Resource Efficiency in Practice: Closing Mineral Cycles

The project results

European Commission, DG Environment

18 November 2014

Agenda

- Impacts, causes and costs of nutrient losses
- Solutions to close the mineral cycles
- Case studies
- Project deliverables
- Outcomes of the regional conferences

The nutrient cycles' challenges

Impacts and causes of nutrient losses

- Similar high-level impacts over all regions with nutrient losses

Impacts on …

- **Climate** (GHG emissions)
- **Air** (particulate matter, odour)
- **Water** (acidification, marine and freshwater eutrophication)
- **Soil** (acidification, soil fertility)
- **Biodiversity** (microorganisms, birds, fish) and **ecosystem services**
- **Human health** (related to air, water and soil pollution)

… due to **farming systems** & **agricultural practices**

- **Livestock breeding**
- **Fertiliser application**
- **Soil management**
- **Water management**
- **Farm land management**

… and enhanced by **environmental conditions**

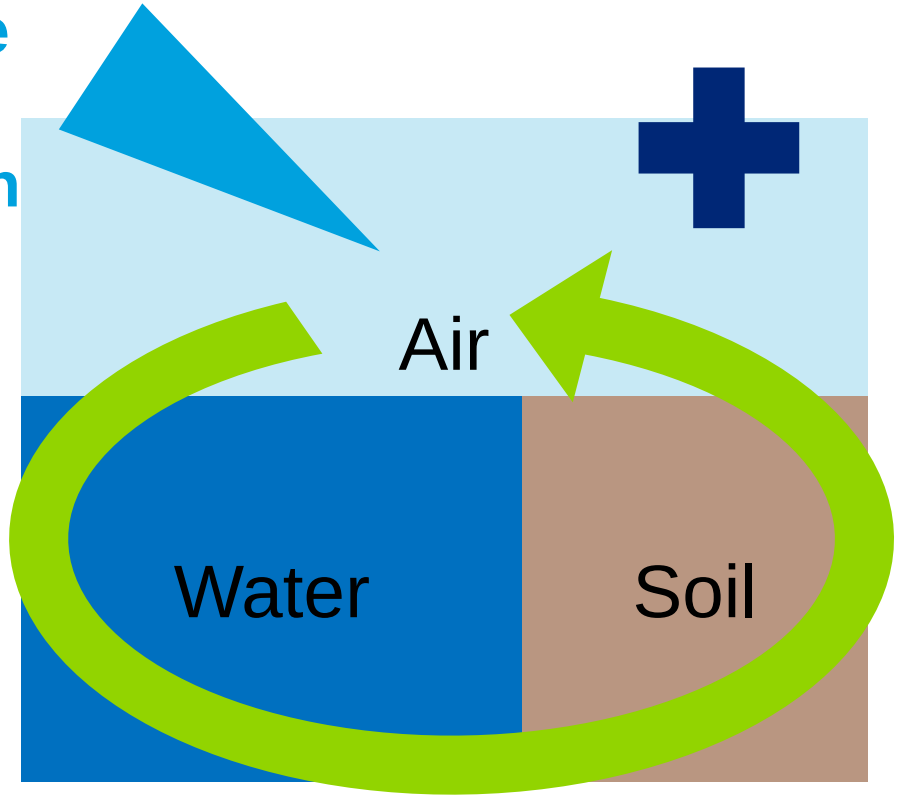
- **Soil**
- **Climate**
- **Landscape**

… but also **industrial activities** and **urban settlements**.

Three types of solutions to close mineral cycles

A wide range of solutions is applicable in crop, livestock and mixed farming systems. However, most relevant solutions depends on the local specificities and challenges.

1. Reduce the sources of contamination



2. Improve nutrient efficiency

3. Control the contamination pathways

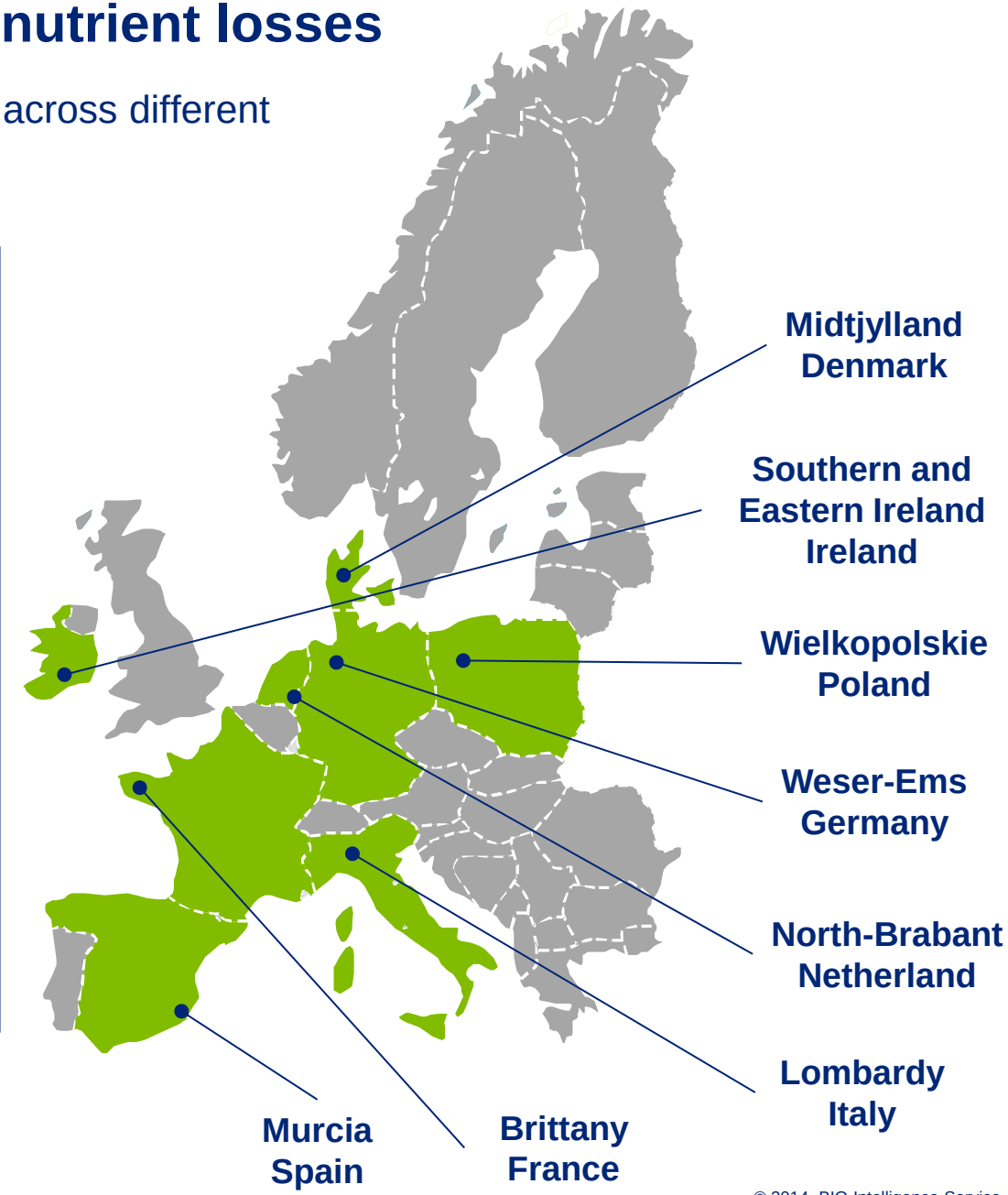
Case studies

Identifying regions with nutrient losses

Nutrient losses can be encountered across different regions and contexts.

Criteria to select key nutrient-saturated areas

- High level of nitrogen and/or phosphorus losses
- Trend in nitrogen losses over the past years
- Risk of environmental pollution (air emissions and nutrient load (N, P) in water)
- Diversity in farming systems
- Diversity of climate and soil conditions



Project team and stakeholders' consultation

Project team
(number of regional-expert reviewers**)**
Affiliation

LEI Wageningen UR

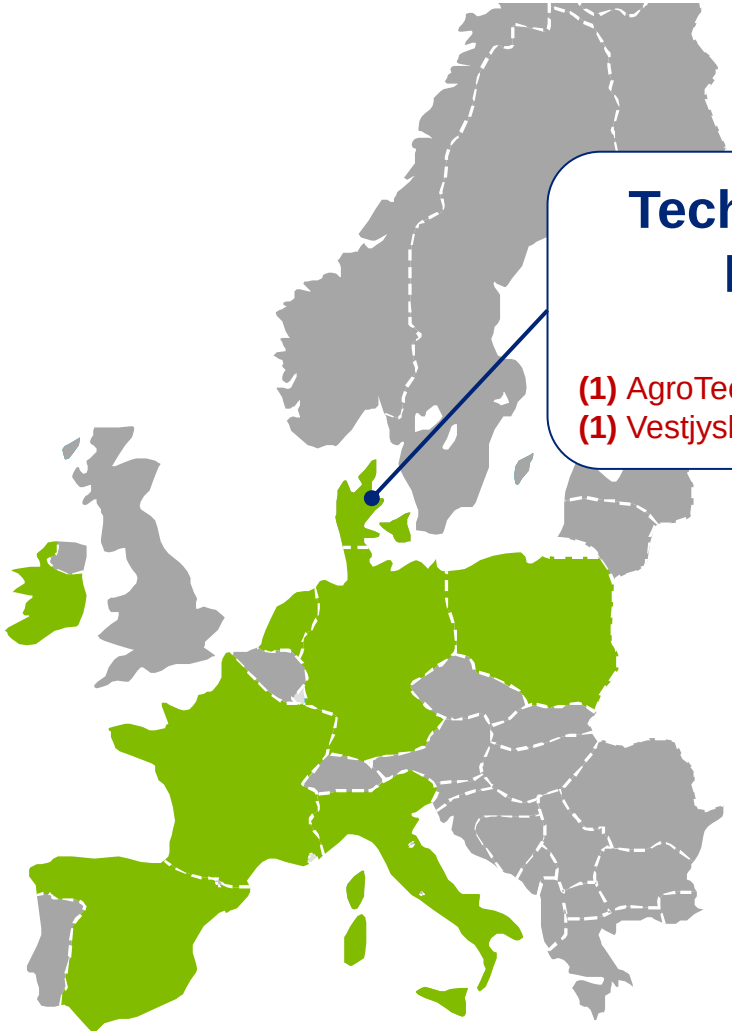
4 experts

(3) ZLTO (farmers union)
(1) PBL (Netherlands Environmental Assessment Agency)

DG ENV
(Project Oversight)

Project team and stakeholders' consultation

Project team
(number of regional-expert reviewers**)**
Affiliation



Technical University of Denmark (DTU)

2 experts

(1) AgroTech
(1) Vestjysk Landboforening (farming advisory)

DG ENV
(Project Oversight)

Project team and stakeholders' consultation

Project team
(number of regional-expert reviewers**)**
Affiliation

Ecologic Institute
(co-leader)
4 experts

(1) Thuenen Institute
(1) River Basin Commission Weser
(1) Chamber of Agriculture, Lower Saxony
(1) OOWV (regional water supply company)

DG ENV
(Project Oversight)

Project team and stakeholders' consultation

Project team
(number of regional-expert reviewers**)**
Affiliation

7 experts

(1) WWF Poland
(1) Ministry of agriculture and rural development
(2) Agricultural Advisory Centre, Brwinow
(1) Inspection of Environmental Protection
(1) Institute for the improvement of arable land and grassland
(1) National Marine Fisheries Research Institute

DG ENV
(Project Oversight)

Project team and stakeholders' consultation

Project team
(number of regional-expert reviewers**)**
Affiliation

University of Milano
4 experts

(1) ARAL (Regional breeder union)
(1) Regione Lombardia (local authority)
(1) Coldiretti (farmers union)
(1) CIA (farmers union)

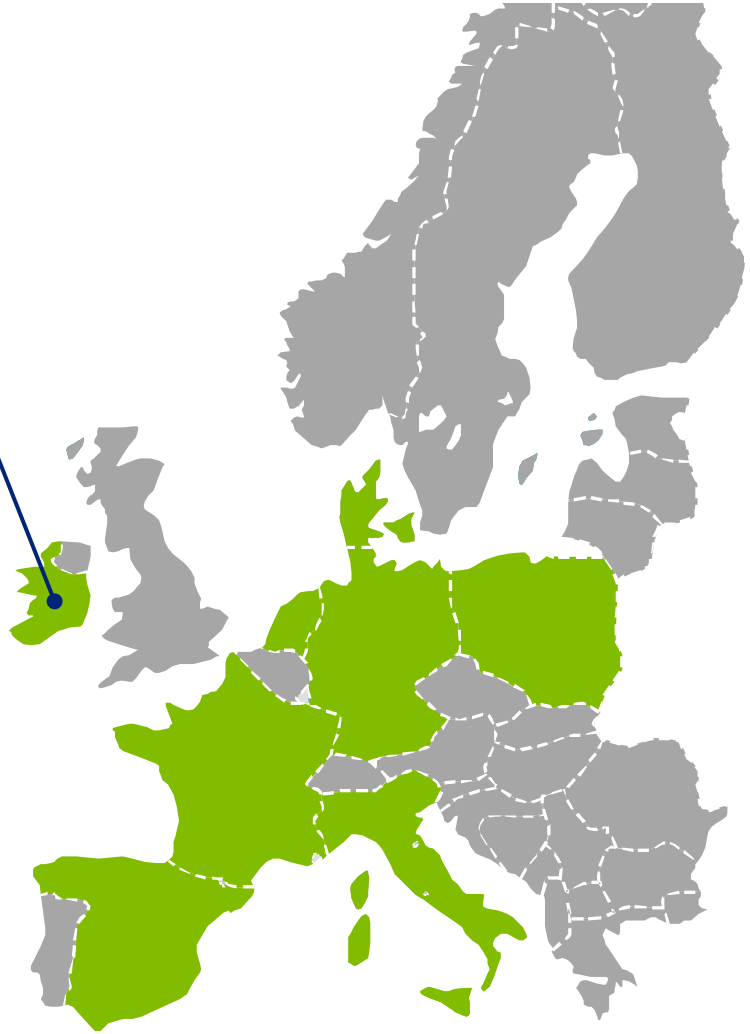
DG ENV
(Project Oversight)

Project team and stakeholders' consultation

Project team
(number of regional-expert reviewers**)**
Affiliation

3 experts

(2) Tegasc (Ireland national authority for agriculture and food development)
(1) South Eastern River Basin District



DG ENV
(Project Oversight)

Project team and stakeholders' consultation

Project team
(number of regional-expert reviewers**)**
Affiliation

BIO (co-leader)
5 experts
(1) Seine-Normandy water agency
(1) ONEMA (French national agency for water and aquatic environments)
(2) FNSEA Brittany (farmers union)
(1) INRA Rennes

DG ENV
(Project Oversight)

Project team and stakeholders' consultation

Project team
(number of regional-expert reviewers**)**
Affiliation

3 experts
(1) UPM (University Politecnica Madrid)
(1) Technical University of Cartagena
(1) CARM (local authority)

DG ENV
(Project Oversight)

Impacts & causes of nutrient losses

- The extent of the impacts varies with the region-specific drivers (example of Germany)

Nitrate leaching to groundwater in Weser-Ems (Germany)

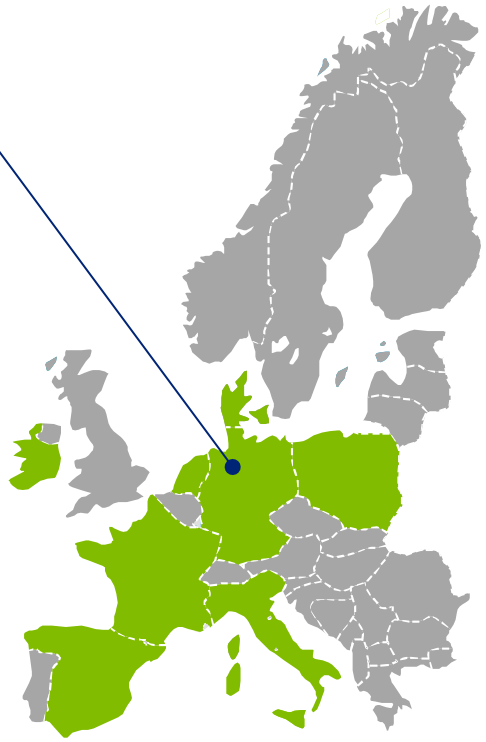
- Ammonia emissions and acidification of forests and damages on ecosystem health
- Soil acidification
- Eutrophication and algal bloom in marine water affecting biodiversity

… due to

- High density of poultry, high production of manure, over-fertilisation
- Uncovered manure during storage
- Biogas production: conversion of grassland, additional organic fertiliser

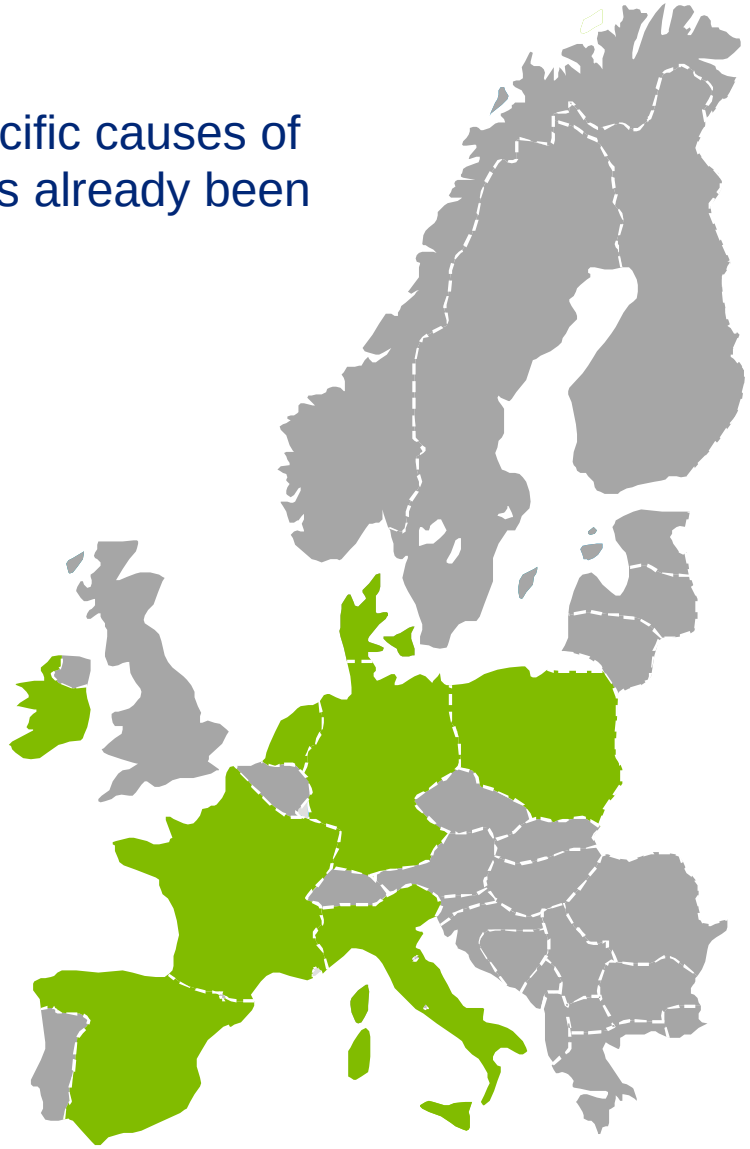
… and enhanced by

- Sandy and nutrient-poor soils (sensitivity to nitrate leaching and dry periods)



Good practices

- Based on the region-specific causes of the impacts and what has already been done in the region



Good practices

Central Denmark

Adding legumes in grassland

Slurry acidification

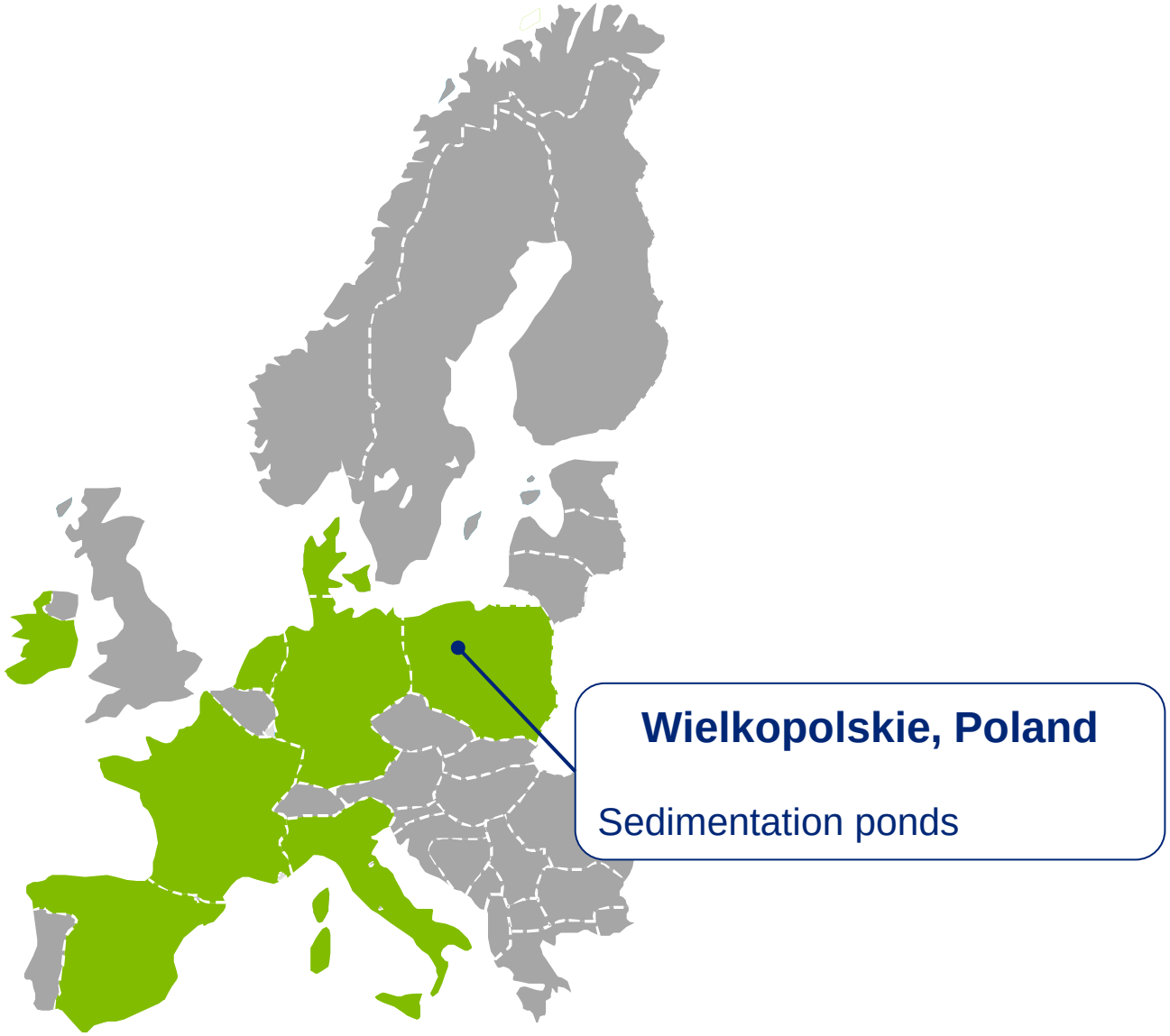
Good practices

Weser-Ems, Germany

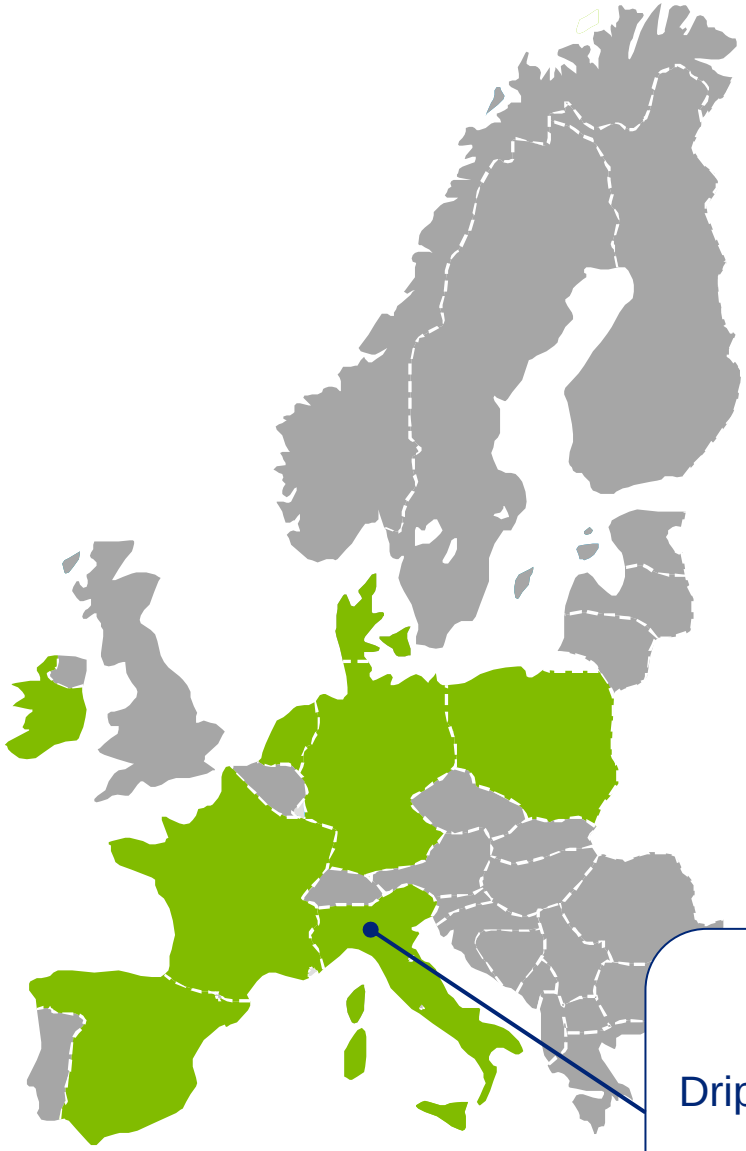
Improving fertilisation management plans for all agricultural sites

Improving manure storage and cover

Good practices



Good practices

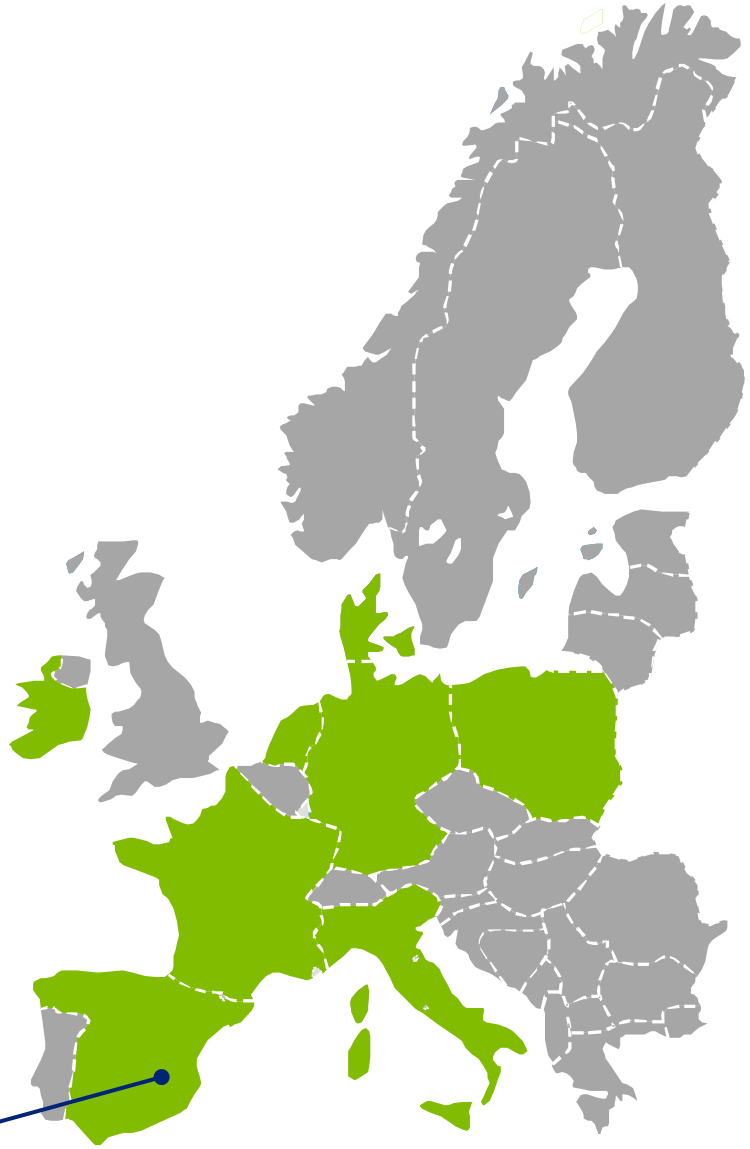


Lombardy, Italy

Drip irrigation

Manure treatment through anaerobic digestion

Good practices

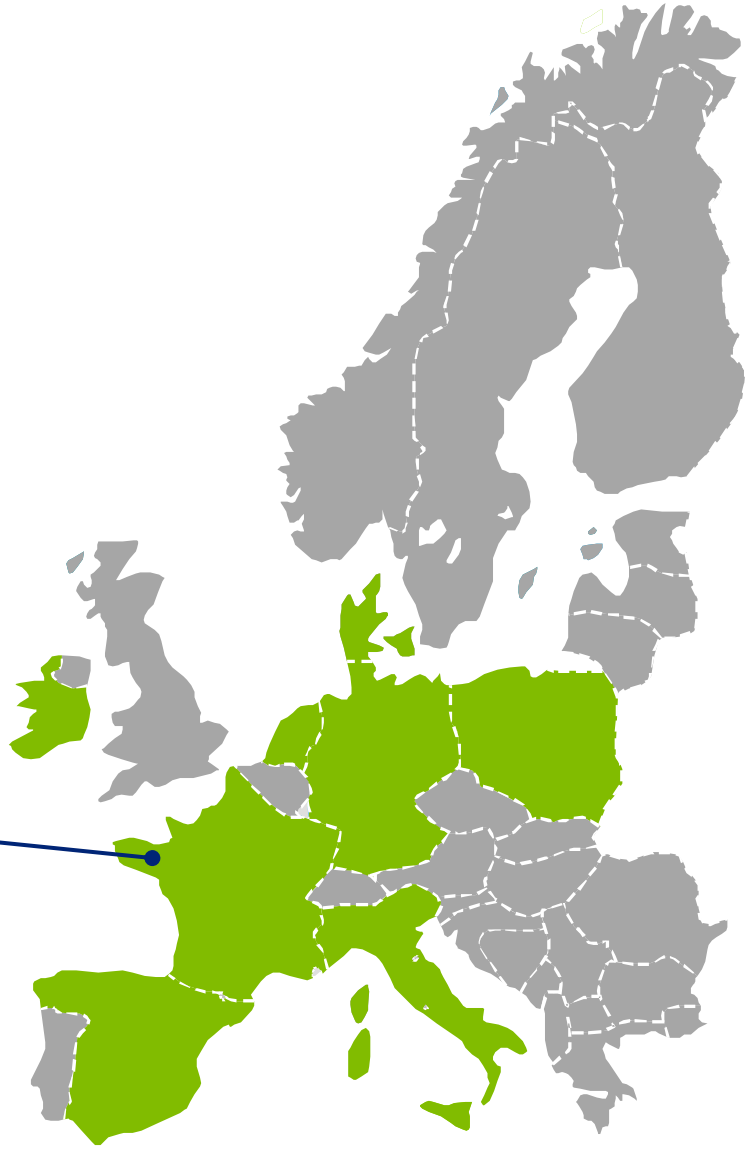


Murcia, Spain

Separating liquid and solid fractions of manure

Fertigation

Good practices



Brittany, France

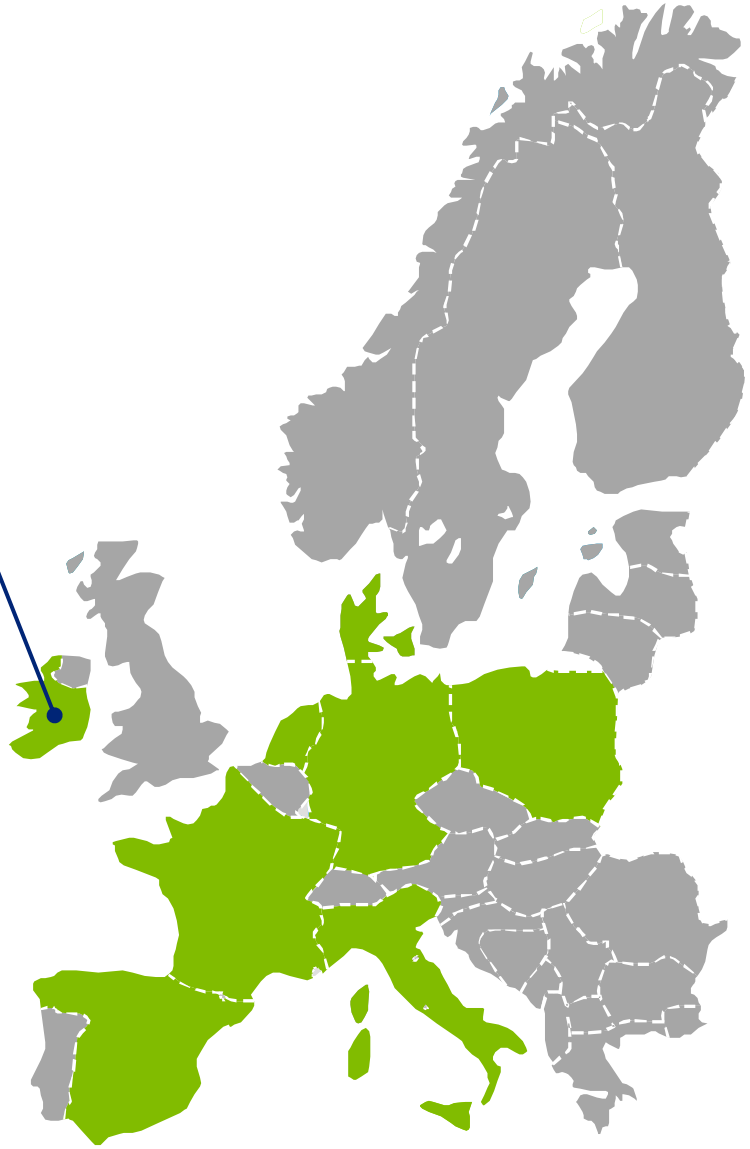
Processing manure (nitrification/denitrification system and anaerobic digestion)

Good practices

Southern and Eastern Ireland

Optimising grazing

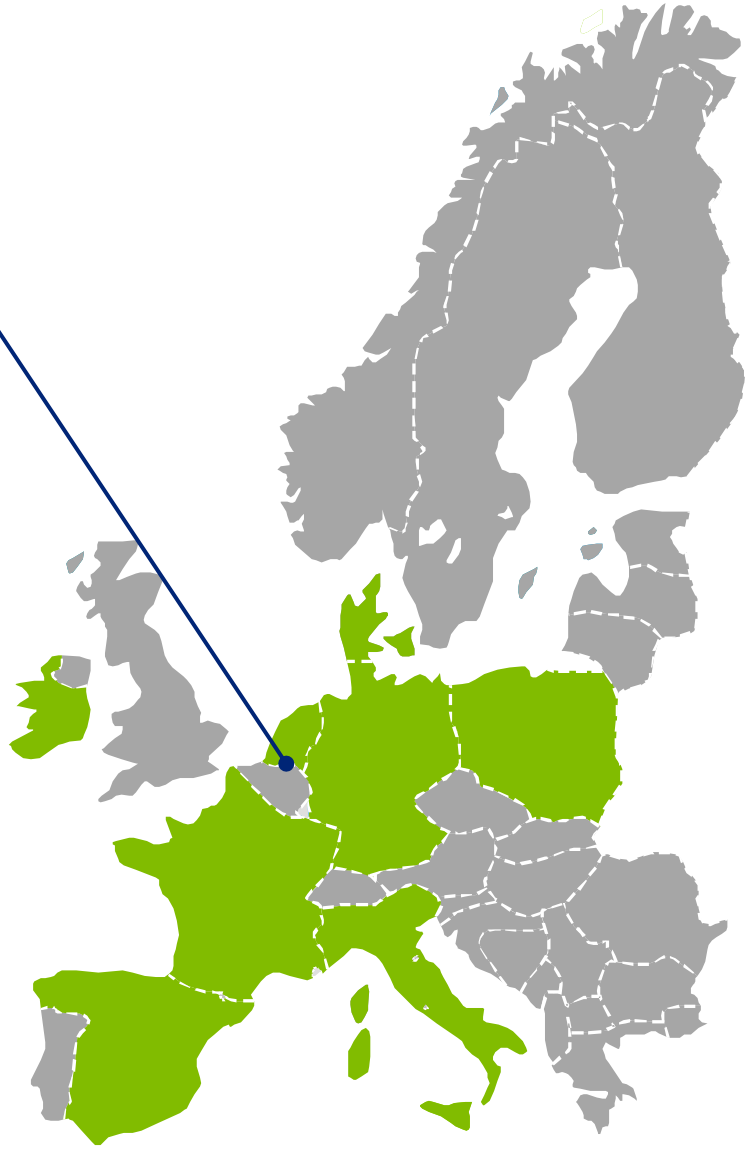
Optimising the timing and quantity of application



Good practices

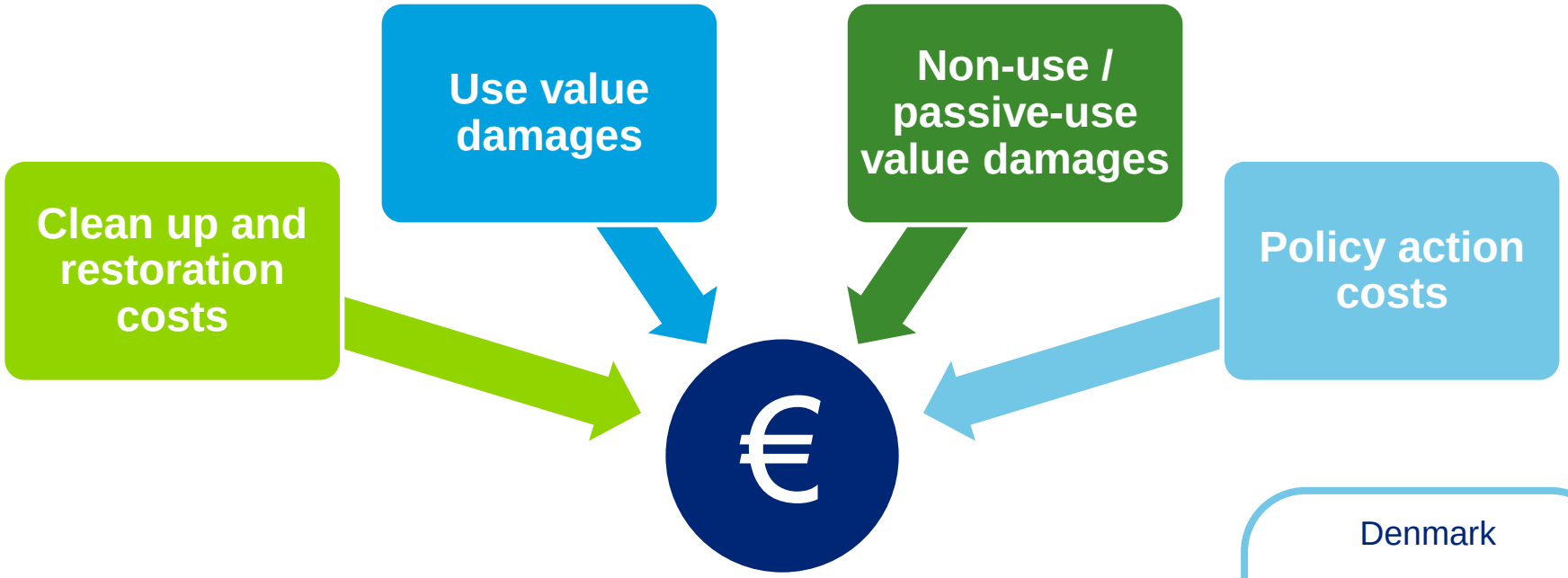
North Brabant, Netherlands

Adjusting drainage system (control of groundwater table on plot level)



Costs of nutrient losses

Four categories of economic value damages and examples



Brittany (FR)

Algae clean-up on the beach

€ 1.4 million in 2012

Lombardy (IT)

Loss of winter tourism due to climate change caused by GHG emissions

€ 29.11 million for the prospective period 2006-2030

North-Brabant (NL)

Willingness to pay for biodiversity

€ 13 million per year (reported in 2007)

Denmark

50 000 hectares of buffer zones established (Action Plan on the Aquatic Environment III)

375 million DKK (c. **€ 50.3 million**) (2005-2015)

Project deliverables

Study

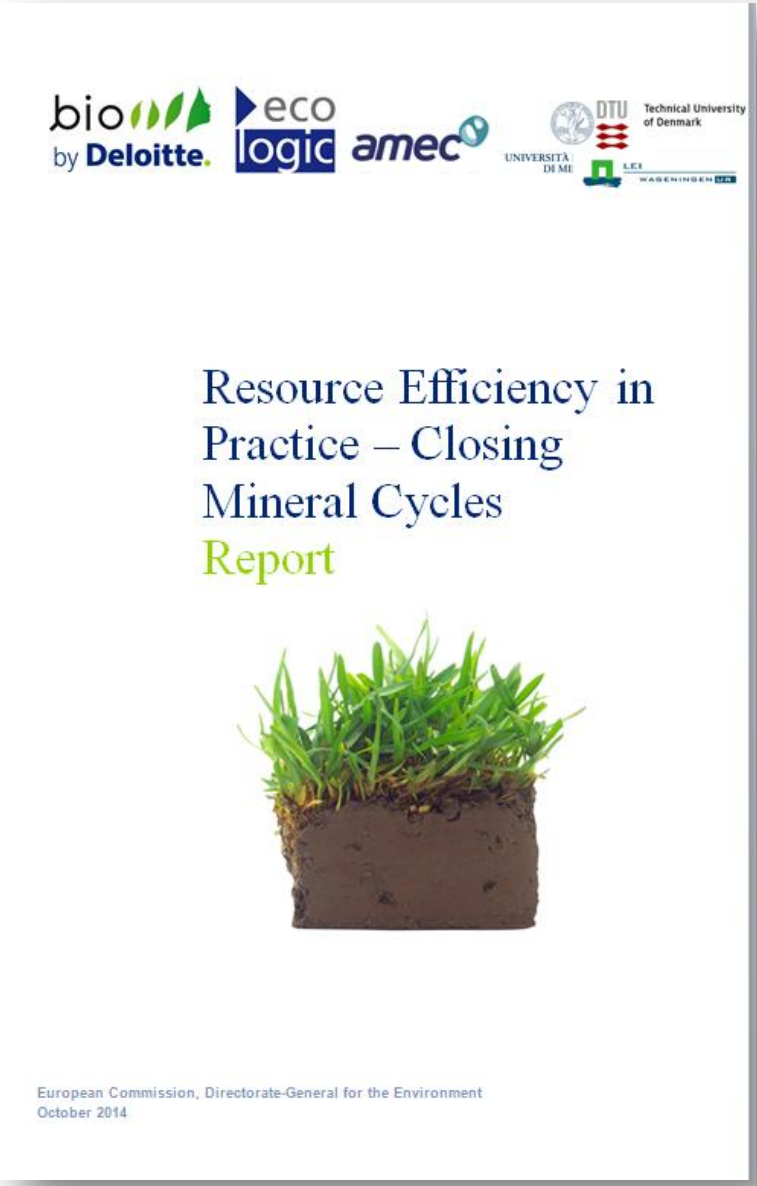
A. Background and selection of the regions

1. Introduction
2. Effects of agriculture on nutrient cycles
3. Solutions to reduce the impacts of nutrient losses
4. Identification of nutrient saturated and nutrient scarce regions

B. Case studies

for each region, the case study is composed by:

1. Impacts of farming systems in selected regions
2. Causes of the impacts
3. Costs of environmental and health effects in selected regions
4. Good practices to reduce the impacts in the selected regions



Database of solutions

Classification of solutions to nutrient losses according to the following aspects:

- Nutrients targeted
- Type of lever for increasing resource efficiency
- Expected effects on the nutrients losses and related impacts (climate, air, water, soil, biodiversity and human health): benefits and trade-offs
- Co-benefits and other trade-offs not related to nutrients
- Links with climate change mitigation/adaptation
- Conditions for effectiveness
- Technical and knowledge requirements for farmers
- Implementation and running costs
- Possible economic benefits or losses for farmers
- Combinations/incompatibility with other measures

a publicly-available Excel file covering 75 measures with filters and sorting

Database of solutions

For example, below is an extract of the **synthesis table of the database of solutions** providing:

- a **qualitative assessment** of expected impacts for the different environmental compartments and for health,
- as well as some elements of **feasibility**,

of three solutions related to *managing water efficiently*:

- *Irrigation – Preferrably use drip irrigation*
- *Irrigation – Multiphase or cyclic irrigation*
- *Irrigation – Timing of irrigation / irrigation scheduling*

Categorization of solutions	Measures	Expected effects of measures on the impacts caused by nutrient saturation																Implementation aspects							
		Climate	Air				Water			Soil		Biodiv.		Human health				Implementation requirements			Potential costs for farmers		Potential economic benefit/loss for farmers		
		Climate change	Acidification	Tropospheric ozone formation (NOx)	Particulate matter	Odour	Freshwater eutrophication	Marine eutrophication	Water acidification	Soil acidification	Soil fertility	Biodiversity	Ecosystem services	Related to Nox and NH_3	Related to nitrate and nitrites	Related to P	Hyperkalemia - K	Technical requirements	Knowledge	Acceptability of farmers	Implementation cost	Running costs	Short term	Medium term	Long term
Managing water efficiently	Irrigation: preferably use drip irrigation technology	+/-	(+)	0	0	0	+	++	+	(+)	+/-	(+)	+	(+)	++	+	0	Low	Medium	Low	€€	€	-	+	+
	Irrigation: multiphase or cyclic irrigation	+/-	(+)	0	0	0	+	++	+	(+)	+/-	(+)	+	(+)	++	+	0	Medium	Low	Low	€	€	+/-	+	+
	Irrigation: timing of irrigation / Irrigation scheduling	+/-	(+)	0	0	0	+	++	+	(+)	+/-	(+)	+	(+)	++	+	0	Medium	High	Medium	€	€	+	+	+
	Irrigation: ensure good quality of																								

Leaflets

Leaflets are **practical and region-specific guidance documents for the farming community** that content:

1. **Background information** *(applicable to all leaflets)*
   - Role of nutrients in agricultural production
   - Nutrient losses – A problem to be addressed?
2. **Region-specific information**
   - Agricultural structure
   - How does nutrient losses affect *[the case-study region]* and what are the causes?
   - How does nutrient losses affect farming business and society in *[the case-study region]*?
   - What has already been done to address the problem in *[the case-study region]*?
3. **Set of region-specific good practices**
   - Top 6 practices
   - Further good practices on farm level
4. **Further information**
   - Further actions needed
   - Further relevant links (including region-specific networks)

Example of a « top 6 practices » sheet for Lombardy (Italy)

Use appropriate manure application techniques

Definition of the measure	The choice of an appropriate manure application technique can reduce ammonia emissions by up to 90 % and as a consequence, improve the amount of nitrogen utilised by the crops. An even distribution of manure can improve the utilisation of nutrients. In the recent years, new spreading techniques have been tested and have demonstrated efficient incorporation of manure, such as top dressing fertilisation of crops like maize.
Technical implementation	Emissions reductions can be achieved by immediately incorporating manure into the soil after surface application.
Technical requirements	The farmer must utilise equipment that can ensure an even distribution and reduce the emissions to air. Some of these types of equipment can also improve the timing of application as well as lead to more efficient use of nutrients.
Effects, benefits and costs	
Benefits for the farming business	Cost-savings from reduced purchase and application of additional fertilisers
Costs for the farming business	Purchase of equipment and potential costs from reduced field capacity of the machinery (use of contractors could be a possible solution to reduce expenses)
Co-benefits and trade-offs	Higher nutrient content retained in the manure reduces the amount of mineral fertiliser needing to be applied, but the higher nutrient content may result in higher overall amount of nutrients applied, leaching, and run-off.
Environmental effects	• Decreased nitrous oxide emissions • Reduction of mineral fertilisers and nutrients applied • Decreased acidification, improved soil fertility • Less ammonia emissions during application • Reduction of nutrient run-off due to incorporation into the soil • Leaching is limited by the reduction of nutrients applied

Outcomes from the regional conferences

Main outcomes from the regional conferences

Choice of locations based on:
- Geographic diversity
- Minimal overlap with similar events
- Areas with nutrient losses

Target audience
- Farmers, advisers and associations
- Regional policy makers
- Regional NGOs
- Academics

Conference formant
- Scene setting
- Discussions & questions (reflection on good practices)
- Small group discussions
- Plenary restitution

Poznań, Poland (13 November)
45 attendees
Important issue of soil acidification
Very few collective actions (e.g. for material purchase)
Lack of financial capacity, especially for small farmers

Milan, Italy (5 November)
57 attendees
No lack of funding as such, but maybe poorly targeted
No objection of presented measures
Dissemination and technical assistance essential for implementation of best practices

Portlaoise, Ireland (28 October)
55 attendees
Importance of knowledge transfer
Raise awareness on the economical benefits of measures
Need for direct/simple tool to improve fertilisation management

Murcia, Spain (4 November)
140 attendees
Importance of the lack of water in the farming practices' choices
Lack of awareness on environmental effects of farming practice
Large context differences between the areas within the region

Contact information

Project Oversight

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Study content

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Dissemination
Conference organisation

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