Country case study: lessons from the Netherlands

Jarl Kind, Sr. Economist, Deltares

ECONADAPT Policy Workshop
27-28th September 2016, Brussels
1. The Dutch Delta Program
2. Economic analysis: three examples
   • CBA for New Flood Protection Standards
   • CEA Rhine-Meuse Estuary
   • CBA Fresh Water
The Dutch Delta Program
The National Delta Program

Multi-governance

Long term (2050 / 2100)
- Flood protection
- Fresh water supply
- Spatial adaptation

Well embedded
- Delta Law
- Delta Fund (€ 1 billion p.a.)
- Delta Commissioner
- Delta Program (annual)
- Delta Decisions
National Delta Scenario’s

![Graph showing climate change and population growth](image-url)
Adaptation Tipping Points

Figure 2.8  Adaptation tipping points for the Rhine-Meuse estuary

- Fresh water supply
- Defence against storms
- Open shipping route
- Sand nourishment to counteract coastal erosion
- Energy supply

Note: Red bullets indicate endpoints of a strategy, blue arrows indicate the strategy can cope with higher sea levels. The climate scenarios used in the Netherlands are marked with dotted lines.

Source: Jeuken et al., 2010.
Adaptation Pathways Map

Action A
Action B
Action C
Action D

Changing conditions
Time low-end scenario
Time high-end scenario

Transfer station to new policy action
Adaptation Tipping Point of a policy action (Terminal)
Policy action effective
Decision node

Costs and benefits of pathways

<table>
<thead>
<tr>
<th>Pathway</th>
<th>Costs</th>
<th>Benefits</th>
<th>Co-benefits</th>
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<td>9</td>
<td>++</td>
<td>+</td>
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Pathways that are not necessary in low-end scenario

CBA for Flood Protection Standards
55% of the Netherlands is flood prone:

- 26% below sea level
- 29% above sea level
Flood protection: legal standards for dike ring areas

Legal standards

Coastal areas:
1/4000 – 1/10,000 per year

River:
1/1250 – 1/2000 per year
History of legal standards:

1953: Floods in Southwestern part of the NL
1960: (First) Delta Committee: protection standards for coastal areas
1977, 1993, 1995: protection standards for other areas proposed by other Committees
1996: Flood Defenses Act: protection standards enforced by law

Hence, existing legal protection standards:

1. have no common basis
2. are not up to date
Cost-benefit analysis, from static to dynamic

**Static CBA:**
- How much to invest?
- Minimize total of investments and expected damages

**Dynamic CBA:**
- How much, when and when again to invest?
- Minimize total of investments and expected damages
Lessons from the Netherlands - Jarl Kind

Dutch Water Sector

Home | News | Dutch flood expert team wins 2013 Edelman Award with method to calculate the economic optimal dike heights

April 9th, 2013 by nwp

A team of Dutch organisations specialized on flood control, headed by the Dutch Delta Program Commissioner, won the 2013 Franz Edelman Award for Achievement in Operations Research and the Management Sciences in San Antonio on April 8.

The Dutch organisations Delta Commissioner of Holland, Ministry of Infrastructure and the Environment, CPB Netherlands Bureau for Economic Policy Analysis, Delft University of technology, Tibrug University, research institute Deltares, consultancy

Dutch flood expert team wins 2013 Edelman Award with method to calculate the economic optimal dike heights

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- IRC WASH-conference: first baseline of all Ethiopian water and sanitation facilities
- Intech wins £75m Thames Water project for digestion of waste water
> 700 inundation scenario’s

For each scenario assessment of economic damages and number of casualties
Results

Economically efficient flood probabilities

<table>
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<tr>
<th>Probability per year</th>
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<td>1/500</td>
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<tr>
<td>1/1.250</td>
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<td>1/4.000</td>
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<td>1/20.000</td>
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<tr>
<td>1/40.000</td>
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<tr>
<td>1/80.000</td>
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</table>

Outside the dike ring
High ground
Results

Economically efficient flood probabilities

Legal standard

Lessons from the Netherlands - Jarl Kind
Results

Economically efficient flood probabilities

National flood risk map
(maximum water depths)
CBA Conclusions

- Existing standards are inefficient (too high, too low)
- Higher standards are needed esp. along Rhine and Meuse
- → Flood risk reduction 67%, at a cost of € 3.7 billion.

- Earlier advice of 2\(^{nd}\) Delta Commission, 2008: tenfold increase in standards everywhere
- → Flood risk reduction 90%, at a cost € 11.5 billion.

- Hence, CBA leads to savings in investment cost of € 7.8 billion.

- Extensive support for CBA: most of the updated flood protection standards (approved in Parliament in 2016) are in line with CBA outcome.
Lessons learned

New flood protection standards
- Sensitive issue, equity and efficiency considerations
- Long process (>10 years between start CBA and political decision in Parliament)
- Dependent on political support and openness
- CBA by consortium, led by Deltares, involving consultants and universities (→ credibility)
- International scientific recognition through Franz Edelman Award 2013
- Uncertainty range in optimal standards considerable → new classes of 1/1000; 1/3000; 1/10000 etc. per year.
CEA for Flood Protection Strategies Rhine-Meuse Estuary
Lessons from the Netherlands - Jarl Kind

Maximum Water Depth
• Sea level rise, increased river discharges, socio-economic development

• Objective: reach and maintain (updated) flood protection standards
• Default measure: improve dikes
• Other measures:
  • Storm surge barrier (improve / replace)
  • Water storage
  • Change discharge distribution
  • (Room for the River)
• Q: What is an optimal strategy? → Cost-effectiveness analysis
Location of Measures

1. Maeslantbarrier
2. Retention Grevelingen
3. Channel Deepening
4. RftR packages
5. Change Discharge
1. What are economically efficient measures?
2. When should those be implemented?
3. What combinations are possible?
4. What are the remaining cost for dike increases?
5. Consistent calculation framework, database
Hydraulic boundary conditions and dike design

Lessons from the Netherlands - Jarl Kind
Hydraulic boundary conditions and dike design

With measures which reduce hydraulic loads

Dijkverhoging Koswatvак 16-1-4-B-1-Z

Dike fails test
Invest later
Allowance for robustness

Subsidence
Design horizon
Lower HBN

m+NAP

2010 2020 2030 2040 2050 2060 2070 2080 2090 2100

Lessons from the Netherlands - Jarl Kind
5 measures
4 choices:
• Do not implement
• Implement in short term
• Implement in medium term
• Implement in long term

→ 1024 combinations

2 x 16 chosen for Steam and Rest scenario
### Table 2: Summary of strategies and present values of costs and expected damages

*Steam scenario*

<table>
<thead>
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<th>Strategy No.</th>
<th>Measures of the strategy with assumed year of implementation</th>
<th>Costs, in Million Euro Present Value, 2013 prices</th>
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Lessons learned

- A tool is needed to collect information and provide consistent estimates of costs and benefits
- It is difficult to find (near optimal) adaptation strategies
- It is difficult to include uncertainty (climate change)
- The information was sufficient to discard certain measures
Delta Program Fresh Water
Aim Delta Program Fresh Water: Provide sufficient fresh water

Two economic analyses were conducted within the Program to provide information on the cost and benefits of proposed national fresh water measures.

These analyses didn’t provide sufficient information to take decisions.
Hoofdwatersysteem en regionaal watersysteem

Korte termijn maatregelen (voor 2028)
- Slim watermanagement (stuw Hoil, Issel en Hogezee, ARK-NIZK)
- Structurele buffer Issel- en Markermeer (20 cm)
- Verbeterde zoet-zoutafdelings sluizen
- Uitbreiding kleinschalige wateraanvoer (KWA naar 15 m³/sec)
- Bypass IJkesluisen (0,1x KWA+)
- Noordervaart naar 5 m³/sec

Middellange termijn: mogelijkheden
- Structurele buffer Marker- en Isselmeer (tot resp. 40 en 50 cm)
- Uitbreiding kleinschalige wateraanvoer (KWA naar 24 m³/sec)
- Alternatieve robuste zoetwatervoorziening Volkerak-Zoommeergebied
- Beperkt extra water naar Kogge Zandgronden (in gebieden met aanvoer)
- Extra Waalwater naar de Maas sturen
- Noordervaart naar 6 m³/sec

Lange termijn opties (t.c.m. 'accepteren tekorten')
- verbeteren vergroting buffer Isselmeer
- Vergroten aanvoer via Issel
- Uitbreiding KWA > 25 m³/sec / permanente Oostelijke aanvoer
- Beperking zoutindringing / Nieuwe Waterweg

Maatregelen zoet water HWS fase 4 DPZW
Experienced difficulties

- Lack of quantified impacts (both physical and welfare) due to high complexity:
  - Multiple sectors are affected
  - Return time is high: almost every year a sector is affected by drought. Many model runs are needed
  - Sectors adapt autonomously
- Communication problems between economists and hydrologists
**2021: Update Delta Decision**

- New measures and strategies
- Agreed service level (‘standards’)

To support these decisions a method and tool is now developed by Deltares to provide insight into the economic risk of water shortages.