Sustainable Delta

a serious game about water management under uncertainty

http://deltagame.deltares.nl
Sustainable Delta was originally developed by a team from Deltares, University Utrecht, Maastricht University-ICIS, Carthago Consultancy, Pantopicon, KNMI, and University of Twente.

It has been further developed by Deltares, Carthago Consultancy, and the New Zealand Climate Change Research Institute, Victoria University of Wellington.

It has been played over 60 times with water managers, spatial planners, and students during workshops and international conferences all over the world.
Why play the game?

• Experience the future and its uncertainties
• Awareness about adaptive water management
• Awareness of the role of negotiation and collaboration
• Reflect on policy decisions
• Discuss robust and flexible policy actions
Waas River

Dike Ring 1
Dike Ring 2
Dike Ring 3
Dike Ring 4
Dike Ring 5

Location A
Location B
Location C

Waas City
15 years ago...

Delta times

Severe drought in Waas delta!
River unnavigable in places!

Farmers demand more water for crops!
Another flood hits the delta! Despite all the recent studies and measures, the Waas delta has flooded a second time in 3 years. Mayor: This may never happen again!
History

Flooding Images

Drought Images
In the future...

Climate change?

Socio-economic growth?
Climate Change

Climate is changing!

Bigger peak flows?

Lower summer flows?
There is no such thing as a climate crisis
Socio-Economic Change?

Population growth?  Economic growth?
Your role

To develop a sustainable management plan for the Waas area for the next 100 years in the context of an uncertain and changing environment.

- Mitigate flood risks
- Pay attention to navigability
- Pay attention to nature
- Pay attention to community attitudes
- Acknowledge uncertainties
Two Teams

Captain

Log Keeper
1. Determine team’s point of view and strategy

2. Take into account society’s point of view
   (Local communities and NGOs)

3. Each team chooses maximum two actions

4. Negotiate preferred actions

5. ‘Overrule society’
1. Determine team name, point of view and strategy

Team name:

We have chosen the following measures:

The most important reasons therefore are:
2. Take into account society’s point of view

River Times

Nature conservation demands land purchase to promote water quality and outdoor recreation
3. Discuss and select two actions only
Policy Actions

Room for the river

Medium scale

Costs

- 60
- 1.8

Impact

More room for the river is created by widening the river bed. This results in a moderate increase in nature area. Space in area B cannot be used for developments that are not flood proof.

Blocks development vulnerable to flooding in area B

Room for the river
Policy Actions

Raise dike levels

Levees to design discharge
1 : 500 yr + 0.5 m

Costs
- 30
- 0.3

Impact

Raise dike ring 1 by 2 m

Costs
- 7
- 0.1

Impact

Increase the height of dike ring 1 by 2 m.
Policy Actions

Dikes around urban areas

Levee strength

Dikes around urban areas

Costs

- 80
- 0.8

Impact

- Large cities will be embanked, resulting in a lower damage to urban areas and less casualties in case of flooding.
- No social support in case of financial crisis
Levee strength

Climate dikes

Costs

- 80
- 0.8

Impact

Strong wide embankments that result in a lower chance of failure in case water levels are lower than the dike height.

No social support in case of financial crisis

Climate dikes
Policy Actions

Evacuation training

Costs
- 3
- 0.6

Impact
Provide education to citizens of what to do in case of flooding

Be Prepared
Be Aware
Be Ready

Evacuation training
Cooperation with upstream communities

Upstream cooperation
Equal safety level

Costs
- 1
- 0.5

Impact

Cooperation with upstream water managers, resulting in an equal safety level like in the Waas areas. Maximum discharges reaching the Waas river remain the same (20,000 m³/s).

Implementation of this action is uncertain
Policy Actions

Land use area A

Floating houses

**Costs**
- 40
- 0

**Impact**
Increase the urban area at the expense of farmland in area A. Houses are built so that they will float in case of floods.
Policy Actions

Dredging

Small scale dredging

Costs

5

Impact

The navigation channel is deepened at a small scale, resulting in a minimum depth of 4 m at 700 m³/s
Policy Actions

**Boat types**

**Medium boats**

**Costs**

- Symbol: 
- Value: 40
- Symbol: 
- Value: 4

**Impact**

- Symbol: 
- Symbol: 
- Symbol: 
- Symbol: 
- Symbol: 

Vessels up to 3000 ton. Smaller boats have the ability to navigate the river in case of lower discharge. A minimal depth of 3 m is required.

**Boat size**
Limits on Actions

**Levee Strength**

**Dikes Around Urban Areas**

**Costs**
- 80
- 0.8

**Impact**
- Additional embankments around large urban areas, resulting in reduced damage and casualties in these areas during peak flows.

**No social support in case of financial crisis**
Choose preferred two team actions and provide rationale

Team name:

We have chosen the following measures:

The most important reasons therefore are:
4. Negotiate
5. Overrule society
(if needed to implement negotiated actions)
6. Simulate to assess impacts

Flood Damage

Nature

Casualties

Drought (Navigation)
Let’s Play!
Debriefing
Evaluation after simulating 100 years

• Were there actions that were more effective than others?
• Did you notice any changes in your decision-making behaviour?
• (When) did you experience change in strategy or vision?
• What arguments did you use to change?
• Which uncertainties did you experience?
• What was the role of negotiation?
• In hindsight, would you have played the game differently?
Alternative Scenarios

Scenario 18: G

Scenario 14: G

Scenario 20: G

Scenario 11: G
Alternative Scenarios

Scenarios Comparison: 8, 18, 28

- Scn 28: Wp
- Scn 18: G
- Scn 8: No CC

Time (years)

Annual Peak River Discharge (m³/s)
1. Analyse objectives, vulnerabilities & opportunities using scenarios

2. Identify actions and assess efficacy, sell-by date of actions

3. Develop and evaluate adaptation pathways and map

4. Design of an adaptive plan, inc. preferred pathways and triggers

5. Implement the plan

6. Monitor

Development of Adaptive Plans

reassessment, if needed
Adaptation Tipping Points

Performance of actions for an ensemble of possible futures

Conditions at which a policy begins to perform unacceptably

Haasnoot et al. (2012).
DOI: 10.1007/s10584-012-0444-2
Adaptation Pathways

A sequence of policy actions

Adaptation Pathways

- Adaptation pathways can support robust decision-making (options, lock-ins)
- Water managers tend to respond to events and near events. Climate variability is important.
- Win-win may result in loss-loss (negotiation)
In practice...

• What are the vulnerabilities and opportunities?
• What could be (un)acceptable impacts and thresholds (adaptation tipping points) to implement adaptation actions?
• Are there specific drivers that cause these vulnerabilities?
• What adaptation actions can be taken? What could make these fail? What is their path-dependency?
• What adaptations are robust or flexible options?
In practice...

Adaptation

Pathways:
a sequence of policy actions

Tipping Points:
conditions at which a policy begins to perform unacceptably

An Adaptive Plan could be:
• Small dredging and switch to large scale dredging, if necessary.
• Implement corrective actions to mitigate negative side effects.
• Monitor river discharges and transport developments.

Flexible action = small scale dredging
Robust action = small ships

Haasnoot et al. (2013).
Questions?

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