SUSTAINABLE FARMING
suggestions for focus : InterReg NSR:
Top Soil & Groundwater
The challenge in the near subsurface

Henk Kieft, i/c Arnout Venekamp and Dries van Rozen

Netherlands

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Key issues

- 2015 Year of Soils
- 50 years of little attention for OM + soil life
- Farmers, water boards, drinking water companies, nature orgs, citizens, all need fresh water, healthy food, climate resilience, all depending on good soil
- Develop practical tools to improve soil & water quality *and quantity*

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Total N-losses to air and aquatic systems, incl nitrate, other Nr, leaching and wastewaters.

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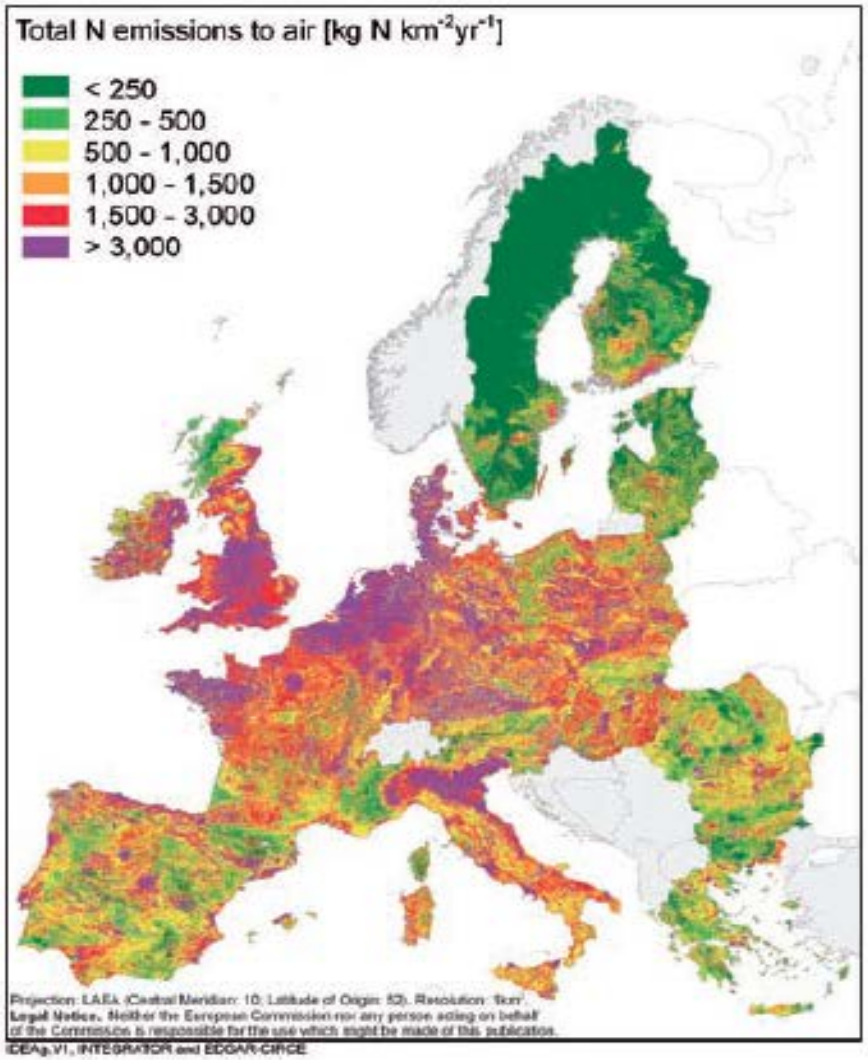

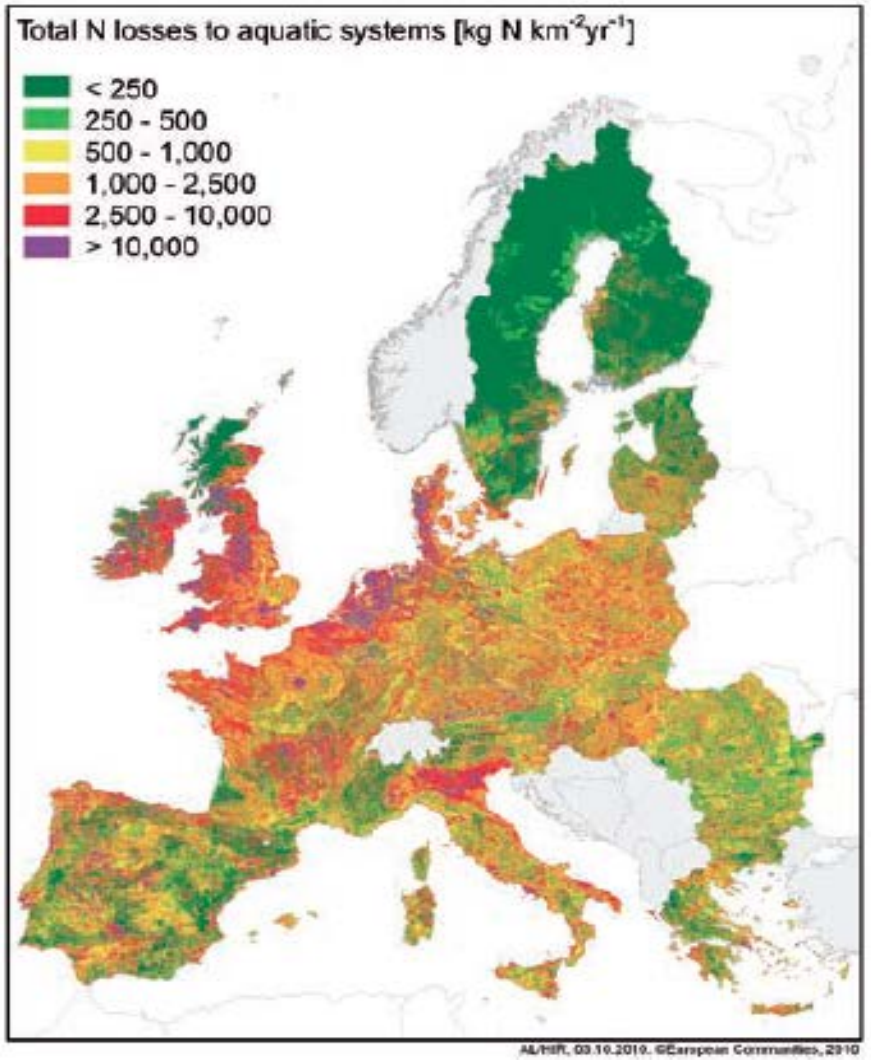

Figure 7.3 Estimated distribution of reactive nitrogen emissions across Europe (expressed as kg N per km^2 for 2000) including (**left**) emissions to air as the sum of NO_x, NH_3 and N_2O, and (**right**) total losses to aquatic systems, including nitrate and other N_r leaching and wastewaters. These high spatial resolution maps illustrate the challenge of managing nitrogen flows given the wide spatial variation experienced (based on Leip et al., 2011).

Our Nutrient World

The challenge to produce more food and energy with less pollution

Global Partnership on Nutrient Management
2013
Secr: UNEP

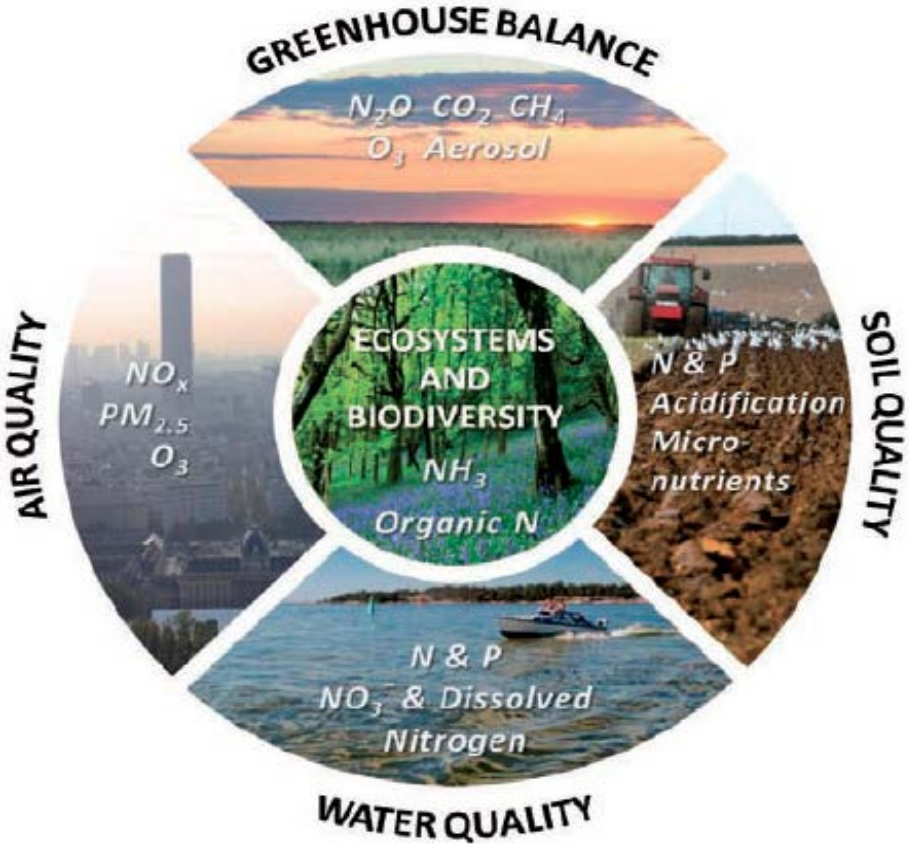

Figure ES1 The five key threats of too much or too little nutrients (Chapter 4).

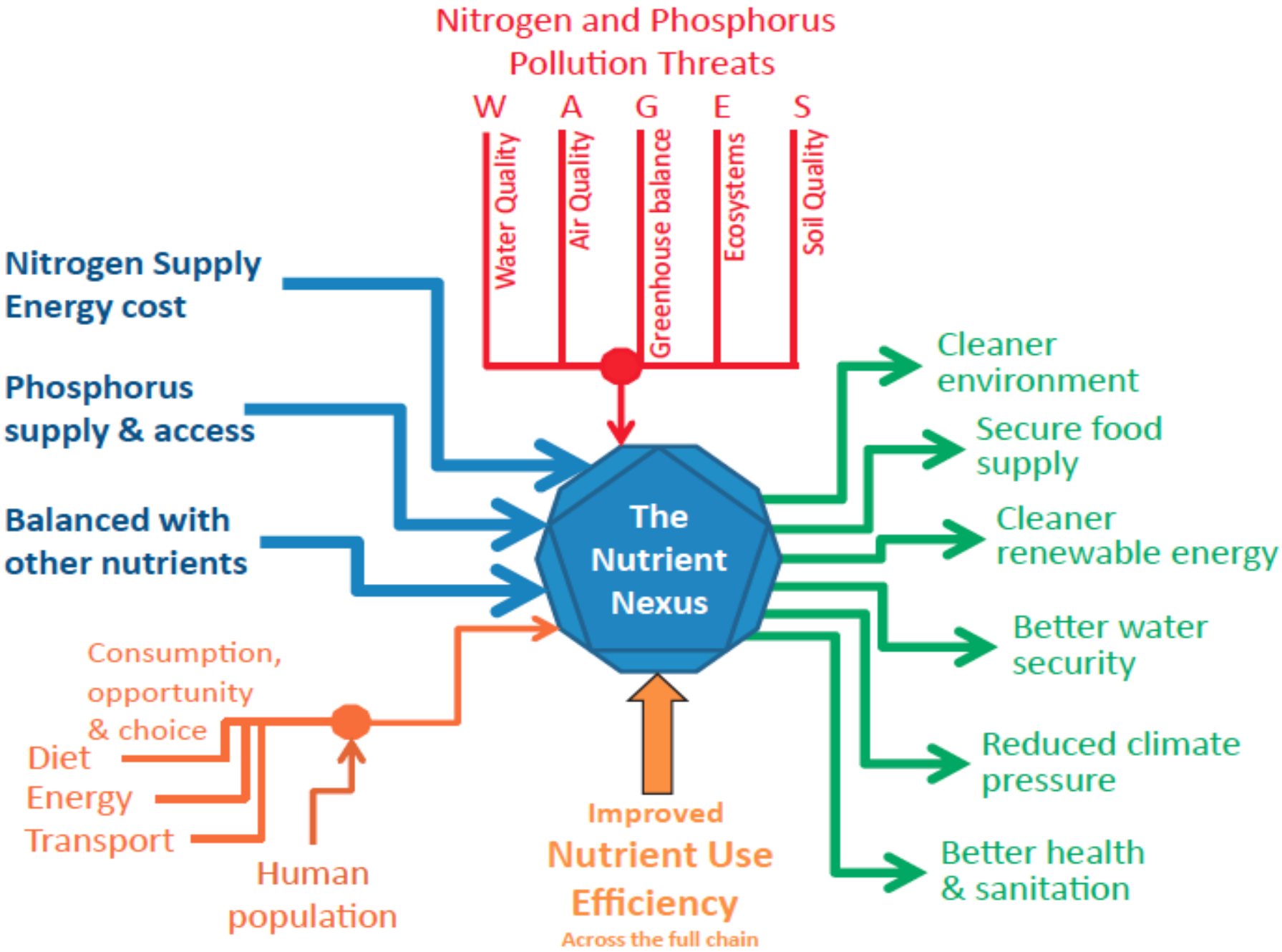

Figure 7.7 The 'Nutrient Nexus'. Nutrient cycles represent a key nexus point between global economic, social and environmental challenges. Improving full-chain Nutrient Use Efficiency becomes the shared key to delivering multiple benefits (original graphic).

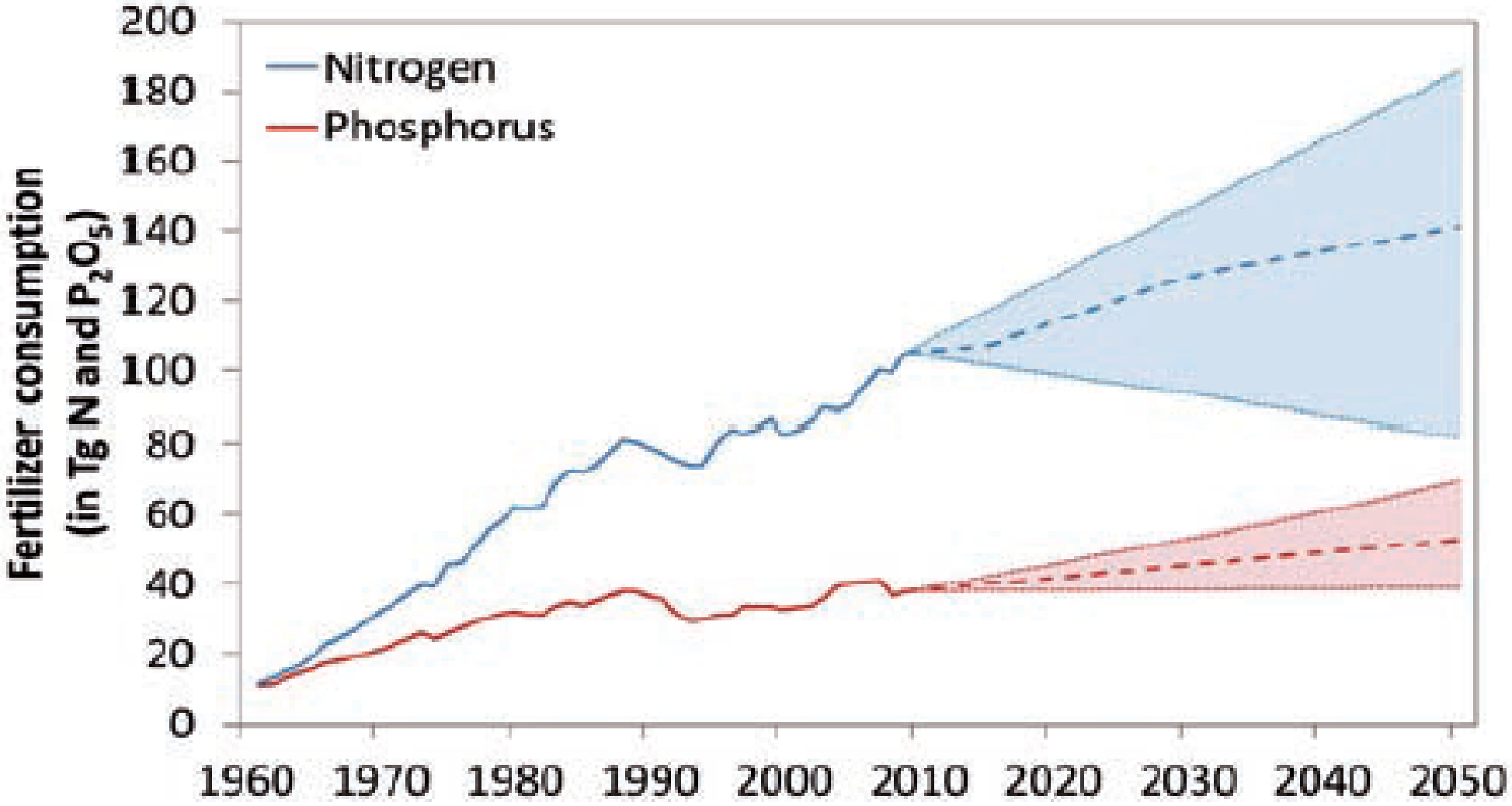

Figure ES2 Trends in global mineral fertilizer consumption for nitrogen and phosphorus and projected possible futures. The amounts of N and P in 2050 will depend on present-day decisions (expressed as N and P_2O_5) (Chapter 2).

N costs caused by EU livestock sector compared to added value generated in primary sector and livestock processing

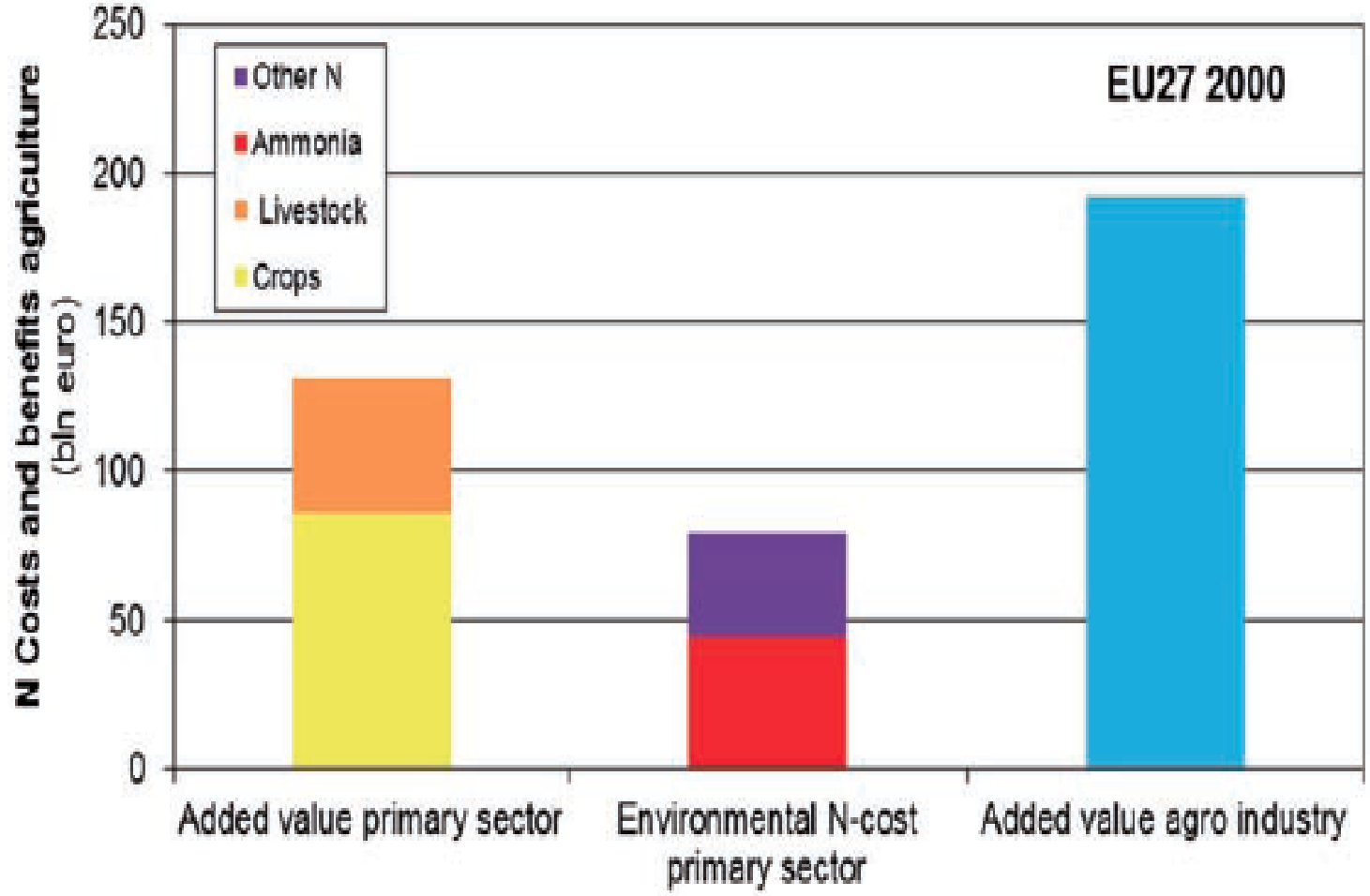

Figure 5.3 Nitrogen costs caused by the European livestock sector in 2000 as compared to added value generated in the primary sector and the livestock processing industry (original graphic based on Grinsven et al., 2013).

Develop The Nutrient Nexus

- higher NUE automatically → immediate economic, food and energy security
- obvious win-win outcome helps overcome barriers to change

… *if not* …

- judge total *net benefit to society* (health, environmental and climate costs) even if changes not justified from *private economic benefit* to some actors

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The 20:20 aspiration

20% improvement in NUE

save 20 million tons/y of N

in 2020

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Make N + P + C highly visible

- multi-faceted role of N+P+C cycles to be part of policy agendas for each of food, energy, health, environment and climate
- N+P+C to be central in public debate on how to produce more food and energy with less pollution

- the **Nutrient Nexus draws together the biogeochemical cycles of N+P+C e.o. and their good management with all global challenges**

- world citizens to realize how nutrients represent a nexus that unites all our concerns → so that governments become empowered to support society in taking actions.

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Break out Sustainable Farming

- select focus and goal for InterReg NSR project :
  - Innovative Practical methods for vital soil / Org Matter / NUE (as indicator) ???
- inventory of experiences to build on, for example:
  - DK: ecosystems services; irrigation management, internet water acc
  - NL: smart recycling in farming (dairy and arable); soil/water policy NBr; climate smart sprinkling
  - Germany ....
  - Study groups in Lithuania (and other partners in ENCORE)
- removing barriers to change / enabling policy
- suggest member states and partners to be invited
- major activities
- share work on next steps
- ….

Overlap break-out 2 or 3?

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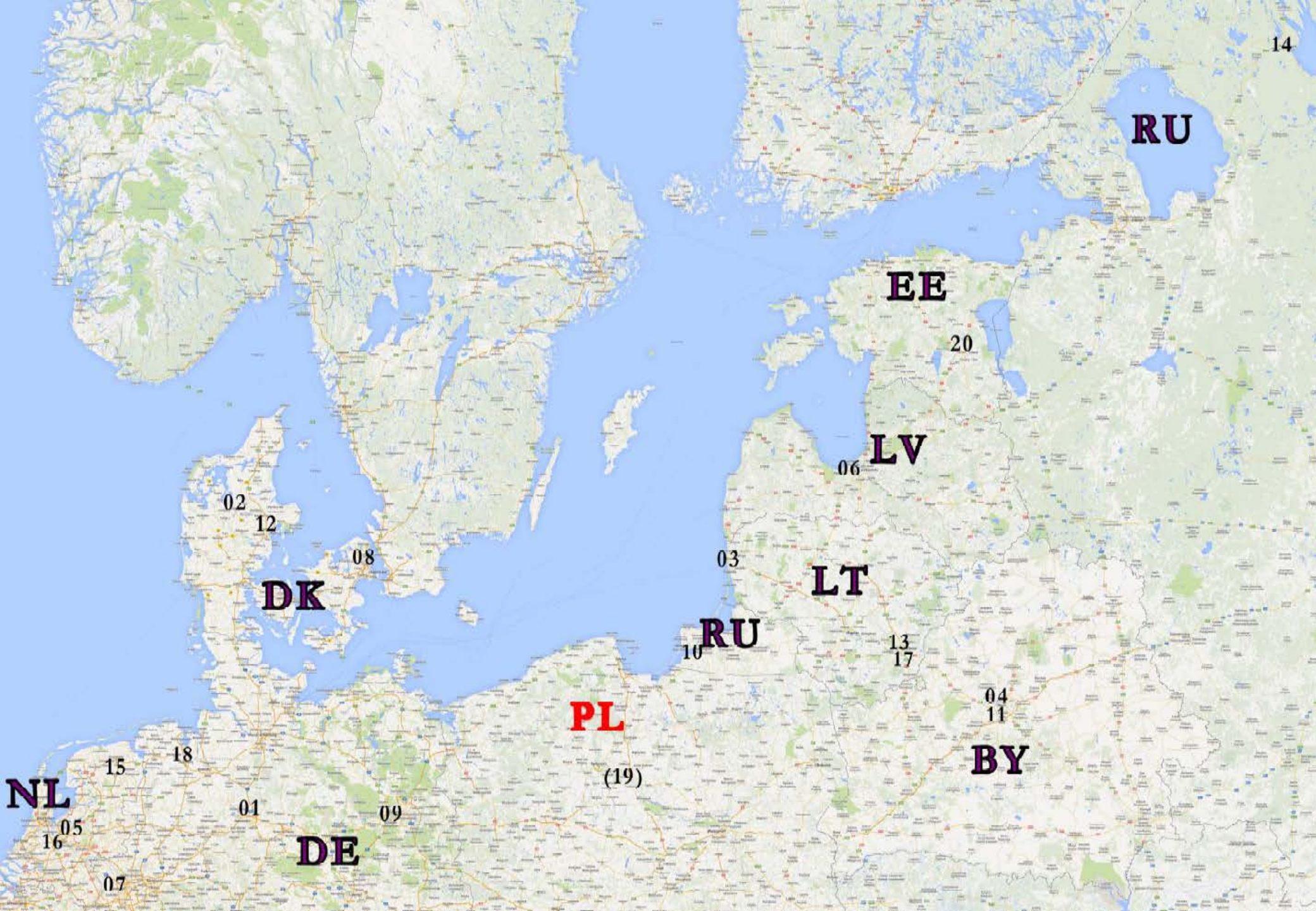
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“NUE” = common message, easy to understand metric, for region-specific strategies.

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- Component NUE estimates
  - Crop NUE
  - Animal NUE
  - Industrial NUE
- For better nutrient management and recycling
- Mix policy approaches: voluntary + economic + regulations
- Improve communication and understanding between stakeholders

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N-fertilizer use can be cut by 30% or more, with no impact on crop yields (Ju e.a. 2009).

- **in fact yields often increase slightly when excessive N rates are reduced to a rational level.**

- **current high rates of N application**
  - **→very low Nutrient Use Efficiency NUE**
  - **→with serious environmental impacts**

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Essential challenges

- demonstrate win-win outcomes from NUE
- bring together '**the gravity of common cause**' between multiple stakeholders
- provide options + tools to support countries, industries and citizens, + science + techniques
- provide **indicators** to assess progress
- provide a forum to **investigate barriers** to change
- provide a basis to quantify how NUE also helps to meet other international commitments

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2 scenario's 20% better NUE$_N$ in: constant output or constant input

- constant output = lower input

  → saves 170 billion USD/year

- constant input = higher output

  → saves 70 billion USD/year + benefits of extra production

NB: add estimations for NUE Phosphorus

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Cost-benefit 20:20
constant input scenario

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- Fertilizer costs saving – 0 billion USD/year
- Environm+health threats – 80 billion (20-200)USD/year
- Implementation costs + 12 billion (5-35)USD /year
- Value of extra food + energy produced ……

- **Net economic benefit for Nitrogen**

> 70 billion (15-165)/year

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add savings for Phosphate

Cost-benefit 20:20
constant output scenario

- Fertilizer costs saving – 23 billion USD (18-28)/year
- Environm+health threats –160 billion (40-400)USD/year
- Implementation costs + 12 billion (5-35)USD/year

- **Net economic benefit for Nitrogen**

170 billion(50-400)USD/year

add savings for Phosphate

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Agri-food structure EU (2)

- EU: many small farms, but most produce from medium and large farms.
- cattle in EU: 70% animals in farms > 50 animals = 13% of cattle farms.

- if regulation focuses on 13% larger farms then 70% of pollution is tackled.
- and this cluster point fosters a culture of NUE throughout the whole sector

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Threats *from* land use on groundwater resources; Nitrate

- Groundwater is vulnerable both to point sources of pollution and diffuse sources;
  - nitrate pollution, mainly as diffuse pollution from land use
  - point source pollution might come from intensive livestock husbandry and slurry stores.
- Good agricultural practices reduce the Nitrate content in the ground water significantly.

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Potential measures

- identify barriers to change (we must feed the world, survive in competition)
- make regulations more effective and enforce
- demonstration of best practices
- education, training + targeted research
- 2 particular challenges:
  - to handle regional variations
  - to handle large number of divers actors

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desired activities

- assess N, P and other **nutrient interactions between air, land, water, climate, biodiversity**
- develop consensus on **indicators** - as NUE
- investigate **options** for improved NUE
- address major **barriers** to change
  - education, multi-stakeholder discourse, public awareness
- set **targets** N + P management at region / planet scale
- **quantify** multiple **benefits** of NUE
- **monitor** progress

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Significant reductions in nitrate in groundwater

- In Denmark planning for the protection of the drinking water resources has taken place since the 1980'ties.
- This planning has had a significant positive effect on nitrate load in the groundwater.
- A number of practices in agriculture has been changed (we think its relevant to compare different practices across countries).

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SHOWCASE 1

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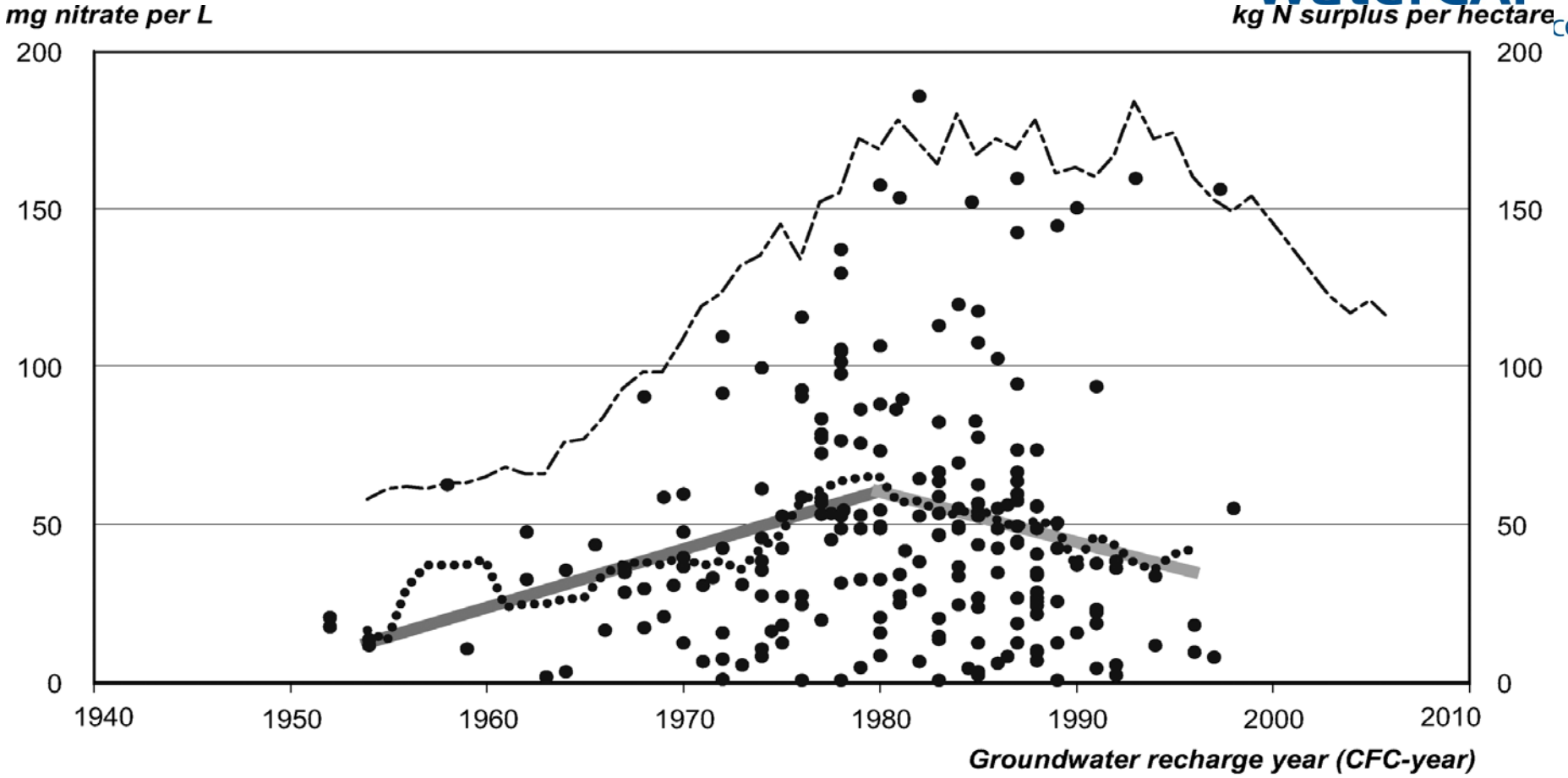

Farmers part of the solution

- Farming with water - the farmer as water managers
- Less use of water, pesticides, phosphorus and nitrogen
- Constructions of buffer zones and water bassins etc.
- Catchment based cooperation

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Key: MORE EFFICIëNT CYCLE of NUTRIENTS
→ reduced farm cost + cleaner water

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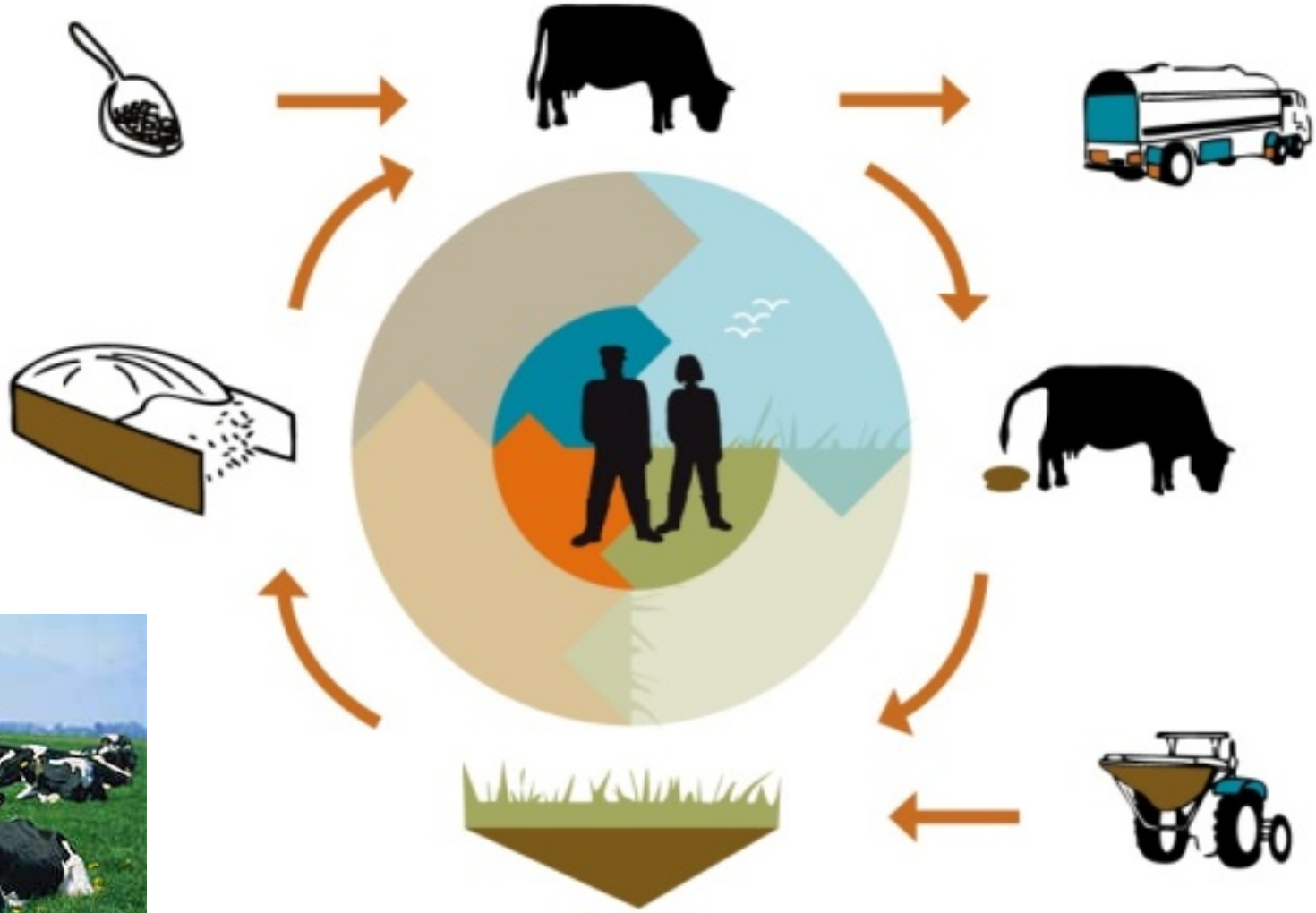
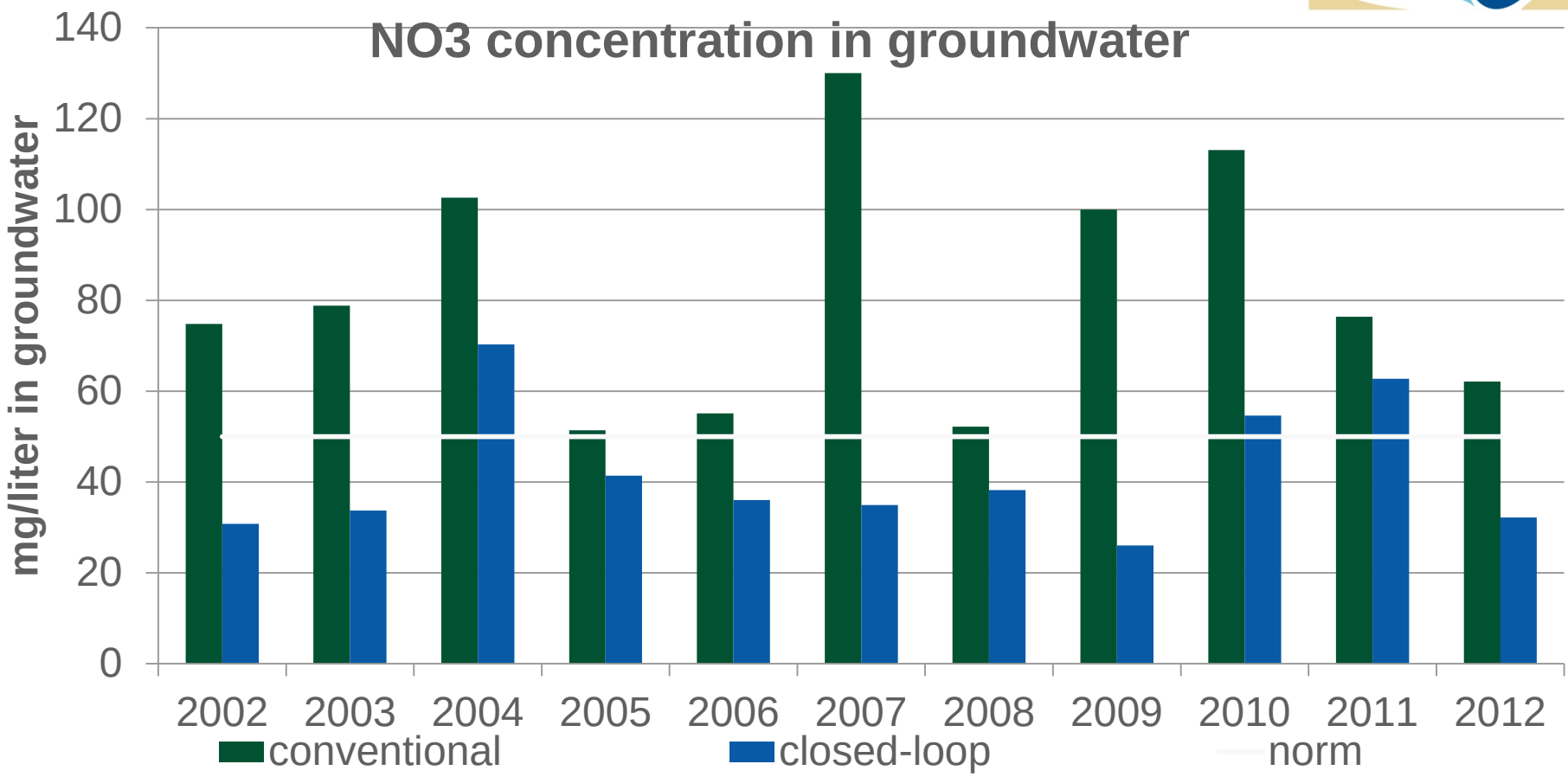


Result: Nitrate emissions reduced

[*province of Drenthe, Netherlands*]



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Potential lower emissions for province Drenthe

- performance top 20% compared to average
- savings upscaled over 66.000 ha in Drenthe

- lower N soil surplus : **4.224 ton N** in NO_3
  - top 20% at 91 kg/ha performes 64 kg/ha lower than average 155 kg N/ha
- lower ammonia emissions: **500 ton N** in NH_3
  - 5 kg N/10.000 kg milk x 1 billion kg (33 instead of 38 kg N)
- lower P soil surplus: **1.056 ton P_2O_5**
  - top 20% at 5 kg/ha performes 16 kg P2O5/ha lower than average 21 kg P2O5/ha

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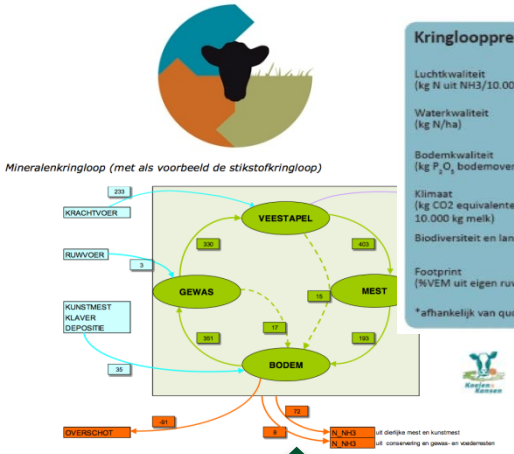
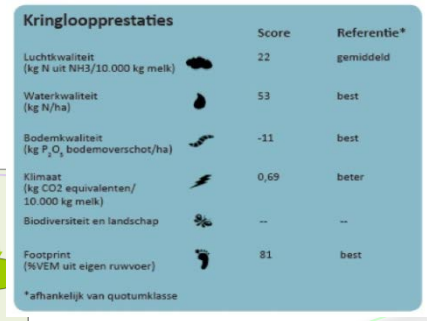
Upscaling
Performance based Rewarding

1. Collect Farm data → efficiency N+P





Kringlooprestaties	Score	Referentie*
Luchtkwaliteit (kg N uit NH3/10.000 kg melk)	22	gemiddeld
Waterkwaliteit (kg N/ha)	53	best
Bodemkwaliteit (kg P_2O_5 bodemoverschot/ha)	-11	best
Klimaat (kg CO2 equivalenten/ 10.000 kg melk)	0,69	beter
Biodiversiteit en landschap	--	--
Footprint (%VEM uit eigen ruwvoer)	81	best

*afhankelijk van quotumklasse

2. Improve via workshops, trips and farmers

Personal advice for training etc.

Arrange payment in Euro or farm development rights

Certify quality via formal trainers and 'diplome'

Negotiate reward for performance

3. Transparancy in resultats : certificate

4. Negotiate reward for improvement!

- organize delivery to farm
- more production space for farm
- premium from waterboard
- farm publicity + "licence to produce"

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Aim Innovation Council Utrecht West

- Design performance based rewarding for Recycling in Farming.
- Collect data on RiF in peat area.
- Translate farm performance to environment at regional level: emissions to water(Water Framework EU) and emissions to nature (N2000).
- Relate farm performance with policy objectives of regional government and product chain partners.
- Suggest policy innovation for extra effect on environment while improving financial performance of farms.

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Smart Recycling Monitor: aim

- The SRM shows –for one specific farm- the Nutrient Use Efficiency of N, P and C
- based on easily available data (links to dBases of milk factory, concentrate bills and accountant).
- Help farmer to improve NUE and reduce emissions, while maintaining income.
- Important: get area specific data about emissions from farms.
- Add farm water management plans.

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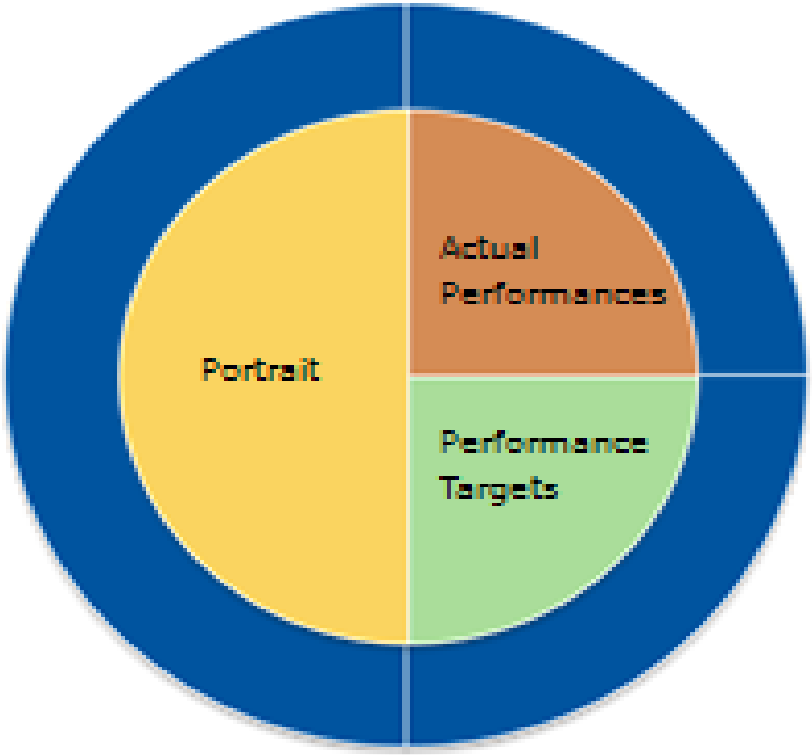
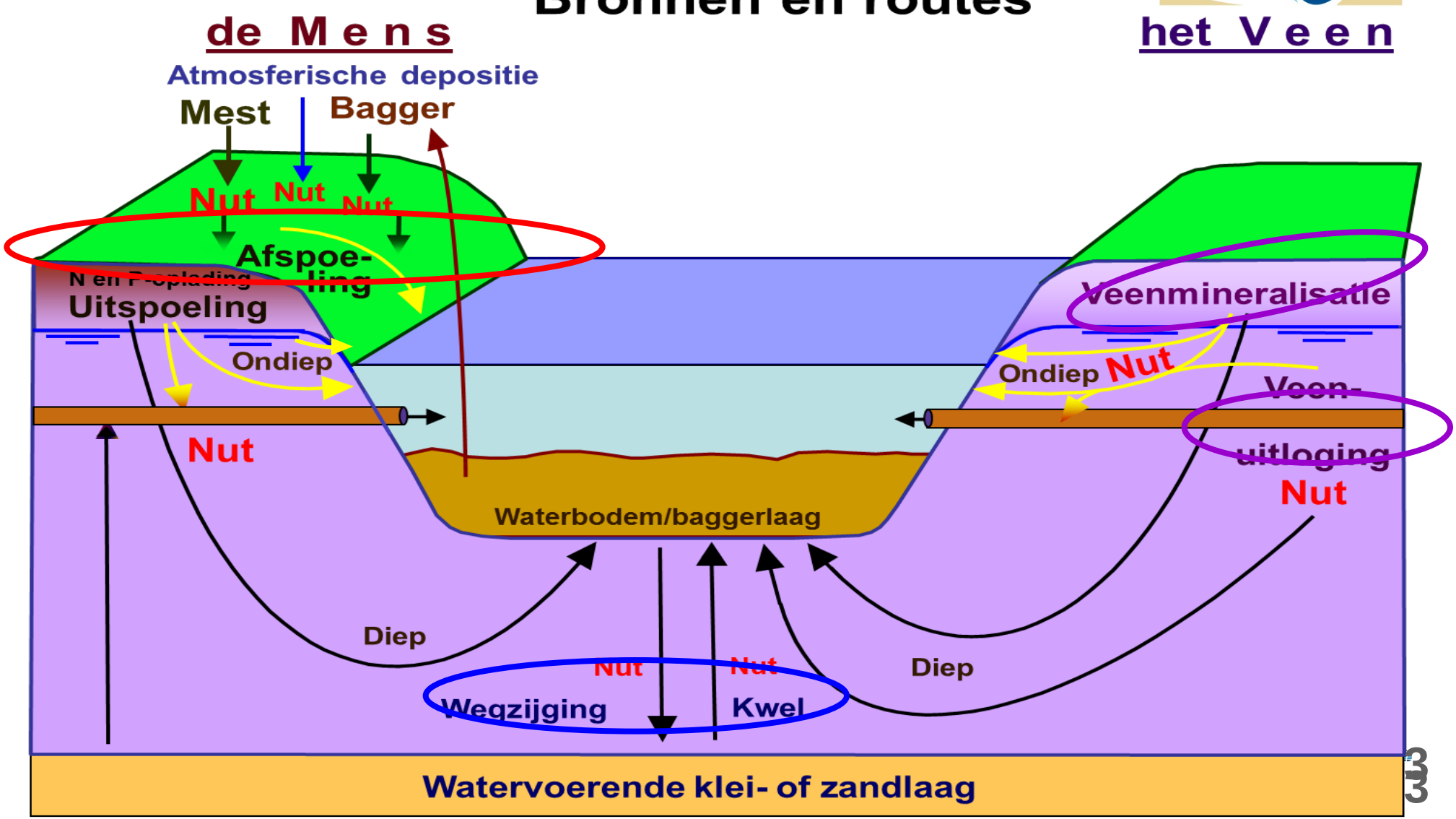
Smart Recycling Monitor

1) Farm Portrait → 2) Actual Performances → 3) Targets a. Farmer b. Water Board → 4) Farm Improvement Plan → 5) Expected Performances



Peat land: Nutriënt loads to ditch



Rol manuring history in nutriëntloads

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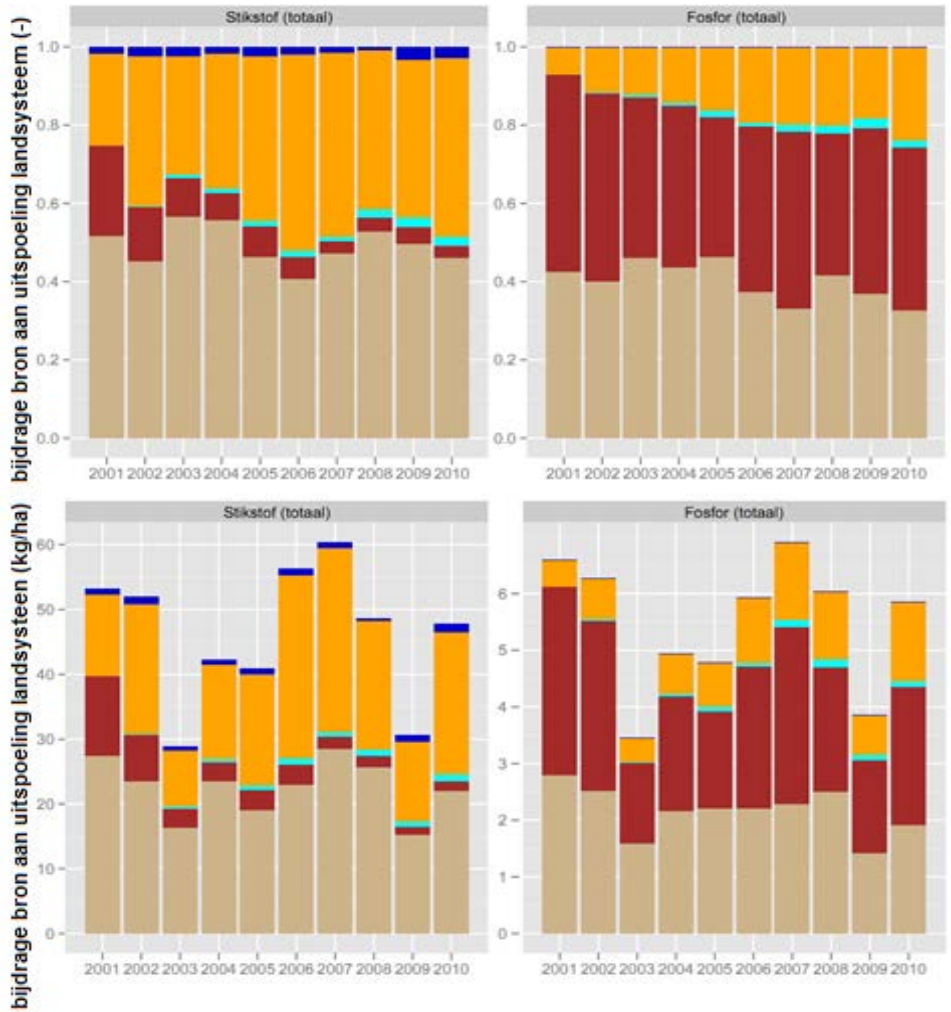

= argument to use SRM-data in WSA

= sign of common interest waterboard and farmers

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Showcase 3: TRENDS IN FERTILIZER INPUT, YIELDS AND POLLUTION

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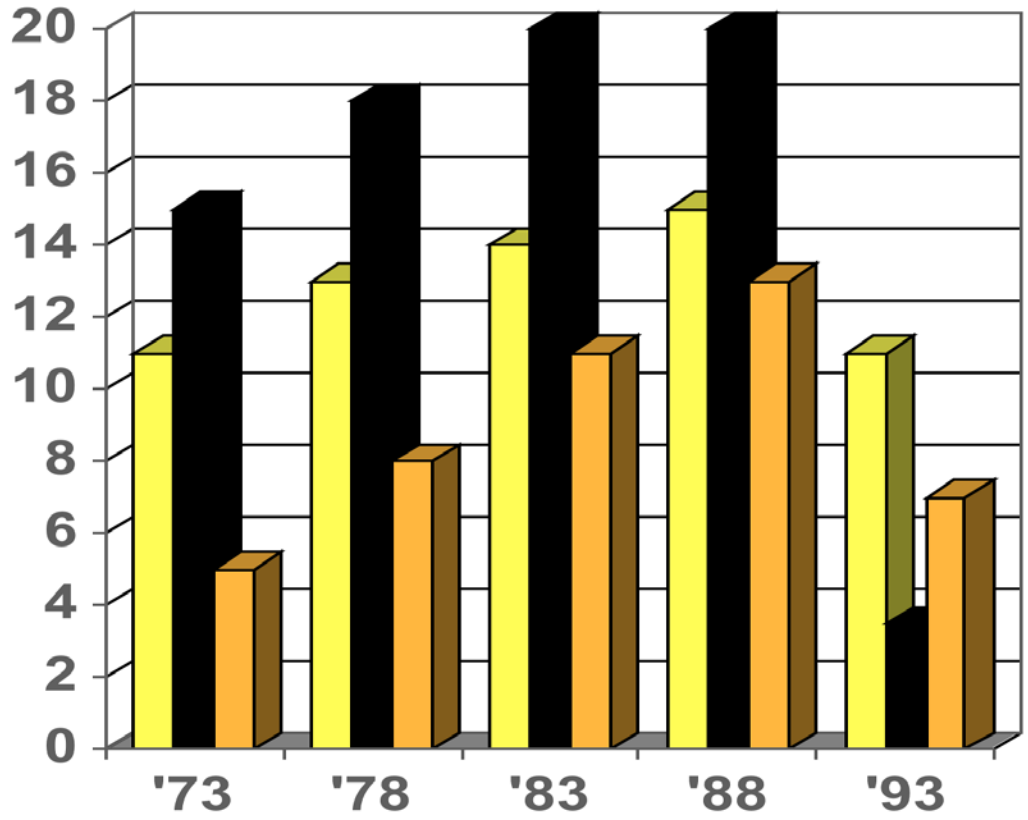
River TISZA graph HUNGARY



Yellow bars (left):
CEREAL YIELD
[million tons/year]

Black bars (middle):
FERTILIZER USE
[in 10 kg N/ha]

Brown bars (right):
NITRATE POLLUTION
[mg NO3/liter river water]

Inputs dropped to 17% (33kgN/ha) in 1993 while yields dropped to 70% and pollution dropped to 50% (compared to 1988).

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THE SECOND CYCLE

- 1st nutrient cycle to be ‘closed’ is on-farm

- **2nd nutrient cycle to be ‘closed’ is regional: consumer-producer**

Link the citizen

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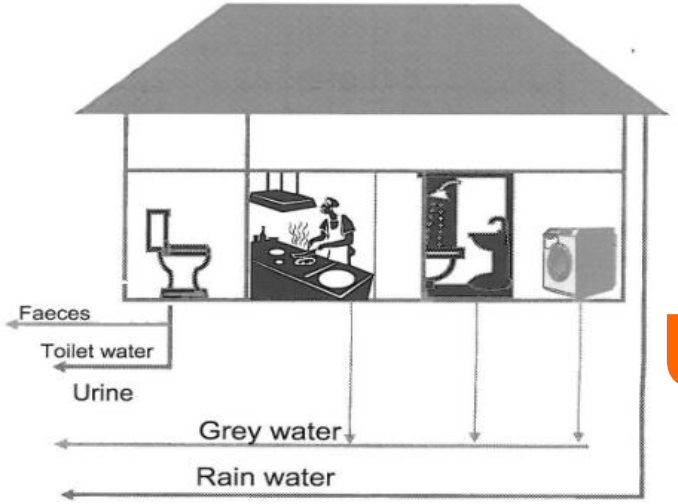
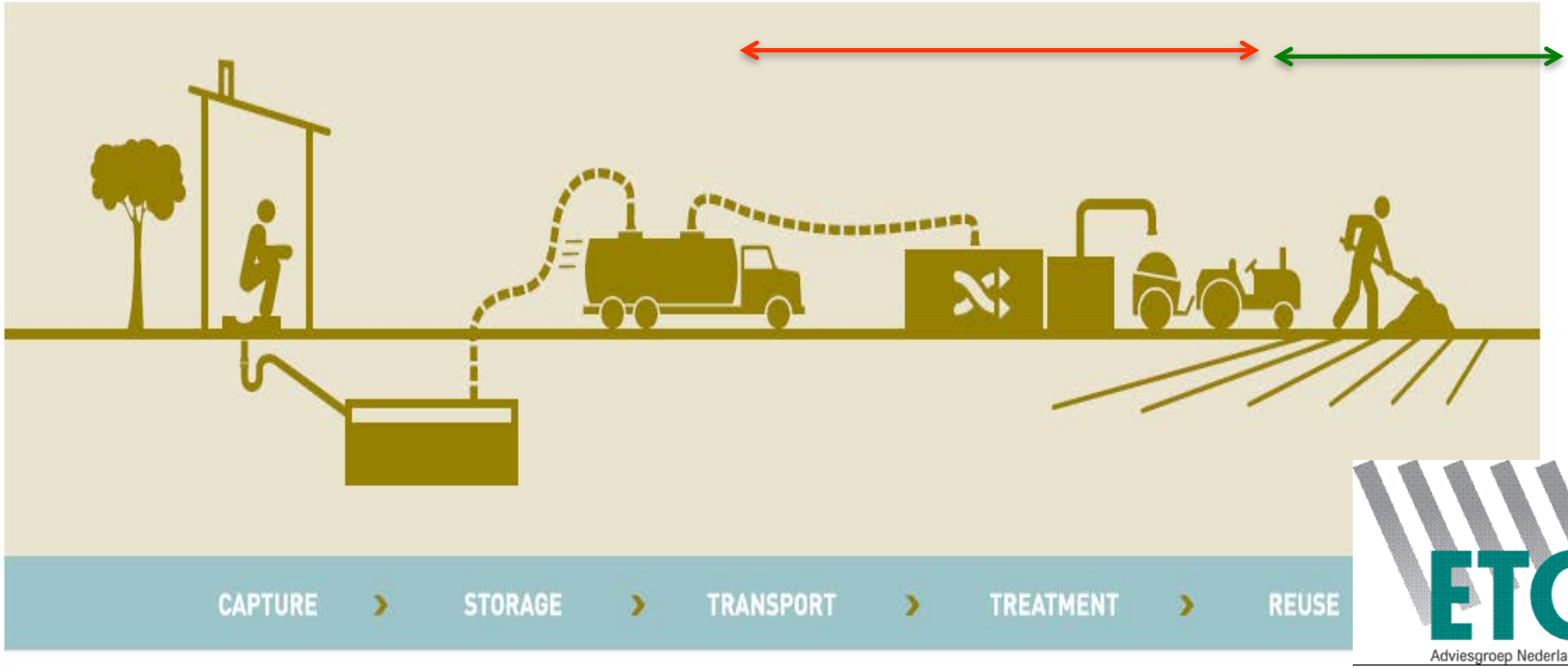
Separate collection and treatment of flows



Recycling Waste = Urban-Rural Linkage

Create value from Waste



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- So the *farmers* both have *farming problems* because of the groundwater challenges and *are part of the solution to the problems*

- Thanks for listening

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Thank you for your attention