Implementing optimal and resilient freshwater supply

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Introduction

- The Netherlands – a water rich country coping with drought?
- Climate change: drought periods more frequently
- Risk of salinization increases

Objective: How to develop resilient investment portfolio to prevent water shortages
Dutch Deltaprogramme (2nd)

Dutch Deltaprogramme for climate change
A. Flood protection
B. Freshwater supply

Long list of measures to combat water shortage
Dutch Deltaprogramme Freshwater

- Cost effectiveness analysis of measures in main water system (expand reservoir Lake IJssel), not in regional waters (hydrological models)
- Benefits of measures proved to be difficult to compute, private adaptation not taken into account
Lessons learnt from Dutch water policies (1)

Policy 1. Flood protection
- CBA to compute optimal measure
- Spatial solutions might be cheaper in low population density areas
Lessons learnt from Dutch water policies

Policy 2. Water pollution reduction

- Public waste water treatment plants
- Firms taxed for pollution discharge
- Prevent public measures to become obsolete, due to firms’ rapid adaptation to water pollution taxes
Criteria for ranking potential measures 1.

- **Innovation potential.** If more technological development is expected, than more potential for innovation.

- **Adaptation.** Private measures are preferred over public measures, more knowledge about local situation.

- **Private versus public good characteristics.** Demand reducing measures are preferred over supply augmenting measures.
Criteria for ranking potential measures 2.

- **Risk reduction.** Entrepreneurs are risk averse. Over investment in private measures.
- **Minimising market effects.** Large scale measures are more likely to distort the market.
- **Sequence of measures.** Public measures may substitute (more efficient) private measures.
Summarizing criteria for ranking potential measures

A. Demand reducing measures are preferred over supply augmenting measures (external effects, private and public good characteristics of water)

B. Private measures are preferred over public ones (adaptation, risk minimization, sequence of measures)

C. Measures with potential for innovation are preferred

D. Small scale measures are preferred over large scale
Waste hierarchy (EU waste directive)
Water supply hierarchy

1. Supply from other region
2. Store regionally
3. Store by water user
4. Reuse waste water
5. Substitute
6. Save
# Ranking measures for water supply hierarchy

<table>
<thead>
<tr>
<th>Supply hierarchy</th>
<th>Dem/Supply</th>
<th>Priv/Publ</th>
<th>Innovation</th>
<th>Scale</th>
<th>Costs</th>
<th>Example</th>
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<tbody>
<tr>
<td>1 Save</td>
<td>Dem</td>
<td>Priv</td>
<td>++</td>
<td>S</td>
<td>+++</td>
<td>Less irrigation</td>
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<td>+++</td>
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<td>5 Store regionally</td>
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<td>L</td>
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<td>Reservoir</td>
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<td>6 Supply other region</td>
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<td>Publ</td>
<td>---</td>
<td>L</td>
<td>-</td>
<td>Canal</td>
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</table>
Switching steps in hierarchy

Costs €

Reuse

Substitute

Save

Reuse

Store

Drought impact
<table>
<thead>
<tr>
<th>Measure</th>
<th>Category</th>
<th>Effect (Mm³)</th>
<th>Cost effect (euro/m³)</th>
<th>Rank CE</th>
<th>Rank hierarchy</th>
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</thead>
<tbody>
<tr>
<td>Smart irrigation, satellite info</td>
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<td>2.5</td>
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<td>Reuse rinsing water</td>
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<td>Temporary water level raise</td>
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<td>Retain water, raise drainage base</td>
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<td>Water buffers near villages</td>
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</table>
Cost effectiveness (euro/m3)

- save
- Substitute
- Substitute
- Substitute
- Reuse
- Store by user
- Store regionally
- Store regionally
- Store regionally
- Store regionally
- Store regionally
- Supply

Cost effectiveness (euro/m3)
Cost effectiveness (euro/m3)

- Smart irrigation, satellite...
- Improve soil structure
- Drought resistant crops
- Substitute sprinkler for...
- Reuse rinsing water
- Seasonal storage by small...
- Temporary water level raise
- Optimize water level
- Retain water, raise...
- Water buffers near villages
- Retain water in nature areas
- Optimize water supply

Cost effectiveness (euro/m3)
Advantages for process water supply

- Rule of thumb to include important elements in the decision on measures, overlooked in standard CBA
- Facilitates simple communication on efficient water supply measures
- Without extensive hydrologic and economic models, measures can be easily ranked
- Ranking can be changed, based on CBA that takes the criteria specified into account
Next steps

- Quantify contribution of innovation, adaptation and external effects, in effectiveness of measures
- Elaborate instruments to implement methodology, using waste hierarchy’s experience
- Start pilot
Questions?

Thank you!