Bifurcation point Pannerden Source: Michiel Wijnbergh-DE BEELDREDAKTIE

Lessons from Dutch River Management:

Insights and Opportunities for Ethiopia

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of Technology
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Rijkswaterstaat
Ministry of Infrastructure
and Water Management

TU Delft

Ocassion:
Lecture IHE-March 21, 2025
Ethiopian Students

Who am I

- Ralph Schielen
- PhD in Mathematics, 1995
- Rijkswaterstaat since 2000
- Department of Water, Traffic and Environment (WVL)
- Involved in hydraulic and morphological analyses for Room for the River, Deltaprogramme, Integral River Management
- Project leader of Rivers2Morrow, research programme to study climate and human effects on lowland rivers
- 2 days a week Senior Researcher TU Delft-Connect RWS with Academia
- Missions abroad: USA, Canada, Ethiopia, Bangladesh, Myanmar

sequence	Project leader: to be defined by AwBA	importance	deadline	Required knowledge	Finance	Names	Remarks
1	make database set up	2	1-dec-15	available within awba	no	Daniel & BSR&IMDept.	Debebe absent two weeks in november
2	make fields	2	1-dec-15	available within awba	no	Daniel & BSR&IMDept.	
3	make relations	2	1-dec-15	available within awba	no	Daniel & BSR&IMDept.	
4	Add historical data	3	1-1-2016	available within awba	no	Data encoder (to be determined)	Collection of data may take time!!
5	Add administrative data	2	1-1-2016	available within awba	no	Data encoder (to be determined)	Data encoder needs to be expert on excell and acess
	(4 and 5 to be collected through and by Awba)						
6	make forms, queries and reports	2	15-1-2016	available within awba	no	Daniel & BSR&IMDept.	Many times, specific information is required from the database. Training on this might be needed.
7	IT and sharing/network requirements	3	15-1-2016; before actual use	Need training, know-how and consultancy	150.000 Birr + annually 50.000 Birr	Daniel & BSR&IMDept.	need separate computer for database; costs are hardware/software, excluded consultancy
8	Improve (or develop) data delivery system	3	1-6-2016	available within Awba	yes	Staff Awba: team from different departments	eg. Telephones, other equipment. Perhaps consultants, universities.
9	Enable automatical import	4	1-7-2016	Advice and training needed - VBA might be needed	yes	Daniel and Data-encoder	Nice to have

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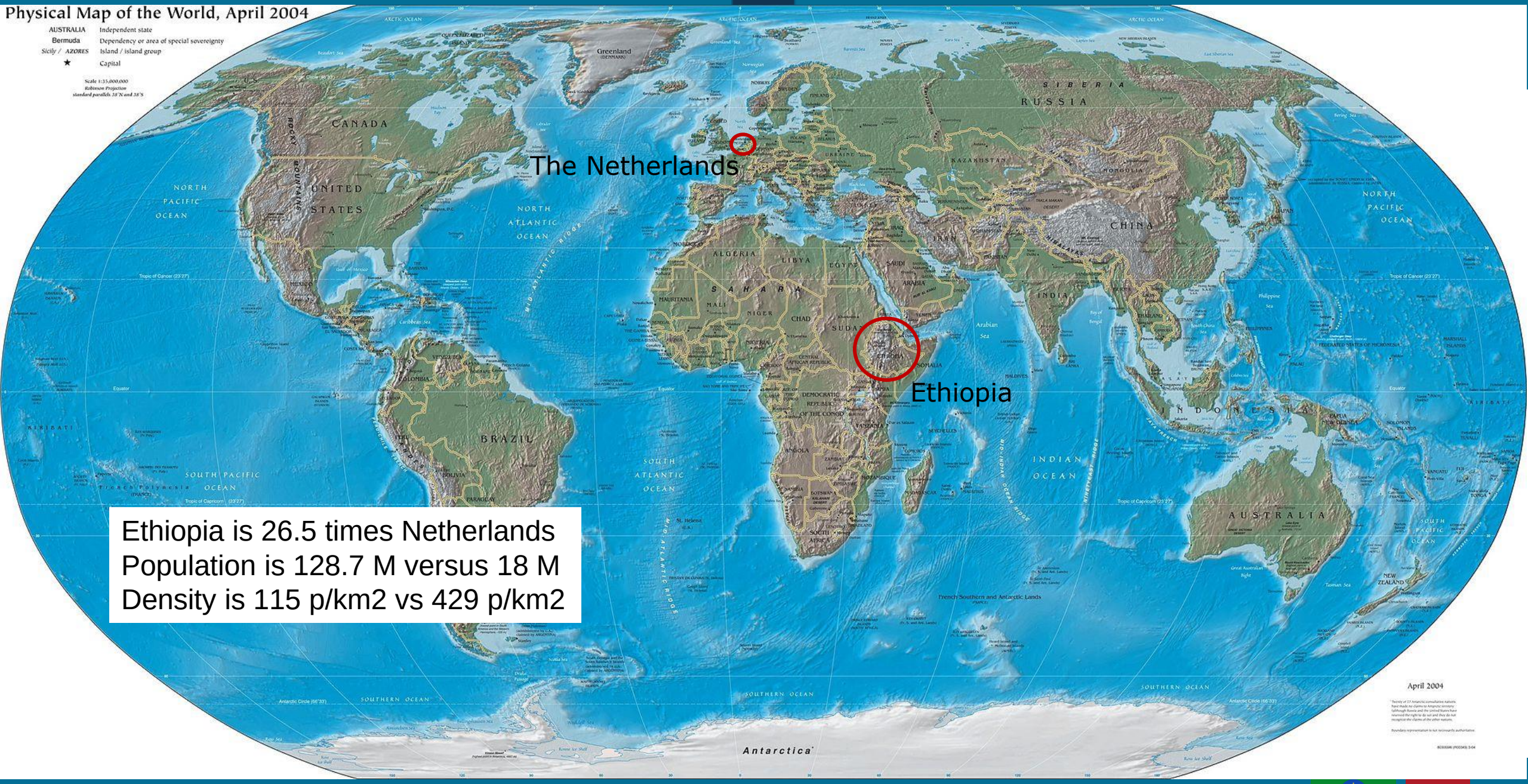
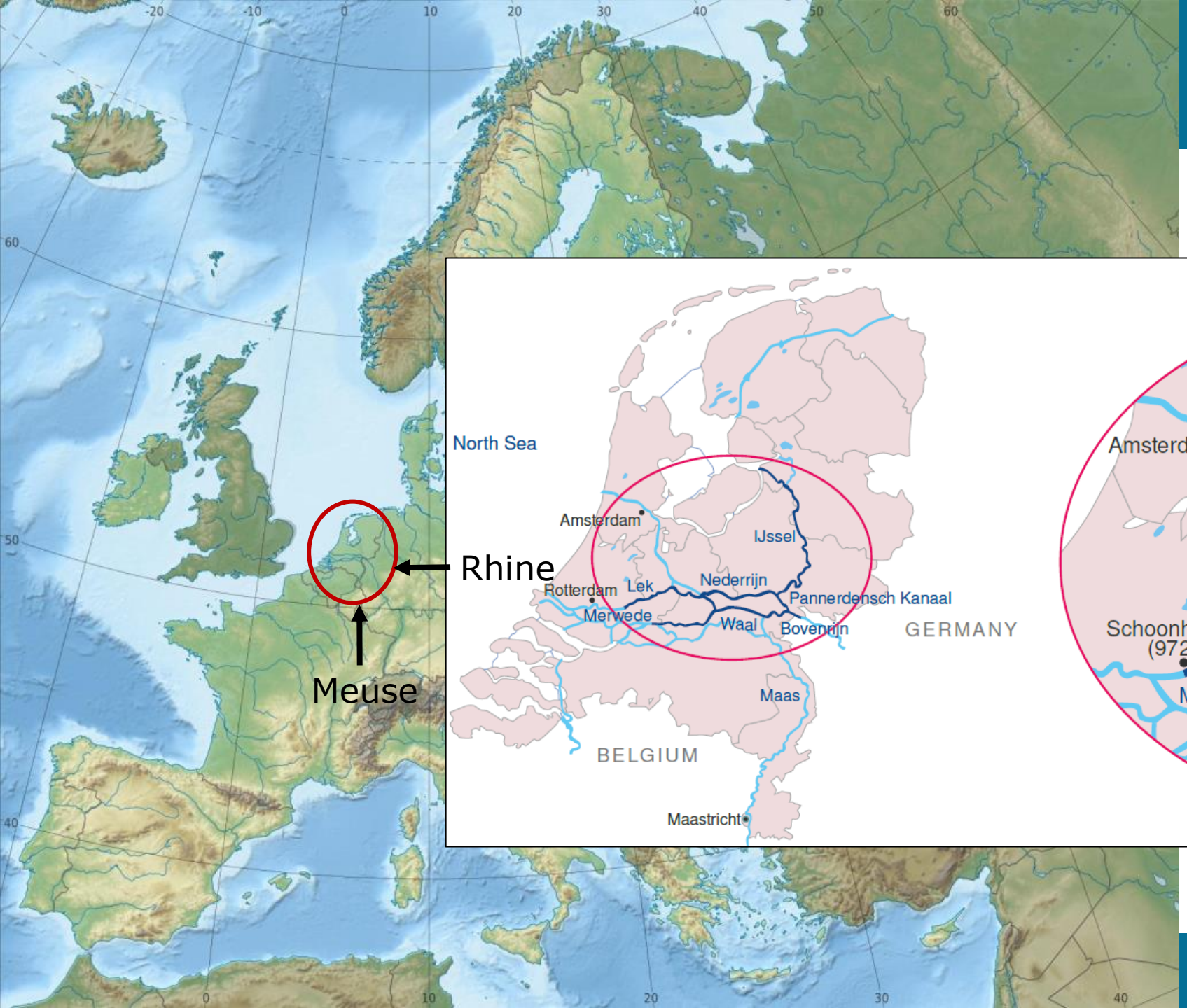
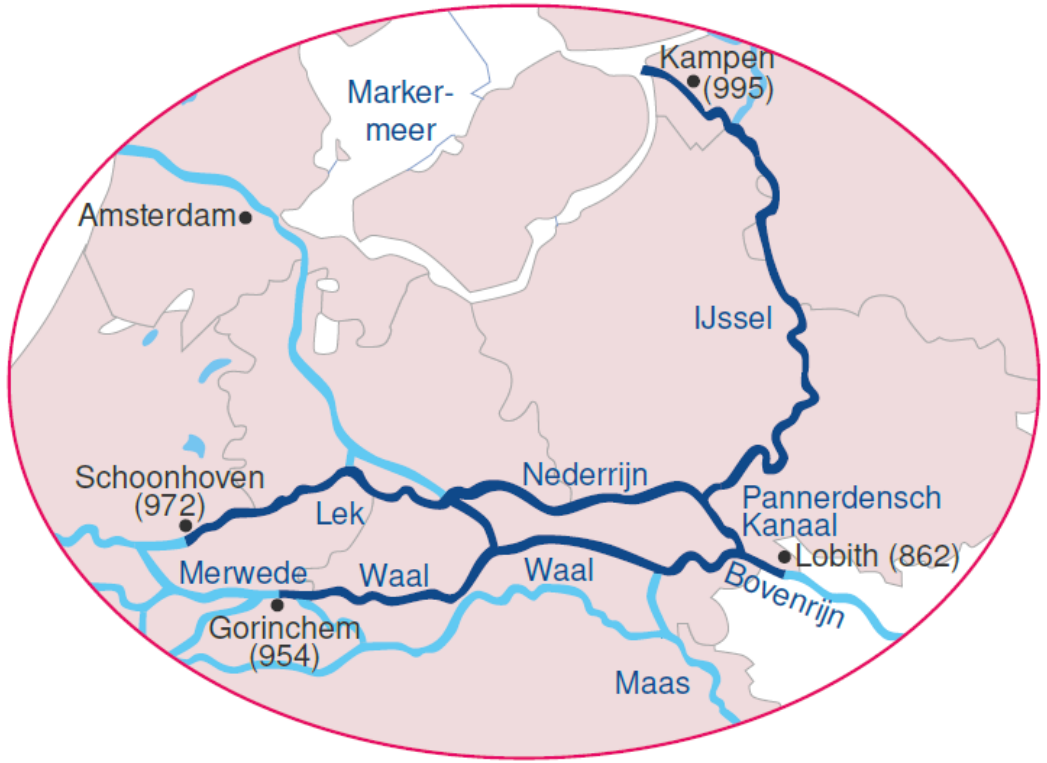

Physical Map of the World, April 2004
AUSTRALIA Independent state
Bermuda Dependency or area of special sovereignty
Sicily / AZORES Island / Island group
★ Capital
Scale 1:35,000,000
Robinson Projection
standard parallels 38°N and 38°S
The Netherlands
Ethiopia
Ethiopia is 26.5 times Netherlands
Population is 128.7 M versus 18 M
Density is 115 p/km2 vs 429 p/km2
April 2004

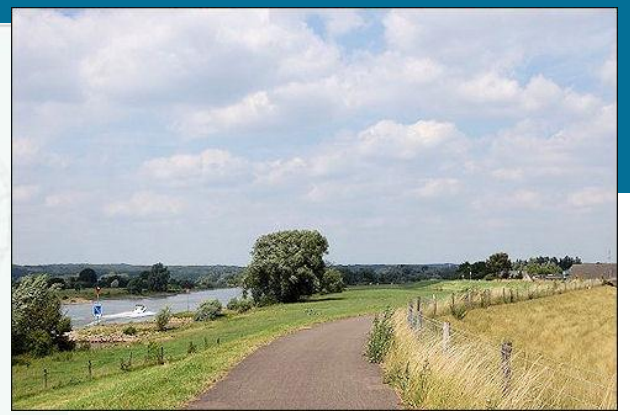

Rhine
Meuse

North Sea
Amsterdam
Rotterdam
Lek
Merwede
IJssel
Nederrijn
Waal
Pannerdensch Kanaal
Bovenrijn
Maas
BELGIUM
GERMANY
Maastricht

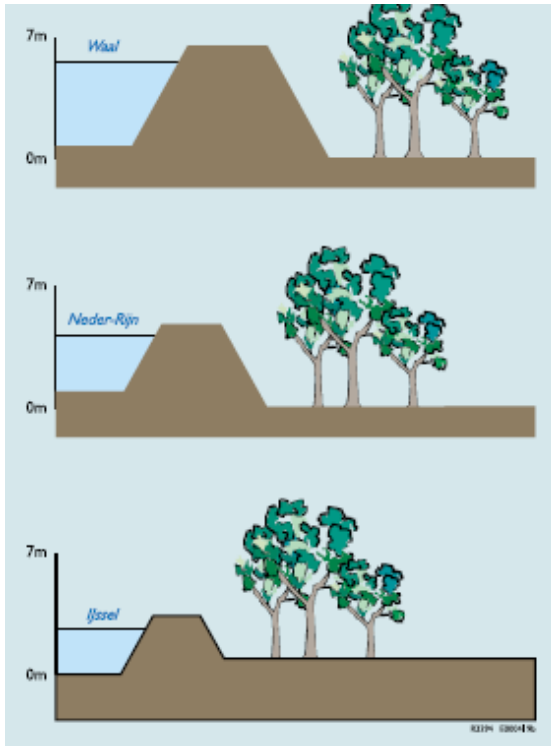

Kampen
(995)
Marker-
meer
Amsterdam
IJssel
Schoonhoven
(972)
Lek
Nederrijn
Pannerdensch
Kanaal
Lobith (862)
Merwede
Waal
Waal
Bovenrijn
Gorinchem
(954)
Maas

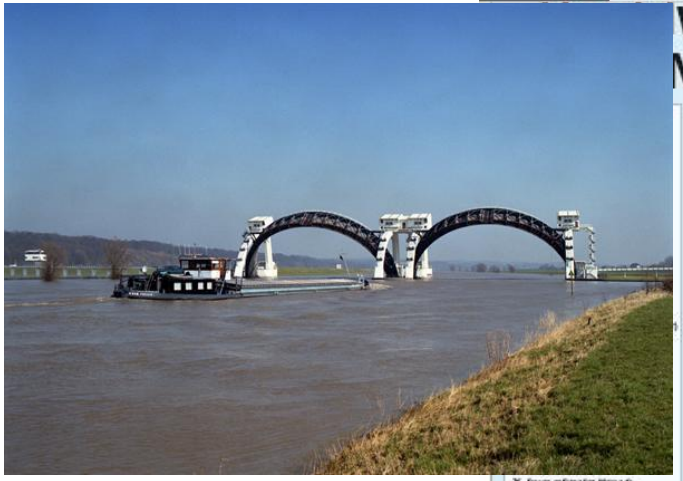
Levee along the Lek

Levee along the Waal

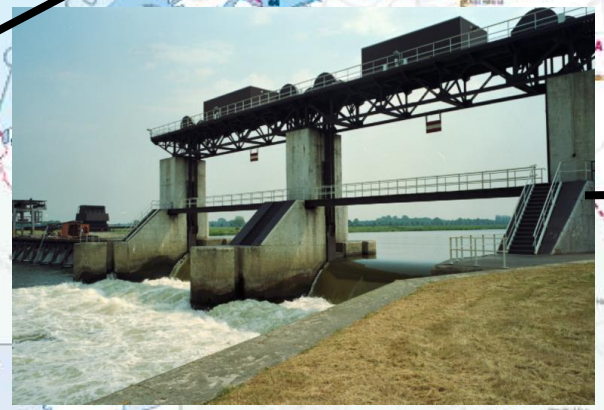


Levee along the IJssel





Heavily engineered system which needs to be managed!



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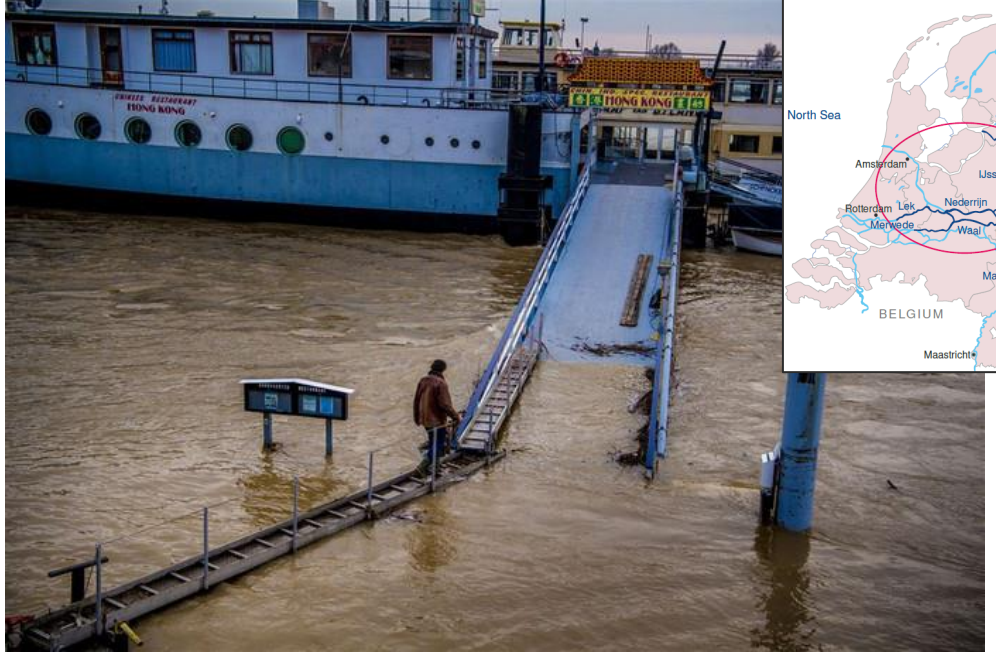
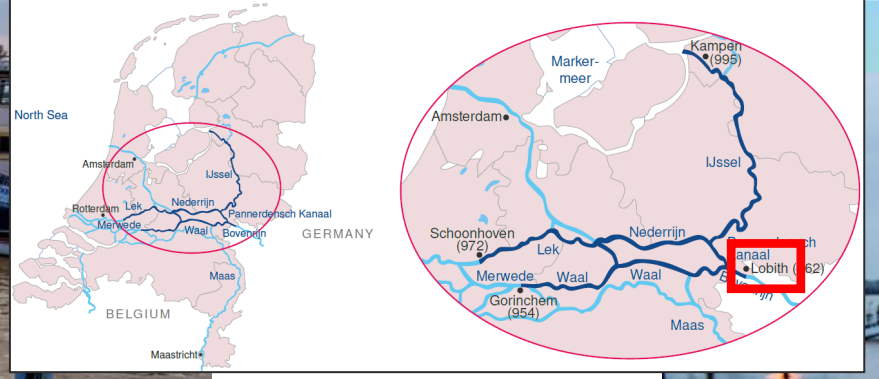
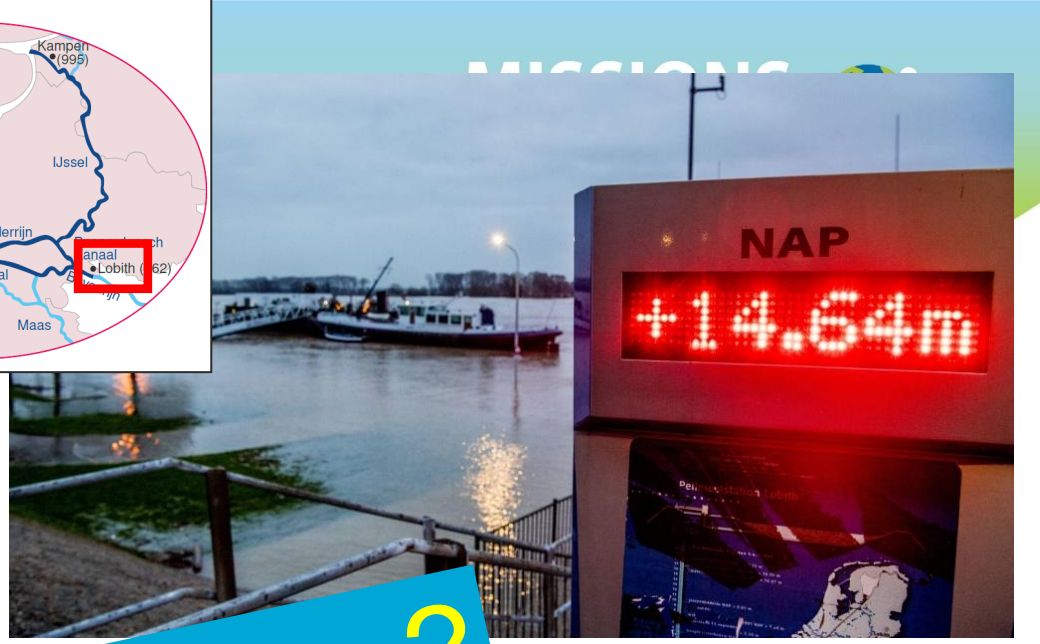
The Netherlands: Scenery
and Threats

Need good water management







January 2018

Is this climate change?

August 2018

Average water discharges Rhine and Meuse (2000-2011)

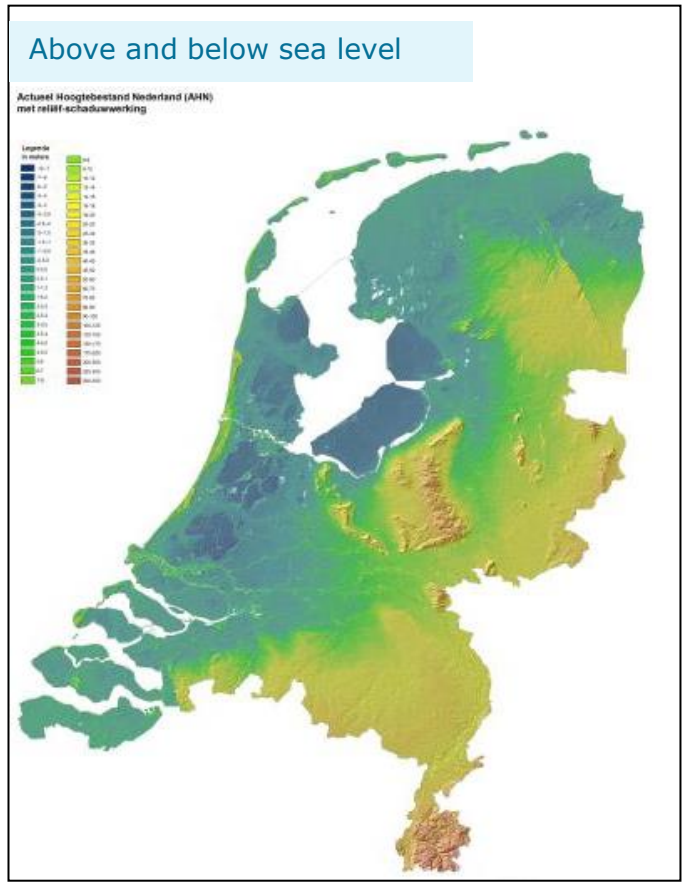
Important points:

-Relative importance of the rivers
-Bifurcation points
    -low water
    -high water
    -delta
-Bifurcation points in delta
-Drainage in sea and lake
-Salt intrusion

Importance of Water Management

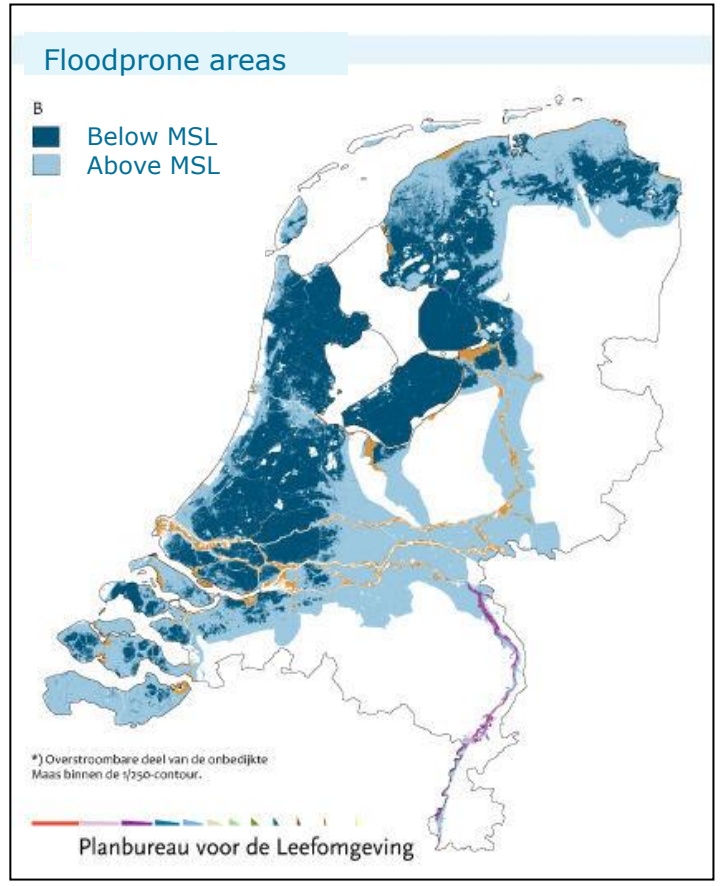
- Engineered rivers, since ~500 AD
- 25% of the country is below sea level
- ~18 million people, 22nd largest economy, 5th most densely populated country
- 60% of people (9 million) live in, 70% of GDP (600 bln) produced in, areas between 1 and 6.5 meters below mean sea level
- ~600 km of rivers, 3600 km of flood defenses, hundreds of locks, sluices, etc.
- subsiding, changing climate
- water management is a matter of *national survival*
- water is an *opportunity*

Above and below sea level



Source: Actueel Hoogtebestand Nederland

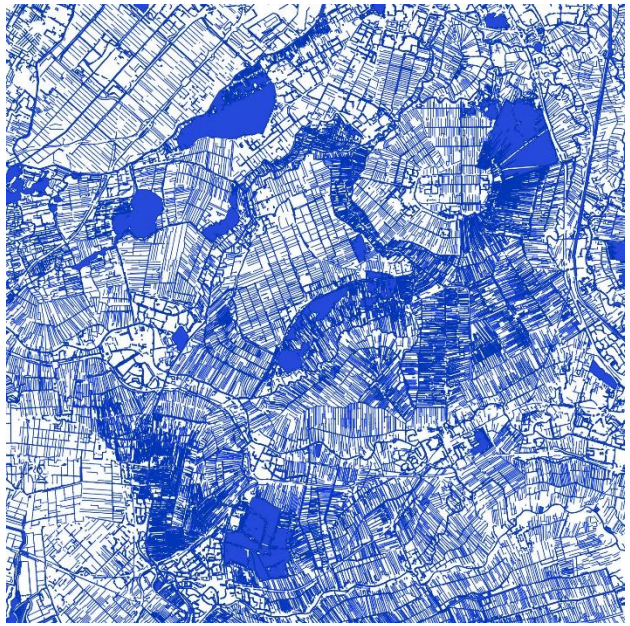
Floodprone areas

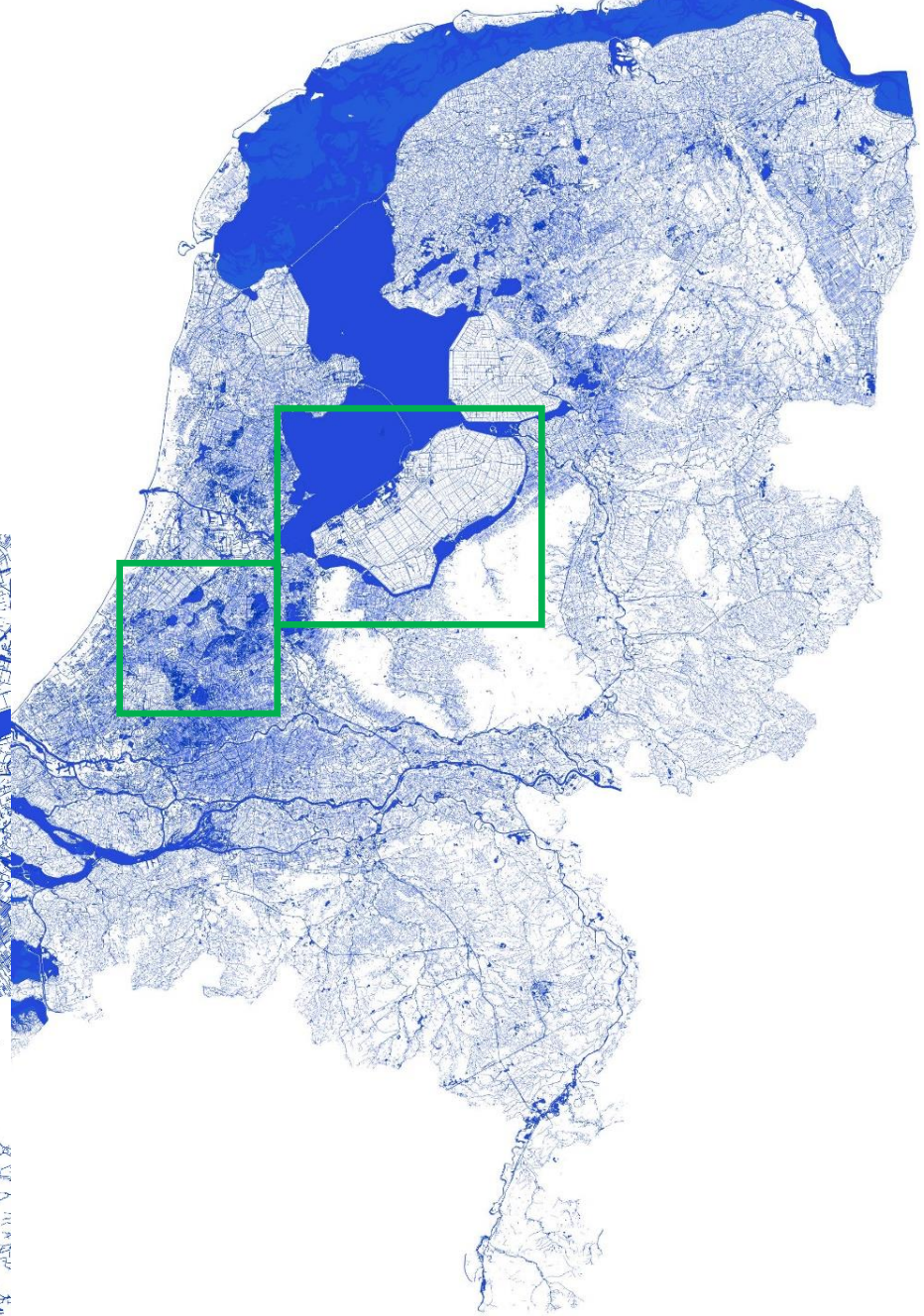


Source: Netherlands Environmental Assessment Agency

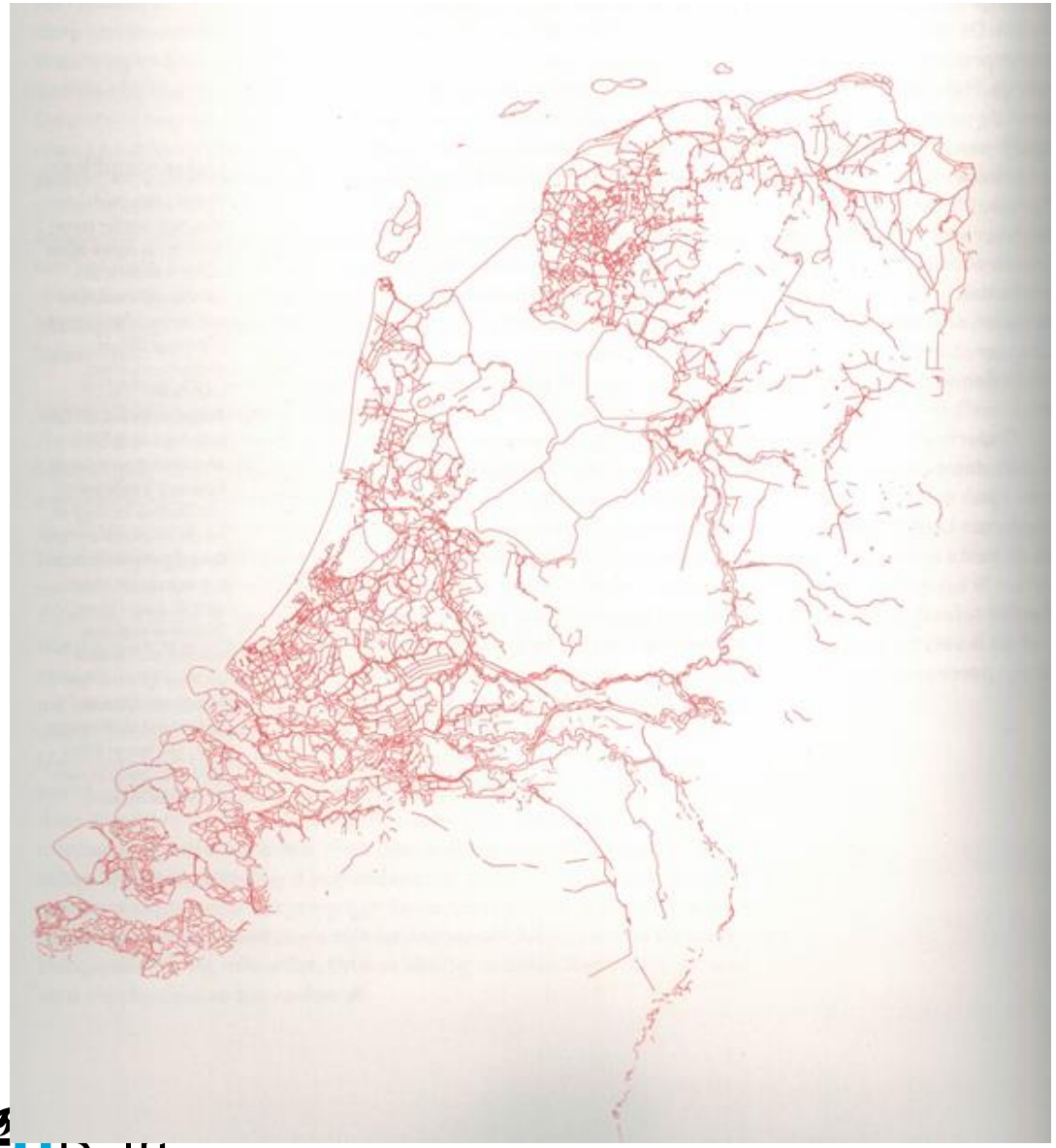
What am I *not* talking about?

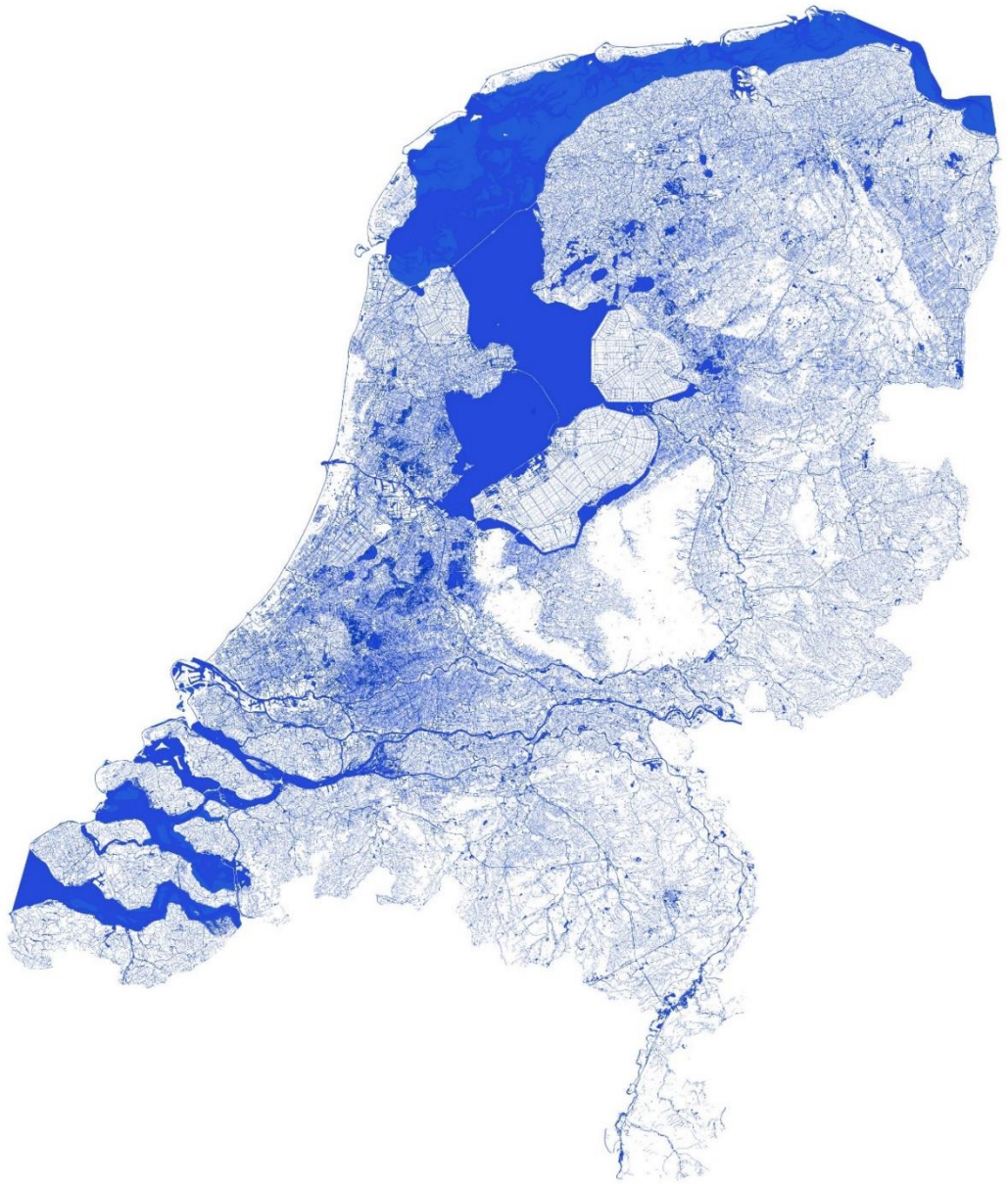
1.3 million lakes, ponds,
rivers, streams, canals





Source: reddit.com





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Outline-National River Management

- Some words about managing authorities in (and outside) The Netherlands
- The origin of the Dutch river landscape, interventions from the past and the consequences
- Some major events and the consequences
- Interventions: Room for the River-Deltaprogramme-Room for the River 2.0 (water quantity)
- What about climate change?
- Catchment management plans (water quality)
- Comparison Ethiopia and The Netherlands
- Takeaways

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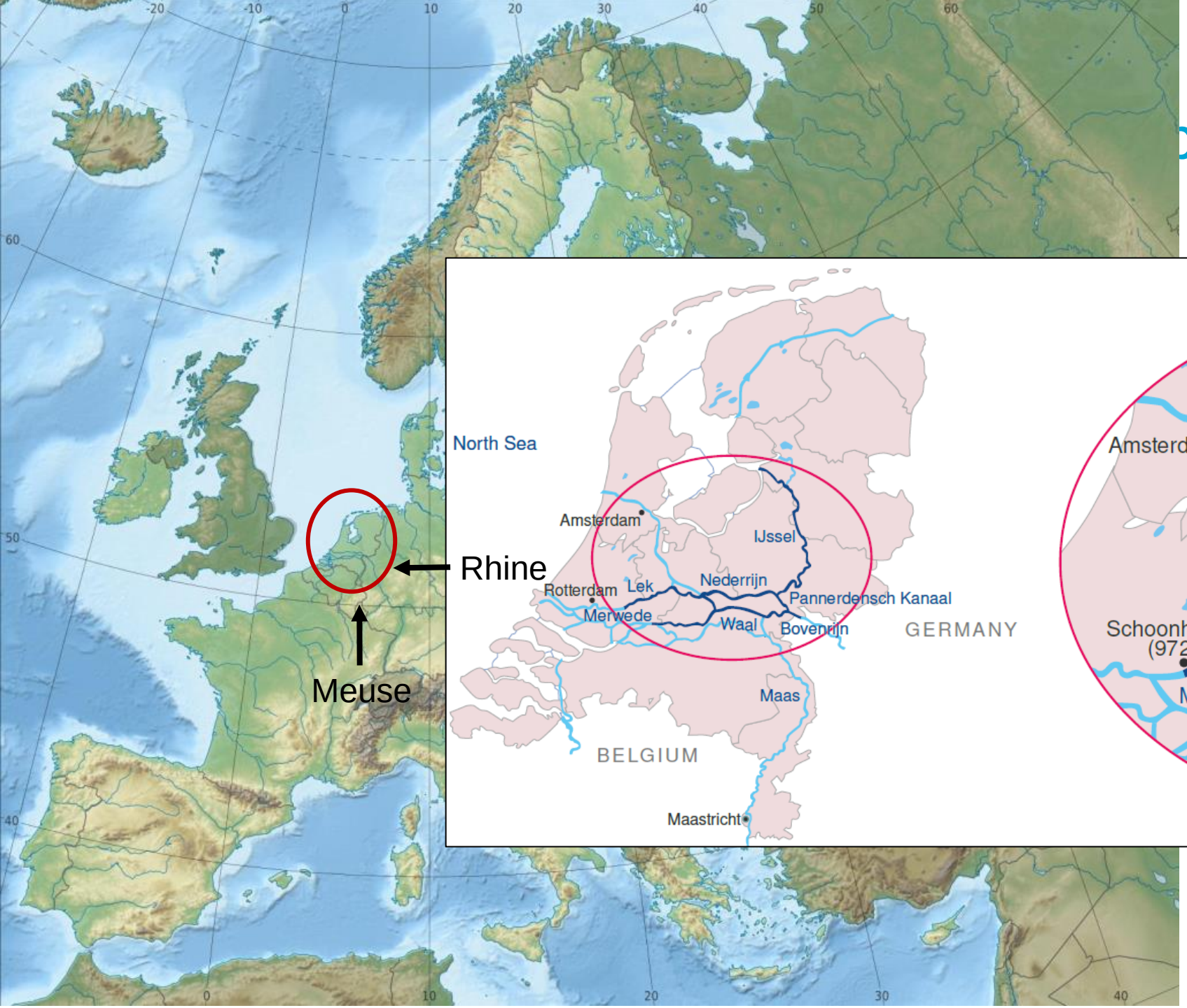
bout?


Rhine
Meuse

North Sea
Amsterdam
IJssel
Rotterdam
Lek
Nederrijn
Pannerdensch Kanaal
Merwede
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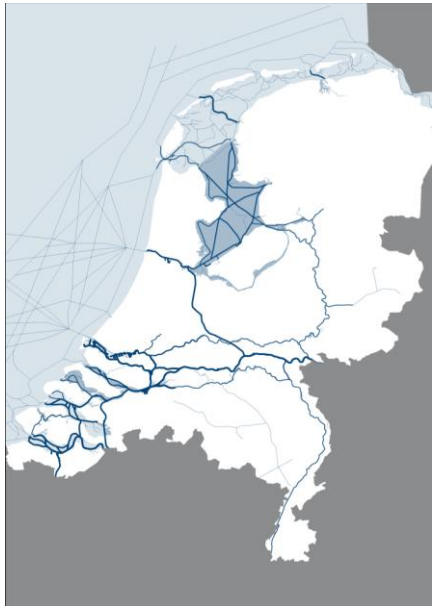
Lobith (862)
Merwede
Waal
Waal
Bovenrijn
Gorinchem
(954)
Maas


Rhine
Meuse
North Sea
Maastricht
MAP 1


km
100
200
North Sea
Netherlands
The Hague
Lek
Nederrijn
Ijssel
Vecht
Waal
Lippe
Ruhr
Düsseldorf
Germany
Sieg
Rhine
Bonn
Belgium
Koblenz
Lahn
Main
Fränkische Saale
Mosel
Nahe
Luxemburg
Regnitz
Neckar
Saar
Strasbourg
France
Meurthe
Basel
Liechtenstein
Aare
Switzerland
Vaduz
Austria
Italy

Rijkswaterstaat-DG Public Works and Water Management



Highways

3.077 km	Highways
2921	Fly-overs
27	Tunnels
801	Bridges
56	Wildlife crossings
7	Traffic control centres
300	Road inspectors

Channels

3437 km	Canals en rivers
91	Locks
344	Bridges
10	Traffic control centres
3.646 km	North sea shipping routes

Water system

90.191 km²	Surface water
200 km	Dike, dams and dunes
10	Major weirs
6	Storm surge barriers
2 barrier dams (Afsluitdijk en Houtribdijk)	

Rijkswaterstaat: Established in 1798

1672

Christiaan Brunings

1707

Organisation

Ministry of Infrastructure and Water Management

HQ, The Hague

Rijkswaterstaat
Ministry of Infrastructure and Water Management

DG Rijkswaterstaat

Water, traffic and natural environment, Lelystad

Human Environment and Transport Inspectorate
Ministry of Infrastructure and Water Management

DG Inspection

HQ Rijkswaterstaat, Utrecht

Ministry of Infrastructure and Water Management

DG Policy

Regional directorate, Arnhem

10.000 + employees

Rijkswaterstaat and the Water boards

- Rijkswaterstaat takes care of the area between the dikes
- Water boards take care of maintenance of the dikes (RWS only covers 3%)
- Close cooperation for requirements and resulting maintenance
- A thorough check every 12 years of the embankments

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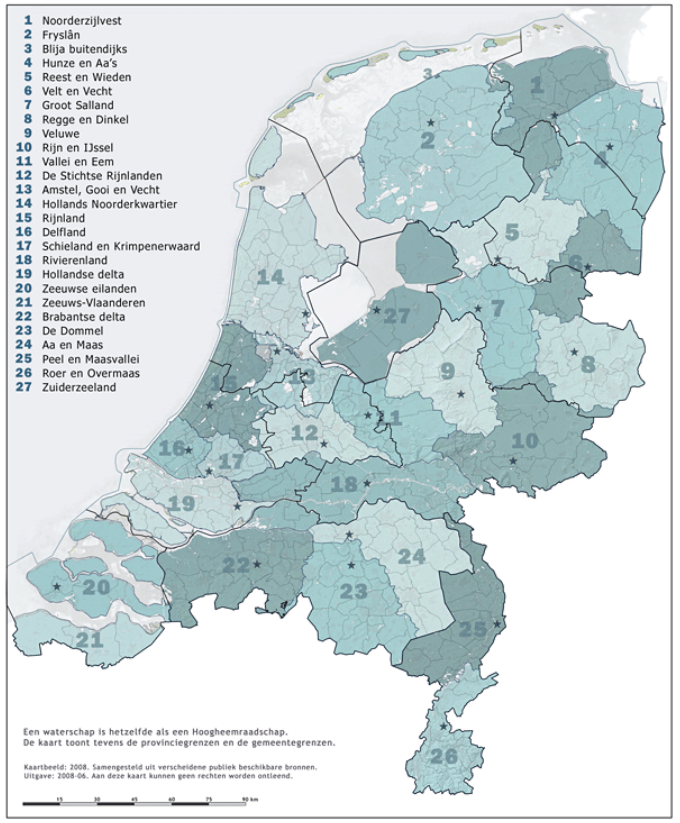
Water managing organisations

15 regions

21 water boards



12 provinces

Provinces and municipalities

Rijkswaterstaat
Ministerie van Infrastructuur en Milieu

Waterschappen

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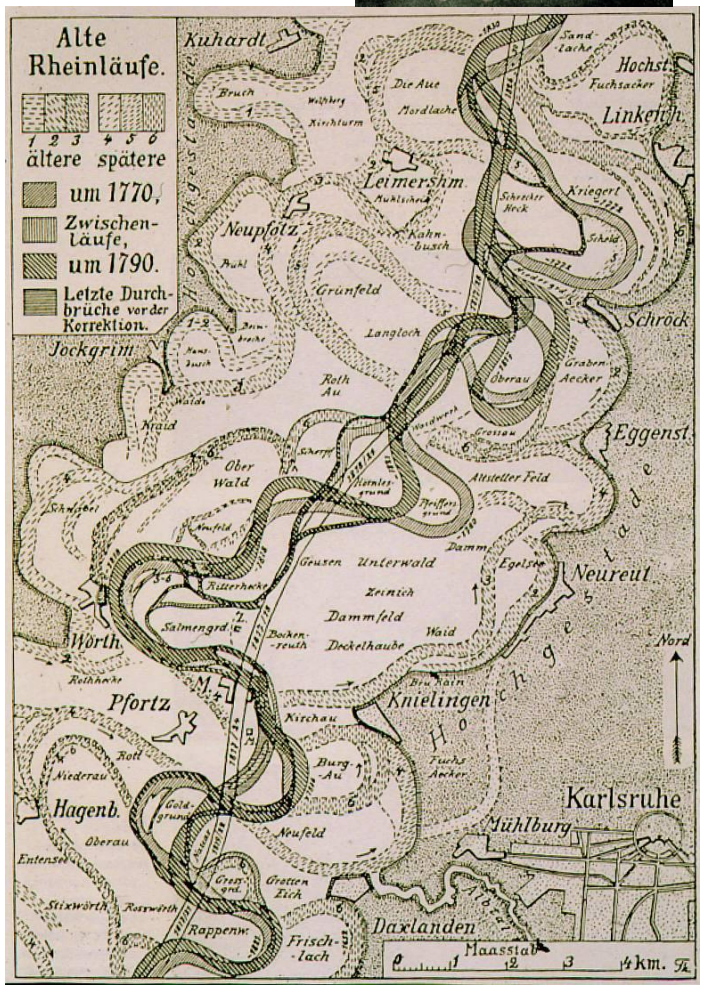
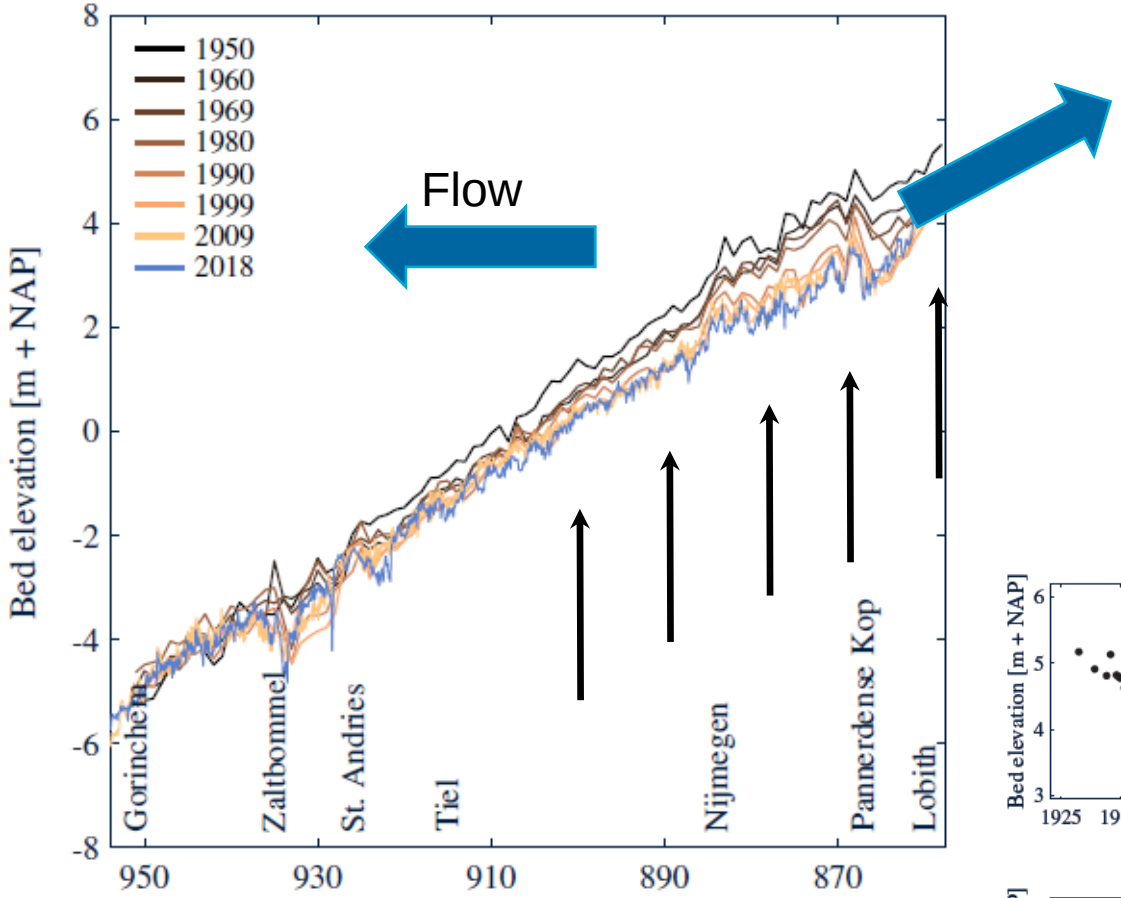
Past: 1800-2000

Johann Gottfried Tulla

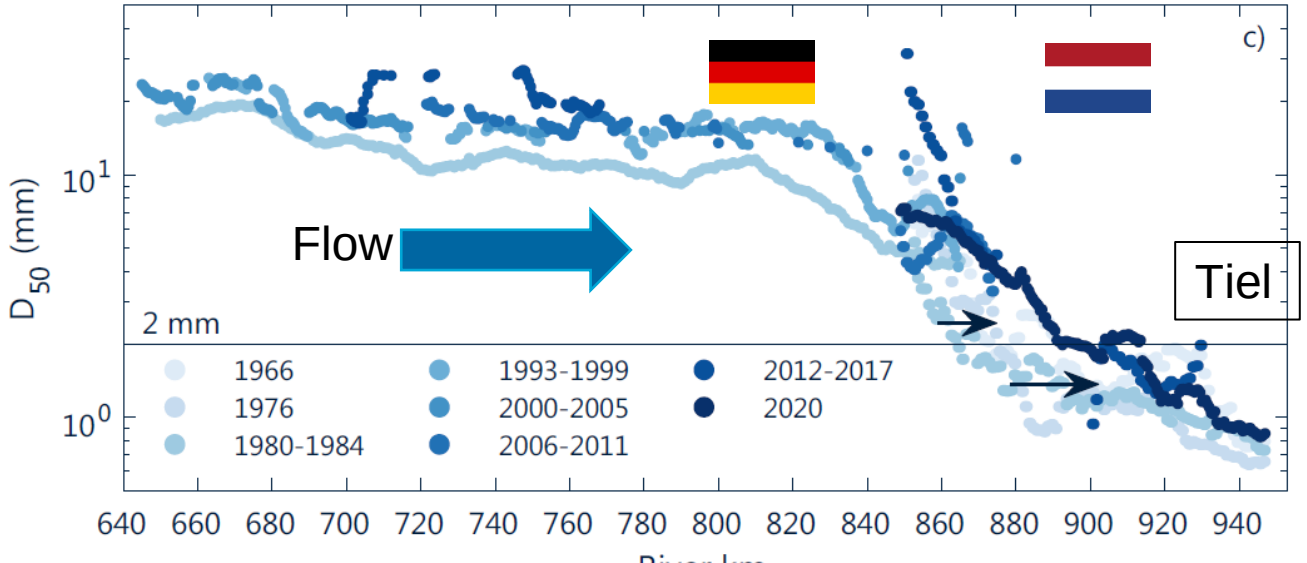


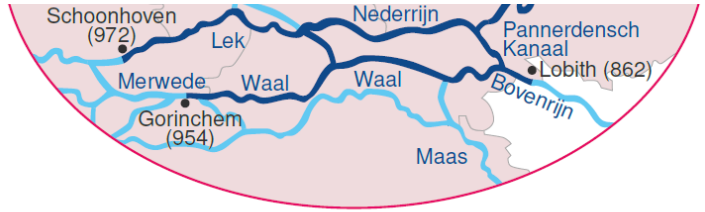
- 3-4-12-40 (!) kilometers wide
- Swampy area
- Lots of damage due to floods
- Started in 1817
- By 1876, the Rhine lost 81 kilometers
- Completed by Max Honsell (1913)

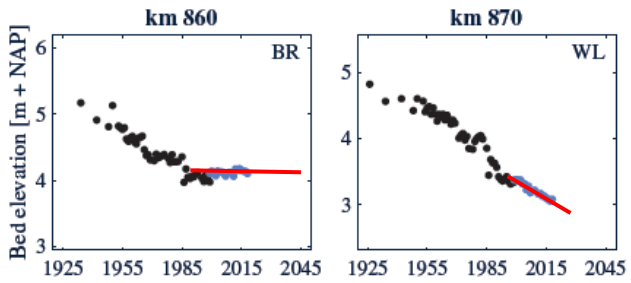
Bed degradation

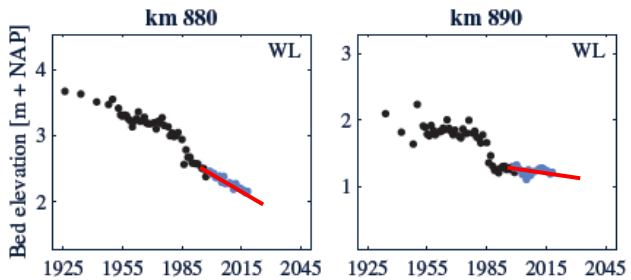


Ylla Arbos et. al (2020)









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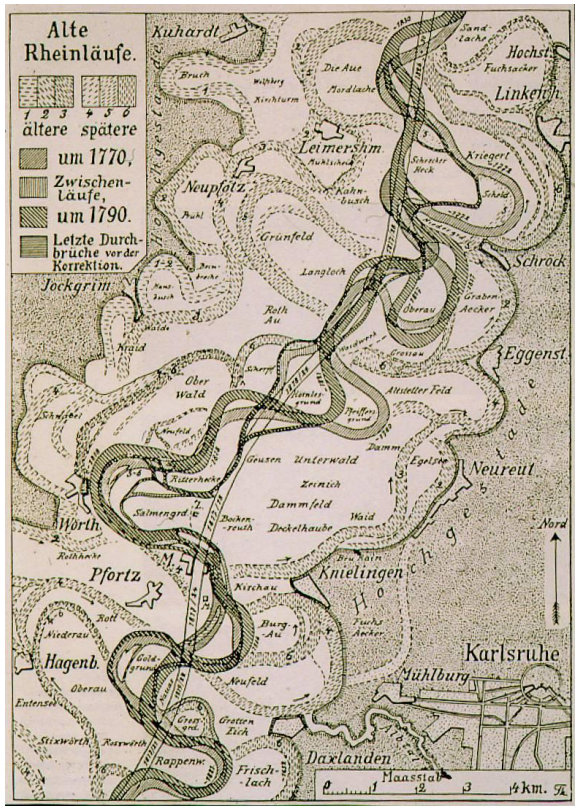
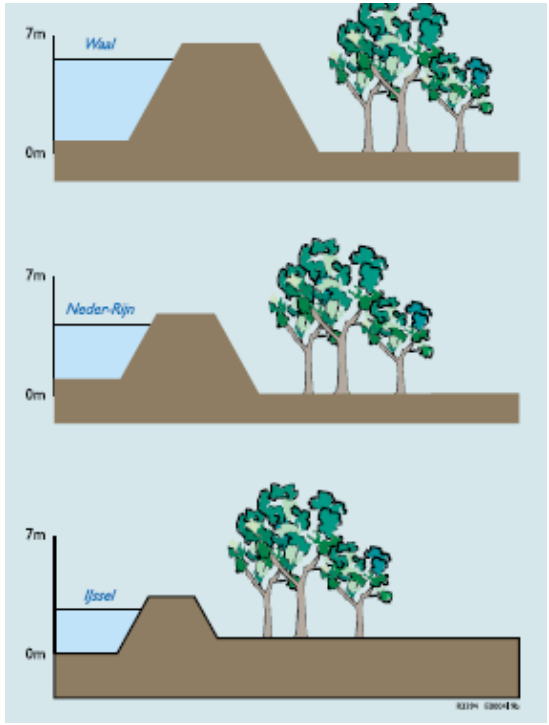
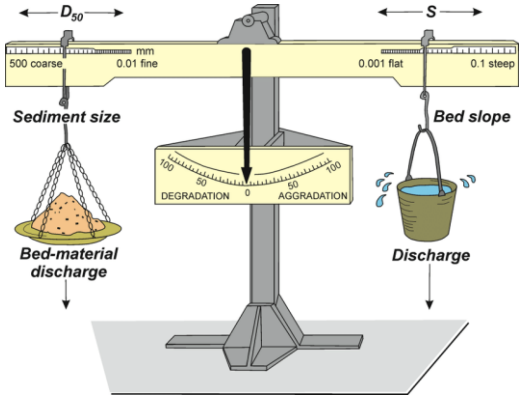
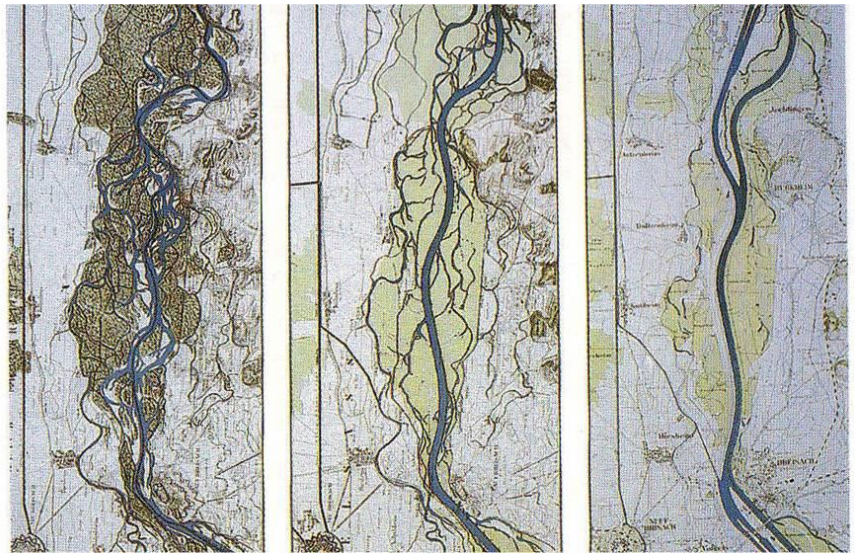
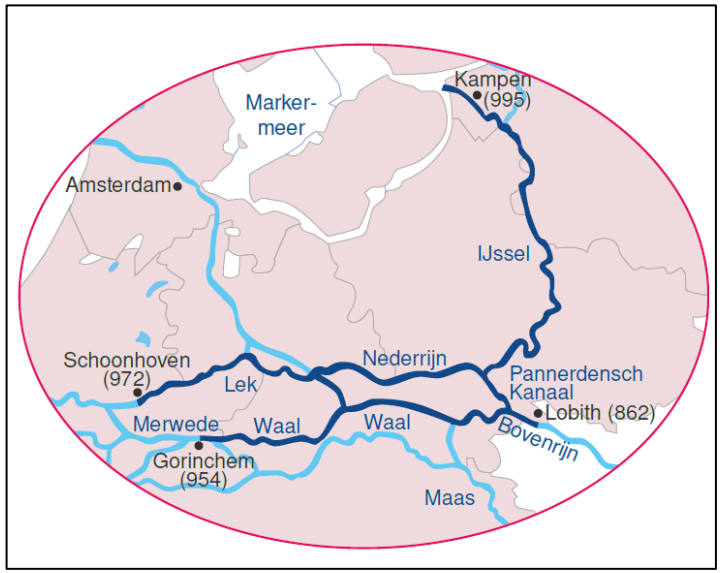

Alte Rheinläufe.
1 2 3 4 5 6
ältere spätere
um 1770.
Zwischen-läufe,
um 1790.
Letzte Durch-brüche vor der Korrektion.
Kuhardt
Hochst
Linkenh.
Leimersh.
Neupfotz
Grünfeld
Schrock
Jockgrim
Eggenst.
Neureut
Wörth
Pfortz
Knielingen
Karlsruhe
Hagenb.
Mühlburg
Daxlanden
Maasstab
4 km.


7m
Waal
0m
7m
Neder-Rijn
0m
7m
IJssel
0m


CAUTION
DON'T TRY
THIS AT HOME


D50
S
mm
500 coarse
0.01 fine
0.001 flat
0.1 steep
Sediment size
Bed slope
DEGRADATION
AGGRADATION
Bed-material discharge
Discharge




Marker-meer
Kampen (995)
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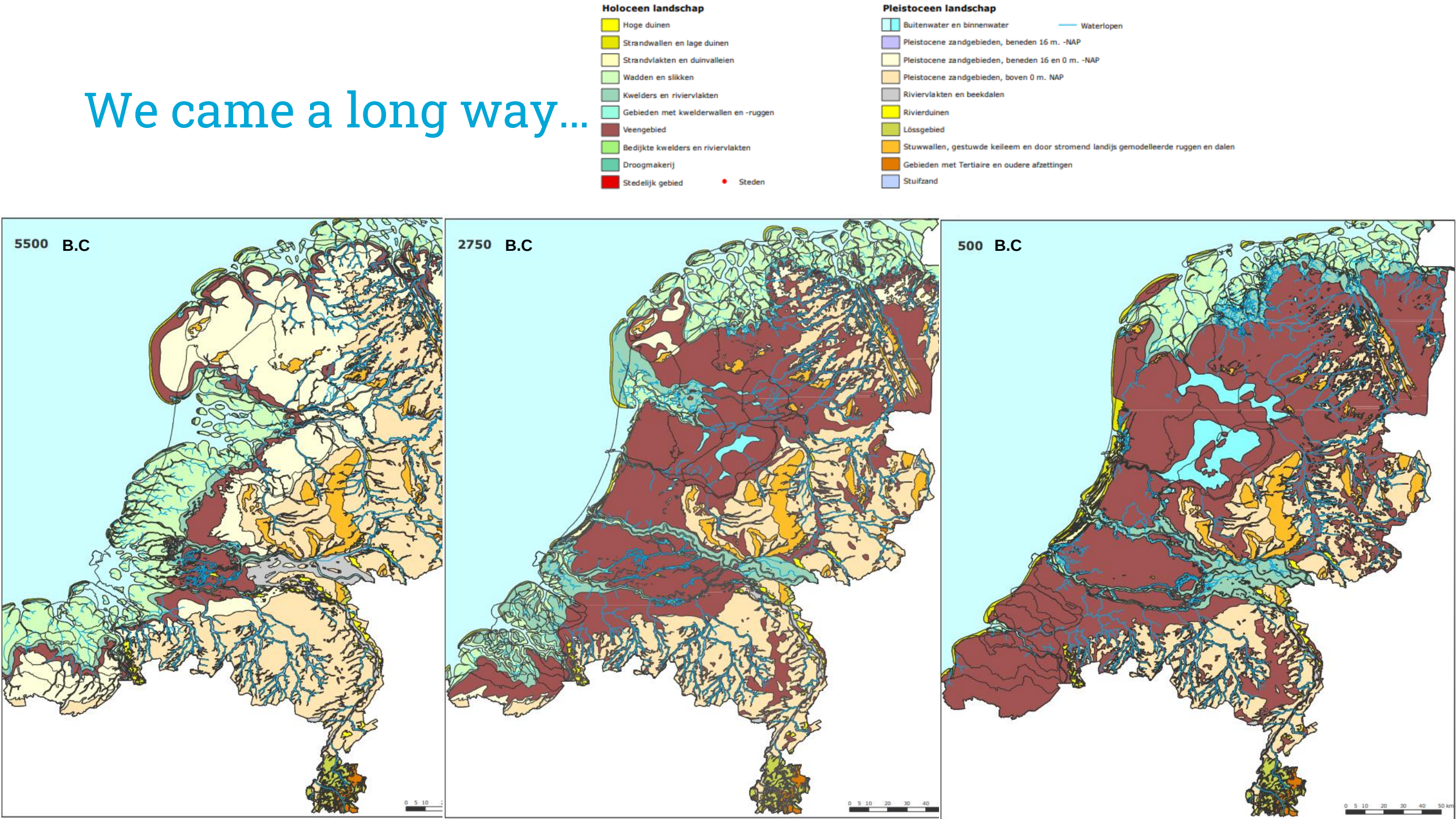
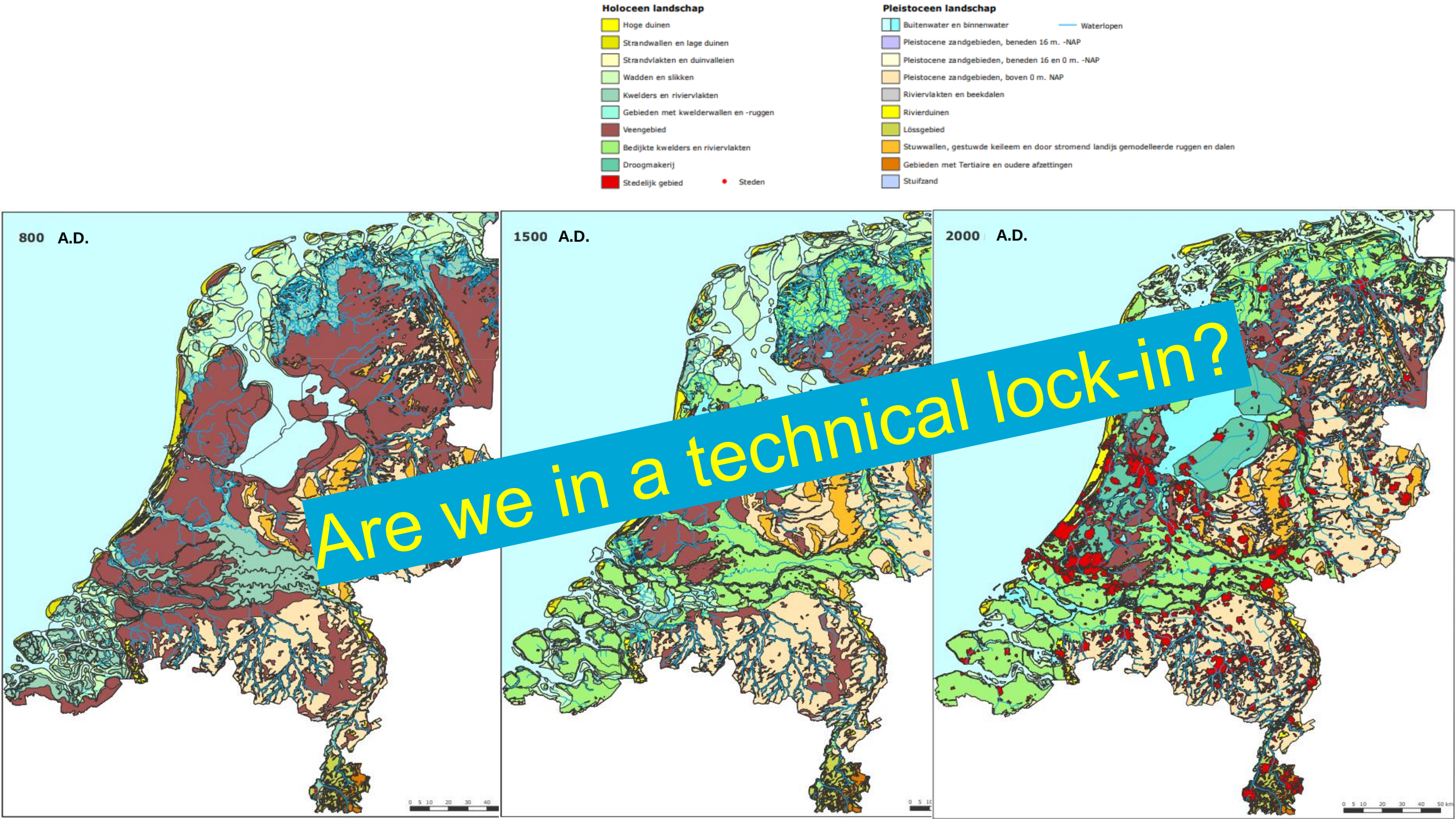
Lek
Nederrijn
Pannerdensch Kanaal
Lobith (862)
Merwede
Waal
Waal
Bovenrijn
Gorinchem (954)
Maas


Nature-Based Solutions
Room for the River

We came a long way…




Holoceen landschap
Hoge duinen
Strandwallen en lage duinen
Strandvlakten en duinvalleien
Wadden en slikken
Kwelders en riviervlakten
Gebieden met kwelderwallen en -ruggen
Veengebied
Bedijkte kwelders en riviervlakten
Droogmakerij
Stedelijk gebied
Steden
Pleistoceen landschap
Buitenwater en binnenwater
Waterlopen
Pleistocene zandgebieden, beneden 16 m. -NAP
Pleistocene zandgebieden, beneden 16 en 0 m. -NAP
Pleistocene zandgebieden, boven 0 m. NAP
Riviervlakten en beekdalen
Rivierduinen
Lössgebied
Stuwwallen, gestuwde keileem en door stromend landijs gemodelleerde ruggen en dalen
Gebieden met Tertiaire en oudere afzettingen
Stuifzand
800 A.D.
1500 A.D.
2000 A.D.
Are we in a technical lock-in?

Floods are entangled with Dutch history

Outline

- Some words about managing authorities in (and outside) The Netherlands
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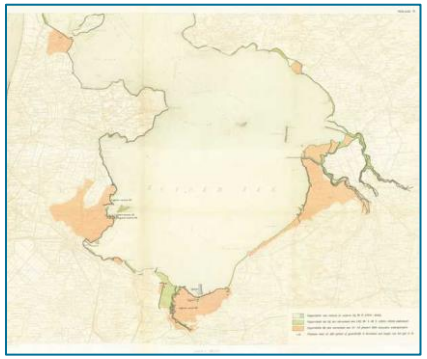
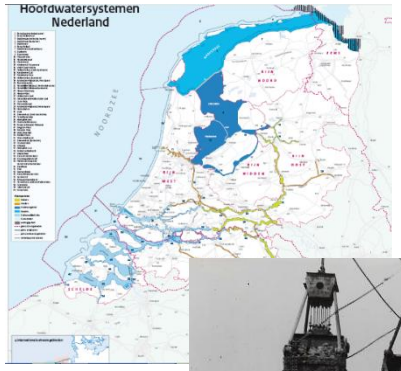
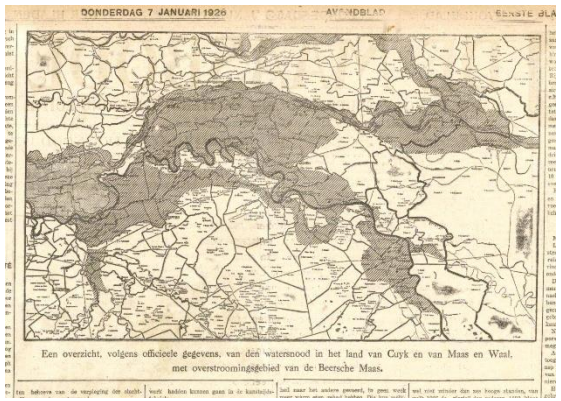
Water management in the Netherlands is about protection: Some events and the consequences

1916 — 1926 — 1993/95 — 2005 — 2025 →







Delta programme
Delta fund
Delta law
Delta commissioner

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High discharge event January 1995

Evacuation of people

Flooded infrastructure

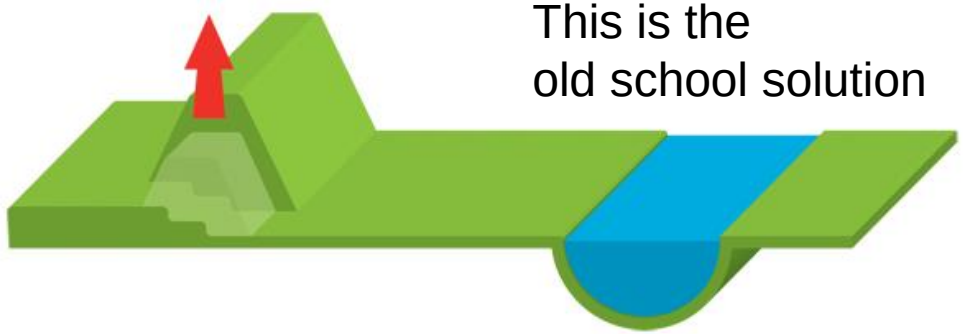
Extremely high water levels

Evacuation of live stock

Protecting weak dikes

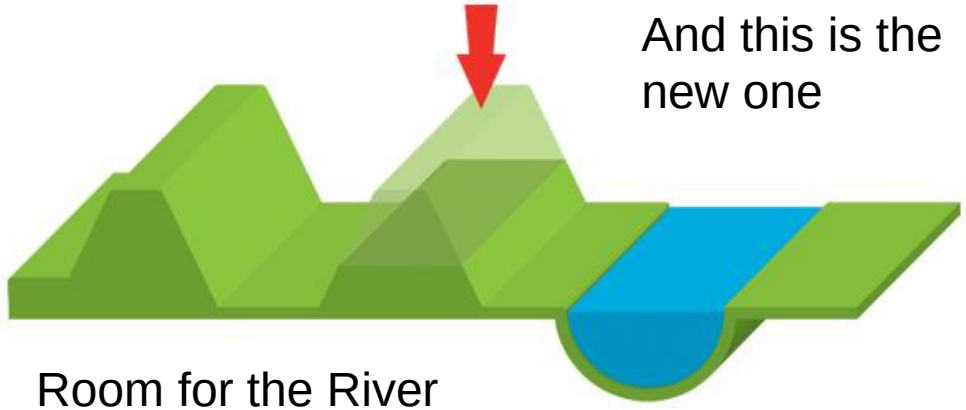
If this is the problem....

Strengthening dikes



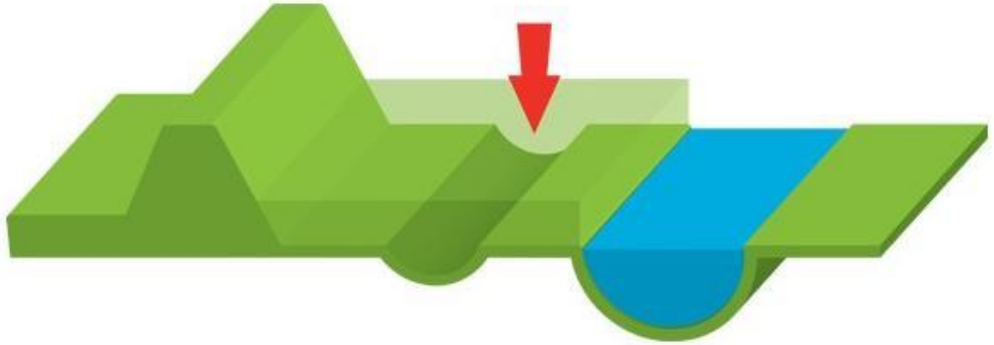
This is the
old school solution

Depoldering



And this is the
new one

Room for the River



TU Delft


Room for the River-programme
Two goals: 1. Flood safety
2. Increase spatial quality
Coherent program, no shopping possible!
Know the system, make use of backwater curves

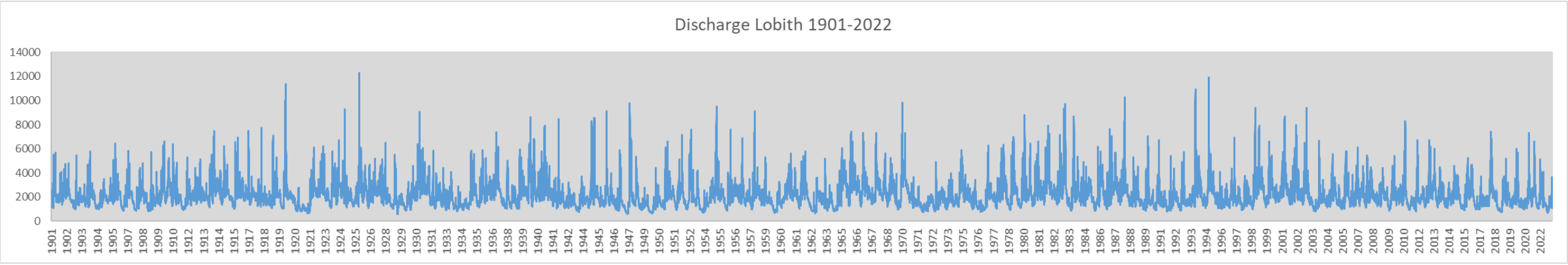
EUROPEAN UNION

Isn’t this applying Nature based Solutions?

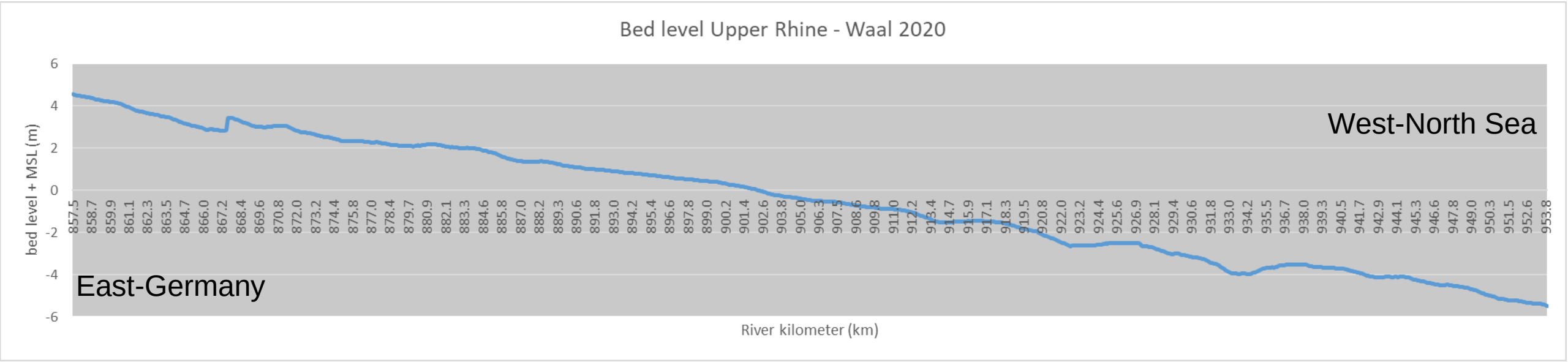
If you want to intervene in a system, you need data …

Data

Discharge

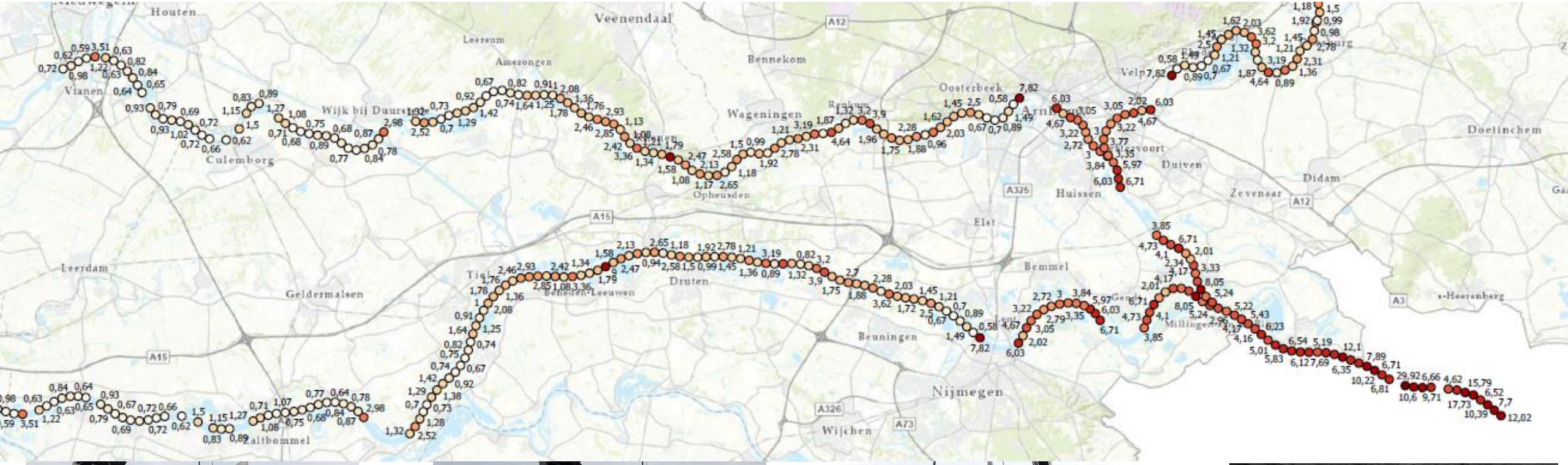


Bed level



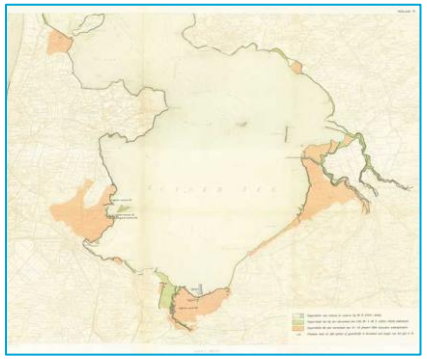
Data (c’td)

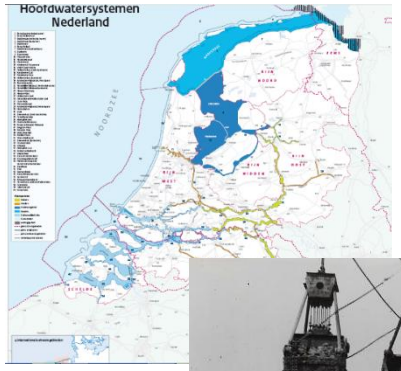
D50 (and D10, D90, fractions)

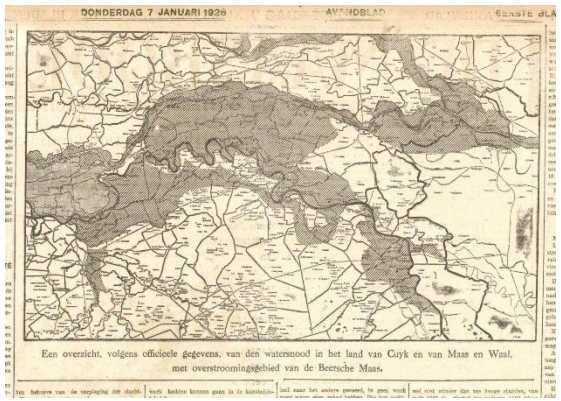


Water management in the Netherlands is about protection: Some events and the consequences

1916 — 1926 — 1993/95 — 2005 — 2025 →







Delta programme
Delta fund
Delta law
Delta commissioner

2022 RIVERS GROUP CONFERENCE
MAKING ROOM FOR RIVERS

Outline

- Some words about managing authorities in (and outside) The Netherlands
- The origin of the Dutch river landscape, interventions from the past and the consequences
- Some major events and the consequences
- Interventions: Room for the River-Deltaprogramme-Room for the River 2.0 (water quantity)
- **What about climate change?**
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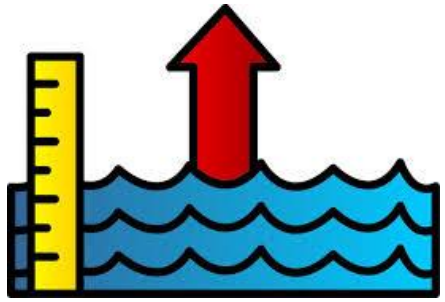
Climate change

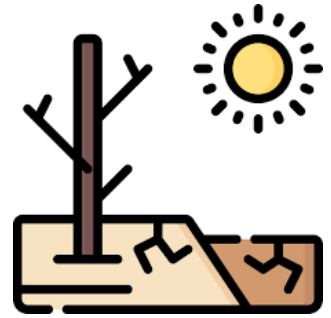
Temperature rises

Sea level rise

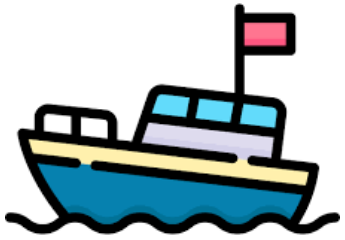


More floods

More droughts



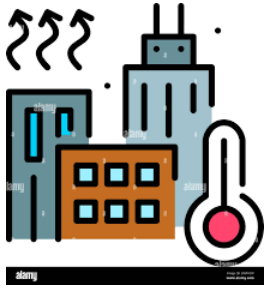
Shipping problems



Intense rainfall

Urban floods

Urban heat stress

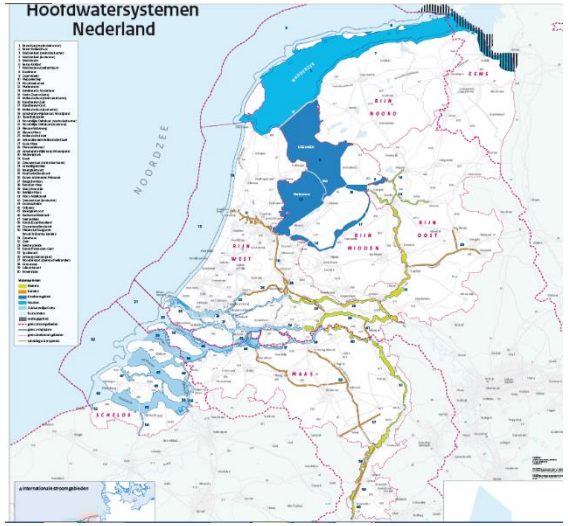


Solution

TU Delft

The deltaprogramme and Room for the River

Delta programme (since 2010)



Highlights Room for the River 2.0

- Ready in 2050
- Combination of dike reinforcements and room for the river measures
- Restore discharge distribution-high and low discharges
- Maintain bed level (but which one?)-important for navigation

www.beeldredaktie.nl

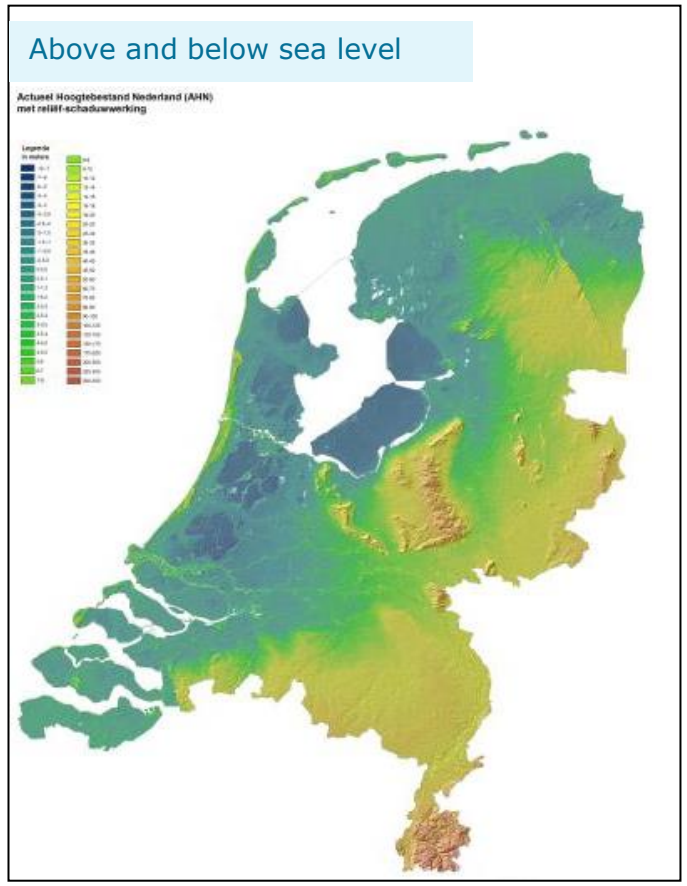
Holland Luchtfoto

Omroep Gelderland

Importance of Water Management

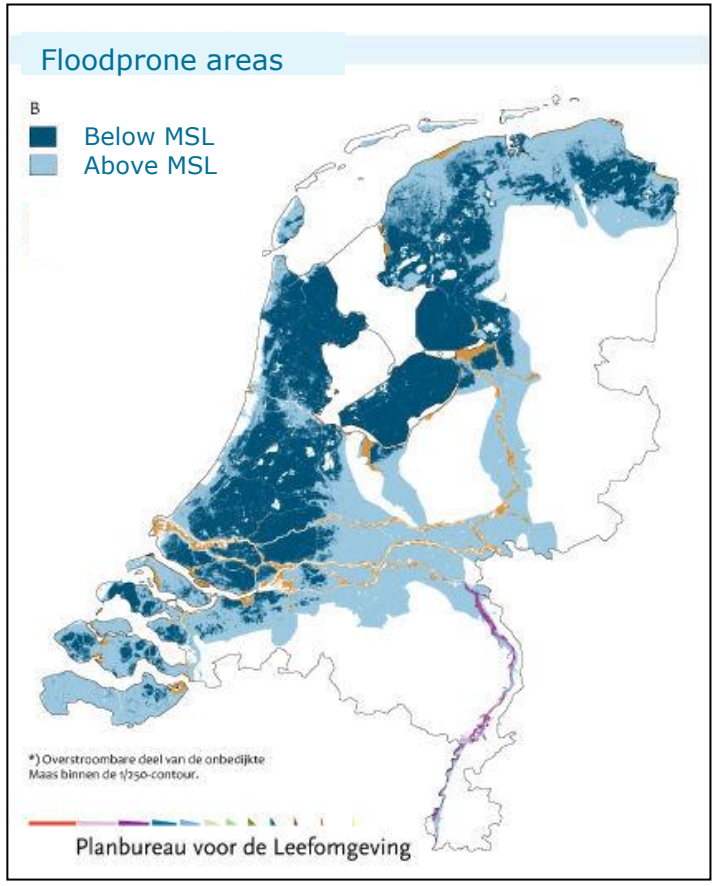
- Engineered rivers, since ~500 AD
- ~17 million people, 22nd largest economy, 5th most densely populated country
- 60% of people (9 million) live in, 70% of GDP (600 bln) produced in, areas between 1 and 6.5 meters below mean sea level
- ~600 km of rivers, 3600 km of flood defenses, hundreds of locks, sluices, etc.
- subsiding, changing climate
- water management is a matter of *national survival*
- water is an *opportunity*

Above and below sea level



Source: Actueel Hoogtebestand Nederland

Floodprone areas



Source: Netherlands Environmental Assessment Agency

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Catchment Management Plans

Main points 1/1: River Basin Management Plans (RBMPs) in the Netherlands

- **Every 6 years**, RBMPs are updated under the **EU Water Framework Directive (WFD)**.
- Current plan covers **2022–2027**, integrating **Rhine, Meuse, Scheldt, and Ems basins**.
- Key focus: **water quality, ecology, pollution control, and groundwater management**.
- Assessments of **745 surface water** and **23 groundwater bodies**.
- **Pollution monitoring improved**, but **emerging pollutants** remain a concern.
- **Biodiversity improving**, but **nitrate levels in agriculture runoff are rising**.

Main points 2/2: Key Challenges & Actions (2022–2027)

Pollution control:

- **Stricter discharge permits** & **source control for chemicals**.
- **Stronger manure regulations** & **modernized wastewater treatment**.

Water system resilience:

- **Restoring natural water systems** & **balancing groundwater levels**.
- **Integrating water quality with freshwater supply**.

Regional challenges:

- Addressing **nature reserves & drinking water protection**.
- Tackling **cross-border pollution**.
- **Goal:** Implement measures by **2027** to **achieve good water status ASAP**.

How are we doing (2024)?

- **Only 9.4%** of Dutch surface waters meet **chemical quality standards**, down from **nearly 40% in 2019**.

- The **ecological status** of surface waters has **declined by 0.3% over six years**, meaning **0.0%** of waters are now classified as being in **‘good’ ecological condition**.

- By **2027**, only **5.2%** of Dutch waters are expected to meet the **ecological requirements**.

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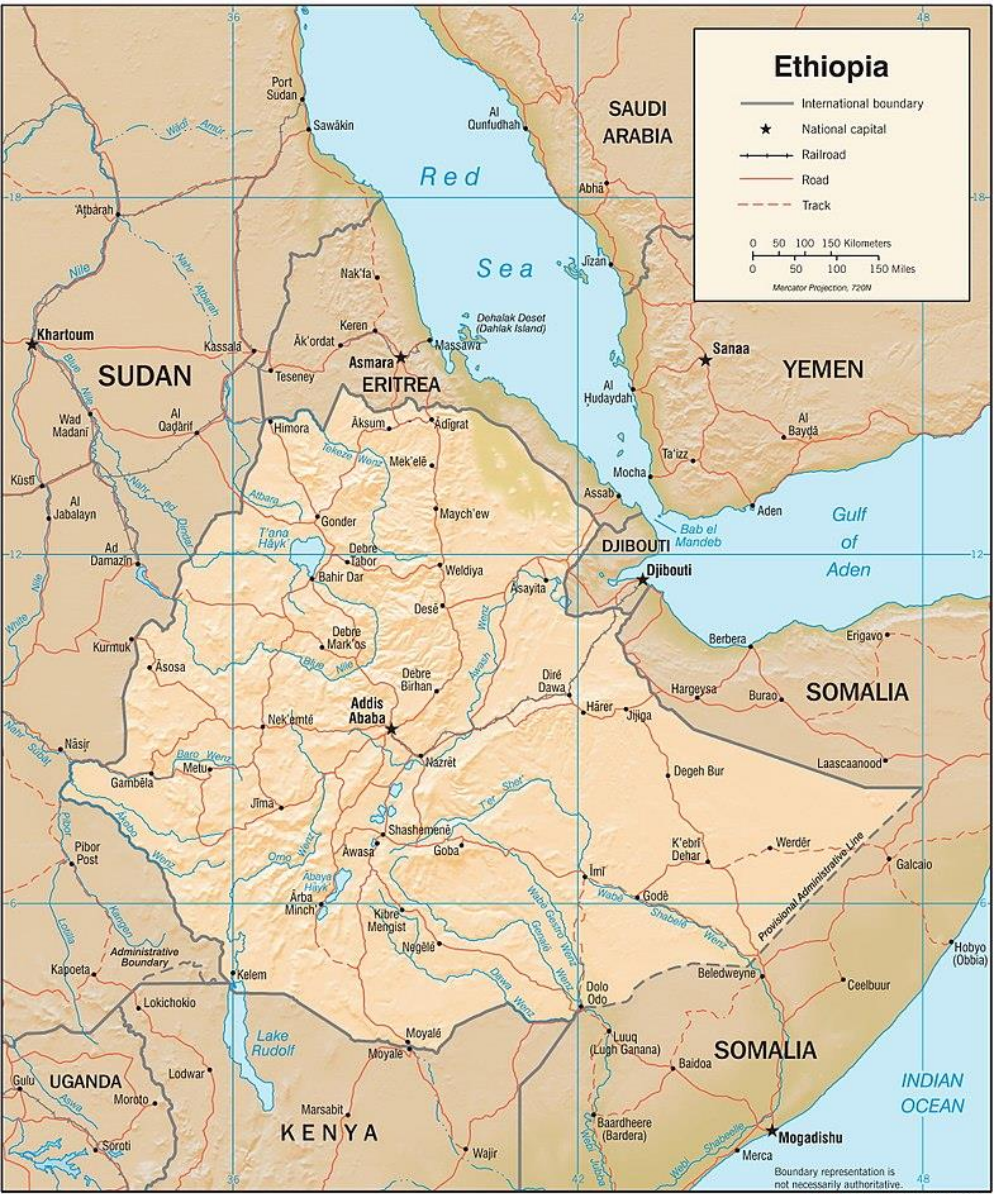
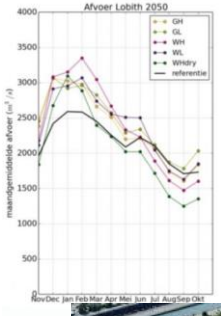
Comparison Netherlands Ethiopia



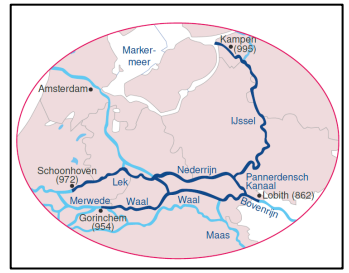
1. Water scarcity and seasonal variability



2. Soil erosion and land degradation

3. Flooding and disaster risk

4. Water use conflicts

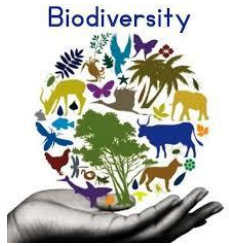


5. Inefficient Irrigation and Water Management

Rijkswaterstaat
Ministry of Infrastructure and Water Management

6. Pollution and Water Quality Degradation

7. Hydropower Development and Environmental Concerns



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Conclusions

Conclusions

- Think carefully about the management options and measures
- Avoid (getting into) a lock-in
- Create/maintain a (climate)-resilient river system
- Create the right governance conditions
- Apply Nature based Solutions
- Think about the consequence of climate change

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