WATER FOR AGRICULTURE & THE ENVIRONMENT: THE ULTIMATE TRADE-OFF

Henry Vaux, Jr.
University of California
Intensifying Water Scarcity

= 

f(Population Growth, Economic Development)
THE GLOBAL WATER SITUATION
GLOBAL POPULATION GROWTH

** 30% by 2025 ~ 1.6 billion
** 50% by 2050 ~ 3.1 billion
FALKENMARK STRESS INDEX
(in m³/person/year)

** > 1700 = Self-Sufficient
** 1700 > STRESS > 1000
** < 1000 = Chronic Scarcity
### WATER-SHORT COUNTRIES

<table>
<thead>
<tr>
<th>Status Year</th>
<th>STRESS</th>
<th>SCARCe</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>11</td>
<td>18</td>
<td>29</td>
</tr>
<tr>
<td>2025</td>
<td>19</td>
<td>29</td>
<td>48</td>
</tr>
</tbody>
</table>
GLOBAL WATER USE

* AGRICULTURE = 84%
* DOMESTIC & INDUS = 6.5%
* RESERVOIR LOSS = 9.4%
ENVIRONMENTAL FLOWS = 30-35% OF UNIMPAIRED FLOW
WATER FOR AGRICULTURE
GROWTH IN AG WATER DEMAND BY 2050

Rockstrom et al 2007          5200 km³/yr
Lundquist, et al 2007          3300 km³/yr
IWMI, 2007                    1800 km³/yr
Rockstrom, et al, 2008        1700 km³/yr
SUPPLEMENTAL WATER?

1. Acquire Additional Green Water
2. Harvest Rainwater
3. Increase Water/Crop Productivity
4. Import Food – Virtual Water
BLUE WATER = Run-off & accessible ground water

GREEN WATER = Soil moisture
## PROJECTED SHORTAGES 2050

<table>
<thead>
<tr>
<th>GREEN BLUE</th>
<th>GREEN SHORT &lt; 1300 m³/person/year</th>
<th>GREEN FREE &gt; 1300 m³/person/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLUE SHORT &lt; 1000 m³/person/yr</td>
<td>Iran, Pakistan, Jordan, Egypt, Ethiopia, India, China</td>
<td>Kyrgyzstan, Czech Rep., Lesotho, South Africa,</td>
</tr>
<tr>
<td>BLUE FREE &gt; 1000 m³/person/yr</td>
<td>Japan, Bangladesh, Togo, N &amp; S Korea, Nigeria</td>
<td>Zimbabwe, Ghana, Angola, Botswana, Chad, Kenya, Mali, Sudan</td>
</tr>
</tbody>
</table>
** AGRICULTURAL WATER

** w/o MORE, INSUFFICIENT FOOD
AGRICULTURAL WATER

** w/o MORE, INSUFFICIENT FOOD
** DEFICIENT COUNTRIES
2050: Total water availability

Blue + green water

Scenario A2
Slow fertility decline

under 1300 m³/p yr
= red + orange
AGRICULTURAL WATER

** w/o MORE, INSUFFICIENT FOOD
** DEFICIENT COUNTRIES
** AFRICA LOOKS BETTER
WATER FOR THE ENVIRONMENT
SUPPLIER OF LAST RESORT?

Environmental Uses

OR
ENVIRONMENTAL SERVICES
PROVISIONAL SERVICES

** FOOD
** FRESH WATER
** WOODFUEL
** TIMBER
** FIBER
** BIOCHEMICALS
** GENE RESOURCES
REGULATING SERVICES

** CLIMATE REGULATION
** DISEASE REGULATION
** FLOOD REGULATION
** WATER PURIFICATION
CULTURAL SERVICES

** SPIRITUAL
** INSPIRATIONAL
** AESTHETIC
** EDUCATIONAL
** RECREATIONAL
SUPPORTING SERVICES

** SOIL FORMATION
** SOIL CONSERVATION
** NUTRIENT CYCLING
** PRIMARY PRODUCTION
** BIODIVERSITY
CONCERN For FUTURE

** Loss of biodiversity
CONCERN For FUTURE

** Loss of biodiversity

** Existence of thresholds
CONCERN For FUTURE

**  Loss of biodiversity
**  Existence of thresholds
**  Dryland vulnerability
ENVIRONMENTAL WATER IS WATER FOR PEOPLE
CONCLUSIONS
THE BIG TRADE-OFF

** Significant levels of starvation

OR

** High cost environmental instability