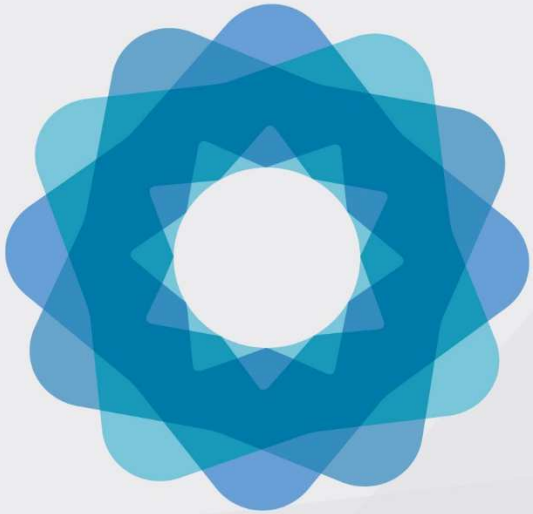


System of Environmental Economic Accounting

System of Environmental Economic Accounting

Water Accounts in the Netherlands

Cor Graveland

10-11-2016

United Nations

Outline

- Water issues / problems in NL
- Dutch water accounts
- History / Projects / international
- Physical Water flow Accounts
  - Sources
  - Methodologies
  - Experience / challenges / difficulties / …
- Results & indicators
- Use / policy use of PWFA in NL

Water issues in the Netherlands

Safety, protection against flooding

Water management: water resources and water use

Water management: excess of water

Water pollution

Water quality

Dutch water accounts - overview

1. ***Physical water flow accounts*** (m^3), water flows
2. ***Physical asset / stock accounts*** for water (m^3)
3. ***water mission accounts***, based on emission registration (kg), national and regional data
4. ***Water quality accounts***
5. ***Economic accounts for river basins***, mainly based on the national and regional accounts (euro's, employment)
6. ***NAMWA matrix*** (NA Matrix including water accounts), incl. water related monetary data (taxes, subsidies etc.)

7. **Economic Performance of EGGS** particular in water
8. ***Economic description*** of the North Sea (NAMWA)
9. ***Economic performance of flood prone area***
10. **Valuation** of Dutch water resources (ecosystem accounts)
11. ***Indicators*** for water

Physical water account

- Supply and use of water (products) in the Dutch economy in m^3
- Use: tap water, groundwater, surface water ('industry water')
- Abstraction from environment: surface water, groundwater, soil water, eventual rain harvest
- Resident principle
- Distributed over 38 industries and households
- Data sources: water statistics, environmental reports (PRTR-Register), data from water companies and detailed information from LEI
- Connect to monetary water data in NA
- Time series 2003-2012 (historic figures 1990-2001)

Policy demands

- **Main users:** Ministry of infrastructure and environment, water boards, water companies, Eurostat, other etc.
- **Water Framework Directive**
  - Description of the economic importance / interests related to the use of water
  - Important as potential ground for derogation (disproportionate costs; socio-economic reasons)
- **Marine Strategy Framework Directive**
  - Initial Assessment asks for 'Economic analysis of marine waters'
- **Climate change policies** → expenditure for climate change mitigation / adaptation
- **Indicators for green growth, for SDG's, use-efficiency, to determine water stress, ..**

Ongoing dvmt of Water Accounts in NL(1)

1. 1996: Pilot: first experimental NAMWA
2. 2002, 2003-2005: Extensions of original NAMWA further extension: addition of more pollutants, more detail for river basins
3. 2006: ES - Pilot project 'Dutch Water flow Accounts
4. 2007-2008: IO-analyses, decomposition analyses
5. 2009-2010: Water abstraction and –use at 7 River Basins (Baas & Graveland)
6. 2010-2011: ES / EFTA: NAMEA Task Force on Water Accounts
7. 2011: Aim to compile full Water balance / water asset accounts for national territory
8. 2010-2011: TF on RUMEA incl. water. Aim to test CRUMA on Resource Management Activities (& R.Use)

Ongoing dvmt of PWFA in NL (2)

6. 2011 – 2013(..) CREEA-project: Compile & refine econ & environmental accounts incl. water → PSUT
7. 2011: Contribute to OECD green growth indicators incl. water
8. 2012: Pilot water quality accounts
9. 2013: Time series 1976 onwards for tap water & surface & groundwater
10. 2014: Experimental valuation of Dutch water resources following SNA & SEEA
11. 2015: Min. of economic affairs add to material monitoring also physical water via detailed (133 industry) PSUT
12. 2016: Water in (Experimental) Ecosystem Accounts .
13. Future plans:
    - Composite indicators
    - Environmental - Economic Analyses
    - water footprint / virtual water work
    - What in regular production?

PSUT for water in the Netherlands

- Focus on use table: Use of tap water, groundwater and surface water by industry
- Time series from 2000-2014
- In 2015 compile PSUT for water ‘08, ‘10, ‘12
- > 100 Industries and households
- ISIC, in line with NA
- Full supply use tables have been compiled for 1 year

Data sources, general (1)

On water abstraction, water use, water assets:

1. Join the work between water statistics & water accounts in the NSI and elsewhere
2. Use register data
3. Connect / cooperate with external organizations
4. Surveys / questionnaires only if really required
5. Eurostat grants highly appreciated or essential because allows for on-going development
6. Eurostat connection via WG & TF essential to facilitate data & methodological development (i.e. DSDs)

Data sources, use & abstraction (2)

1. **Agriculture** (ISIC 01-03), from FADN, LEI (Agric. Research inst.)
   a. Sample survey plus extrapolation per farm type
2. **Industrial Activities** (ISIC 10-35, 37-39) from AERs via the PRTR
   a. Annual Environmental Reports (AER) of 1000 companies
   b. Additional estimates by NSI for some NACE 3-d
   c. Extrapolations (former) former Nat. water Survey
3. **Public Water Supply** (ISIC 36) from VEWIN (Assoc. of Public Water Supply companies)
   a. Statistics of 10 Public Water Supply Companies (PWS)
   b. Includes supply to households
4. **Services, etc.** (ISIC 40-98), customer files from 10 PWS (Drinking Water)
   a. Water use coefficients (m3/year) derived per employee per ISIC 3 digit
   b. Combined with labor accounts (remainder)
   c. Extrapolated to new years
5. All ISIC, from Nat. groundwater register (Provinces, Water Boards) (2014 pilot)
6. Optional monetary figures: National Accounts (check)
7. Optional: Data Tax authorities
8. Balancing

Data sources for compiling water PSUT (3)

- Environmental reports
- Water surveys (stopped in the Netherlands since 2001)
- Data from water companies
  - → Total water abstracted, total tap water produced
  - → Register data on water use
- Tax data on water abstraction
- Data on agricultural water use from Dutch agricultural research institute (LEI) based on farmer surveys
- Auxiliary data to allocate water use to industries

Methodologies

- Main sources for water use data: external registers and the water statistics
- Enlarge observed selections of data by means of additional estimates, extrapolations to totals, etc. (NSI)
- Confront bottom up data with top down totals (PWS) which introduce balancing item for drinking water use
- Compile regional (River Basin) data by:
  - Use of the spatial information in the source data, i.e. in the SBR or i.e. n farm locations
  - Apply regional statistics (inhabitants, employees, etc.)
- Trend in towards getting the micro – based data
  - Use of the National Groundwater Register
  - Use of 'industry water' in Industry (ISIC 10-39)
  - Potential for connecting with other data (big data)

Methods for regionalization water data

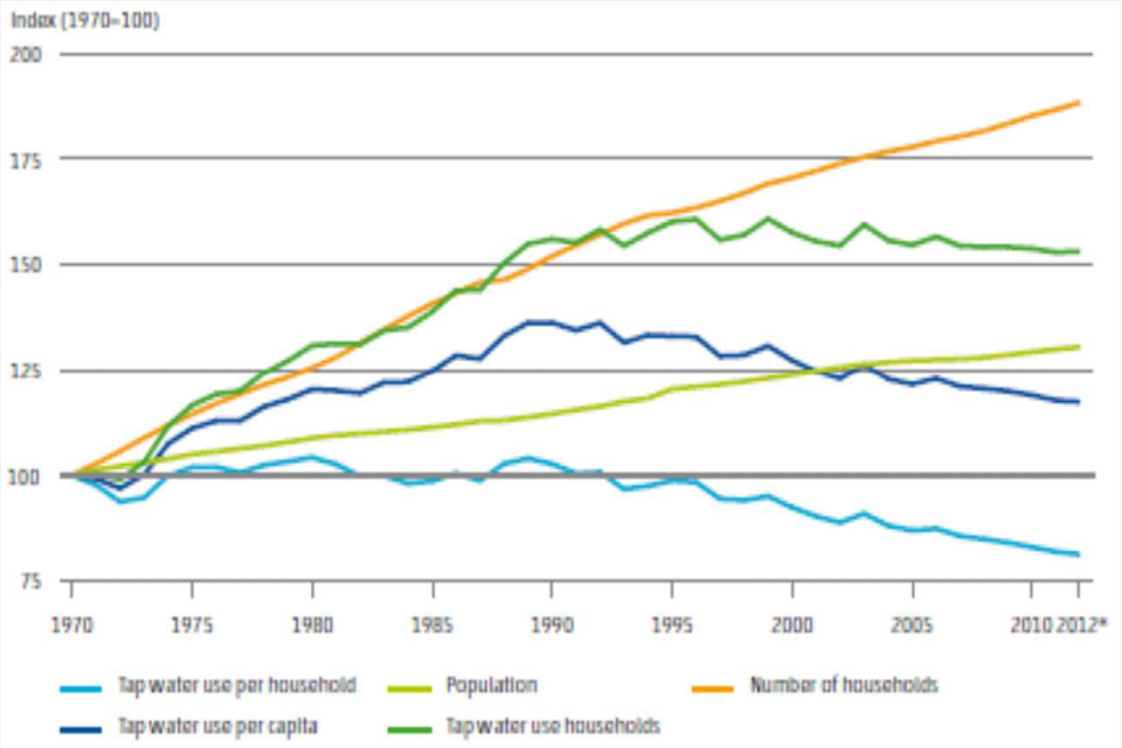
Methods:

- Water use of households: distributed via data of 10 Public Water Supply companies combined with number of inhabitants per municipality per river basin
- Agriculture: on request distributed over the river basins by LEI
- AER data for industry: individual users / abstracters/are located via x-y coordinates
- Additional estimates for manufacturing industry are allocated to river basins by use of employee numbers per river basin
- Public Water Supply companies: river basin data (abstractions) can be compiled on basis of VEWIN data
- Water use by services: distributed to river basins along employee numbers per river basin.

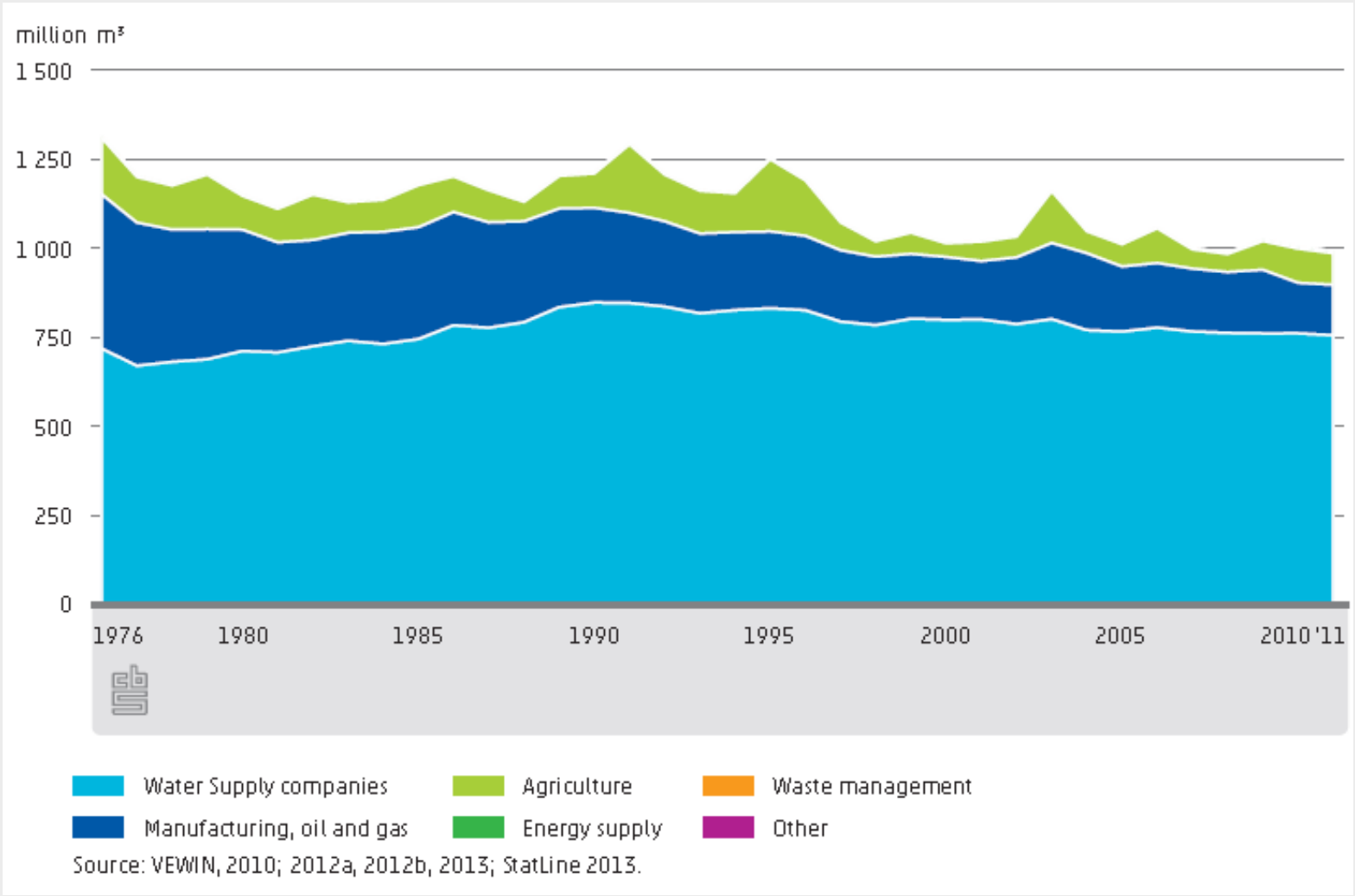
Some Result (NL water accounts)

Results: Water Use households, population & # hh

- Tap water use by households
- Tap water use by Industries
- Compilation in detail 2003 -2012
- Time series from 1970 onwards by completion of old data via statistical methods
- Statline publication of the data (in English)
- Combine with population data
- per capita water use

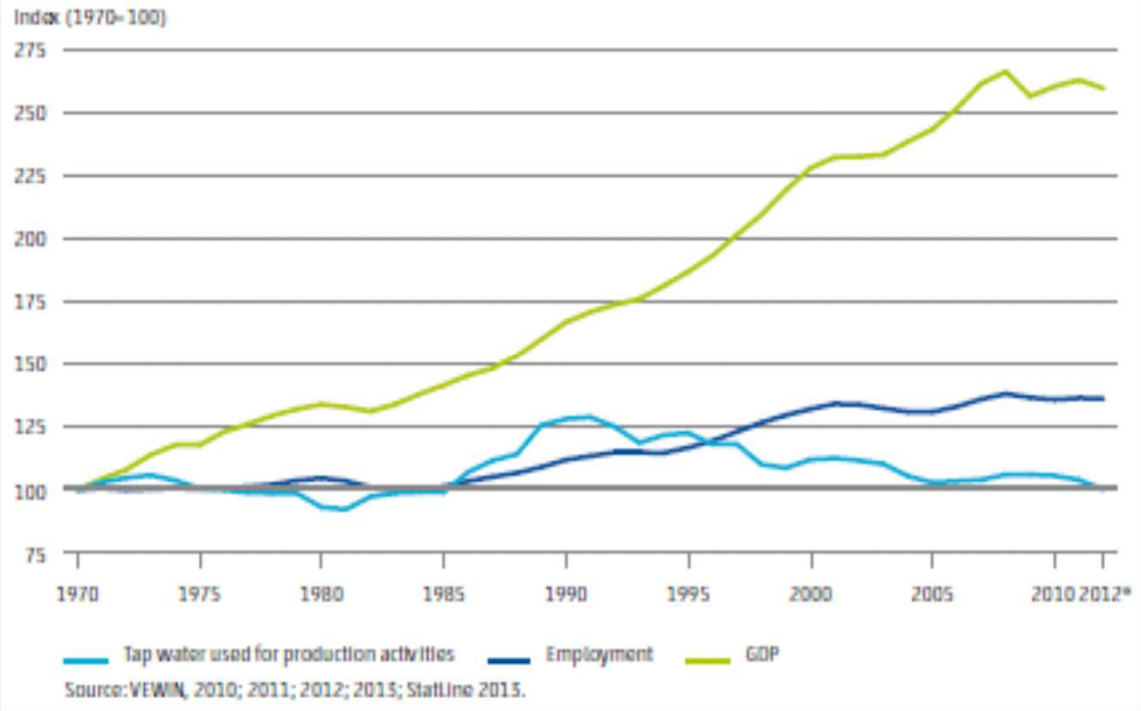


Groundwater abstraction by industry

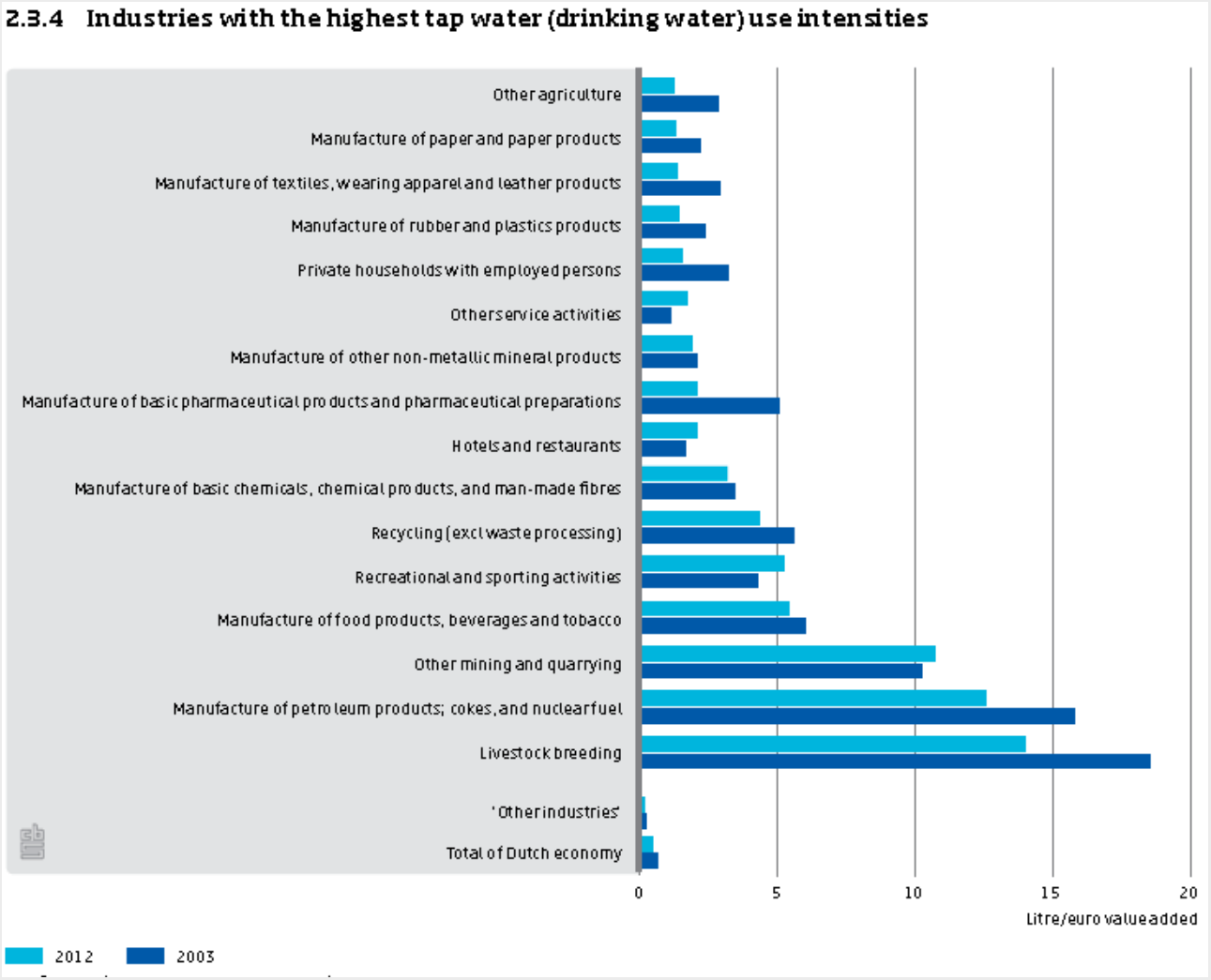


Results: Tap water & production

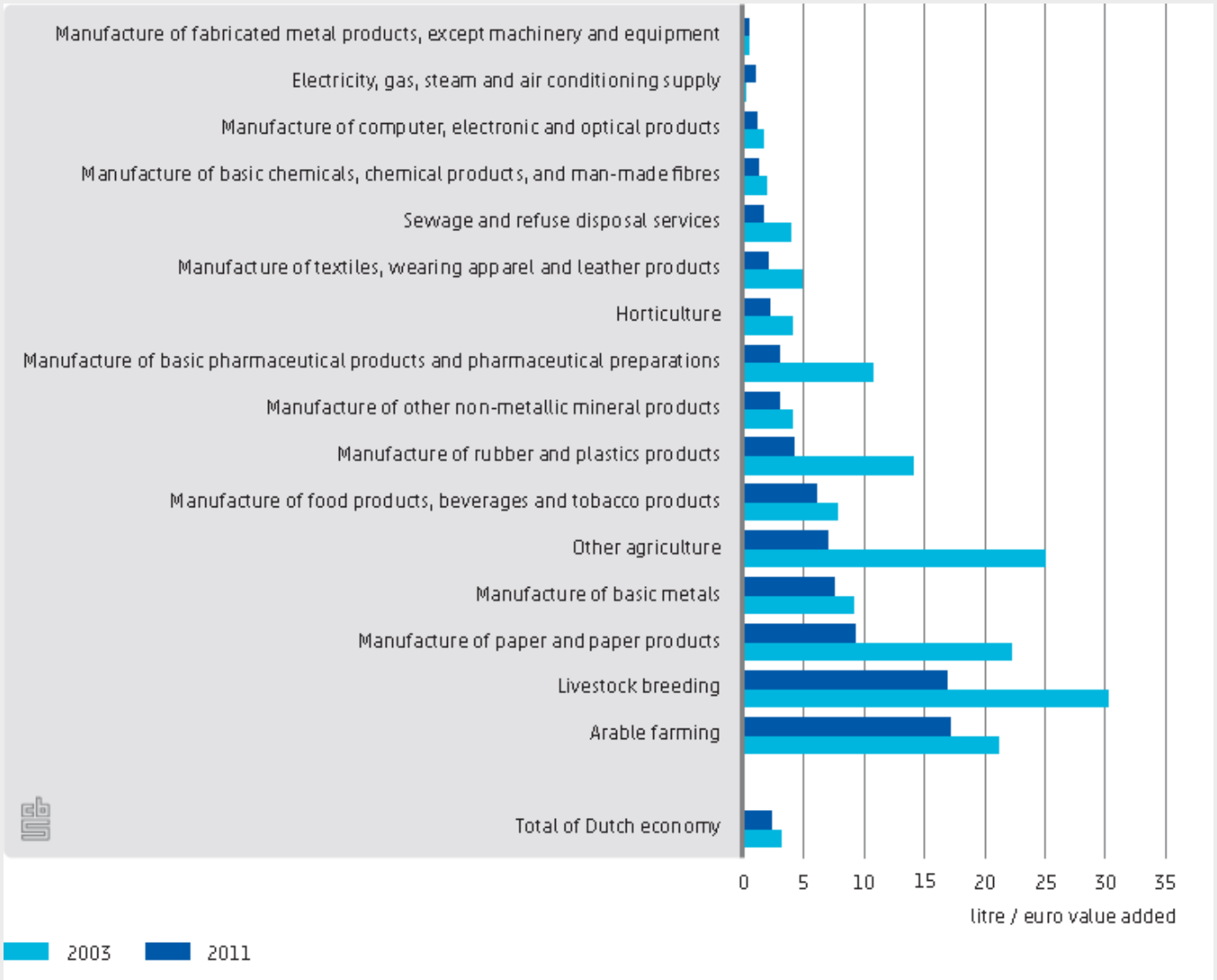
- Tap water used for production activity & Volume change GDP, employment combined
- Compilation in detail 2003 -2012
- Time series from 1970 onwards via statistical methods
- Statline publication of the data (in English)



Results: What are the most important water Is their water efficiency improving ?



Industries with the highest use intesities for groundwater



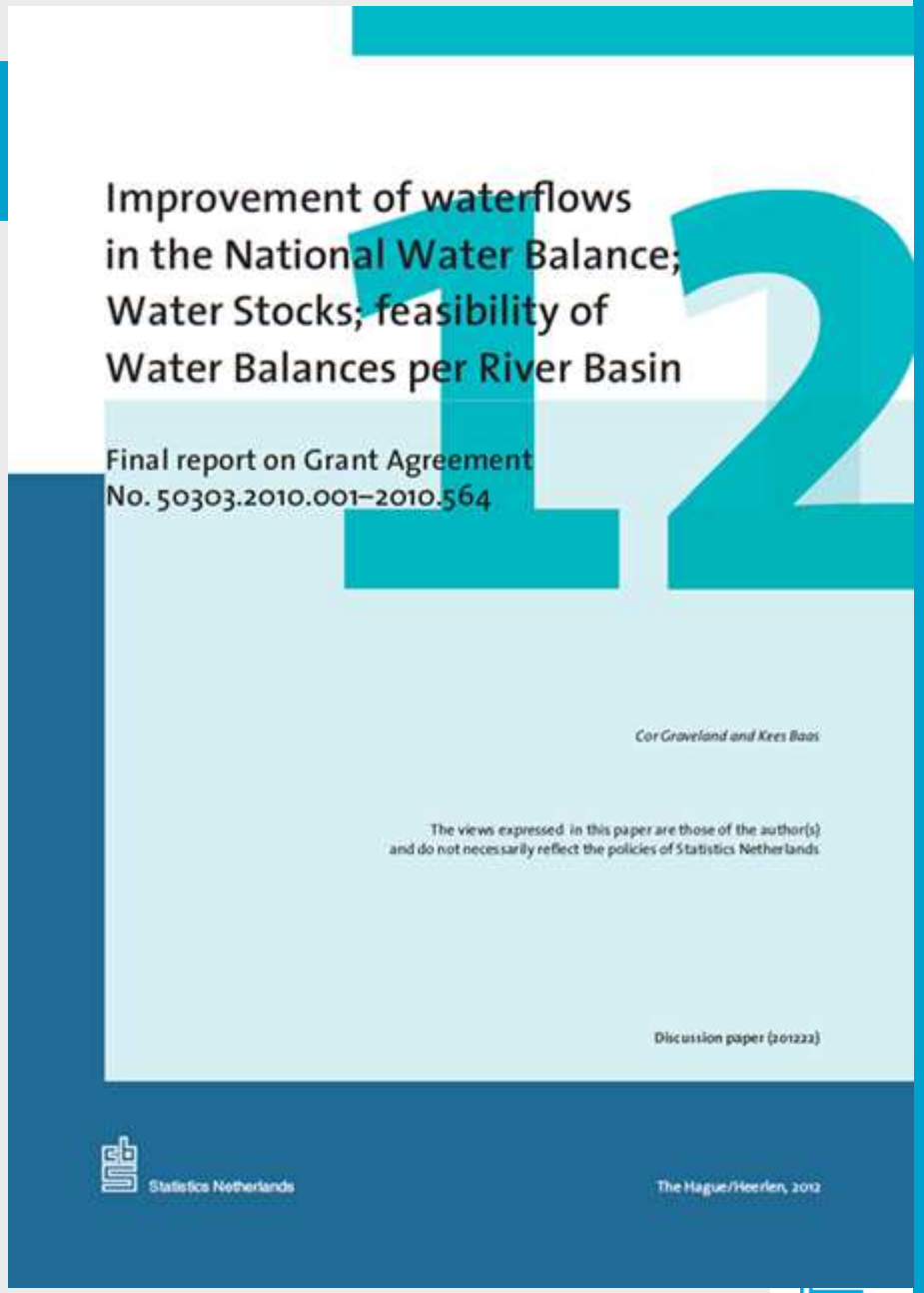
Bron: CBS, Nationale rekeningen 2012.

Experience / challenges / difficulties / …

- General, the ‘organisation’ of the data requires sufficient amount of time
- Dependent on FADN (LEI), if monitoring stops or enlarging exercise gets to costly, we have a problem
- Outside the observed population via the AERs in manufacturing accuracy and quality of the figures is limited and hard to judge
- What industry detail is preferred, needed, doable?
- Connection of micro level data (i.e. for) water to the Business register (SBR) deserves more attention to use full potential
- Balancing is very important and requires more guidance and examples
- The use of customer files from PWS has potential, but is very labour-intensive, costly, but has mutual benefit. Can only be done in a joined project
- Biennial production of the data saves time and budget
- Support and coordination by Eurostat is crucial

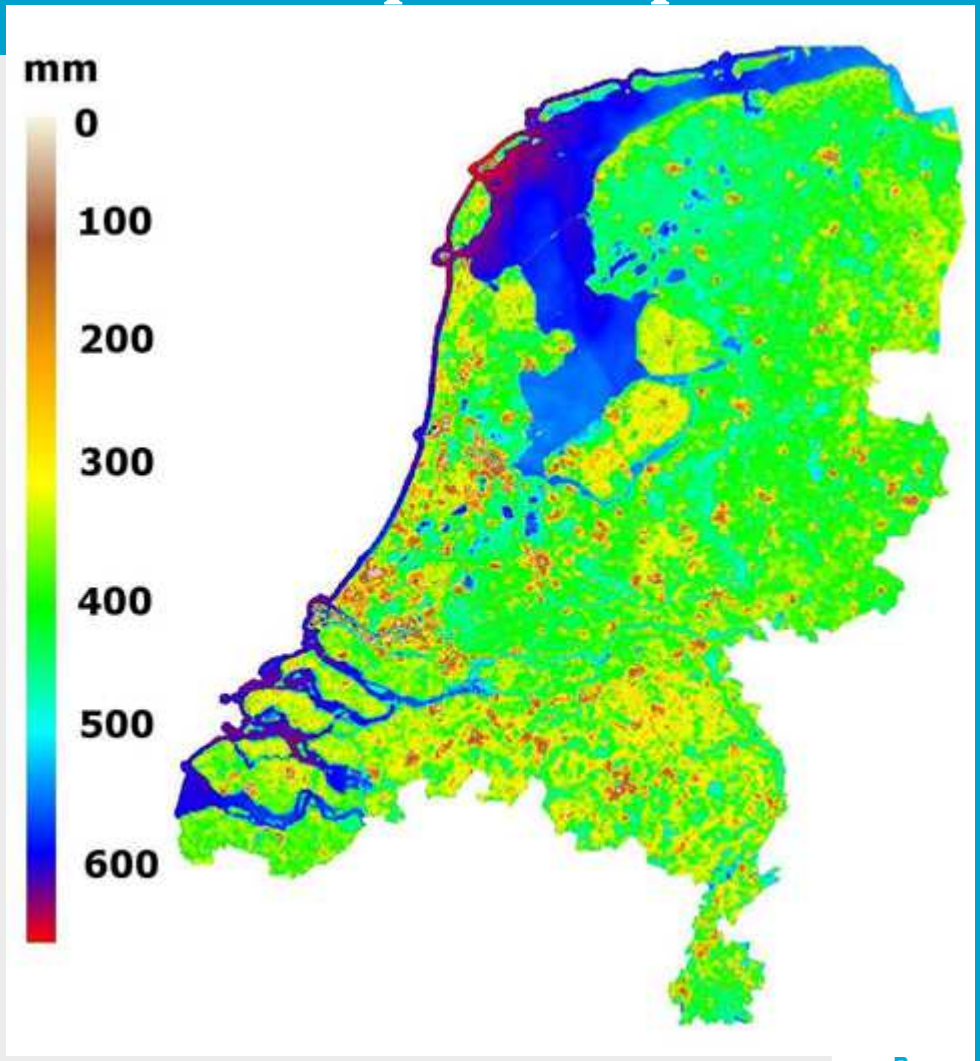
Example Asset Accounts (1)

- Objectives:
  - Water balance :
    - Precipitation, evapotranspiration (inland)
    - & External inflow from upstream, Other flows and
    - actual outflows
    - Exchange of water between river basins …
  - Abstractions & discharges at 7 (sub-) River Basins …
  - Stocks … :
    Groundw., Surface W. & Soil Water
  - Tuning



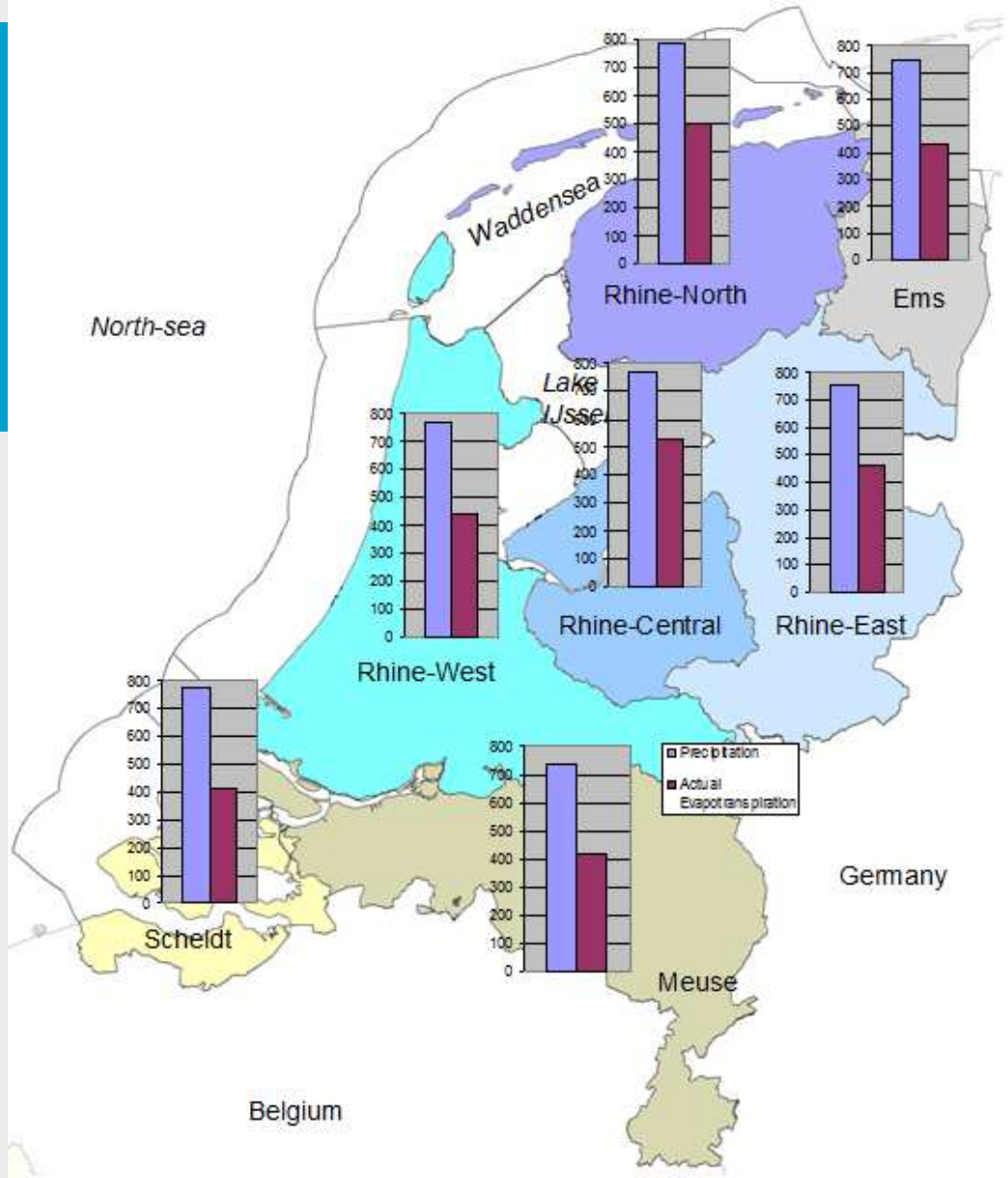
Remote Sensing data: Actual Evapotranspiration

- Evaporation (soil)
- Transpiration (crop)
- Per Grid
- Summer 2009
- Based upon satellite images



Precipitation and Actual Evapotranspiration (volumes) by Catchment

- Results per (sub-)River Basin
- mm per year
- The volumes are calculated using the surface of land and of freshwater basins per River Basin area.

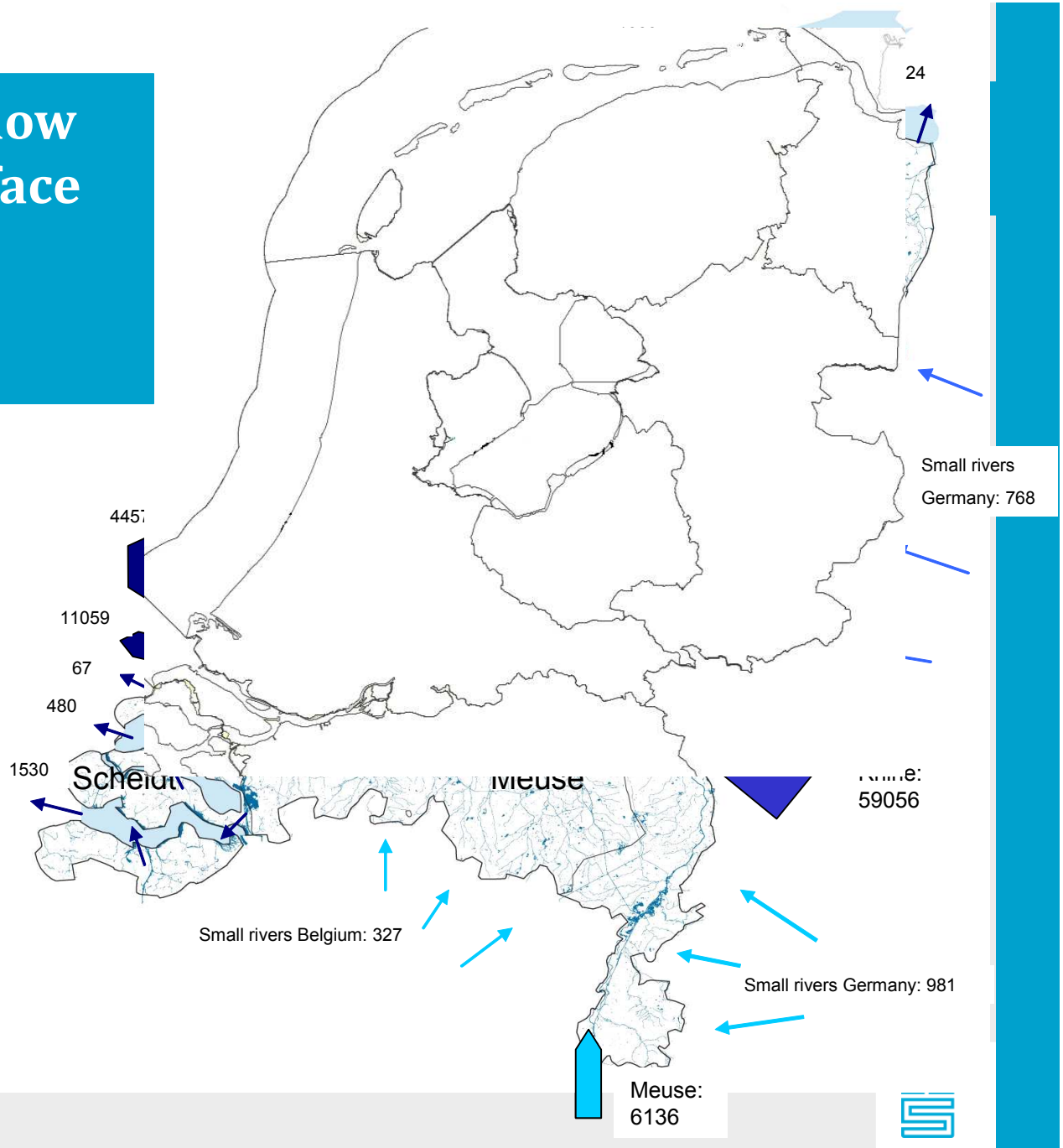


Actual external inflow and outflow of surface water

Method / processing:

- inventory and collection of flow data from water boards and national water authority
- Most files received contain daily average flow rates (m3/sec), some contain monthly flow totals.
- Inflow: 30 gauging stations at border locations
- Outflow: only to sea, in total 28 data files on 81 outlets
- Data were aggregated to monthly, seasonal and yearly totals (mio m3), national & per River Basin.
- River Scheldt (from Belgium) is not accounted for as inflow already has become marine/brackish.

Actual external inflow and outflow of surface water, overview Mln m3 / year



Quantification of major water balance items

Estimates for:

	Year	Summer	Winter
	million m³		
1. Precipitation	28 294	12 193	16 101
2. Actual evapotranspiration	17 022	14 240	2 782
3. Internal Flow = 1 - 2	**11 273**	**-2 047**	**13 319**
4. Actual external inflow from foreign territory	67 962	31 231	36 731
5. Total actual outflow to sea	75 839	32 311	43 530
6. Total freshwater resources = 3 + 4	**79 235**	**29 184**	**50 050**
7. Recharge into the Aquifer = 6 - 5	3 396	-3 127	6 521
8. Groundwater available for annual abstraction = 7 (max)	3 396		
Abstraction of ground water	1 011		
Abstraction of fresh surface water	10 654		
Discharges to fresh water	11 478		
Discharges to sea	175		
Balance abstraction - discharges	13		
Imports of tapwater and water in product	54		
Exports of tapwater and water in products	33		

Assessment of Stocks of fresh water

– Stock of fresh groundwater

– Stock of fresh soil water

– Stock of fresh surface water

→ Fresh water: salinity <300 mg Cl-/l

Stock of fresh groundwater / soil water:

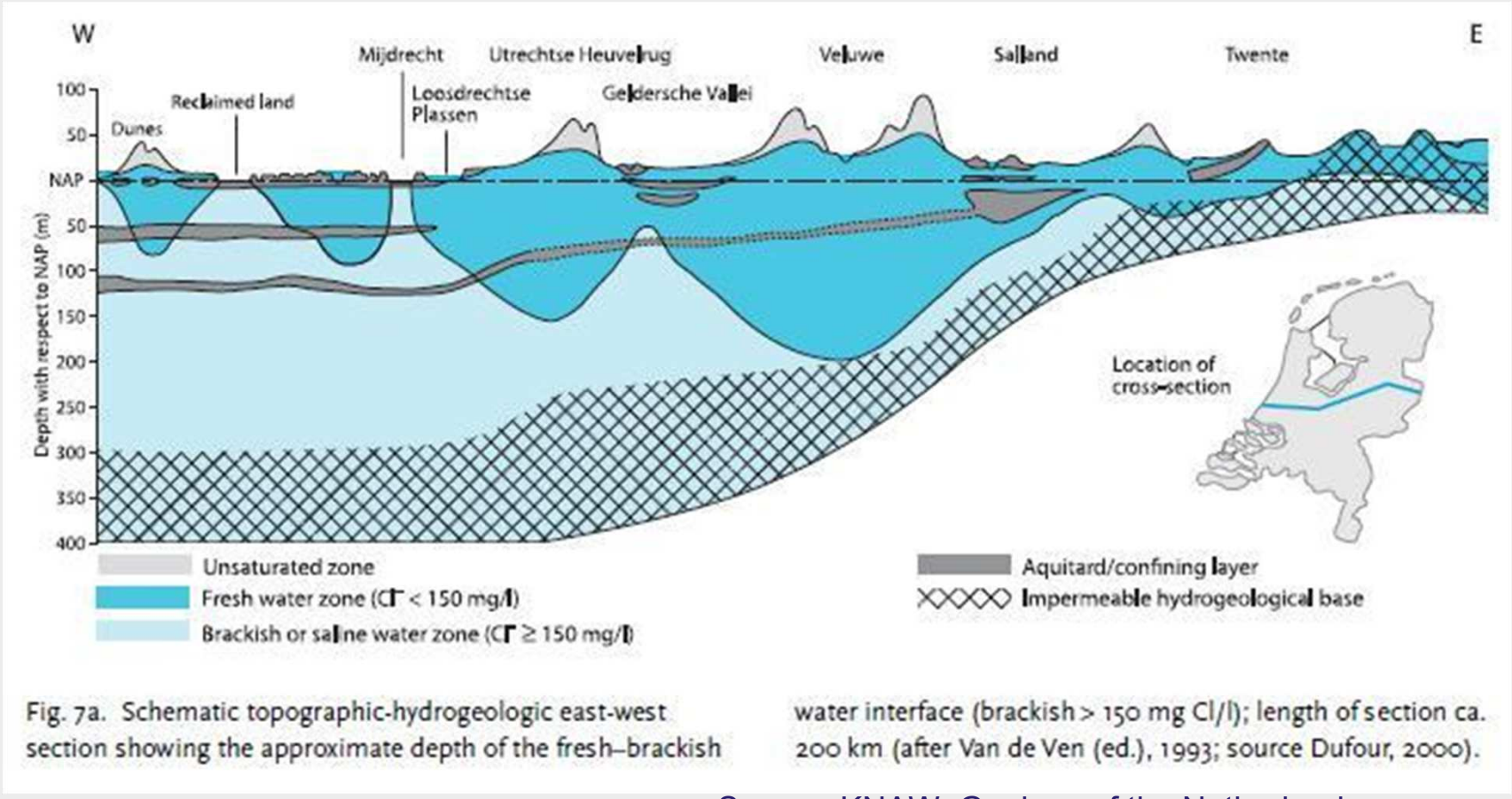


Fig. 7a. Schematic topographic-hydrogeologic east-west section showing the approximate depth of the fresh–brackish water interface (brackish > 150 mg Cl/l); length of section ca. 200 km (after Van de Ven (ed.), 1993; source Dufour, 2000).

Source: KNAW: Geology of the Netherlands
Groundwater in the NL (KNAW), by De Vries

Stock of fresh groundwater

- Calculation (layer solely saturated with fresh water):
  - Soil volume
    - Area of land
    - Thickness of relevant soil layer ('maximum', 'relevant')
    - Upper bound of saturated zone (=groundwater table)
    - Lower bound of groundwater column, incl. fresh / brackish interface
  - The porosity (= water content) of the total soil volume vs the relevant fresh water column
- Method / approach: clear
- Parameterization: reasonable
- For 37 bln m^2, a estimated stocks of 800 – 1100 Bln m^3
- → Stock of fresh groundwater = 1000 times annual abstraction !
- National balance ((? Regionalization to the RBs?)
- Due to large bandwidth, annual monitoring hardly make sense
- → Thus no yet yearly opening & closing stocks ..
- Connect to (ground) water modelers for methodology, tuning and conformation

Stock of fresh groundwater (2)

- Printhulp

Stock of fresh Soil water

- Calculation stock of fresh soil water:
  - Soil volume
    - Area of land, with unsaturated zone above ground water table
    - Thickness of relevant soil layer:
    - Top side of unsaturated zone of soil water column
    - Lower bound of soil water column, the interface with groundwater table largely determined by 'level of control (drainage)'
    - The porosity of the relevant soil zone (water and air)
    - Level of (un-)saturation of the pores (=water content)
- Method / approach: clear
- Parameterization: reasonable
- Precision: bandwidth
- For 37 bln m^2, a first preliminary estimate is around 30 – 50 Bln m^3 (3 – 5 percent of fresh groundwater stock)
- National balance.
- Regionalization to the 7 (sub-) River Basins → requires soil type
- Significant seasonal variation, annual monitoring requires real time monitor
- In touch with (ground) water modellers for methodology, tuning and conformation

Stock of fresh Soil water (2)

- Printhulp

Stock of fresh Surface water

- Calculation stock of fresh surface water bodies (m3):
  - Area of the water (bodies) within the country (by category of water body?) in m2 (1)
  - Average depth of these fresh water bodies (m) (2)
  - Method / approach: clear
- Parameterization: area good; depths within certain range
- Area of water: 7,2 bln m^2
- Average depth differ
- Result in estimate of 10 Bln m^3
- → Only 1 percent to groundwater stock!
- Stock = compares to abstraction of fresh surface w (10.6 bln m3)
- Inflow is even > 6 times as big (68 bln m3)
- Regionalization to the 7 (sub-) River Basins (RBs)
- Due to large variation, annual monitoring hardly feasible
- Connected to modelers and WFD people for methodology and data

Assets of fresh water

Groundwater	Soil water	Surface water
Billion m3		
1,115.0	'11.0 - 44.0	11.3

Conclusion:

→Groundwater stock = 1000 times annual abstraction

→Once for every few years, no annual opening / closing stocks

→Inflow of fresh surface is even 6 times as big as fresh water stock

Findings asset accounts (water balance)

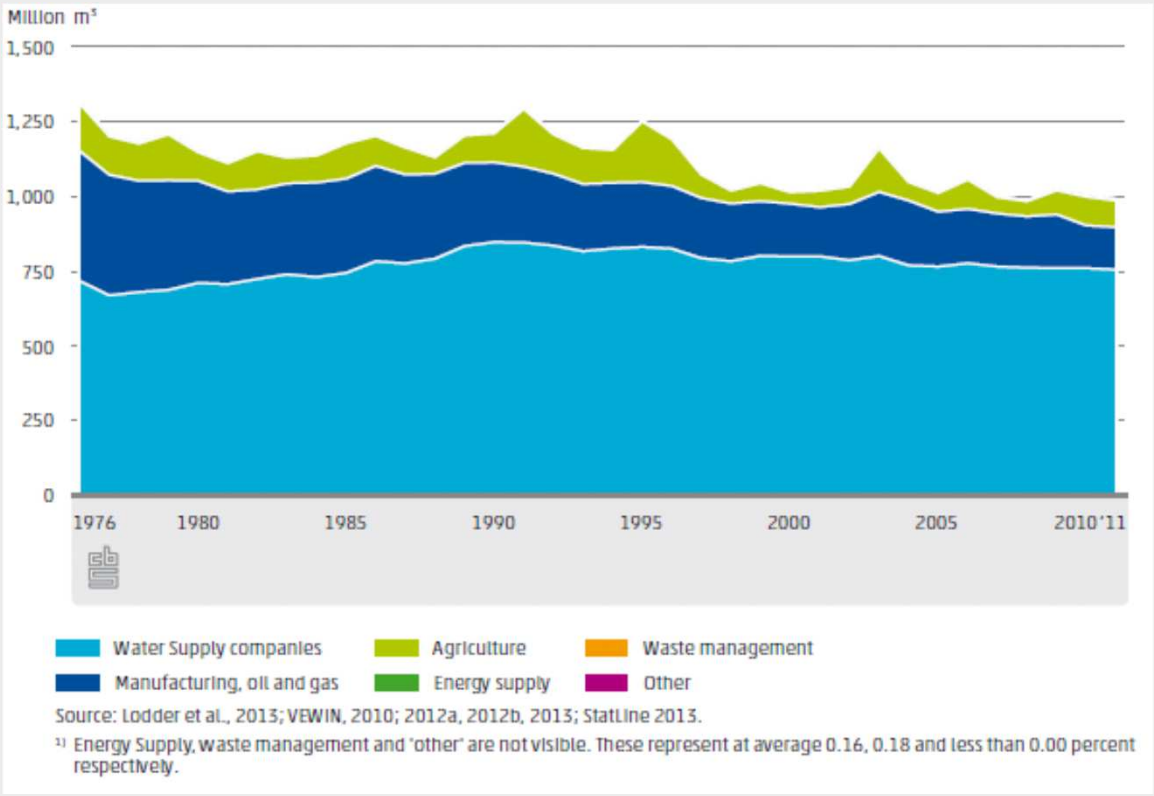
- Development project relied on funding by Eurostat
- Largely rely upon existing data sources (registers)
- Close cooperation water statistics and SEEA - Water accounts
- A clear need for data by policy (law) & society
- National & European legislation is key
- Cooperation with external partners and experts has proven very useful for the project

Recommendations

- Try to base upon existing data sources (registers)
- Integrate & connect with hydrological and hydro geological models i.e. for ground- & surface water flows and soil water
- Due to bandwidth discovered, reasonable to present a range for the calculated stocks
- For quantifications of actual evapotranspiration easily better, more realistic values obtained from Remote Sensing technologies

Water abstraction

- Groundwater abstraction for production activities by industry
- Compilation in detail 2003 -2012
- Added time series from 1976 onwards by adding to incomplete old data via statistical methods
- Monitoring over time



Thank you !

Questions / remarks / suggestions ?

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SEEA