WATER FOR A STARVING WORLD

some approaches since the 1977 warning

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Past 30 years

- UN Conferences: water blind or blue only
- 1980’s: African drought dilemma, blue water scarcity
- 1990’s: virtual water, river depletion, green water
- 2000’s: MDG’s/hunger alleviation, environmental sustainability/ecosystems, consumptive water use
Globally available water - the water paradigm

Precipitation 100 %

Green Water Resource 65%

Forests

Consumptive Use

Grasslands

Wetlands

Croplands

Return Flow

Blue Water Resource 35% 90%

65 %

35 %
Rainfall partitioning

Two partitioning points:
-- land surface
-- root zone
Backcasting/MDG’s 2050

• possibility to meet food water requirements to feed humanity?

• possible pathways to hunger alleviation?

• ASSUMPTIONS: protect ecosystems by production on current croplands
Undernutrition vs food production

* no undernutrition -> 3000 kcal/p d
  - 2500 kcal/p d = 20 % undernutrition
  - 2000 kcal/p d = 40 % undernutrition

* assumed 20 % animal protein
How much water is there to meet requirements?

- requirement = 1300 m³/p yr -> enough to meet requirements?
- availability = 85% of green water on croplands + 70% of available blue (max + 15% increase on irrig land)

(rainfall partitioning based PIK-model/ LPJm: pixels, climate change SRES A2, UN medium population)

- country based calculations

- water surplus countries, water deficit countries
Country based water deficits/surpluses and agricultural improvements

<table>
<thead>
<tr>
<th></th>
<th>Deficit (km³yr⁻¹)</th>
<th>Surplus (km³yr⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current water productivity</td>
<td>4471</td>
<td>2052</td>
</tr>
<tr>
<td>WP improvements</td>
<td>-1973</td>
<td>532</td>
</tr>
<tr>
<td>Irrigation expansion</td>
<td>-348</td>
<td>1379</td>
</tr>
<tr>
<td>Net deficit / surpl (round numbers)</td>
<td>-2150</td>
<td>3960</td>
</tr>
</tbody>
</table>
## Compensate deficit by import??

<table>
<thead>
<tr>
<th>income</th>
<th>deficit km3/yr</th>
<th>population bln</th>
<th>HOW?</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOW</td>
<td>1404</td>
<td>3.8 bln</td>
<td>national solutions</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>487</td>
<td>2.1 bln</td>
<td>import</td>
</tr>
<tr>
<td>HIGH</td>
<td>259</td>
<td>0.5 bln</td>
<td>import</td>
</tr>
</tbody>
</table>
Food water deficit geography 2050
Can the food security goal be achieved?

30 % have surplus
- 2.7 bln = can export

70 % have water deficit
- 2.6 bln = can import

- 3.8 bln too poor
  = national solutions/
    reduced diet
    expectations
  + food aid

2.6 bln
2.7 bln
3.8 bln
Water shortage driven food trade

• altogether 750 km³/yr

out of overall water deficit of 2150 km³/yr

ca 30 % only
Options for 3.8 bln poor

1) modernise agriculture/reduce water losses

2) produce what is possible/reduce diet expectations

0.6 bln: reduce meat
1.9 bln: to 2500 kcal/p d + food aid to poorest
1.3 bln: try to manage on 2000 kcal/p d + food aid to poorest
Pathways to the 2050 goal

ways to meet the food water requirements

Increasing food water requirements

reduced needs

undernutrition

increased production

water productivity increase

food loss reduction

aid

trade
Implications

• *most food production can take place on current croplands*

• *loss reduction will be essential:*
  - water losses by agricultural modernisation in all developing countries - 2400 km\(^3\)/yr to gain;
  - food losses in the food chain - might reduce food production needs by some 20 %

• *essential to generate economic development in poor countries to get purchasing power*
Hot issues

- realism of huge virtual water flows in a carbon free world?

- realistic options for food loss reduction?

- realism of production explosion in surplus countries?

- maximising crop per drop
  = loss of return flow = increased river depletion
Thankyou!