Delta Committee
Preparing the low-lying
Dutch Delta for climate
change

Marcel Stive Water Research Centre Delft Delft University of Technology "Een land dat leeft, bouwt aan zijn toekomst"



Basal topography

depth top Pleistocene deposits



Topography



- 10 million people in floodprone areas
- Deepest location Zuidplaspolder around Nieuwerkerk aan den
 IJssel: MSL – 6,76 m.

Shortening of coastline in response to flooding events





Figure 1.4: Map showing principal features of the main flood protection rings or "polders" in the New Orleans area. [Modified after USACE, 2005]

lagere gemiddelde zomerafvoer rivieren en vaker extreem laag overgangsgebied hoog - laag gevoelig voor wateroverlast periodieke wateroverlast beekdalen schorren en platen kunnen verdrinken bij zeespiegelstijging aandacht voor hoogte en stabiliteit waterkeringen (periode 2008-2050) aandacht voor hoogte en stabiliteit water-keringen (periode 2050-2100) spuicapaciteit IJsselmeer onder druk bij zeespiegelstijging invloedsgebied zee/IJsselmeerverschuift rivieropwaarts als zeespiegel stijgt

Presentation, reflection and discussion

- Three steps towards a safe(r) delta
- A new safety standard
- Plausible high-end scenarios RSLR
- "Delta dike"
- Regional recommendations

Acute? No, Urgent? Yes

- Water defences are not up to 1960 standards (following 1st Delta Committee)
- Current standards are inadequate (recommendation increase safety with a factor 10!)
- Climate change may accelerate

Risk approach: combination of probability and consequence

The principle of economic optimization

I – investments in safety measuresR – risk (economic damage)K – total costX – optimal safety

Safety standard for 53 dike-ring areas

De facto a varying safety:

- NH and ZH 1/10.000 per year
- North and South 1/4.000 per year
- Yellow 1/2.000 per year
- Green: 1/1.250 per year

NB:

Probability individual loss of life in a flooding is 1%, so that the probability due to flooding in the green areas is 1 in 125.000 per year!

- Risk = probability x damage
- Insight in failure probabilities strongly changed (mainly negative)
- Insight in damage strongly changed (both positively and negatively)
- Individual and group risk too high

Relative SLR

High-end scenarios:

- Round 2050: 40 cm/century
- Round 2100: 65 to 130 cm/century
- Round 2200: 2 to 4 m/century

NB: a bit confusing cause KNMI are best estimates

Relative SLR

- Plausible high-end scenarios necessary to judge the sustainability of our dike-ring concept
- High-end and low-end scenarios necessary for robust design
- What lacks is probabilities!

River discharge

Summer: from1700 m³/s now to 700 m³/s in 2100

Winter: from16.000 m³/s now to18.000 m³/s in 2100

Recommendations (1): Principles "Building with nature", multifunctional solutions and the "Delta dike"

Building with nature

- Adapt to changing conditions and predictions
- Minimize costs at the long term
- Seek potential for multifunctional and integrated approaches

"Delta dikes"

Dikes that through height, width or internal structure are practically breach resilient. Requires local optimization.

Popular view

- Plea for breach resilient, wide dikes
- Is not always THE solution
- Can be a solution, but (1) claims space and (2) there are more failure mechanisms that need to yield the same risk
- NB: a chain is strong as the weakest link!

Regional recommendations

- North Sea coast
- Wadden region
- SW Delta
- River regions
- Rijnmond
- IJssel Lake area

North Sea coast

- Building with nature through nourishment
- Beaches follow SLR naturally
- Great potential for coastal extension!

Coastal extension

SW Delta

- Restore tidal dynamics for the Oosterschelde at the end of this century
- Raise Westerschelde dikes
- Volkerak-Zoommeer salt!
- Issue of fresh water!

Wadden region

Coast nourishment garantees the availability of sand for the Wadden Sea and its ebb-tidal deltas

Rivers

- Complete execution of program 'Room for the river'
- Idem Maas
- Acquire strategic grounds

Space for the IJssel

Rivierverruiming langs de IJssel tussen Zwolle en Kampen

Nieuwe Maas at Rotterdam

Rijnmond region

- Protection by a chain of open surge and discharge barriers
- Creation of potential for nature and urban development

IJssel lake

- Mean level of IJsselmeer follows SLR (1.5 m is upper boundary!)
- IJsselmeer remains THE freshwater basin, available for drought periods
- Level of Markermeer unchanged

Costs

- 1,2 to 1,6 billion euro per year until 2050 (order of 1% of BNP, order of 1 per mille of invested infrastructure)
- 0,9 to 1,5 billion per year for 2050-2100
 - Exclusive costs of nourishment for coastal extension

Samen *werken* met water

Working together with water (build with nature & co-operate)

Main flood events

Following 1916

Creation of IJssel Lake and polders

1953 flood

Flood disaster in the SW Delta

The Delta works

• Dikes and barriers

Safety check flooding

Results 2nd check (2006) primary defences:

- 24% no-pass
- 32% no check possible

Since the 1960's:

- Economy increased 600%
- Population increased 50%
- Individual and group risk too high
- (the negative factors)

Since the 1960's:

- Advances in flood modelling
- Dike-rings are no bathtubs!
- (positive factors)

Dike-ring 14 (ZH):

- Economic risk optimal for 1 in 20.000 to 40.000 per year
- For a factor of 10 on 1 in 10.000 increased standard of 5 to 2.5

het RIVM werden gepresenteerd.

DELTACOMMISSIE