Climate Risk Assessment and Adaptation

Kristin Gilroy, PhD; Rolf Olsen, PhD
Alliance for Global Water Adaptation
Institute for Water Resources
U.S. Army Corps of Engineers
Alexandria, Virginia, USA
Overview

Long term planning questions
• Can the system manage increasing demands?
• How will climate change impact the system?

Analyses
• Increased demand
• Climate Change

Adaptation Measure: Sediment dredging
Increased Demands and Climate Change Analyses
Scenario Analysis

Analyses
• Increased Irrigation Demands
  – Current: 20 cms
  – Future: 40 cms & 100 cms
• Drier Climate
  – 10% and 20% Decrease in Inflows
• Wetter Climate
  – 10% and 20% Increase in Inflows

Performance Metrics
• Increased demand and drier climate
  – Low flows at Estuary
  – Hydropower generation
• Wetter climate
  – Annual maximum flows at Bender
Estuary Flow for Increased Demand and Drier Climate
Estuary Flow for Increased Demand and Drier Climate

Reliability of Estuary Flows $> 80$ cms

<table>
<thead>
<tr>
<th>Demand</th>
<th>Climate</th>
<th>Observed</th>
<th>-10%</th>
<th>-20%</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 cms</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td></td>
</tr>
<tr>
<td>40 cms</td>
<td>99.7%</td>
<td>99.3%</td>
<td>99.0%</td>
<td></td>
</tr>
<tr>
<td>100 cms</td>
<td>96.8%</td>
<td>95.5%</td>
<td>93.0%</td>
<td></td>
</tr>
</tbody>
</table>

Unregulated flow reliability 90.90%
Estuary Flow Reliability for Increased Demand and Drier Climate
Estuary Flow Reliability for Increased Demand and Drier Climate
Annual Hydropower for Increased Demand and Drier Climate

Graph showing annual energy (MWh) from 1950 to 2000 with observed climate, 10% decrease, and 20% decrease scenarios.
Flood Risk at Bender for Wetter Climate

ANNUAL MAXIMUM FLOW (CMS)


OBSERVED CLIMATE 10% INCREASE 20% INCREASE

Nonexceedance Probability

Peak Discharge (CMS)

Observed Climate 10% Increase 20% Increase
ADAPTATION: DREDGING STORAGE IN THE DUBASARI RESERVOIR
Dubasari Elevation and Volume

Рис. п.3.5. Кривые объемов Дубоссарского водохранилища

по проекту
НПУ – 28,00
ФПУ – 30,00
объем НПУ – 485 млн. м³
объем ФПУ – 650 млн. м³

Source:
ПРАВИЛА ЭКСПЛУАТАЦИИ ДНЕСТРОВСКИХ ВОДОХРАНИЛИЩ
Flow at Bender
Red: 1979 Storage / Blue: design storage
## Hydropower and Storages

How does the difference between design storage volume and 1979 storage volume affect hydropower?

| Dubasari Hydropower Generation | 1979 Volume |  | Design Volume |  |
|-------------------------------|-------------|-----------------|-----------------|
|                               | Average | Maximum | Minimum | Average | Maximum | Minimum |
| Energy Generated per Day (MWh) | 547.2 | 1152 | 177 | 547.4 | 1152 | 180.7 |
| Power Generated (MW)         | 23     | 48     | 7.4    | 23     | 48     | 7.5     |

Statistics from simulation of 1947-2010
Eerpeni Low Flow Reliability

Percent of time flow at Eerpeni exceeds a value
Green: 1979 Storage / Red: design storage
Conclusions & Feedback

• The Dniester ResSIM model can evaluate multiple water supply demand and climate scenarios with different reservoir operating alternatives

• This type of scenario analysis can be used to assess long-term planning questions

• Evaluating the benefits and consequences of systems operations is a useful tool for transboundary water management negotiations