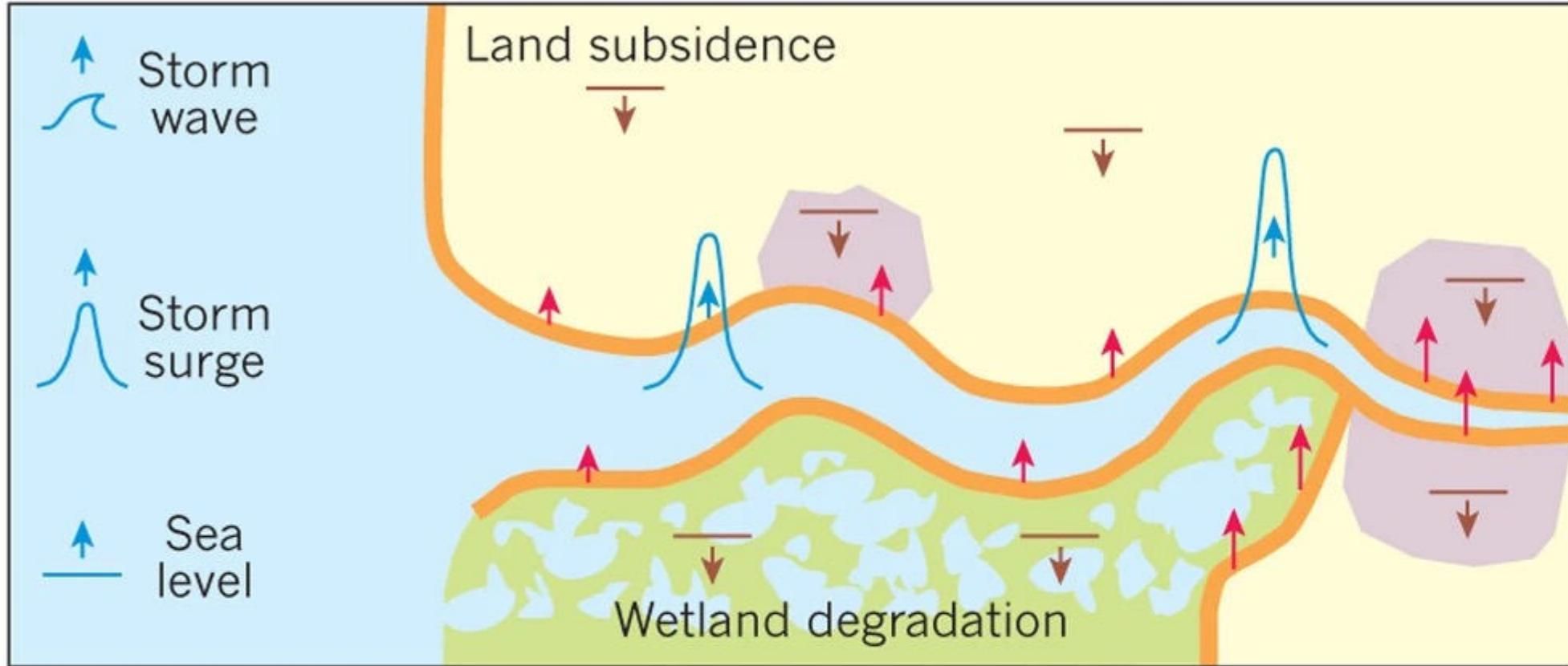


# Double dykes and transitional polders as ecosystem-based solution in the Dutch southwestern delta

Jim van Belzen, Gerlof Rienstra & Tjeerd Bouma

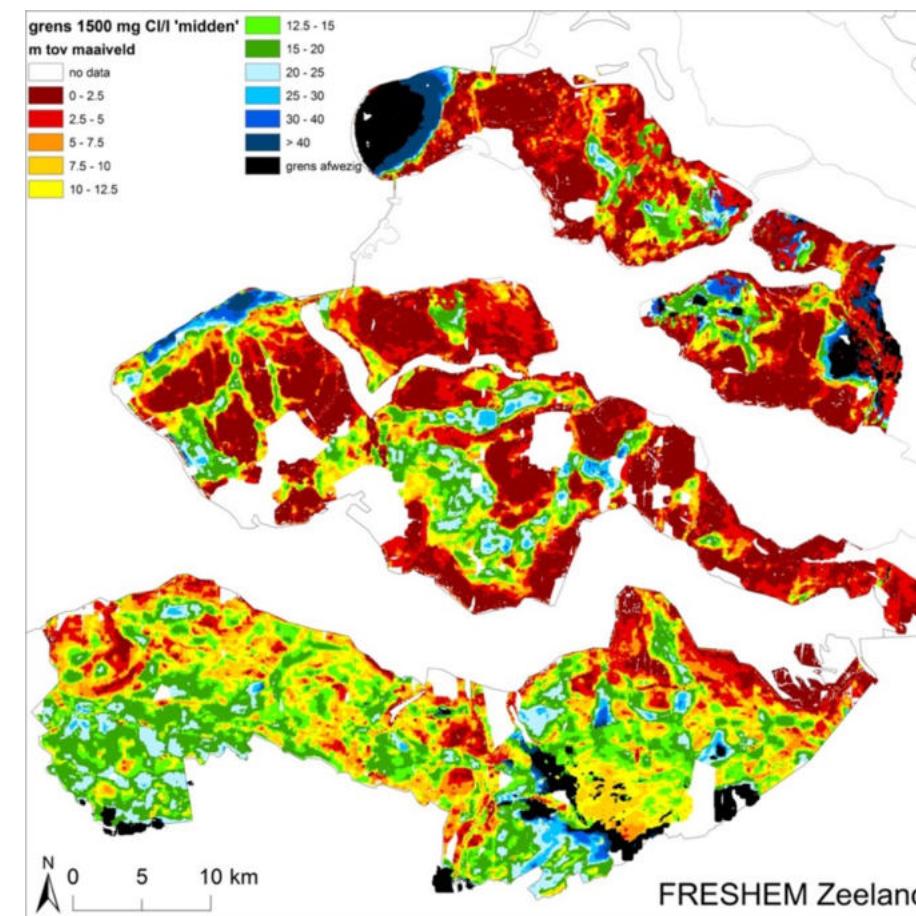
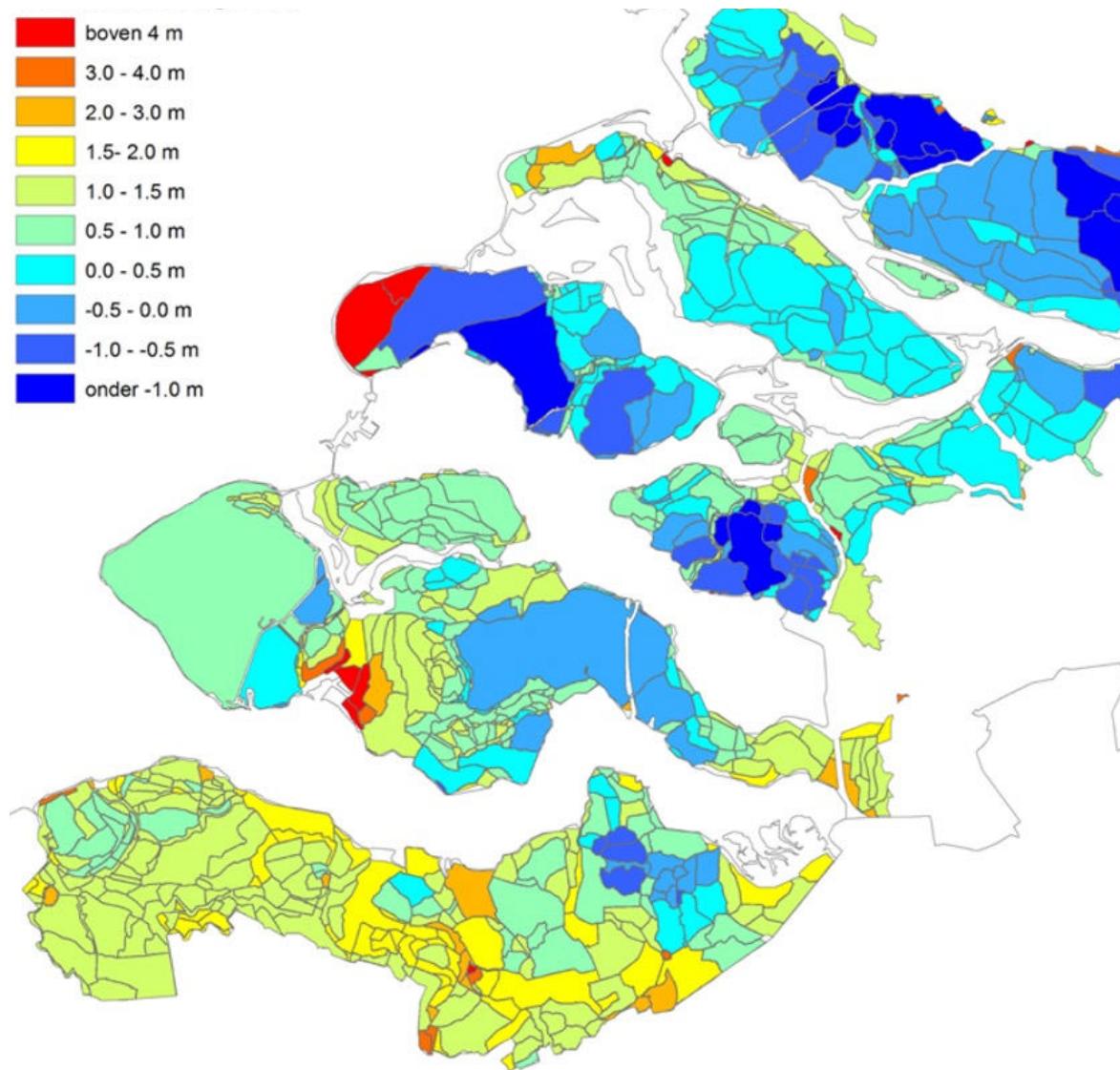


# Conventional coastal engineering

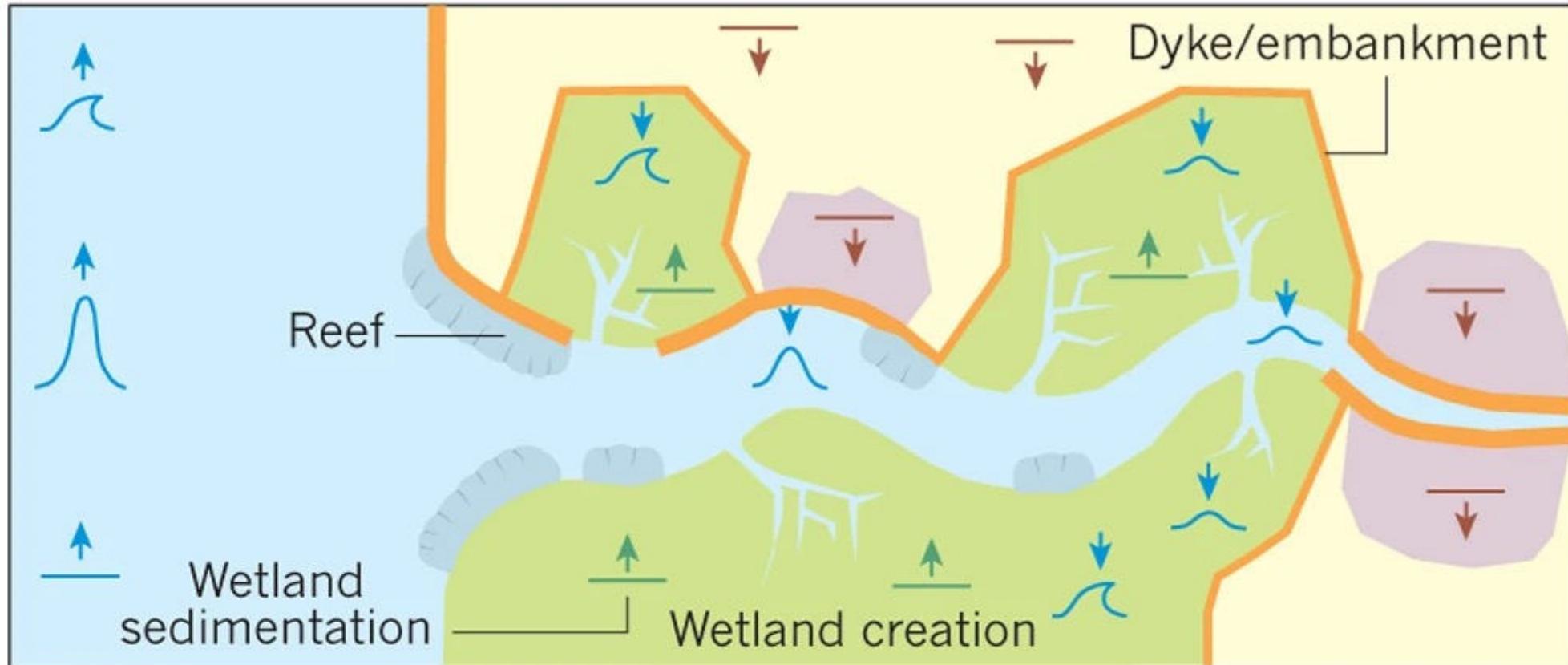


Temmerman et al., 2013 Nature

# Subsidence & salinization in the SW-delta



# Ecosystem-based coastal defence

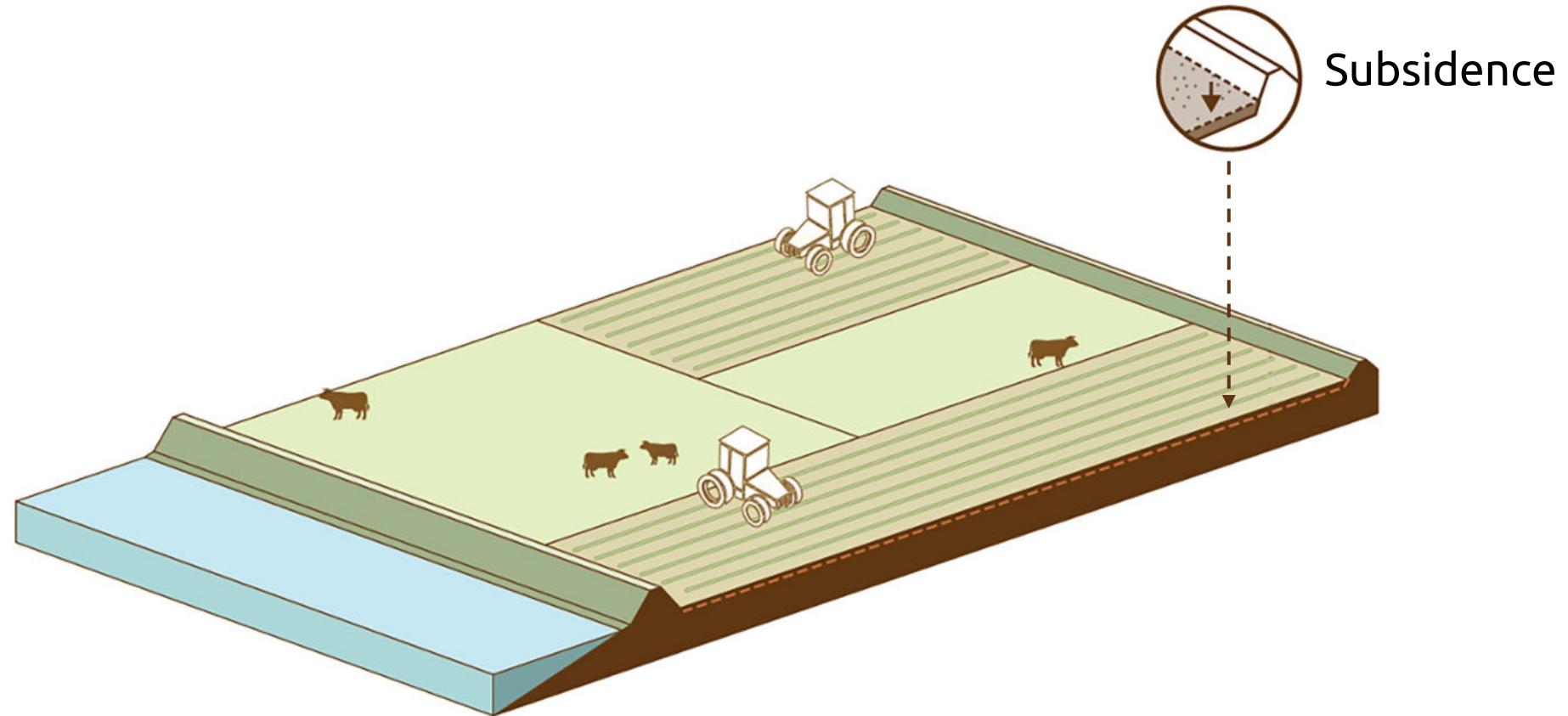


Temmerman et al., 2013 Nature

# Polder Stage 1

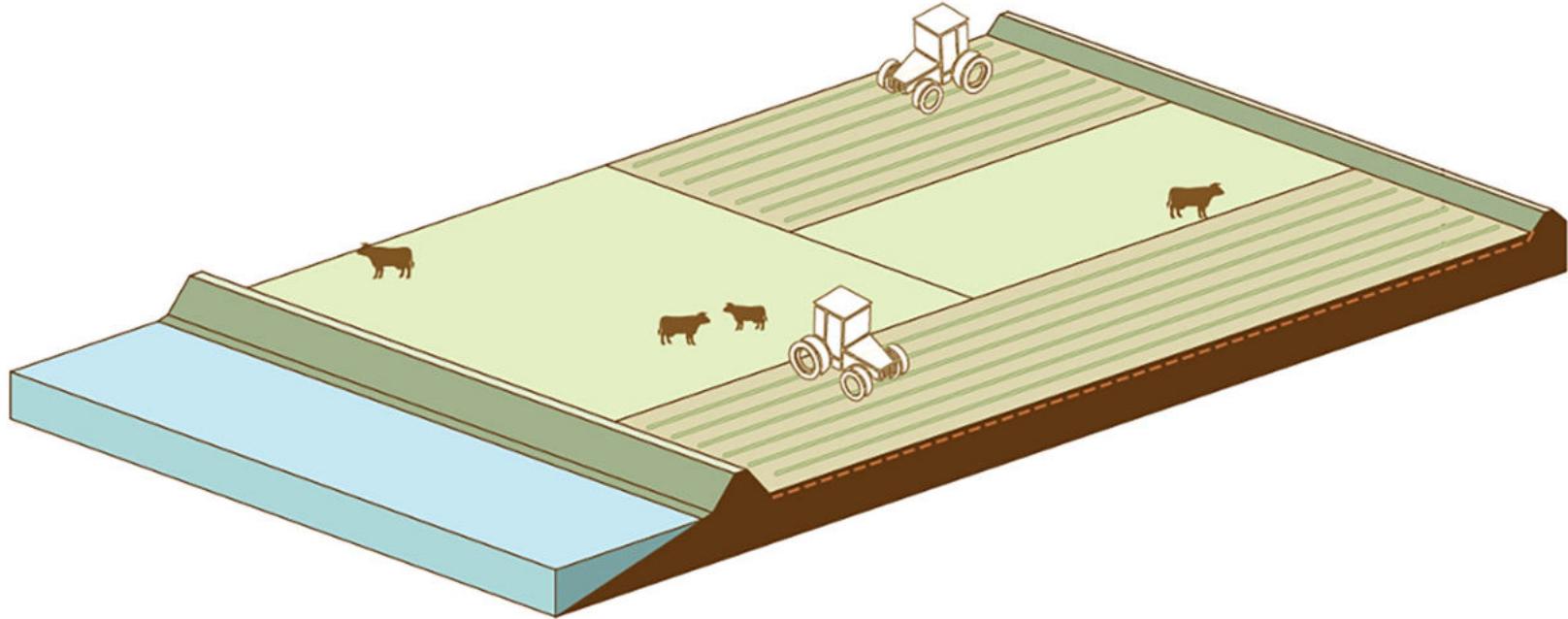


Agriculture function





# Double dyke implementation

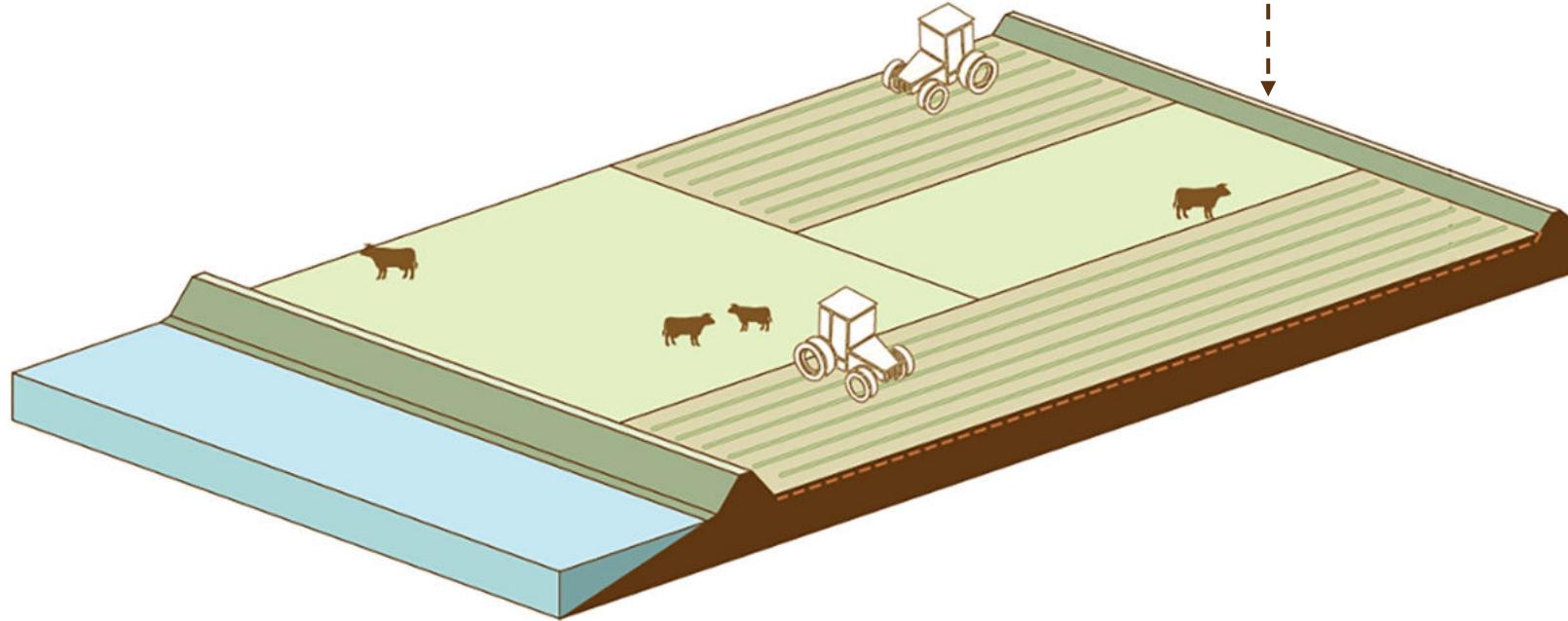




# Double dyke implementation

**Step 1:**

Build new dyke /  
Upgrade polder dyke





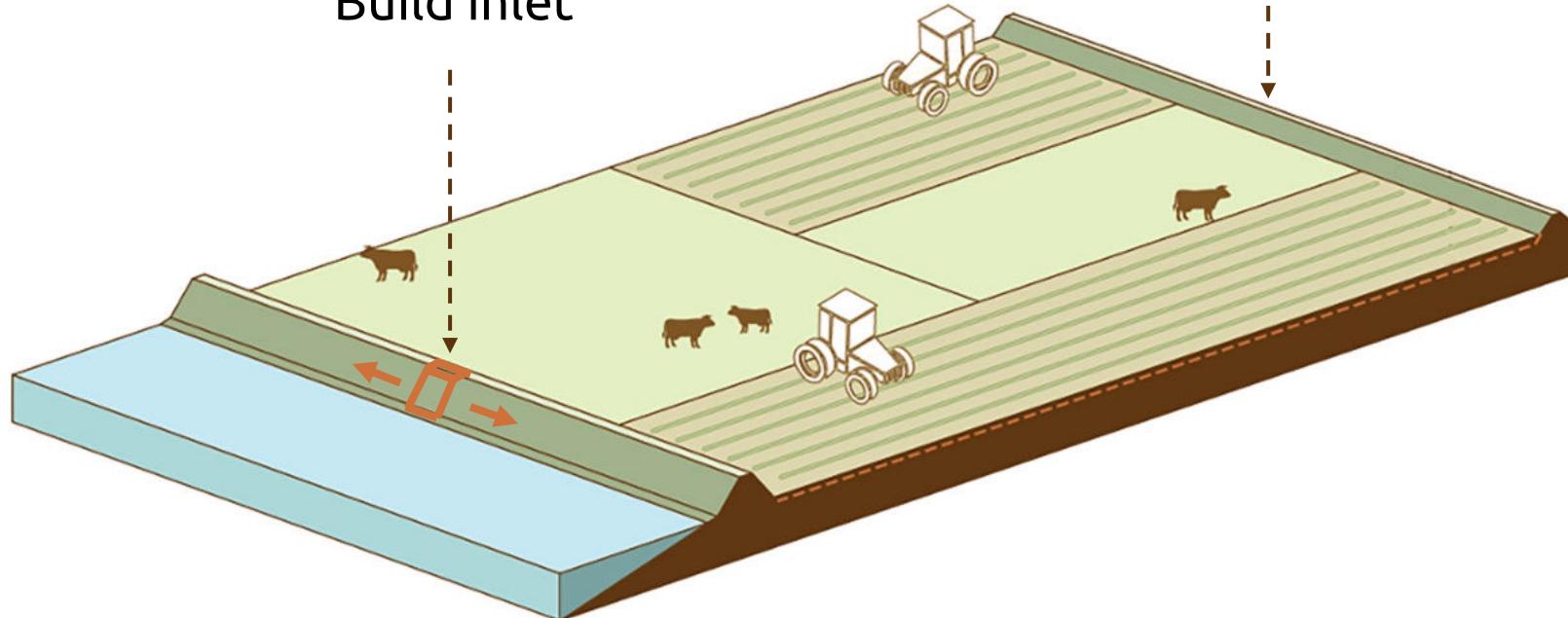
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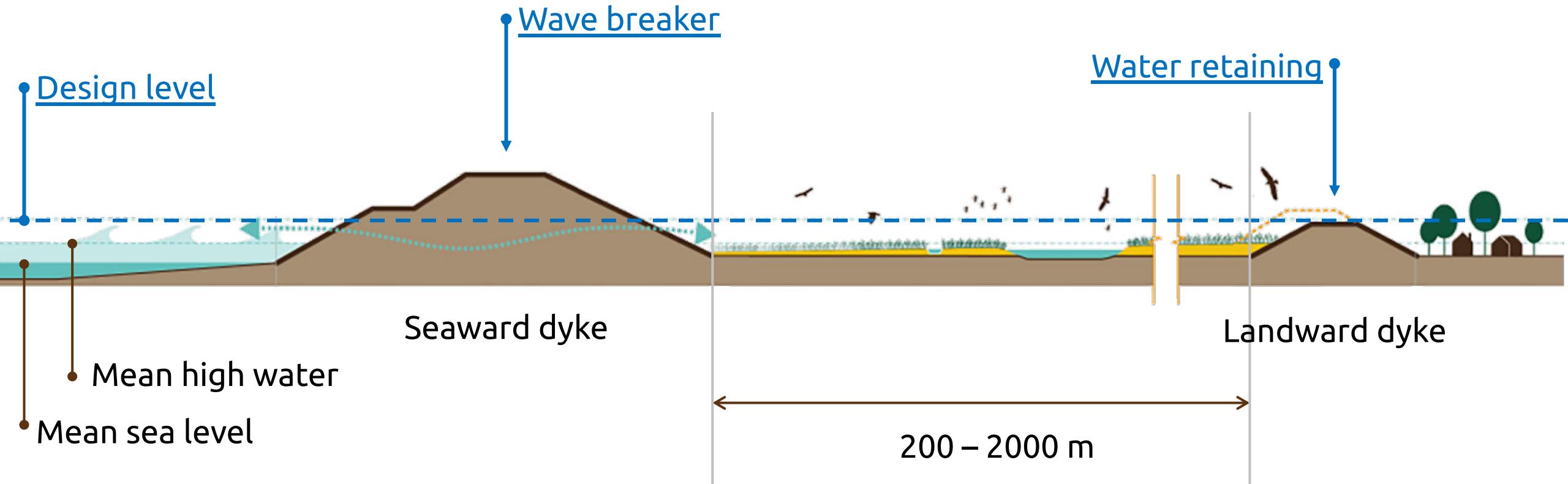
**Step 2:**

Build inlet



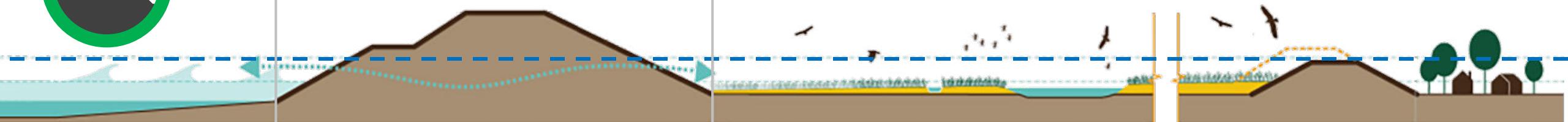


# Double dyke dyke functions



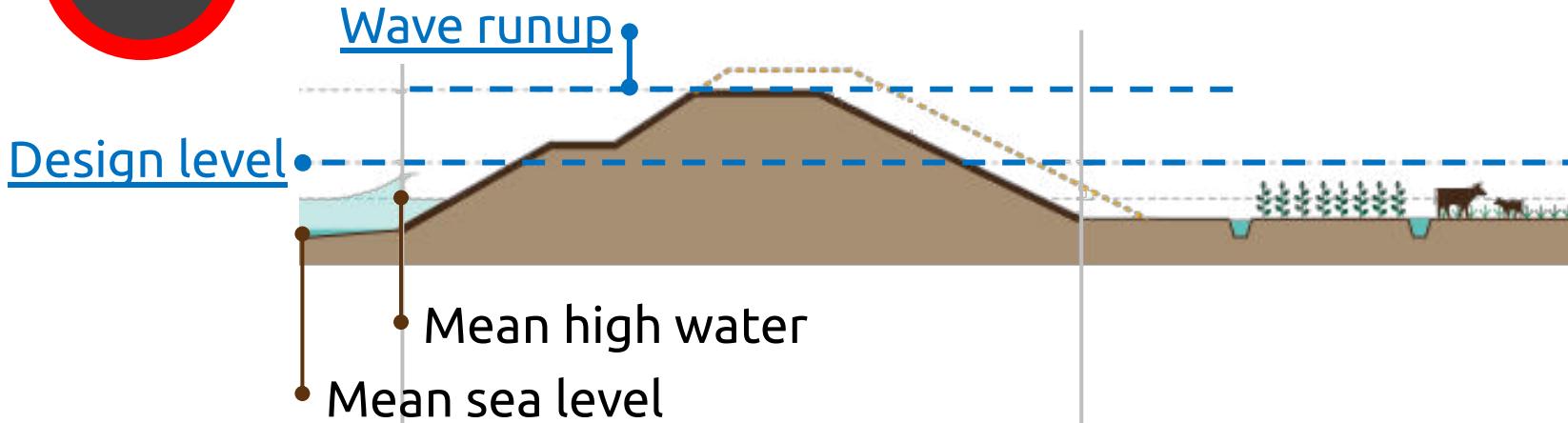


Double dyke

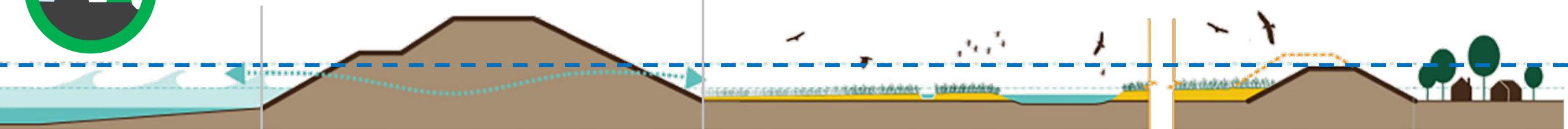




## Conventional dyke

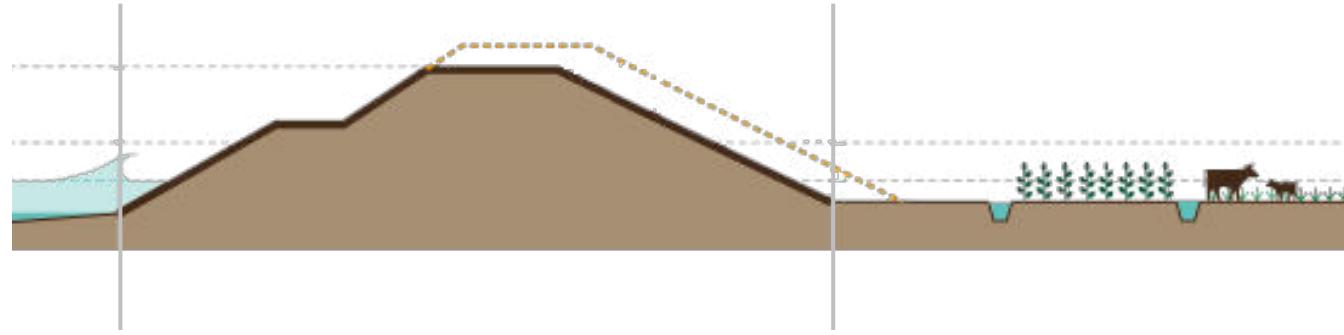


## Double dyke

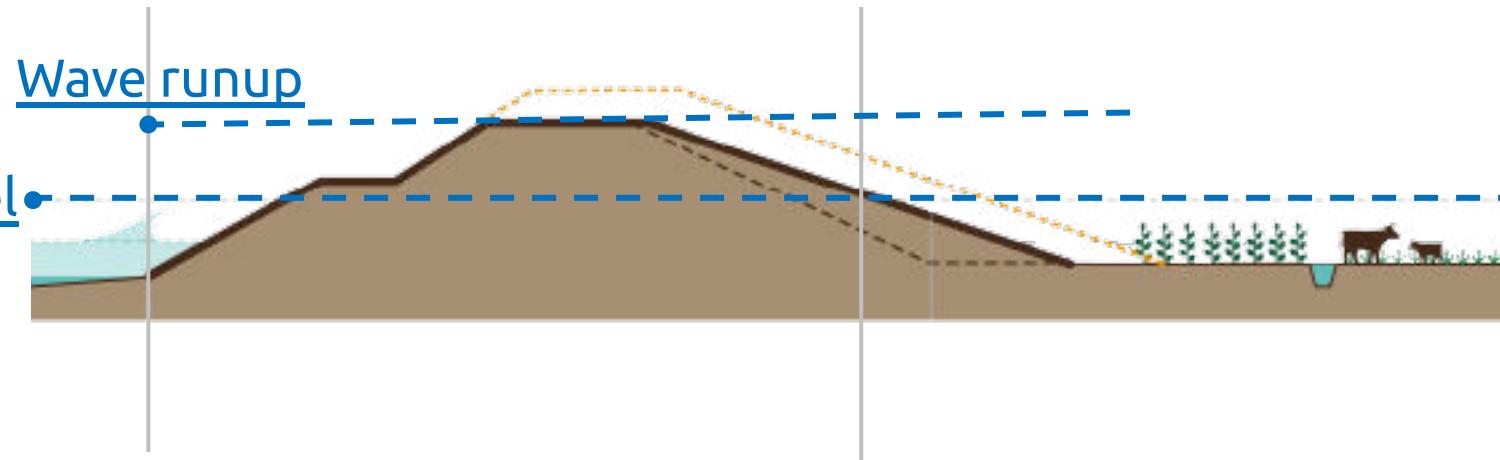




Conventional dyke



Overtopping resistant dyke



Double dyke





Conventional dyke



Overtopping resistant  
dyke

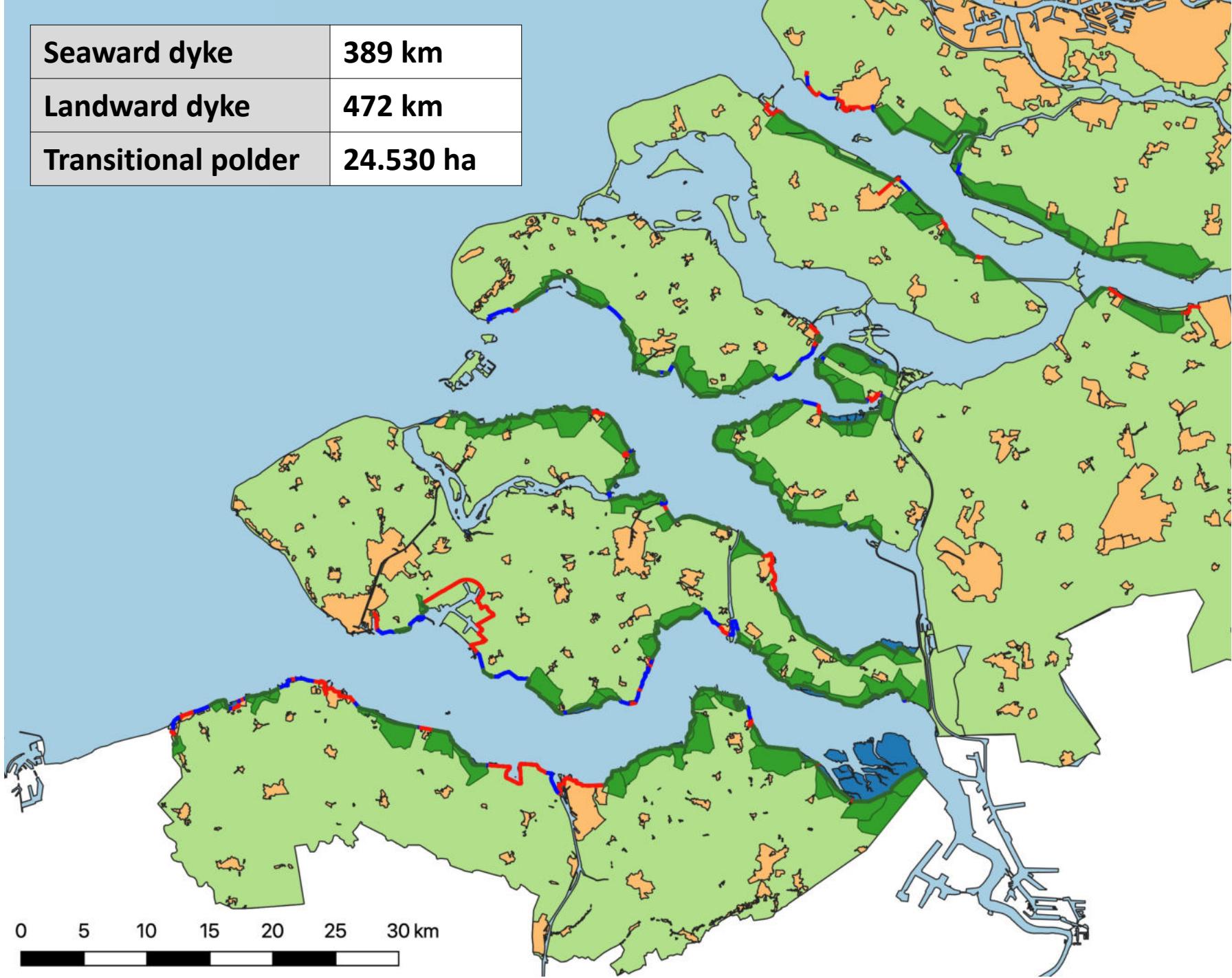


Double dyke

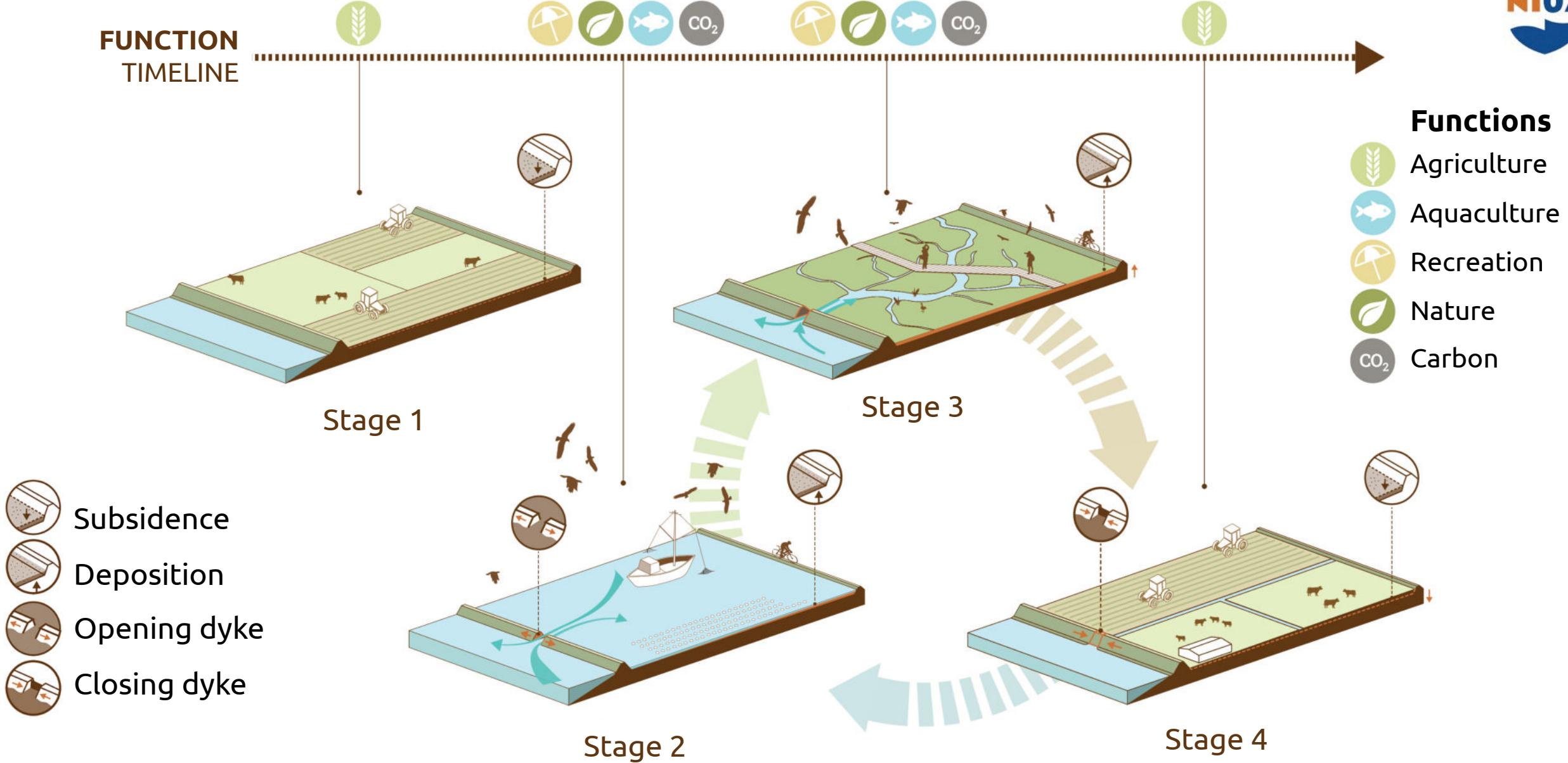


Transitional polder

Seaward dyke	389 km
Landward dyke	472 km
Transitional polder	24.530 ha



**FUNCTION  
TIMELINE**



# Cost-benefit analysis

**Yearly avg. in mln.€**  
over 100 years  
Southwestern delta



	<b>Conventional dyke</b>	<b>Overtopping resistant dyke</b>	<b>Double dykes &amp; transitional polder</b>
Investment	62	40	175
Maintenance & management	1384	259	311
Agriculture 	-	-	13 to 24
Acquisition	-	2	32
<b>Total cost</b>	<b>1446</b>	<b>302</b>	<b>516 to 527</b>

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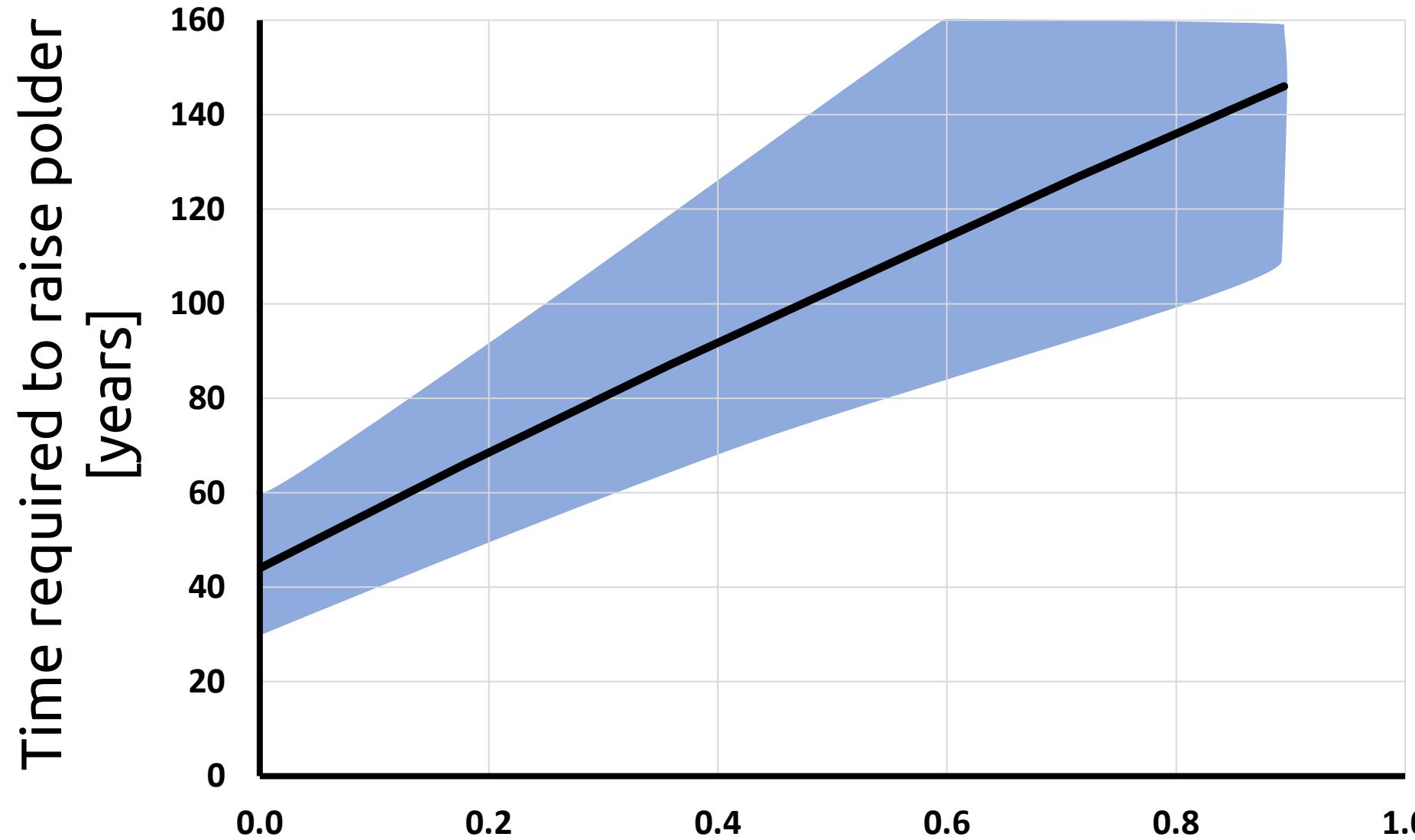
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<b>Nett</b>	<b>-1446</b>	<b>-302</b>	<b>-502 to -86</b>

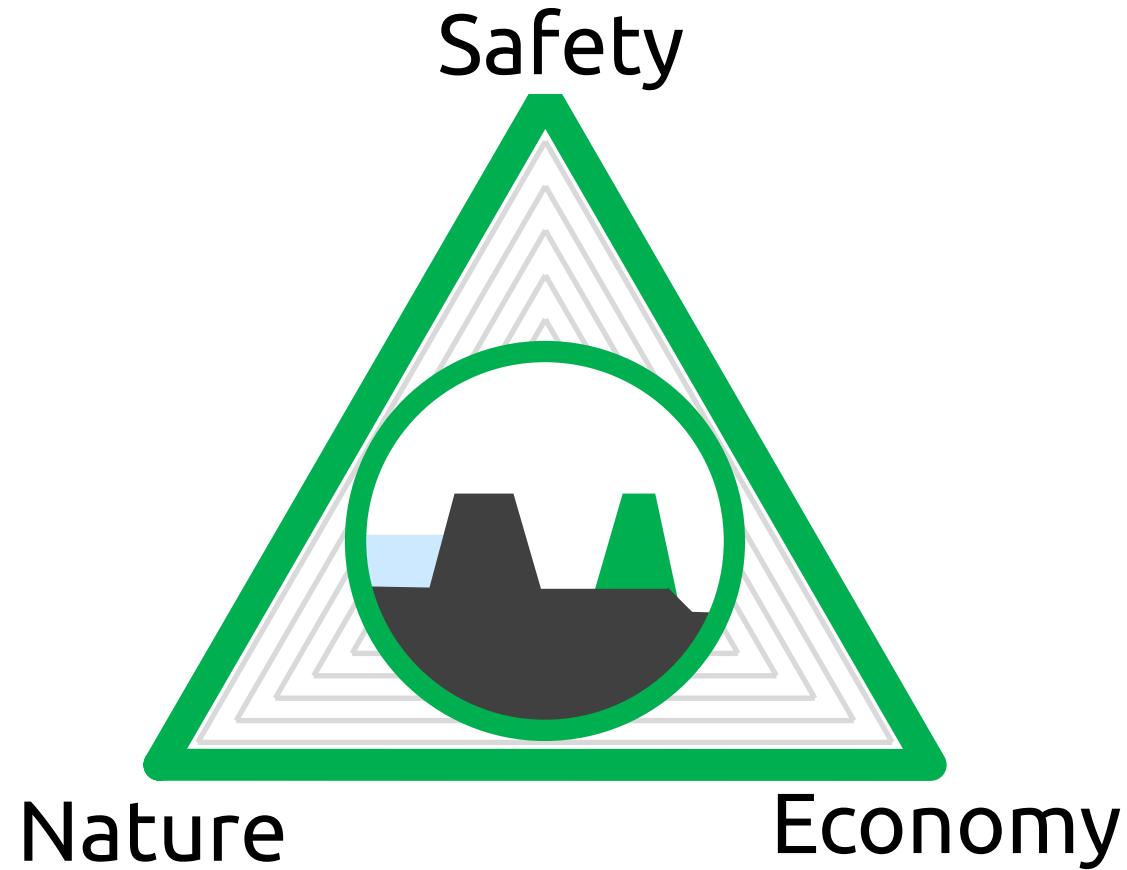
# Raising transitional polders requires time!



*Calculation for Westerschelde  
at +1m SLR in 2100*

Advanced sea level rise [m]

# Double dykes and Transitional polders can be a safe, natural and cheaper alternative



Funding  
WWF

# Double dykes and Transitional polders can be a safe, natural and cheaper alternative



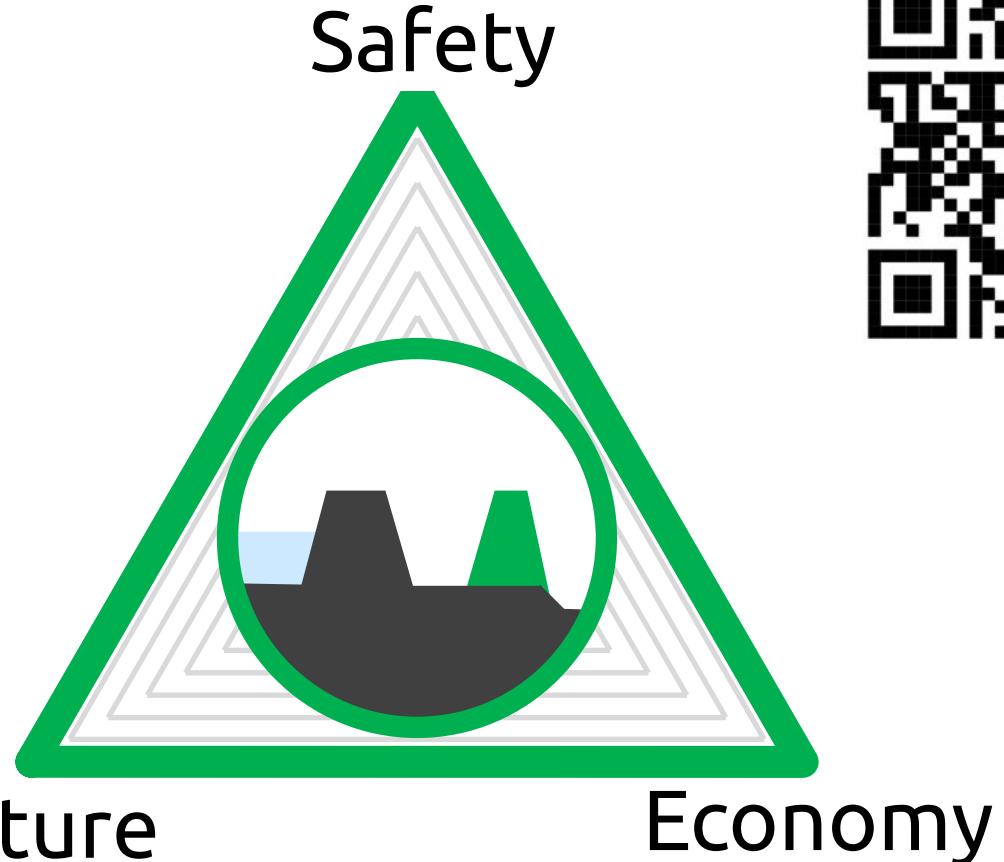
Dubbele dijken als robuuste waterkerende landschappen voor een welvarende Zuidwestelijke Delta.

Jim van Belzen, Gerlof Rienstra & Tjeerd Bouma



NIOZ Koninklijk Nederlands Instituut voor Onderzoek der Zee

Nature



Funding  
  
WWF