The Experiences of Arabian Gulf University (AGU) in Climate Change Studies

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Overview

- Introduction
- Expertise at AGU
- Inquiries in Climate Change:
  - Water Resources
  - Biodiversity: Mangrove
  - Coastal & Marine
- TNC, Bahrain
Introduction

- AGU is a regional educational and research institute founded 30 years ago.
- AGU is a UNEP collaborating center that contributed in several studies including:
  - GEO reports: GEO1, 2, 3, 4, 5, 6.
  - EOAR 2010 with League of Arab States.
  - National Communication Reports for UNFCCC for Bahrain, Oman, and Kuwait; and Iraq as well.
  - SOEs: Yemen, Saudi Arabia, Bahrain.
Introduction

- AGU participated in elaborating Bahrain’s First and Second National Communication Reports (1NC, SNC) to UNFCCC.
The Government of Bahrain adopted one of the recommendations of the First National Communication by issuing and enforcing a legislation governing levels of coastal reclamation as a measure to adapt to SLR.
Bahrain’s Ministry of Public Works released a new manual to be adhered for all land reclamation and dredging activity in the Kingdom (2010).
Expertise at AGU

AGU’s experience depends on a range of scientific disciplines that are taught at the “College of Graduate Studies” and the “College of Medicine and Medical Science”:

- Integrated Water Resources Management
- Innovation and Technology Management
- Biodiversity
- Health
- Disaster Risk Reduction
- Geoinformatics
- Education and Awareness
- Marine and Coastal Environments
- Urban Environment
- Environmental Management
- Energy
Expertise at AGU

- The Climate Change Team (CCT) has gained *work’s experience* by participating in the preparation of national communications for the Kingdom of Bahrain, as well as to contribute to the preparation of national communications reports of Kuwait, Oman, Iraq.
Inquiries in Climate Change

1. Water Resources
2. Biodiversity
3. Coastal & Marine
1. Assessment of Climate Change Impacts on Water Resources in the Kingdom of Bahrain

Prof. Waleed K. Zubari
Water Resources Management Program
College of Graduate Studies

- Impact of Climate change on Water Resources in the GCC Countries.
- Use of Simulation Models in Groundwater Resources Management in the GCC Countries.
- Sustainability of Water Resources Management Systems within IWRM framework.
- Management of the Water-Energy-Food Nexus.
Groundwater Resources Vulnerability and Adaptation to Climate Change in the Kingdom of Bahrain

Simulation modeling

- Assessing the impact of temperature increase on WRM System.
- Investigating the impacts of sea level rise on desalination plants.
Conceptual WEAP Model for WR system in Bahrain

Sectoral water demands in Bahrain per catchment area (2000-2011)

<table>
<thead>
<tr>
<th>Year</th>
<th>Muharaq</th>
<th>Manama</th>
<th>Central</th>
<th>North Vill.</th>
<th>Sitra</th>
<th>AGR Demand, Mm³</th>
<th>IND Demand, Mm³</th>
<th>Total, Mm³</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>15.4</td>
<td>28.8</td>
<td>65.0</td>
<td>14.3</td>
<td>3.4</td>
<td>174.5</td>
<td>7.6</td>
<td>309.11</td>
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<tr>
<td>2001</td>
<td>17.11</td>
<td>32.15</td>
<td>66.02</td>
<td>15.98</td>
<td>4.05</td>
<td>152.80</td>
<td>6.65</td>
<td>294.76</td>
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<tr>
<td>2002</td>
<td>17.30</td>
<td>32.41</td>
<td>67.07</td>
<td>16.74</td>
<td>4.45</td>
<td>156.00</td>
<td>6.76</td>
<td>300.73</td>
</tr>
<tr>
<td>2003</td>
<td>18.26</td>
<td>34.68</td>
<td>70.09</td>
<td>17.97</td>
<td>4.98</td>
<td>154.70</td>
<td>6.61</td>
<td>307.29</td>
</tr>
<tr>
<td>2004</td>
<td>19.44</td>
<td>37.51</td>
<td>71.91</td>
<td>18.91</td>
<td>5.98</td>
<td>145.80</td>
<td>6.11</td>
<td>305.66</td>
</tr>
<tr>
<td>2005</td>
<td>19.89</td>
<td>38.70</td>
<td>74.57</td>
<td>19.79</td>
<td>5.99</td>
<td>134.80</td>
<td>5.61</td>
<td>299.35</td>
</tr>
<tr>
<td>2006</td>
<td>20.86</td>
<td>40.91</td>
<td>79.19</td>
<td>20.82</td>
<td>6.08</td>
<td>133.90</td>
<td>5.55</td>
<td>307.32</td>
</tr>
<tr>
<td>2007</td>
<td>21.82</td>
<td>42.75</td>
<td>79.97</td>
<td>21.87</td>
<td>6.16</td>
<td>136.60</td>
<td>5.53</td>
<td>314.71</td>
</tr>
<tr>
<td>2008</td>
<td>25.44</td>
<td>49.52</td>
<td>84.67</td>
<td>24.59</td>
<td>6.25</td>
<td>143.50</td>
<td>5.51</td>
<td>339.48</td>
</tr>
<tr>
<td>2009</td>
<td>30.49</td>
<td>55.25</td>
<td>94.56</td>
<td>28.22</td>
<td>6.23</td>
<td>143.50</td>
<td>5.51</td>
<td>363.76</td>
</tr>
<tr>
<td>2010</td>
<td>33.54</td>
<td>61.15</td>
<td>102.65</td>
<td>30.12</td>
<td>6.08</td>
<td>143.50</td>
<td>5.51</td>
<td>382.55</td>
</tr>
<tr>
<td>2011</td>
<td>34.15</td>
<td>60.88</td>
<td>105.76</td>
<td>30.22</td>
<td>6.42</td>
<td>143.50</td>
<td>5.51</td>
<td>386.44</td>
</tr>
</tbody>
</table>
Conceptual WEAP Model for the Water Resources Management system in Bahrain
## Adaptation Options: Cost Reduction Analysis

### Effectiveness of adaptive management intervention in demand reduction in the municipal sector for the period 2012-2030

<table>
<thead>
<tr>
<th>Management Interventions</th>
<th>Total Reduction by 2030 (Mm³)</th>
<th>Reduction by 2030 (%)</th>
<th>Total Cumulative Reduction (Mm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leakage reduction in mun. network</td>
<td>44</td>
<td>12</td>
<td>432</td>
</tr>
<tr>
<td>Raising consumers awareness</td>
<td>35</td>
<td>10</td>
<td>527</td>
</tr>
<tr>
<td>Use of water saving devices</td>
<td>71</td>
<td>20</td>
<td>674</td>
</tr>
<tr>
<td>All adaptation measures combined</td>
<td>134</td>
<td>38</td>
<td>1,500</td>
</tr>
</tbody>
</table>

### Cost reduction associated with adaptive management interventions in the municipal sector for the period 2012-2030

<table>
<thead>
<tr>
<th>Management Interventions</th>
<th>Total Cum Reduction (Mm³)</th>
<th>Financial Saving (MUS$)</th>
<th>CO₂ Emission (Mkg)</th>
<th>Natural Gas (Mm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leakage reduction in mun. network</td>
<td>432</td>
<td>831</td>
<td>5,672</td>
<td>363</td>
</tr>
<tr>
<td>Raising Consumers awareness</td>
<td>527</td>
<td>1,013</td>
<td>6,920</td>
<td>443</td>
</tr>
<tr>
<td>Use of water saving devices</td>
<td>674</td>
<td>1,296</td>
<td>8,850</td>
<td>566</td>
</tr>
<tr>
<td>All adaptation measures combined</td>
<td>1,500</td>
<td>2,885</td>
<td>19,695</td>
<td>1,260</td>
</tr>
</tbody>
</table>
2. Ecology and Restoration of Mangrove Ecosystem (Avicennia marina) in Bahrain

Prof. Mohammad S. Abido
Environ. Sci. ces and Nat. Res. Program
College of Graduate Studies

- Quantitative description of some mangrove parameters.
- community composition and structure.
- mangrove stand parameters.
- mangrove physiological parameters.
Age and growth of mangrove & Photosynthesis and Transpiration

- Age was estimated by counting growth rings.
- Width of annual growth was determined by digital basic software.

- CO₂ analyzer, The LI-6400XT Portable Photosynthesis System.
# Mangrove Descriptors

<table>
<thead>
<tr>
<th>Descriptor</th>
<th>Average</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>1250 tree/ha</td>
<td>945-1457</td>
</tr>
<tr>
<td>Coverage</td>
<td>66%</td>
<td>35-100%</td>
</tr>
<tr>
<td>Tree Heights</td>
<td>1.60 m</td>
<td>0.5-3.20m</td>
</tr>
<tr>
<td>Stem Diameter</td>
<td>13.2 cm</td>
<td></td>
</tr>
<tr>
<td>Density of aerial roots</td>
<td>219 roots m(^2)</td>
<td>188-275</td>
</tr>
<tr>
<td>Root Heights</td>
<td>40 cm</td>
<td>25- 60 cm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mangrove Strata</th>
<th>Height (m)</th>
<th>Density (T/ha.)</th>
<th>% of Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>2.5</td>
<td>1350</td>
<td>9</td>
</tr>
<tr>
<td>Mid</td>
<td>1-2.5</td>
<td>1457</td>
<td>50</td>
</tr>
<tr>
<td>Low</td>
<td>1</td>
<td>945</td>
<td>41</td>
</tr>
</tbody>
</table>
Composition of Mangrove Community at Study Site
Age and growth of mangrove stand

- Age 45 years.
- Diameter 13.19 cm
- Growth rate 3 mm yr\(^{-1}\)
- Spring growth 85% of annual growth.
3. Assessing the Impacts of SLR on The Kingdom of Bahrain Coastal Area

Dr. Sabah Aljenaaid
Geoinformatics Program
College of Graduate Studies

- Assessing the Impact of Climate Change on Coastal Zone: Coastal Vulnerability Index-CVI.

- Assessing the Impact of Climate Change on Coastal Zone: Flooding and Inundation.

- Assessing Carbon Stocks Resulting from Coastal LULCC.
exposure

sensitivity

potential impact

adaptive capacity

vulnerability
CVI: Costal Vulnerability Index

- Impact of Climate Change on Coastal Zone: Coastal Vulnerability Index-CVI.
The total coastal length in each risk category

- **Low**: 607.7 Km (85%)
- **Moderate**: 22.22 Km (3%)
- **High**: 33 Km (5%)
- **V. High**: 5 Km (8%)

Coastal Vulnerability Index (CVI)
Inundation scenario analysis

- Assessing the Impact of Climate Change on Coastal Zone: Flooding and Inundation.

Results of the long-term inundation scenario analysis

<table>
<thead>
<tr>
<th>Year</th>
<th>SLR</th>
<th>Total Area</th>
<th>Total %</th>
<th>SLR</th>
<th>Total Area</th>
<th>Total %</th>
<th>SLR</th>
<th>Total Area</th>
<th>Total %</th>
</tr>
</thead>
<tbody>
<tr>
<td>2050</td>
<td>0.3m</td>
<td>83</td>
<td>11%</td>
<td>0.5m</td>
<td>84</td>
<td>11%</td>
<td>1m</td>
<td>188</td>
<td>25%</td>
</tr>
<tr>
<td>2100</td>
<td>1.5m</td>
<td>189</td>
<td>26%</td>
<td>2m</td>
<td>272</td>
<td>36%</td>
<td>5m</td>
<td>407</td>
<td>54%</td>
</tr>
</tbody>
</table>
MORE,

TNC, Bahrain- AGU

Component I: Measures to mitigate climate change
- Transportation
- Industry

Component II: Measures to adapt to climate change
- Water
- Coastal & Marine
- Biodiversity & Fishery
- Health

Component III: Other information relevant to the Convention
- Technology Transfer
- Educations
- Awarrance
Thank You

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