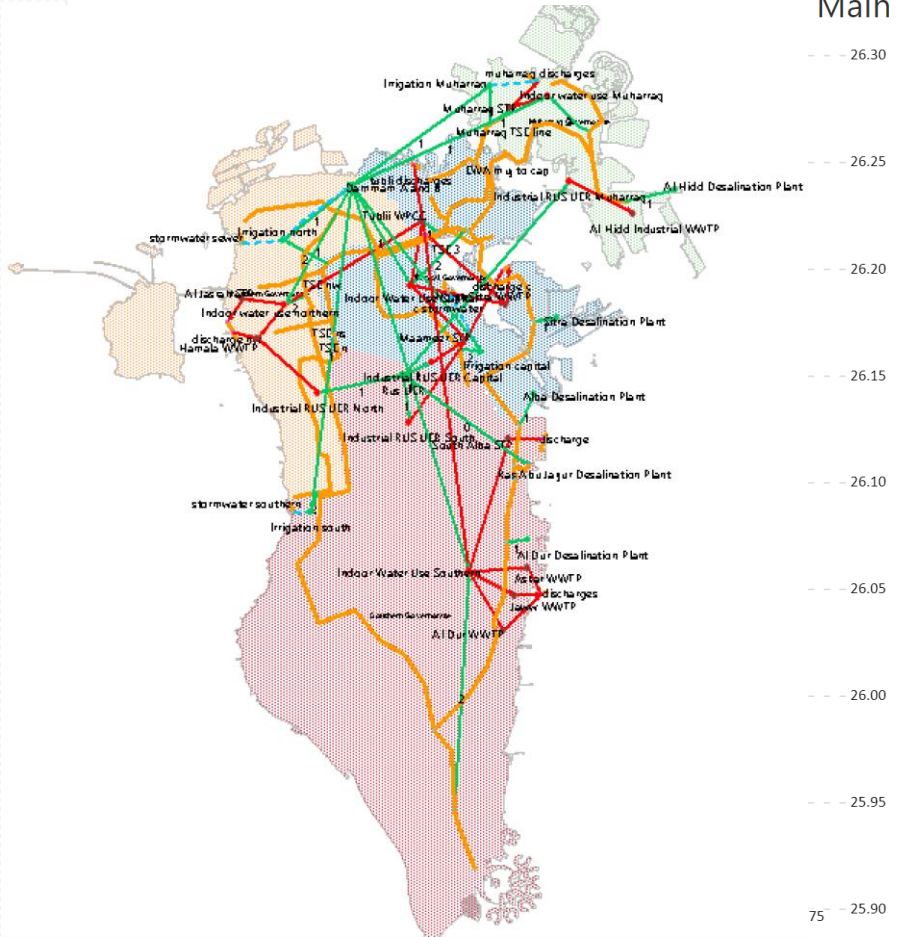
WCKPortal

Sign In

Climate **Water Supply** Water Demand Water Management

## Data and Information

Main title



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[DOWNLOAD MAP](#)

# IWRM – The Water-Climate Knowledge Platform



WCKPortal

Sign In

Climate

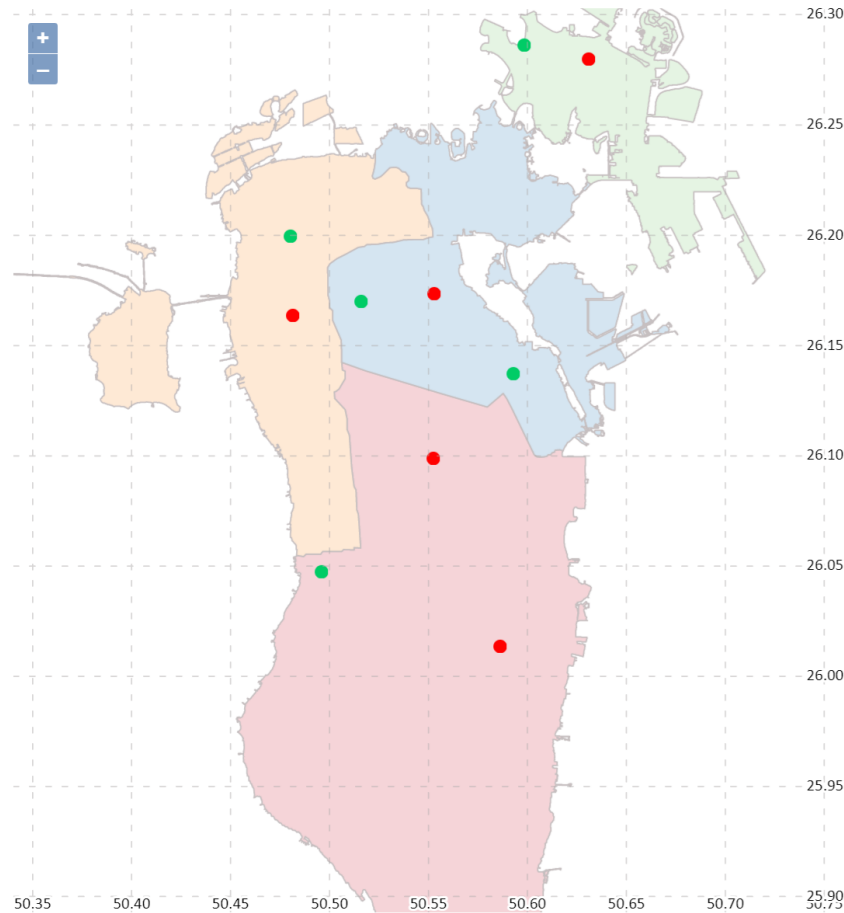
Water Supply

Water Demand

Water Management

## Data and Information

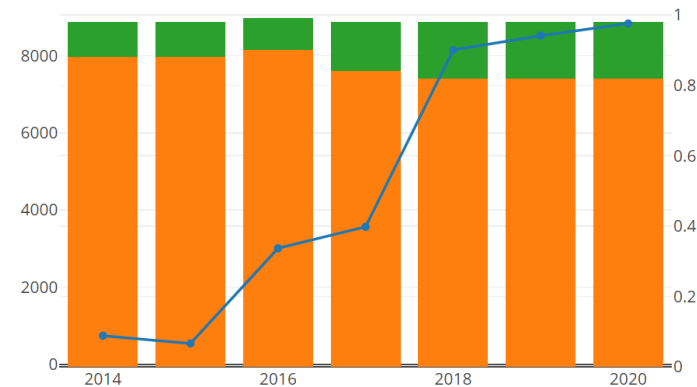
Main title



[DOWNLOAD DATA](#)

[DOWNLOAD MAP](#)

Indoor water use northern



fraction\_commercial fraction\_domestic count

[DOWNLOAD EXCEL](#)

[DOWNLOAD CSV](#)

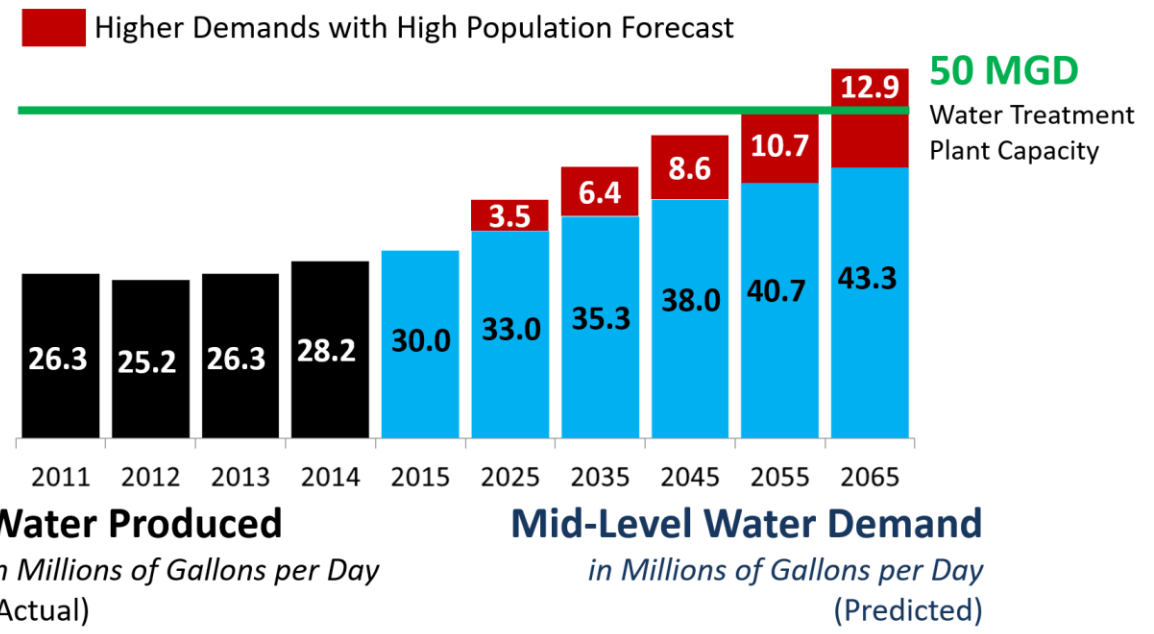
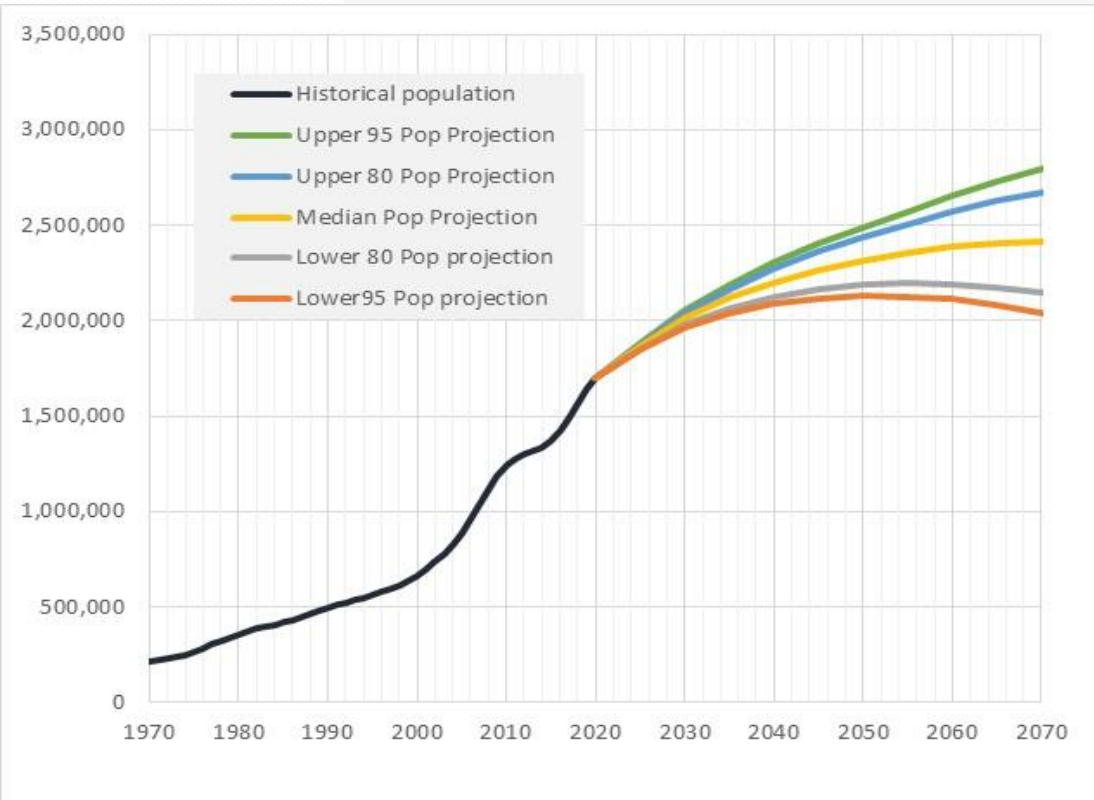
# IWRM – The Water-Climate Knowledge Platform



WCKPortal

Climate Water Supply Water Demand **Water Management** Sign In

Knowledge



# Conclusion and Recommendations

- Taking Data and Information to the “Next Level”
- How do we develop Hydroinformatics that are relevant to both Specialists and Policy Makers?
- How can Decisions Support Approaches (Robust Decision Making / XLRM) be made useful for policy makers
- Policy Implications
  - New insights into water resource sustainability
  - Metrics to Improving Sustainability Metrics
- Common Framework for Storing Historic Data and Adding New Data
- Visualization and Analysis Tools for Improving IWRM