

# Implementing optimal and resilient freshwater supply

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## Water shortage: demand versus supply

Water shortage

First: Reduce demand

Last: Increase supply

- External effects
- Innovation



## Introduction

- Climate change: drought periods more frequently
- Hydrologists forecasted more water shortages
  
- Dutch Deltaprogramme Freshwater
- Programme of measure to combat water shortage



## Objective: Resilient investment portfolio

How to develop and implement:

- resilient water use governance agreement
- associated investment portfolio to prevent water shortages

Ward (2007)

Using economic principles to discover when demand reduction is a cheaper way to cope with shortages than supply expansion



## Current policy - Priority regime banning

Category I	Category II	Category III	Category IV
Safety (dikes)	Drinking water	Agriculture (capital intensive)	Agriculture Nature
Irreversible settling of peat (houses, roads)	Electricity production	Process water for industry	Shipping Industry
Nature (Irreversible damage)			Recreation Fishery

## Dutch Deltaprogramme Freshwater

- Computed water shortage in 4 scenarios in 2050 and 2100, due to climate change
  - Adaptation of water users not taken into account
- Identify measures in national water system and regional water system to improve supply
- Programme of measure
- National measures
  - Enlarging reservoir Lake IJssel
  - Enlarge Canal for Water Supply in the West
- Regional measures

## Dutch Deltaprogramme Freshwater

- Top down evaluation approach
- CBA approach for investments in main water system (expand reservoir lake IJssel), using hydrological models
- Cost effectiveness of measures calculated
- Benefits of measures for water users not computed

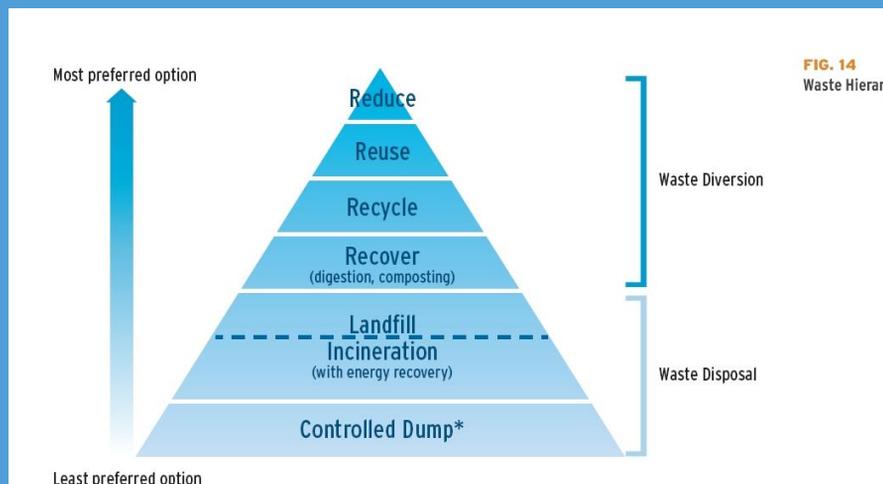
## Private and public good characteristics of water

		Rivalry	
		Low	High
Excludability	difficult	Pure public goods <ul style="list-style-type: none"> <li>• Flood control</li> <li>• Water level management</li> <li>• Landscape</li> <li>• Biodiversity, wildlife (non-use value)</li> </ul>	Common pool resources <ul style="list-style-type: none"> <li>• Community irrigation systems</li> <li>• Catchments</li> <li>• Water supply to agriculture</li> <li>• Biodiversity, wildlife (use value)</li> </ul>
	easy	Club goods (services exclusive to members) <ul style="list-style-type: none"> <li>• Waterfowl</li> <li>• Irrigation systems</li> <li>• Fishing</li> </ul>	Private goods <ul style="list-style-type: none"> <li>• Bottled water</li> <li>• Water in private basins in greenhouse horticulture</li> </ul>

## How to reduce water shortage efficiently

- Water market and water pricing - efficient allocation for private goods
- The Netherlands does not want to implement water pricing
- Public good character (environment) has to be taken into account
- Measures are not independent (firms will react on governmental measures)
- Sequence of measures is important
- What is best order of measures?

## Waste hierarchy (EU waste directive)



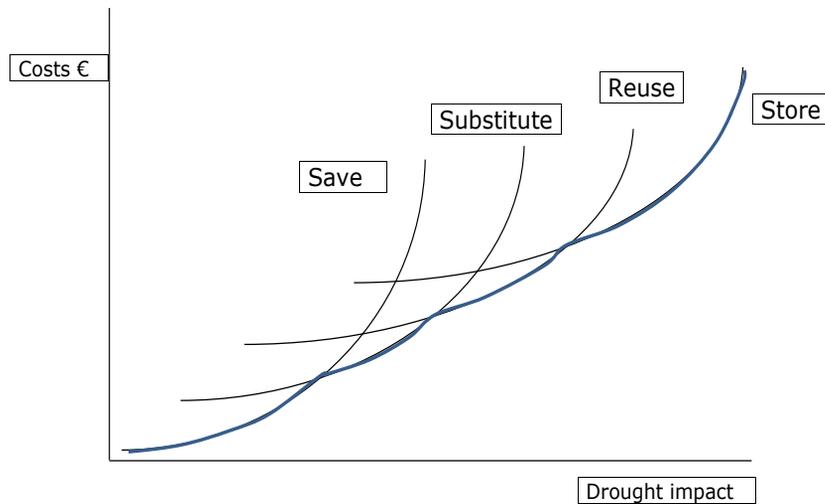
## Water supply hierarchy



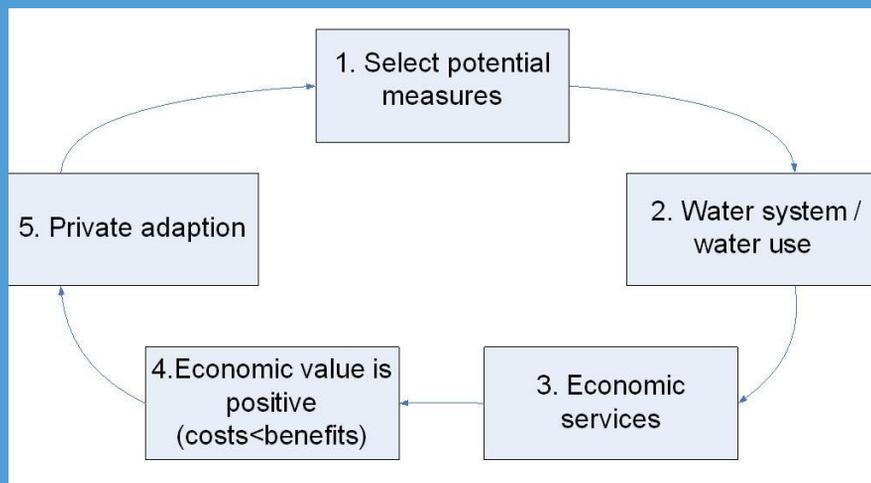
## Water supply hierarchy

	Supply hierarchy	External effect	Scale	Management	Example
1	Save	+++		Private	Less irrigation
2	Substitute	+++		Private	Drip irrigation
3	Reuse wastewater	++		Private	Greenhouse
4	Store locally	+	Temp	Private	Water basin
5	Store regionally	--	Temp	Public	Reservoir
6	Supply other region	---	Spat	Public	Canal

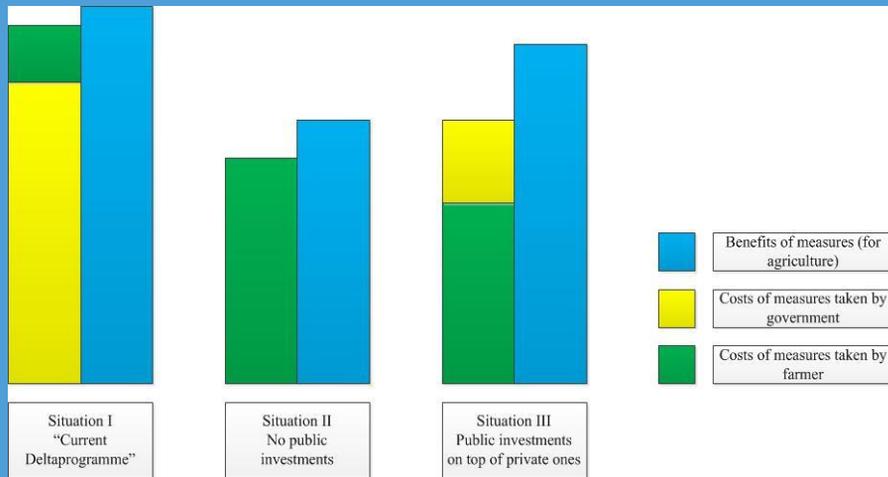
## Switching steps in hierarchy



## Iterative Cost Benefit Analysis



## Costs & Benefits - example



## Benefits of water supply hierarchy

- Stimulates innovation
- Facilitates resilience (optimizes external effects)
- Anticipates (future) behaviour water user
- Water users have better knowledge of costs and benefits than public investors
- Efficient allocation of public and private good characteristics of water
- Prevents public investments to become obsolete

## Next steps

- Calculate an example based on real data
- Elaborate instruments to implement methodology, using waste hierarchy's experience
- Start pilot

## Questions?

Thank you!

