Levees in a changing environment: flexible strategic planning

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Flood defences in the Netherlands

Over 15,000 km of levees in The Netherlands

1900 km ‘Primary’
• 1450 km River Dikes
• 450 km Sea Dikes
14,500 km ‘Secondary’

FRM in the Netherlands

Major shift after flood 1953
→ Prevention cornerstone of flood safety
→ Delta works

FRM in the Netherlands

High river discharges in the rivers Rhine & Meuse, leading to evacuation of hundred thousands of people…

- Quick reinforcement of the dikes
- Every six (12) years assessment of dikes, if they fail → Flood protection programme.
FRM in the Netherlands

Shift in thinking
- Room for the River
- Building with nature
- ....

Flood protection programme (part of Deltaprogramme)
- 360 mln Euro each year for dike strengthening
- Opportunities with other disciplines

FRM in the world

Disaster Risk Reduction (DRR)

- Dutch National Water Plan (2009)
  - 'New' approach: DRR
    1. Prevention as policy cornerstone
    2. Sustainable Delta Planning
    3. Systematizing and sustaining disaster mitigation

2nd layer → focus on mitigation and adaptation

Levees in a changing environment

Opportunity: Creating a water robust environment

- Urban areas (re)developed in such a way, that they are able to cope with a more extreme
  - water surplus
  - shortage of water and
  - Heat

Van de Ven, et al., 2010
Framework

1. Layer of substratum
2. Layer of networks
3. Layer of occupation pattern

Scales

**Temporal scale**
- Levees: 50-100 yrs (in The Netherlands)
- Housing: 30-40 yrs.

**Spatial scale**

Integration in spatial planning and robustness for climate change

Characteristics based on dike safety
1. Technical design
2. Manageability of the dike
3. Planning horizon

Characteristics based on spatial planning
4. Space occupation
5. Dike acts as a barrier between two parts of urban development
6. Functionality

(Van Vleuten, et al. 2010)

Two strategies: synchronisation & anticipation

**Synchronisation**

- Rural area
- Urban area

'Standard' Multifunctional dike

Above: utilization of underground space
Below: adaptive integral levee

**Anticipation - 1**

- Are we in a flood safety situation?
- Is the current land use suitable for flood safety?
- Can we adjust the flood safety levels?

Two strategies:
- Synchronisation
- Anticipation

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## Anticipation

Levee strengthening

The dike reinforcement by laying by materials. Possible solutions include: 
- Sand bags and flood barriers, or 
- New and old buildings can be built on the sides of the strengthened dike. 

A solution could be to move buildings on the sides and strengthen the dike.

## Anticipation opportunities

Around the world: Urban areas

### Around the world: Rural areas

### Conclusions & Recommendations

- Regional (Water) authorities are manager and developer of levees.
- Collaboration between organizations is essential.
- Spatial vision from a life cycle analysis.
- Funding (short versus long term, cost-benefits).
- Active ‘building policy’ for space on and next to flood defences.

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