

# Ecosysteemdiensten van Kwelders: Co-benefits and Trade-offs

Online Kweldersymposium 2022

Jantsje van Loon-Stoopsma, 27 januari 2022





Ceci n'est pas une pipe.

# Verschillende Functies



# Eco-system services

## Millennium Ecosystem Assessment (2005)



### Provisioning services:

- Food
- Non-drinking water
- Drinking water
- Wood
- Fuel

### Regulating Services:

- Soil fertility
- Erosion prevention
- Water retention
- Coastal Protection
- Climate control in cities
- Water purification
- Pest control
- Pollination
- Carbon

### Cultural Services:

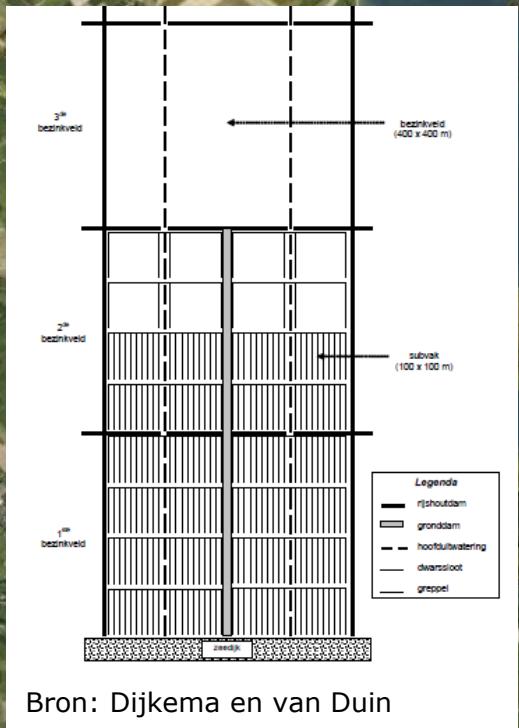
- Outdoor recreation
- Natural heritage
- Symbolic value of nature

### Habitat Services:

- Biodiversity

# Functies Kwelders

- Tot 1970: Landbouwkundig
- Vanaf de 70-er jaren: Natuurbehoud en ontwikkeling (en behoud landschappelijke waardes)
- Vanaf ca. 2010: Belangstelling voor rol in waterveiligheid (adaptatie), maar ook voor recreatie en toerisme
- Recent: Nieuwe functies als bouwmateriaal voor adaptatie maatregelen en vastleggen koolstof/Blue Carbon storage (mitigatie)



Bron: Dijkema en van Duin

# Kwelders: waardevol en beschermd habitat



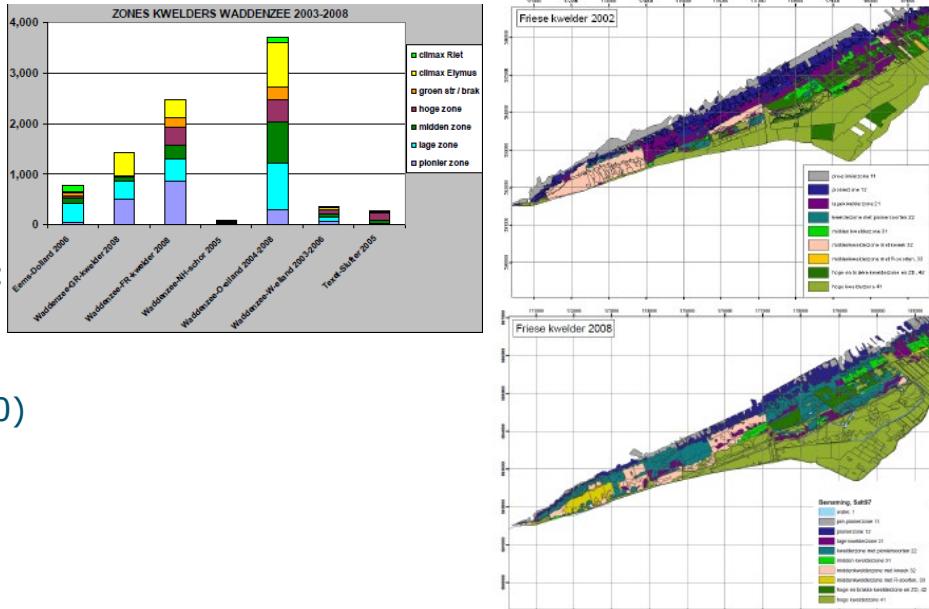
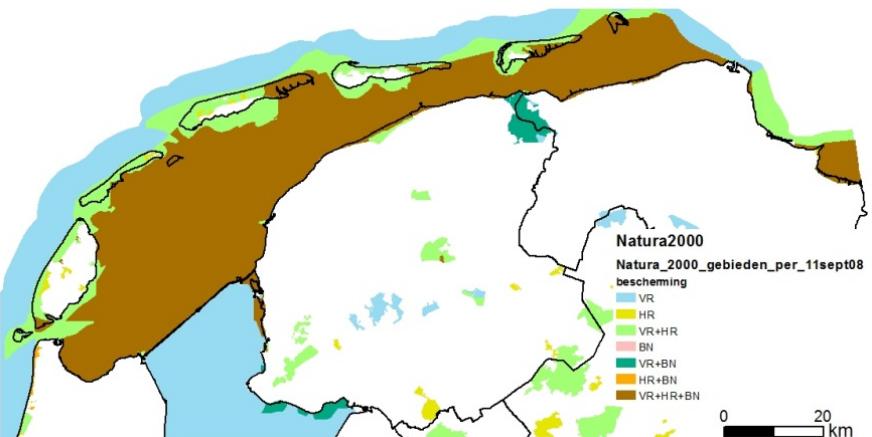
In view of their unique biodiversity values, salt marshes are protected by national and international conservation legislation and policies (e.g. Ramsar Convention, US Clean Water Act, EU Habitats Directive and the Wild Birds Directive, EU Natura 2000, the EU Water Framework Directive and the Netherlands Spatial Key Decision) as well as by trilateral agreements between Denmark, Germany and the Netherlands.

# Doelstellingen Natuurbehoud: areaal en soorten

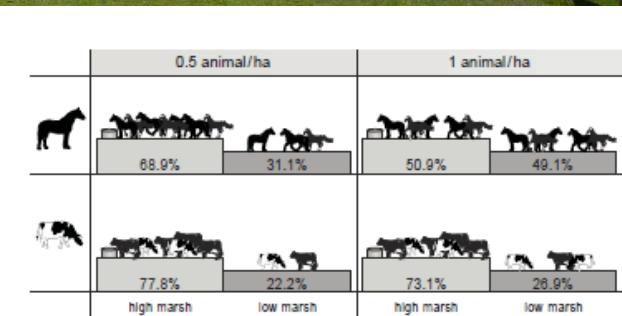
target species and habitats:

- (i) halophyte pioneer vegetation (H1310),
- (ii) Spartina swards (H1320)
- (iii) salt marshes, including a diversity of characteristic vegetation (H1330)

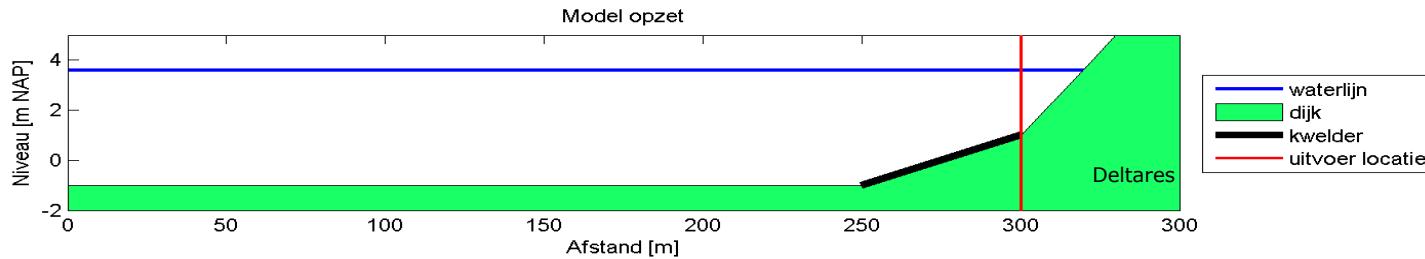
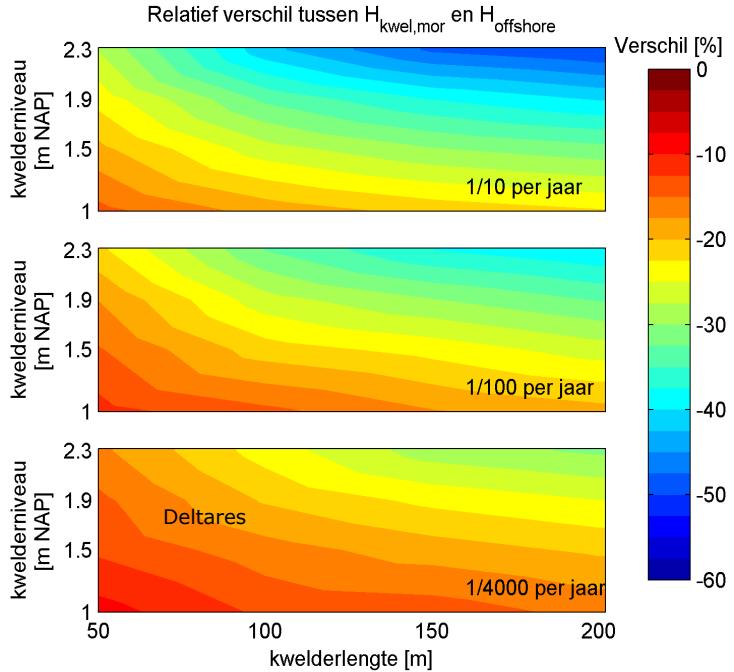
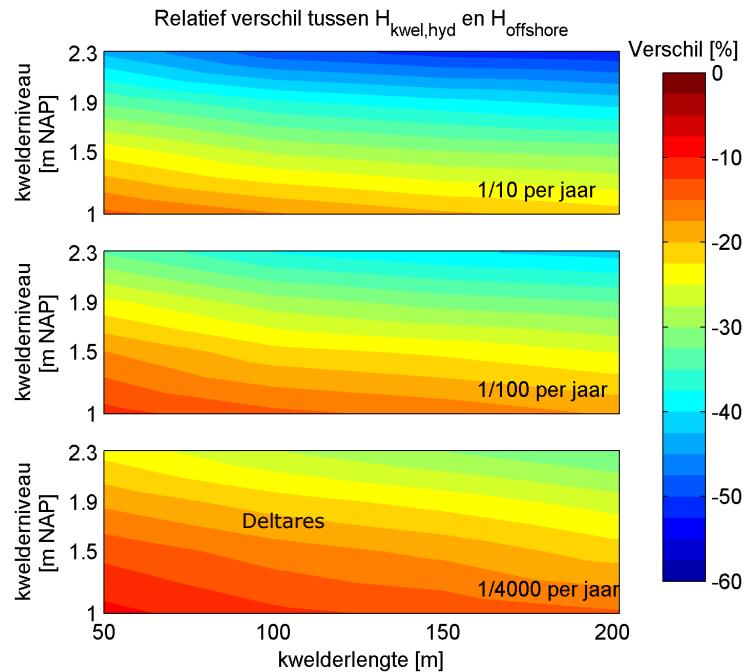
adjacent mudflats are another key habitat type (H1140)



Dijkema K.S., Van Duin W.E., Dijkman E.M., Nicolai A., Jongerius H., Keegstra H., Van Egmond L., Venema H.J. & Jongsma J.J., 2013. Vijftig jaar monitoring en beheer van de Friese en Groninger kwelderwerken: 1960-2009. Werkdocument 229 Wetterselijke Onderzoekstaken Natuur & Milieu, Wageningen.<sup>8</sup>

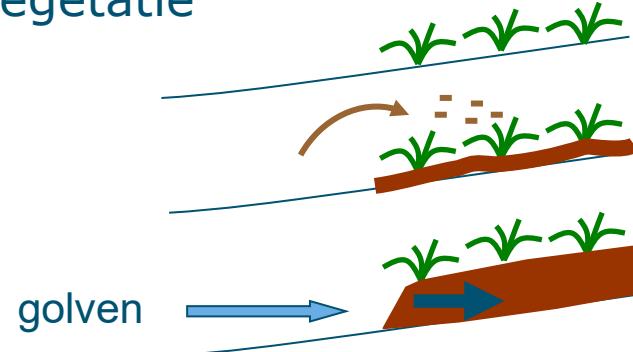


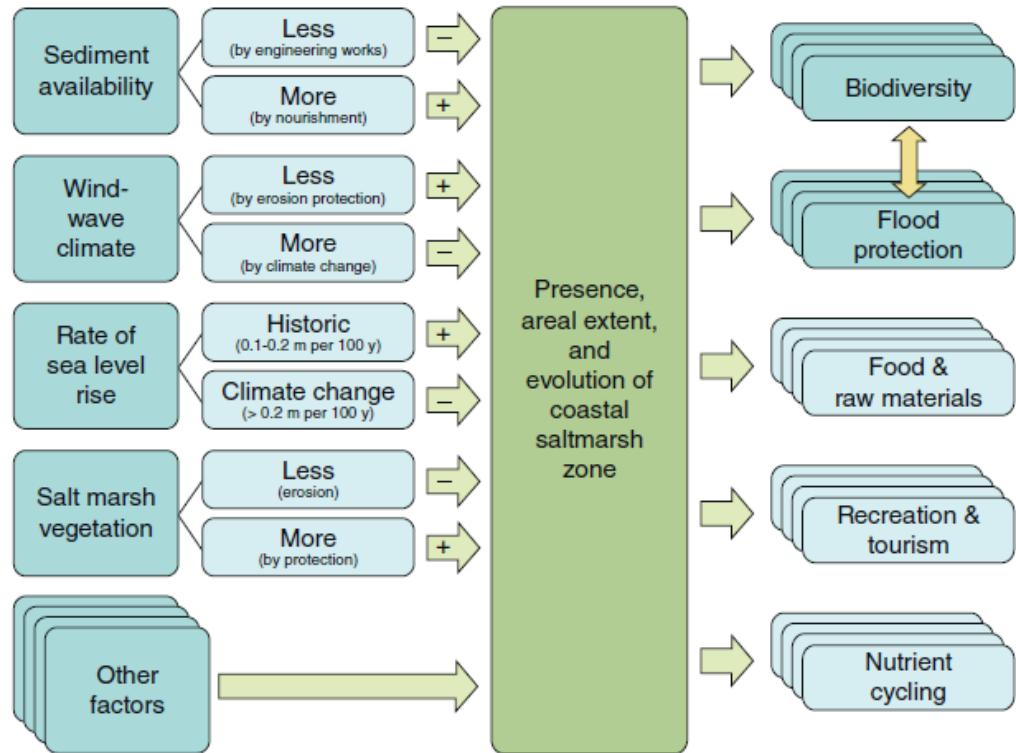
Nolte, S., Esselink, P., Smit, C. & Bakker, J.P., 2014. Herbivore species and density affect vegetation-structure patchiness in salt marshes. *Agriculture, Ecosystems and Environment* 185: 41-47.



# Kwelders: het resultaat van geo-morfologische, hydrodynamische en ecologische processen

- Hoogte
- Sediment beschikbaarheid (g sed/l zee water én & silt in sediment)
- Wind-golf klimaat
- Vegetatie



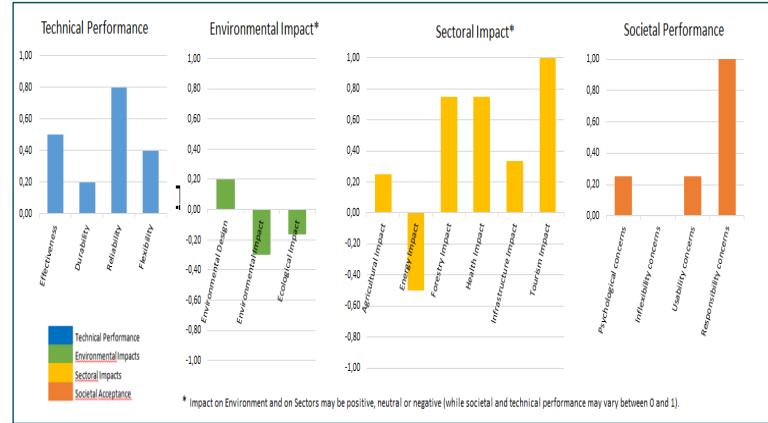


Current Opinion in Environmental Sustainability

Van Loon-Steenisma, J.M. and Vellinga, P., 2013. Trade-offs between biodiversity and flood protection services of coastal salt marshes. Current Opinion in Environmental Sustainability 5(3-4): 320-326.

# Impact Assessment voor aangelegde kwelders

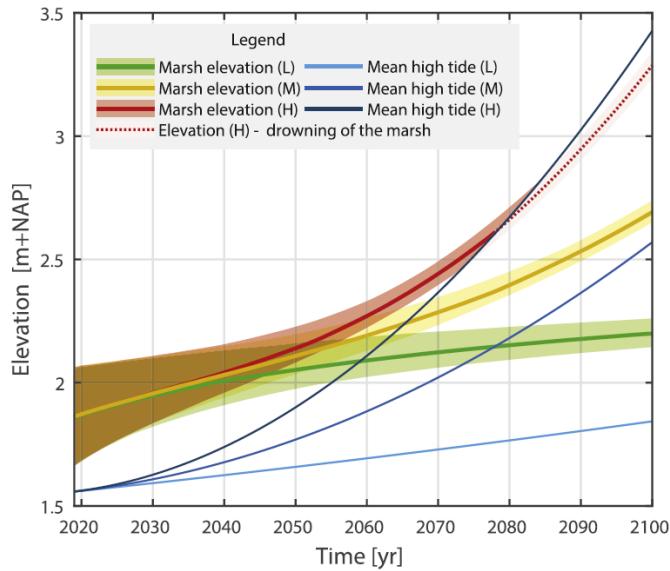
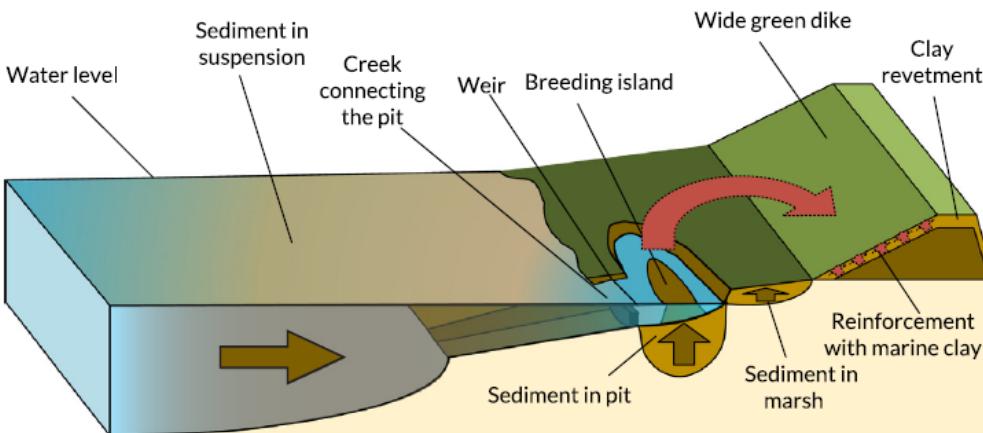
	Environment
<b>Environmental Design / Sustainability</b>	Deliberately use of ecosystems or natural processes; Areal footprint; Quantity of greenhouse gas emission; Recyclable materials; Promoting other ecosystem services
<b>Environmental Impact</b>	Surface water quality and quantity; ground water quality and quantity; sea water quality; soil quality; air quality; debris generation; noise or vibration generation; landscape quality
<b>Ecological Impact</b>	Spatial extent of Natura 2000 (or otherwise protected) nature; Quality of protected habitats; Number of protected species (e.g., birds, vegetation, fish, mammals, other animals); Spatial extent of non-protected nature; Quality of non-protected habitats; number of non-protected species
Socio-Economic Sectors	
<b>Agriculture</b>	Area available for agricultural production; Production conditions; Variety of Agricultural Products; Yield of one or more agricultural products
<b>Energy</b>	Energy production capacity; Reliability of energy production ; Technical effectiveness of energy production; CO <sub>2</sub> footprint
<b>Forestry</b>	Area for wood production; Wood production conditions; Area for non-wood production; non-wood production conditions
<b>Health</b>	Avoided Deaths; Number of physical health affected people; Number of mental/psycho social affected people; Emission of chemical pollutions
<b>Infrastructure</b>	Quality of the built infrastructure; Area available for urban development; Capacity of transportation networks; Reliability of transportation networks; Capacity of infrastructural networks; Reliability of infrastructural networks
<b>Tourism</b>	Quantity of recreational area; Attractiveness of recreation area; Length of tourist season



See: Van Loon-Steenma, J.M. and Goldsworthy, C. (2021). Environmental Performance of Climate Adaptation Innovations. Ambio. <https://doi.org/10.1007/s13280-021-01571-5>

# Kwelders voor duurzame adaptatie dijken

- 9.4 ha of pit can reinforce a 1 km dike section until 2100 under sea-level rise.
- The infill rate of the borrowpit increases with its depth.
- Infilling of the borrow pit is projected to accelerate with sea-level rise.



Marijnissen, R., Esselink, P., Kok, M., Kroeze, C. and Van Loon-Steenisma, J.M. 2020. How natural processes contribute to flood protection - A sustainable adaptation scheme for a wide green dike. *Science of the Total Environment journal.*  
<https://doi.org/10.1016/j.scitotenv.2020.139698>

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