Challenges of WRM in Africa

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# Renewable water resources and water availability by continents

<table>
<thead>
<tr>
<th>Continent</th>
<th>Area, $10^6$ km²</th>
<th>Population x$10^6$</th>
<th>Water resources, km³/yr</th>
<th>Potential water availability x$10^3$m³/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mean</td>
<td>Spatial $C_v$</td>
</tr>
<tr>
<td>Europe</td>
<td>10.46</td>
<td>685</td>
<td>2900</td>
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<tr>
<td>North America</td>
<td>24.3</td>
<td>453</td>
<td>7890</td>
<td>0.06</td>
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<td>Africa</td>
<td>30.1</td>
<td>708</td>
<td>4050</td>
<td>0.10</td>
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<tr>
<td>Asia</td>
<td>43.5</td>
<td>3445</td>
<td>13510</td>
<td>0.06</td>
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<tr>
<td>South America</td>
<td>17.9</td>
<td>315</td>
<td>12030</td>
<td>0.07</td>
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<tr>
<td>Australia and Oceania</td>
<td>8.95</td>
<td>28.7</td>
<td>2404</td>
<td>0.10</td>
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<tr>
<td>The World</td>
<td>135</td>
<td>5633</td>
<td>42785</td>
<td>0.02</td>
</tr>
</tbody>
</table>
Extreme spatial and temporal variability of climate and WR
Natural Challenges and threats of WR in Africa

• Among the “natural” threats are:
  – multiplicity of trans-boundary water basins;
    • Poor transboundary initiatives for sharing WR
      – Nationally (Nile, Niger, Orange, etc)
      – regionally
  – extreme spatial and temporal variability of climate and rainfall ➔ WR, coupled with climate change;
    • High spatial variability of the water resources
    • growing water scarcity,
    • shrinking of some water bodies, and desertification.
  – Unbalanced water trading opportunities
    • Promotes drive to share drops and not benefits
Human Related Threats

- On the other hand, the human threats include:
  - inappropriate governance and institutional arrangements in managing national and transnational water basins;
  - depletion of water resources through pollution,
  - Environmental protection and “development”;
  - unsustainable financing of investments in water supply and sanitation;
  - population pressure;
  - Political misalignment
  - unwillingness to share
  - high incidences of conflicts in most countries on the continent.
  - Poverty
  - Unwillingness to live with risks
  - Poor technologies & over-reliance on rain-fed systems
  - Customs and traditions
  - Many players, no referee
  - Poor monitoring networks (calibration of satellite data)

- All these provide good opportunities for change (natural or anthropogenic) to be very destructive
Floods vulnerability
Flood vulnerability
Drought Vulnerability
Shrinking Water Bodies

The Disappearance of Lake Chad in Africa

- **1963**: The lake is significantly larger.
- **1973**: The lake has started to shrink.
- **1987**: The lake is substantially smaller compared to the previous years.
- **1997**: The lake continues to shrink, with more land becoming visible.
- **2001**: The lake has shrunk to a very small size, with almost all water lost.

**Source**: This collection of maps has been drawn after a series of satellite images provided by NASA Goddard Space Flight Center, available at:

Environmental Degradation and Desertification

Deforestation in West Africa: Côte-d’Ivoire Case Study

Conversion of forest to agriculture by deforestation
Closed forest cover
Fragmented forest

Areas affected by deforestation

Maintaining old WRM strategies when change is intensifying

### EXISTING
- Drought and floods
- Cyclones and windstorms

### SECTORS (PRODUCTION SYSTEMS)
- Agricultural
- Livestock
- Trade and industry
- Transportation and mobility
- Population (poverty, economy)
- Conflicts

### HAZARDS
- Climate Change
  - Pollution (air and water)
  - Allergens
  - U.V. radiation
  - Desertification
- Small scale hazards: go unnoticed at national level but have high impacts at local level (flash floods, hailstorms, frost lightning, etc)
- Weather related transportation accidents (in the context of rapid urbanization with increasing population)
- Landslides due to changing rainfall patterns and migration to sloping areas

### VULNERABILITY
- Food security
  - Food prod
  - Accessibility
  - Availability
- Political stability
- Conflicts
- Those who lack knowledge of environmental conservation
- Rain-fed agriculture
- Soil fertility
- Pastoral farmers (mobility)
- Water availability
- Bio-diversity

### EMERGING
Change drivers may not be local
The change drivers may not be local
Climate change signal is highest in Africa
Natural change is reinforced by anthropogenic change.
Natural change is reinforced by Poor soft and hard technologies & over-reliance on rain-fed system
Change is reinforced by socio-political instabilities.
Distribution of natural disasters, by country and type of phenomena, in Africa (1975-2001)
Distribution of people affected by natural disasters, by country and type of phenomena, in Africa (1975-2001)
Distribution of natural disasters fatalities, by country and type of phenomena, in Africa (1975-2001)
Hazards and Disasters – The Case of Kenya

Prevalence of different types of hazards in Kenya

- Drought: 24%
- Floods: 29%
- Epidemics: 43%
- Wind Storms: 2%
- Famine: 2%

People affected by the different types of hazards in Kenya

- Drought: 2%
- Floods: 5%
- Epidemics: 30%

People killed or affected adversely (DISASTERS) by the different types of hazards in Kenya

- Drought: 2%
- Floods: 38%
- Epidemics: 60%
HAZARD

Society exposed to the Hazard

SOCIETAL RESPONSE TO THE HAZARD
Hazard Vulnerability

- Lack of (or existence of poorly implemented) hazard management policies
- Lack of hazard preparedness strategies
- Poor traditions and lack of skills, resources and options to mitigate impacts
- Conflicts
- Poverty
- Over-dependence on or over-exploitation of natural resources
- Lack of hazard mitigation strategies, etc

HAZARD

Moderate and manageable impacts on society

DISASTER

Adverse (barely manageable) impacts on society

HAZARDS

DISASTER
WATER RESOURCES MANAGEMENT

DEVELOPMENT

DRIVERS
- Climate Change
- Population growth

PRESSURES
- Agriculture
- Urbanization
- Technological
- Poverty

STATE
- System Definition

BASELINE

IMPACTS & VULNERABILITY
- Floods
- Droughts
- Pollution

ADAPTATION (Management)

IMPROVEMENT

QUALITY
- Quantity
Strategic Options

• Sharing
• IWRM
• To target poverty eradication and promote economic integration
• To ensure that initiatives can in a move from planning to action, etc

• Intended to reduce the vulnerabilities BUT very weak in Africa
  • Poor Political commitments
  • Non-collaborating researchers
  • Quick implementation of policies without supervision and follow-ups
  • Usually externally driven
IWRM in Africa – Call for change for change of attitudes and approaches

- Institutions are mainly driven by MOUs.
- Weak Legal Frameworks
- Little delivery of IWRM

Best Scenario Cases
- Not Possible

Sharing through Networks

Institutional Architecture

\[ \frac{\Delta y}{\Delta x} \]

Most of the conventional Training Institutions
With different levels of Complexity

Hydraulics
Hydrology
W-Q
Env. Cons

\[ \Delta y \]

\[ \Delta x \]