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Protection Of Waters Against Agricultural Pollution Through Establishment Of A Monitoring And Reporting Methodology For The Nitrate Action Plans

EuropeAid/140563/IH/SER/TR

NATIONAL CONFERENCE
PROTECTING WATERS AGAINST AGRICULTURAL POLLUTION

Methodologies followed for monitoring the effectiveness of the EU Nitrate Directive

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Ankara

REPUBLIC OF TURKEY
MINISTRY OF ENVIRONMENT,
URBANIZATION AND CLIMATE CHANGE

Environment and Climate Action
Sector Operational Programme

REPUBLIC OF TURKEY
MINISTRY OF AGRICULTURE
AND FORESTRY

NEPİZ

NIRAS

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Protection of Waters Against Agricultural Pollution
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Overview

- → The Nitrate Directive framework
- → Steps of implementation of the Directive
- → National monitoring and reporting
- → Levels and scale of monitoring the effects of policy measures
- → Monitoring networks in MS and regions
  - → types of monitoring levels
  - → development of the networks
- → Points to set for discussion

Examples from and comparisons between EU MS

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Council Directive 91/676/EEC (ND)

→ Water monitoring of all water body types with regard to nitrate concentrations and trophic status

→ Identification of waters that are polluted or at risk of pollution

- on the basis of the criteria defined in Annex I to the Directive

→ Designation of Nitrate Vulnerable Zones (NVZ)

- areas that drain into waters and which contribute to pollution

→ Establishment of codes of Good Agricultural Practices

- implemented on a voluntary basis throughout the MS territory

→ Establishment of Action Programmes

- set of measures to prevent and reduce water pollution by nitrates
- implemented on an obligatory basis within designated NVZ or throughout the entire national territory

→ Review and possible revision

- designation of nitrate vulnerable zones and of action programmes
- at least every four years

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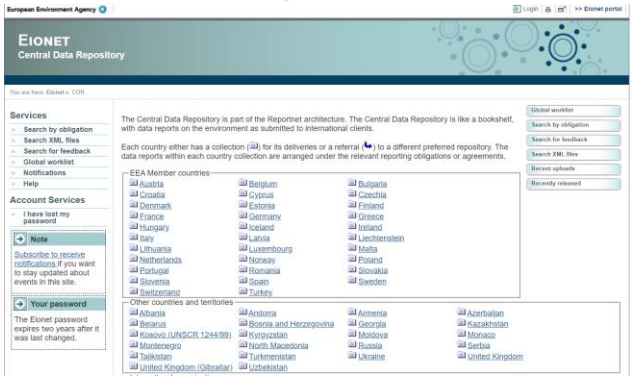
Council Directive 91/676/EEC (ND)

→ submission to the Commission of a progress report on the implementation of the Directive

→ every four years with information on

- Codes of good agricultural practice
- Nitrate Vulnerable Zones
- Water monitoring results
- Relevant aspects of Action Programmes



https://cdr.eionet.europa.eu/ (EU Central Data repository)

European Union (EU) obligations

Nitrates Directive Report (91/676/EEC)

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Steps of implementation of the ND

Detection of polluted or threatened waters (NO_3)

Human heath

Aquatic ecosystems

Eutrophication

Designation of "Nitrate Vulnerable Zones" (NVZs)

Agricultural land significant contribution

to N pollution

Watershed level

Code of good agricultural practice on all MS Territory

Voluntary

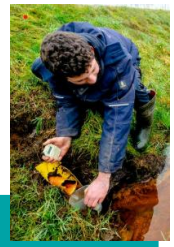
Action Programs within NVZs

Code mandatory

+ Nutrient balance

+ Manure Storage

+ Spreading < 170N organic/ha/year



National monitoring and reporting

Every 4 years NO_3 and Eutrophication

Assessment of Action Programs'impact

Revision of NVZs & Action Programs

- → Surface waters [NO_3]
- → Ground waters [NO_3]
- → Freshwater lakes, estuaries, coastal waters (eutrophication)

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Step 1- Detection of polluted or threatened waters (NO_3)

→ Focus initially directed at the role of Nitrogen in coastal + transitional waters
  → Secondary purpose directed towards the control of Eutrophication
  → Increasingly focused on the need to assess the impact of Nitrogen in freshwaters

→ Need for MS to develop assessment methodologies
  → to assess the role of Nitrogen in freshwater eutrophication
  → How these sites can be most effectively managed
    - Nitrogen hardly seen as being important for Eutrophication of fresh waters unlike Phosphorus that plays a crucial role
    - Should the ND be considered as a legal instrument to regulate Nitrogen and Phosphorus?

→ Broad interpretation of the ND when designating NVZ or applying the Action Programme to the entire country

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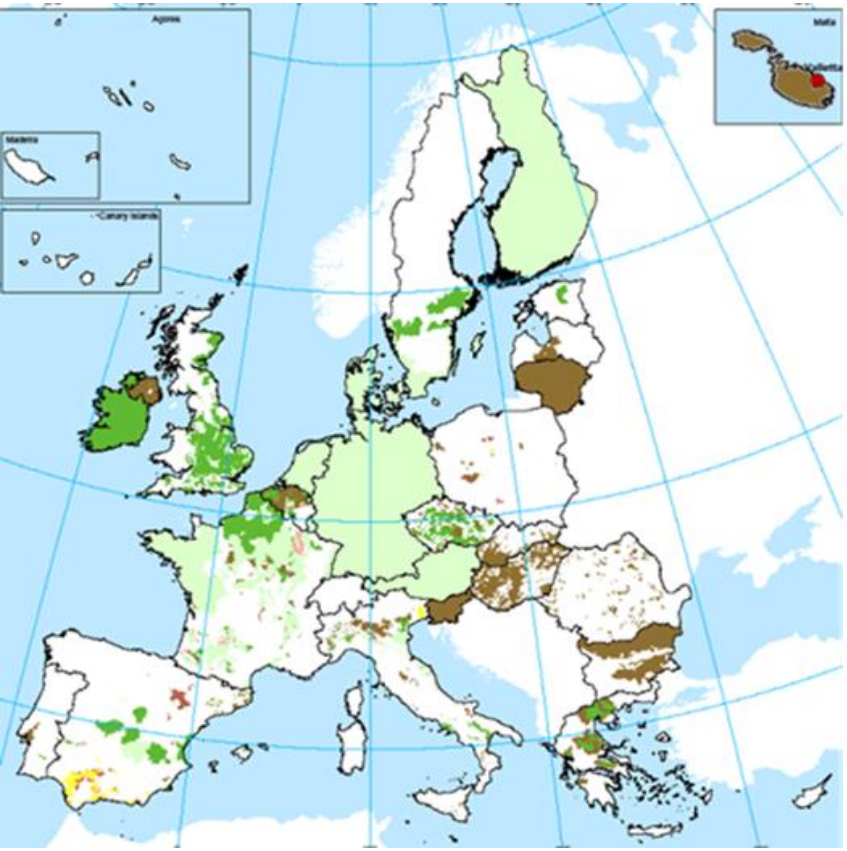
Step 2 -Designation of "Nitrate Vulnerable Zones" (NVZs)



→ Process constrained by scientific and technical problems
+ large social pressures
+ pressure exerted by the EC

Agricultural land designated in NVZs

Flemish region: +5% (1995) > +46% (2002) > +100% (2009)

France: 51% (1999) > 68% (2018)

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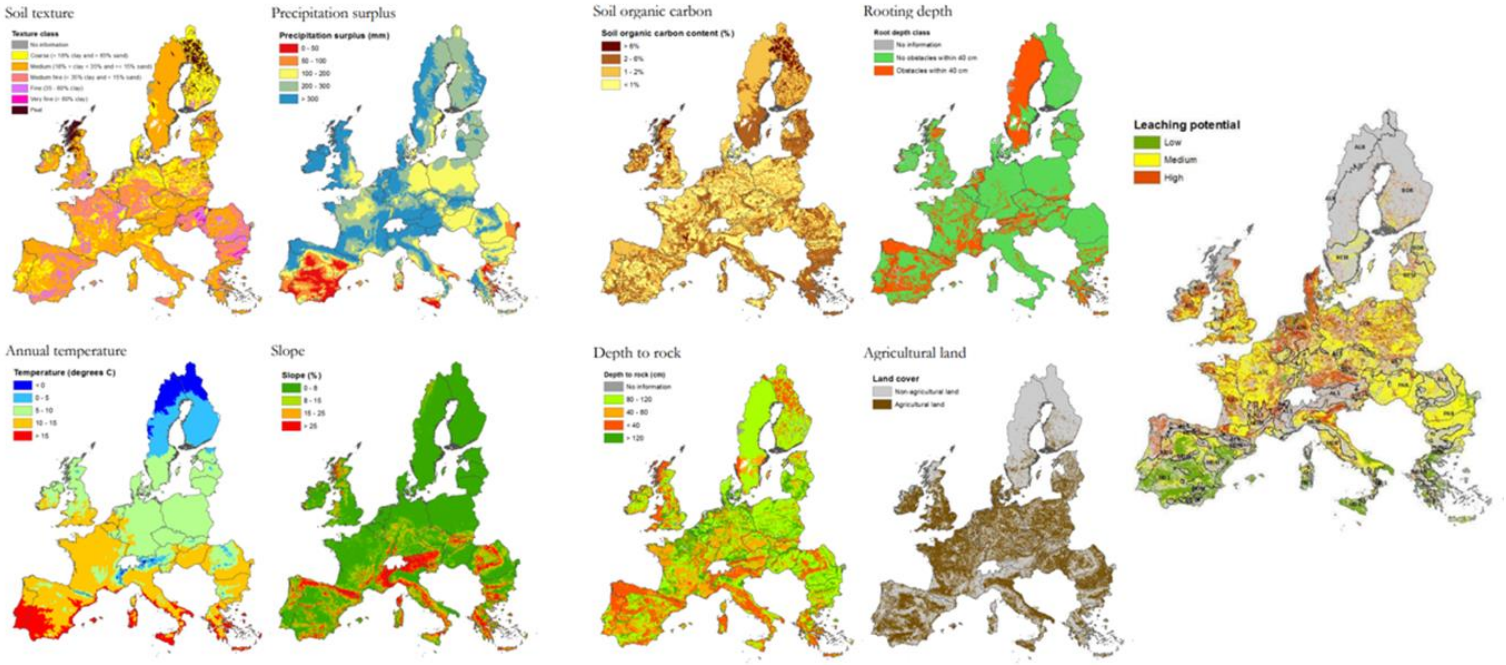
Step 2 -Designation of “Nitrate Vulnerable Zones” (NVZs)

→ Recommendations provided for establishing Action Programmes under the ND

→ Review and differentiation of the pedo-climatic (sub) zones in Europe



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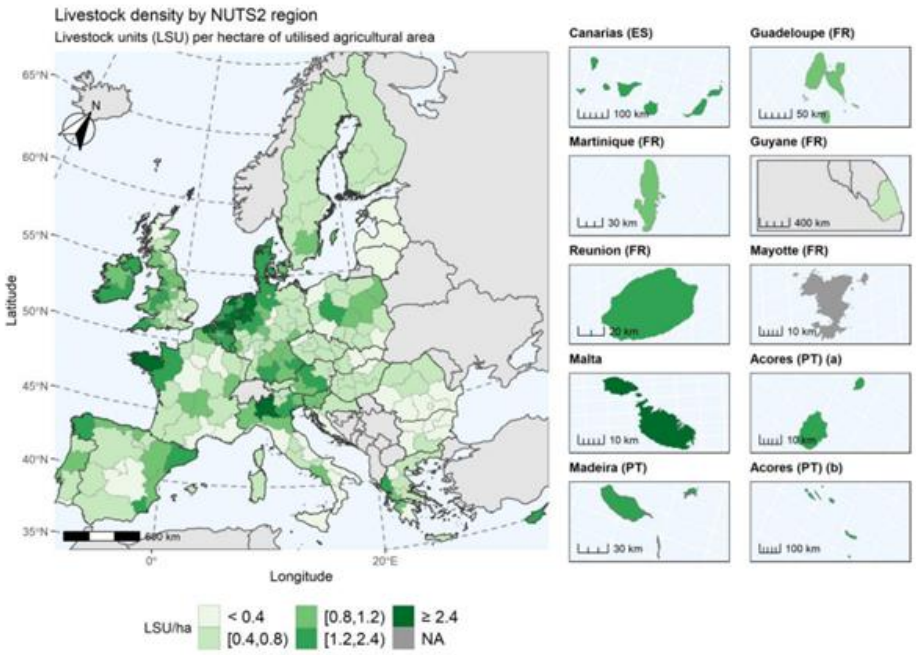
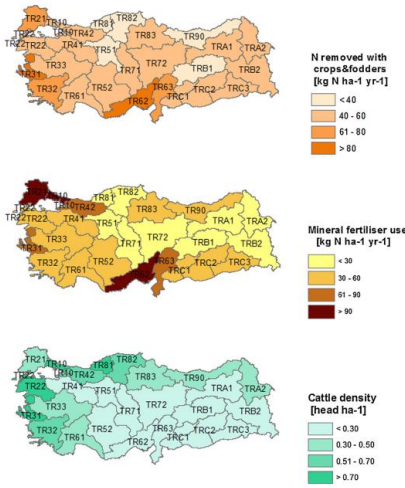
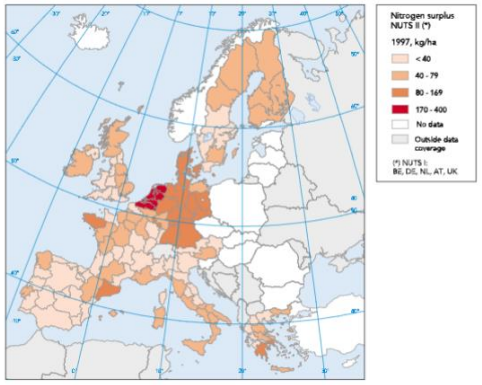
Step 2 -Designation of "Nitrate Vulnerable Zones" (NVZs)

→ Livestock density

→ Agricultural practices







→ Detailed analysis of the link between farming practices and the risks for leaching/run off towards waters and eutrophication processes

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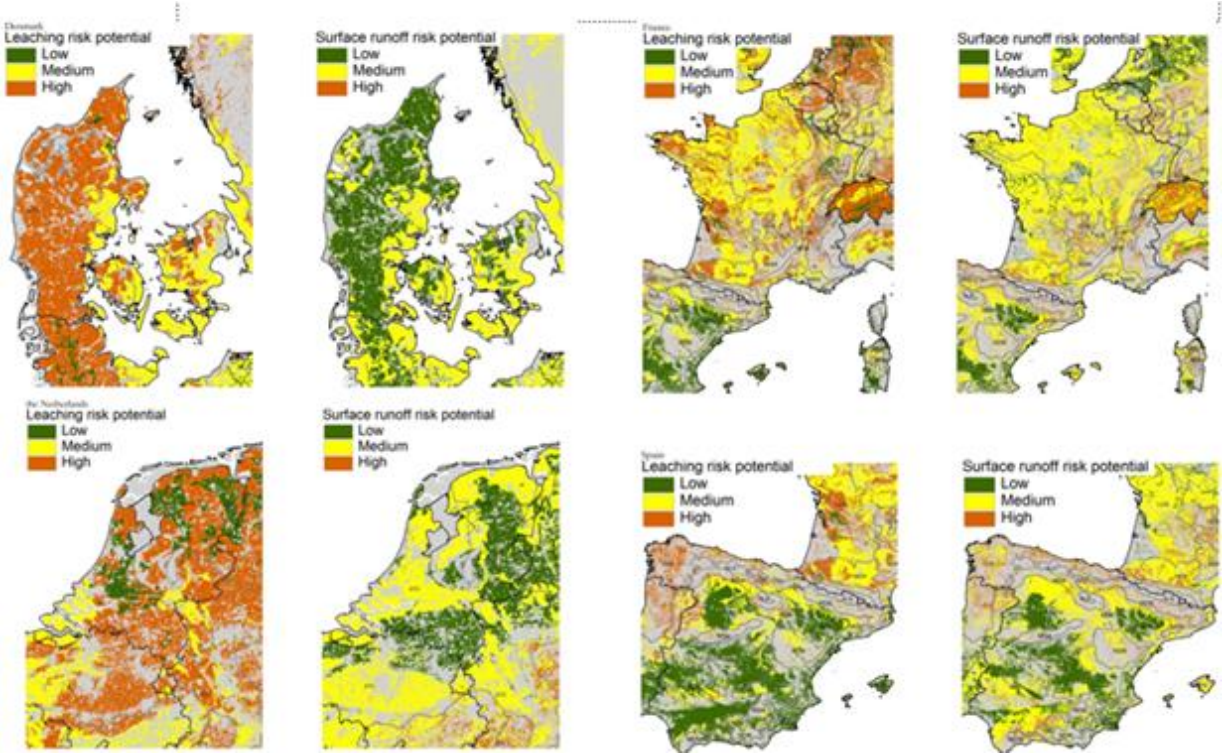
Step 2 -Designation of “Nitrate Vulnerable Zones” (NVZs)



→ Recommendations for all measures to be included in the Action Programmes differentiated for each pedo-climatic zone

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Step 3 - Code of good agricultural practice on all MS territory

→ Measures limiting the periods when nitrogen fertilizers can be applied on land

→ target application to periods when crops require nitrogen and prevent nutrient losses to waters

→ Measures limiting the conditions for fertilizer application (on steeply sloping ground, frozen or snow covered ground, near water courses, etc.) to prevent nitrate losses from leaching and run-off

→ Requirement for a minimum storage capacity for livestock manure

→ Crop rotations

→ Soil winter cover

→ Catch crops to prevent nitrate leaching and run-off during wet seasons

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Step 4 - Action Programs within NVZs

→ Measures already included in Codes of Good Agricultural Practice become mandatory
  → Limitation of fertilizer application (mineral and organic) taking into account crop needs + all nitrogen inputs and soil nitrogen supply
  → Maximum amount of livestock manure to be applied
  → Highest amount of Nitrogen from manure: 170 kg/ha

At the request of MS

provided that they justify scientifically that this shall not lead to higher pollution

→ Adoption by the EC of implementing Decisions (“derogations”) that allow the application of higher maximum limits of nitrogen from manure
  → Specific areas and under particular conditions
  → Do not exempt MS from the water quality objectives of the Directive nor from any other of its measures

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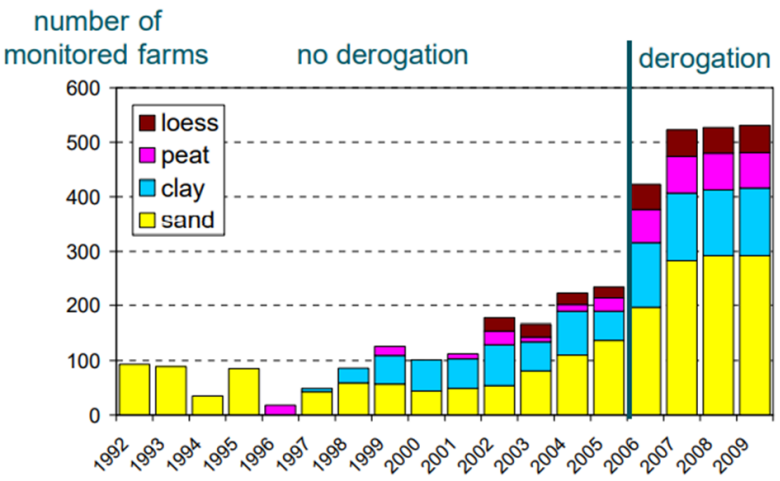
Step 4 - Action Programs within NVZs

→ Commission Decisions that allow for the application of more than 170 kg/ha of Nitrogen from manure per hectare per year

→ This is a temporary agreement only and the effects of the derogation have to be evaluated

→ Derogation is only applied for or considered by MS with a substantial livestock density



230-250 kg/ha: Germany (0,1%), Denmark (4,2%), Ireland (8%), Netherlands (50%)*

* % of agricultural land period 2006-2010

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Step 5 - National Monitoring and reporting

→ Every 4 years NO_3 and Eutrophication

- → Assessment of Action Programs' impact
- → Revision of NVZs & Action Programs

3 types of monitoring

- → Monitoring for the identification of water
- → Monitoring for countries applying the Action Programme to the whole of their territory
- → Monitoring to assess the effectiveness of Action Programmes

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Monitoring for the identification of water

Monitoring required if a number of NVZ are to be designated within the country or region

→ irrelevant if a country or region decides that AP will be applied to the entire territory (no designation of NVZs)

If this type of monitoring is required

→ Use of other existing networks

→ Possibly combined with an adapted monitoring programme (specific areas, higher observation frequency in time, ..)

→ Baseline monitoring of important water bodies and intensively cropped regions

→ National monitoring networks for groundwater and surface water available in all the relevant countries or regions

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Monitoring for countries applying the Action Programme to the whole of their territory

Baseline monitoring of important water bodies and intensively cropped regions

→ National monitoring networks for groundwater and surface water available in all the relevant countries or regions

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Monitoring to assess the effectiveness of Action Programmes

Monitoring human activities (e.g. agriculture, industry, population)

→ General idea of the potential threat to water quality

Monitoring soil or soil moisture (water in the unsaturated part of the soil profile)

→ More direct idea of the threat to groundwater and indirectly to surface waters can be achieved

→ Quality of water and changes therein are monitored in both groundwater and surface waters in most countries

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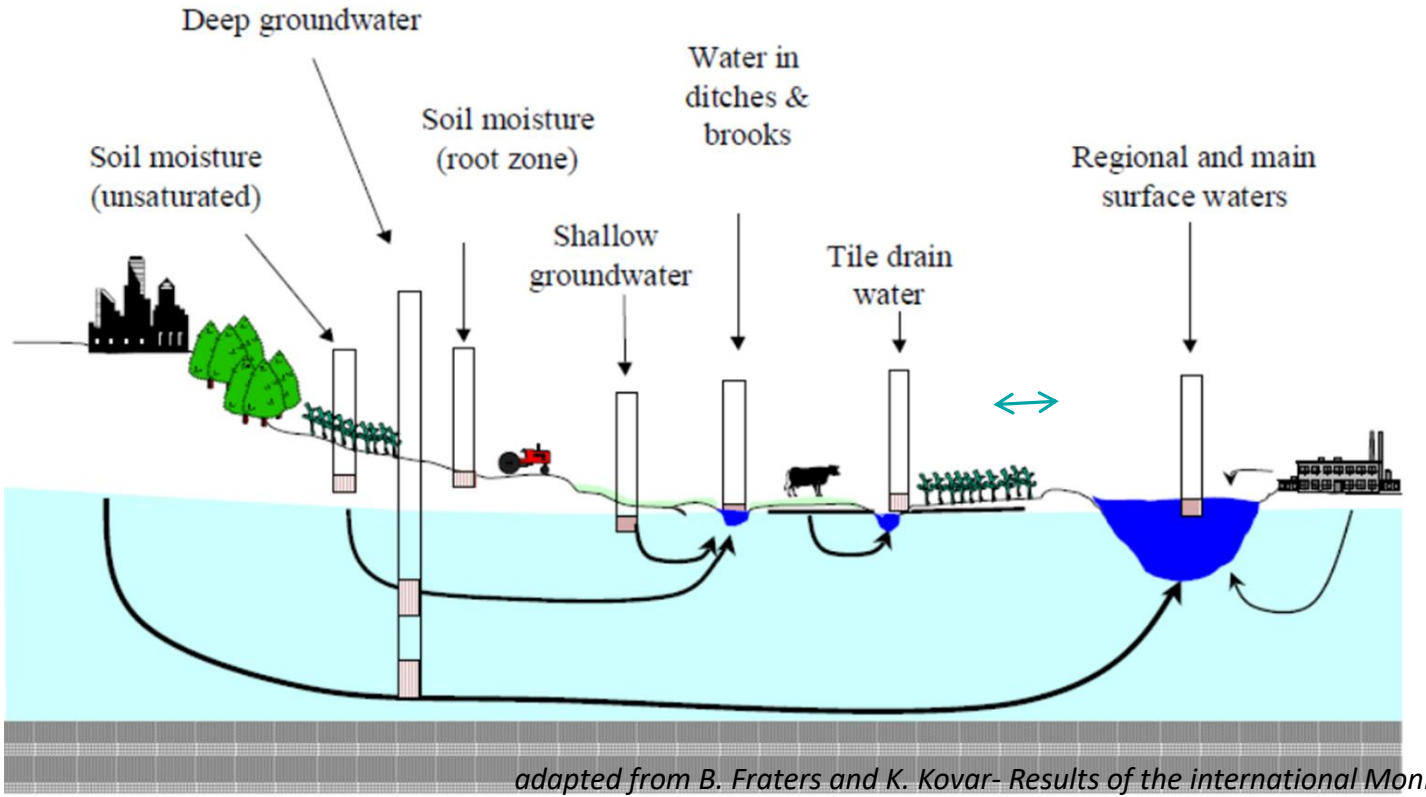
Levels of scale of monitoring agricultural practice and water quality monitoring



adapted from B. Fraters and K. Kovar- Results of the international MonNO3 workshop 2003

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Water quality monitoring for monitoring the effects of changes in agricultural practice

The closer to the source of pollution

- → the shorter the time between measure and effect
- → the smaller the chances that other sources of system processes may influence water quality

Monitoring the quality of regional or national surface waters

→ Essential information for users of these waters

- → but it usually does not provide adequate information for detecting effects of changes in agricultural practice

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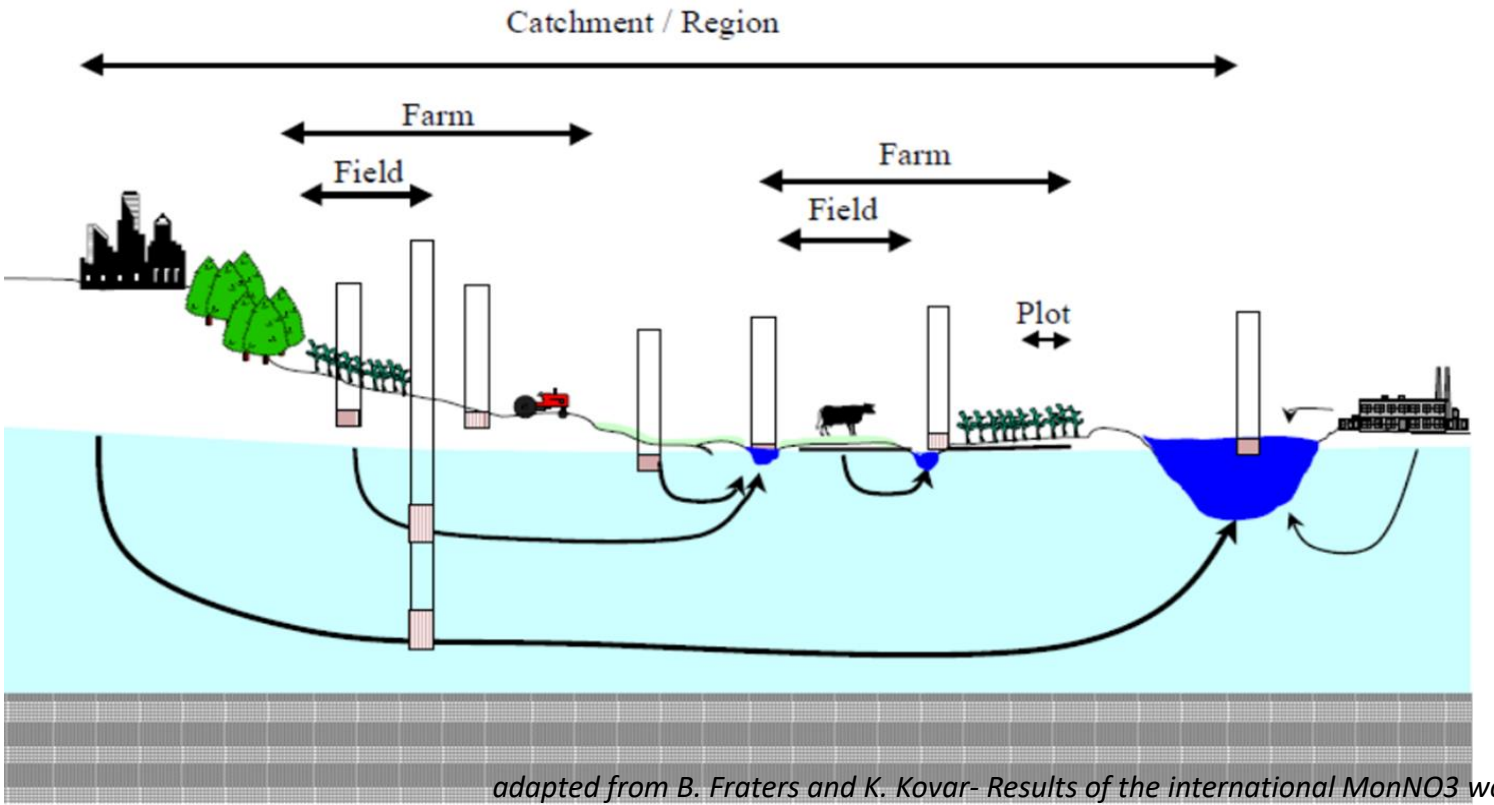
Levels of scale of monitoring agricultural practice and water quality monitoring



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Water quality monitoring for monitoring the effects of changes in agricultural practice

Travel times of surface waters and especially groundwater feeding the regional and national surface waters are long

→Long lag times

- In addition to nutrients from agriculture, these waters receive nutrients from other sources (industries, WWTP)

→The resolution power is low

- Long path of flows of water feeding regional and national surface waters

→Types of interfering processes

- Adsorption and desorption and decomposition and formation

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Water quality monitoring for monitoring the effects of changes in agricultural practice

Type of monitor	Lag time	Resolution power	Importance of interfering processes
Soil moisture	short	high	little
Tile drains	short	high	little
Shallow groundwater	short – moderate	moderate – high	little – moderate
Deep groundwater	moderate – long	low – moderate	moderate – significant
Ditches & brooks	short – moderate	moderate	moderate
Regional & main waters	long	low	significant

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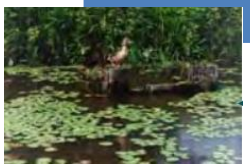
Monitoring the effects of policy measures



Relationships between entities that should be monitored according to the draft guidelines (EC, 1999, 2003) **Policy measures, agricultural practice and environmental quality**

Relationships between the entities **that have to be monitored and factors needed to underpin claims that policy measures change agricultural practice** and thereby ameliorate environmental quality

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Levels of scale of monitoring agricultural practice and water quality monitoring

The choice for a certain level of scale for effect monitoring depends on

- → the scale used in existing monitoring networks
- → level of scale of data collection by regional and/or national authorities for other purposes

The guidelines for monitoring under the Nitrates Directive (EC, 1999, 2003) outline the monitoring

- → Agriculture, nutrient balances, changes in land use and manure storage capacity
- → Water quality (effects of nitrate input to surface water and ground water)

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Levels of scale of monitoring agricultural practice and water quality monitoring

Water quality is not only influenced by agricultural practice but by other factors as well.

→ Environmental factors may cause differences in water quality between locations or in time

- Soil type, hydro(geo)logical characteristics of sediments or rocks or of the surface water system
- Climate and weather

→ The type and structure of the farm, the educational level of the farmer, whether the farmer has a successor or not …

→ These farm factors influence the way policy measures are implemented in farm practice

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Levels of scale of monitoring agricultural practice and water quality

Main characteristics of effect monitoring of ND Action Programmes

→ the effects of the Action Programmes on the environmental quality can be linked to changes in agricultural practices due to policy measures

→ the effects of changes in agricultural practices on water quality can be separated from the influence of changes in environmental factors such as precipitation

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Levels of scale of monitoring agricultural practice and water quality

Scale dependency representativeness

→ In addition to types of monitoring water quality the scale of monitoring is a point of interest as well

- A soil moisture sample is only representative of a few square meters, while a deeper pumping borehole (as long as no denitrification) will usually be representative of a larger area
- Well-screen length and pumping capacity will have large effects on representativeness
- Representativeness can be assessed by knowledge of the system to be monitored

In studying the relationship between the effects of agriculture and water quality

→ collection of data should preferably be on the same scale for both agriculture and water quality

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Levels of scale of monitoring agricultural practice and water quality

Two main approaches of effect monitoring

Upscaling approach concerns collecting a lot of data on a few locations

→ gain an insight into effects of specific measures on water quality

Interpolation approach concerns collecting a few data on a lot of locations

→ provides an unbiased estimation of the changes in water quality on the national scale

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Levels of scale of monitoring agricultural practice and water quality

The upscaling approach uses the results of studies carried out on experimental sites (plots, parcels)

- → Quantify the effects of changes in agricultural practices on nitrate leaching (and water quality)
- → Process models and data on national-scale changes in agricultural practices are used to upscale the experimental-sites results
  - → to describe the effect of the AP on nitrate leaching and water quality on the national scale (Denmark, Sweden)

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Levels of scale of monitoring agricultural practice and water quality

The interpolation approach uses the results of monitoring carried out on a random sample of locations or example farms

→ Quantify the effects of changes in agricultural practices on nitrate leaching (and water quality)

Statistical models and national-scale monitored changes in agricultural practices

→ Describe the effect of the Action Programme on nitrate leaching and water quality

on the national scale (Austria, Belgium, Germany, Ireland and the Netherlands)

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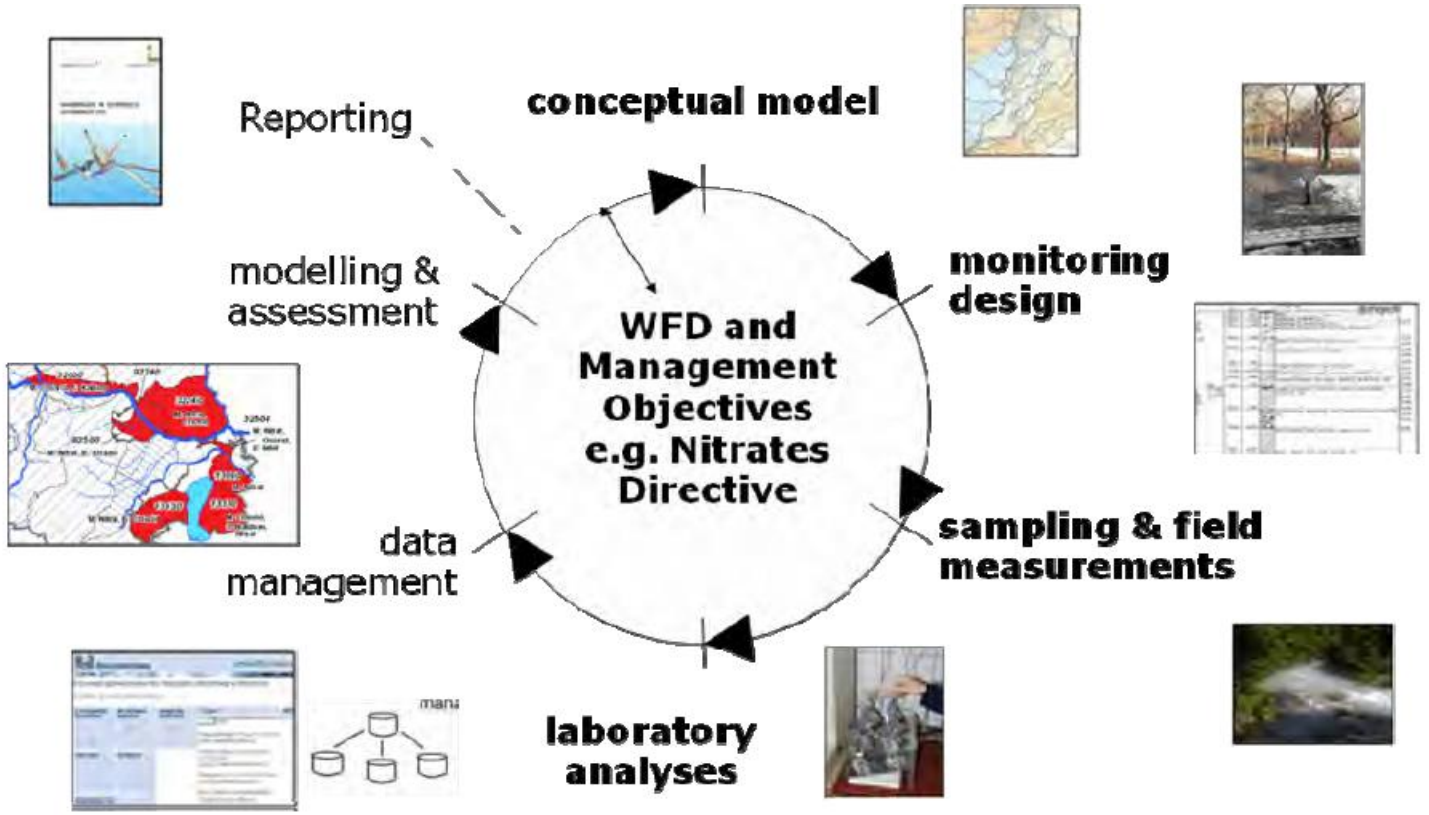
Levels of scale of monitoring agricultural practice and water quality



Water quality monitoring in Austria

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Types of monitoring

- → General monitoring networks and surveys for agriculture, groundwater, and surface waters (interpolation approach)
- → Quick response monitoring networks or early warning networks (upscaling approach)
- → Investigative monitoring (upscalling approach)
- → Compliance checking surveys
  - → All countries
  - → Soil mineral nitrogen analyses (Austria, Flemish region of Belgium)
  - → Residual mineral nitrogen (Germany)

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Types of monitoring

General monitoring networks and surveys for agriculture, groundwater, and surface waters

- → monitoring networks to show the status and trend in the quality of their waters
- → designed and set up as stratified random networks of observation points

Quick response monitoring networks in some countries

- → need for additional monitoring to prove the effect of agriculture and changes in agricultural practice on water quality (Walloon region of Belgium, Denmark, Ireland, and Sweden)
- → The Netherlands used the interpolation approach to set up a quick response network

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Types of monitoring

Investigative monitoring

→ Commonly used to show the effects of specific measures

→ the knowledge gained is usually built into process models

research projects also used to develop models and in combination with agricultural information from surveys at the catchment scale

→ used for upscaling and calculating effects of Action Programmes on water quality (France, Germany)

Compliance checking surveys

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Overview of the monitoring networks in MS and regions

Monitoring should be carried out in all areas where AP apply

→ Monitoring the effectiveness of the AP

→ requires baseline information for comparison purposes

"All major river systems should contain sampling points that are representative of the catchment and are sufficiently sensitive to the results expected of the action programme measures"

For effect monitoring

→ some countries made use of existing networks (identification monitoring, baseline monitoring, or other networks such as those used for agricultural monitoring)

→ other countries made use of networks that have been specifically designed for this purpose

Countries have given their own interpretation on how the monitoring should be carried out

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Overview of the monitoring networks in MS and regions

Long history of monitoring the agricultural practices and the quality of ground- and surface waters in most European countries

→ In many countries the intensity of monitoring has increased

- due to either the discussion with the EC about the designation of NVZs or as a consequence of the request of derogation (>170 kg of manure nitrogen per hectare)

→ Some countries have developed specific quick response effect monitoring networks (in addition to their regular ground and surface water networks)

→ show the effect of their Action Programmes (Denmark, the Netherlands, Sweden)

→ Other countries have additional programmes to monitor the effects (Walloon Region of Belgium, Germany, France)

→ Countries have developed specific networks for monitoring the effect of their derogation (Flemish Region of Belgium and the Netherlands)

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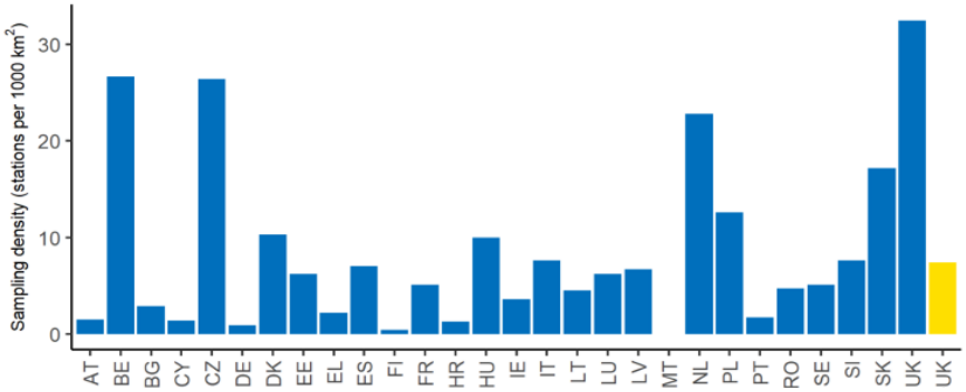
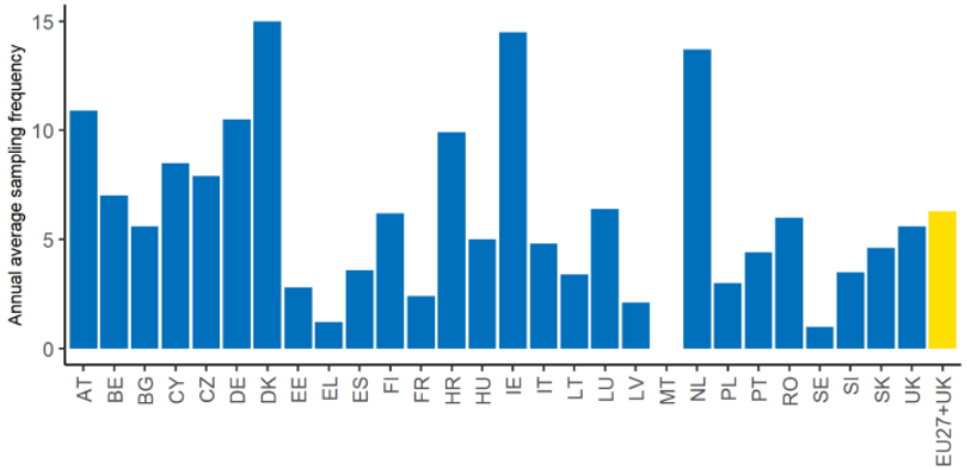
Overview of the monitoring networks in MS and regions



Fresh surface water station density (stations per 1000 km^2 of land) stations with data average Nitrate measurements (period 2016-2019)



Annual average fresh surface water sampling frequency (reporting period 2016-2019) stations with data of average annual nitrate measurements

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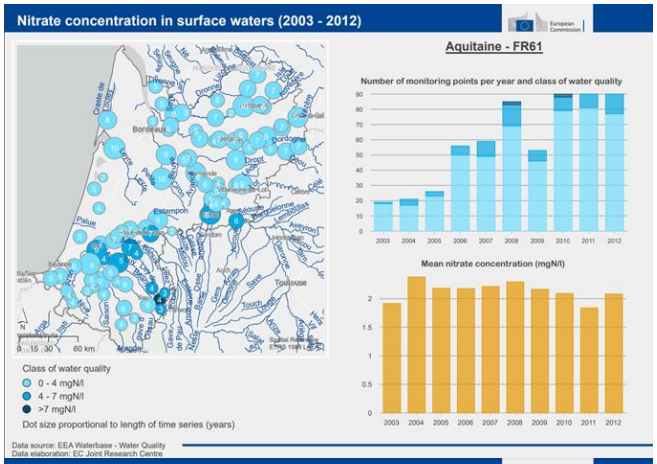
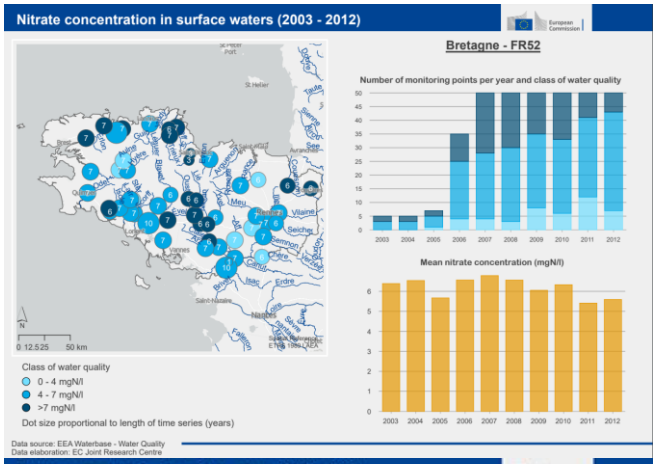
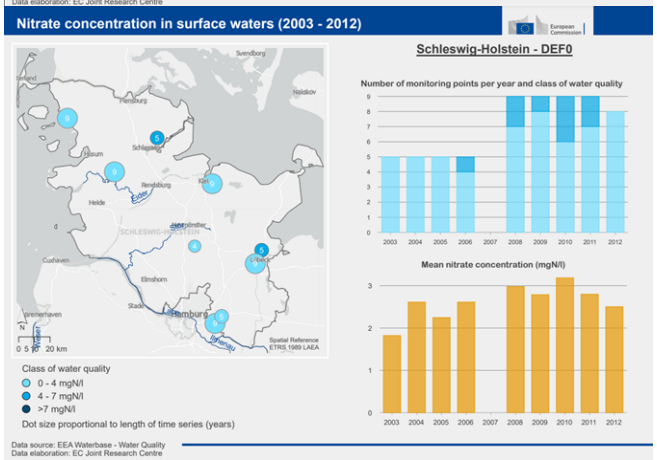
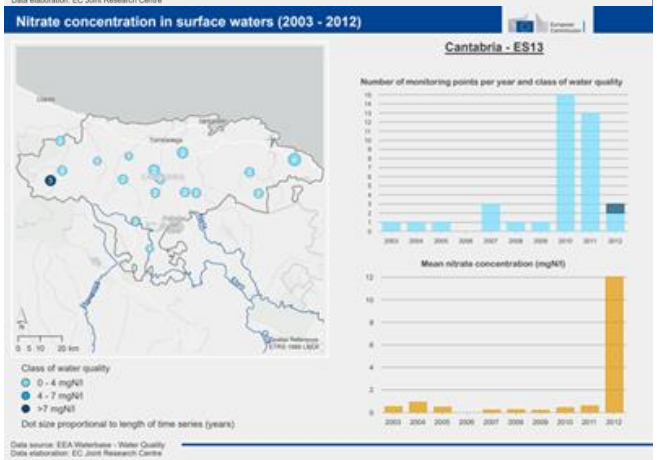
Examples of the monitoring networks in MS and regions









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Major focal points with respect to effect monitoring

Accounting of confounding factors

Factors that ‘complicate’ the analyses of the relationship between measure and effect

→ environmental factors (weather, soil type, …)

For interpretation of the actually measured water quality in relation to measures

→ able to quantify the effects of the confounding factors on water quality

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Major focal points with respect to effect monitoring

Choice of the type of water to be monitored (soil water, upper groundwater, tile drain water)

- → influences the strength of the relationship between measures and effects due to the lag time
- → resolution power (ability to discriminate between sources of measured nitrate in waters)
- → interfering natural processes along the pathway (e.g. denitrification)
- → Choice of the level of scale used for research (plot, parcel, field, catchment, farm)
- → Balance between the levels of scale for which different types of data are available
- → Scale on which data on agricultural practices, water quality and confounding factors are collected preferably the same for all three data sets

→ In case the scales are different

upscaling or downscaling of the data from different data sets to the same scale for analyses should not lead to large uncertainties in the results

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Environmental goals and quality standards

The way countries deal with environmental quality standards and objectives given in the Nitrates Directive (eutrophication and 50 mg l^{-1} nitrate) depends on

- → the manner and stage of implementation of the Nitrates Directive
- → the manner and stage of implementation of the Water Framework Directive
- → the degree of pressure exerted on the politicians by public opinion and the stakeholders

Large differences in targets applying to surface water

- → Belgium : 50 mg l^{-1} nitrate target value in designation of NVZs with respect to surface water (statistical approach towards quantifying the target-value scale)
- → Germany, Ireland and the Netherlands have target values for total nitrogen in surface waters of between 2 and 3 mg l^{-1}
- → Denmark nitrate target value of 35 mg l^{-1} for groundwater flowing directly to surface water

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Network developments

- → System for effect monitoring in place has developed in each country
  - → generated time series of data sometimes for over two decades or more
- → Replacing such a system by another one
  - → cause enormous problems for trend analyses because of discontinuity in observed series
  - → systems did adapt in the past as a consequence of changing circumstances, and will adapt in future
- → Systems for effect monitoring should be adapted or extended organically
  - → ensure that a change in the monitoring system does not result in an insurmountable loss of information

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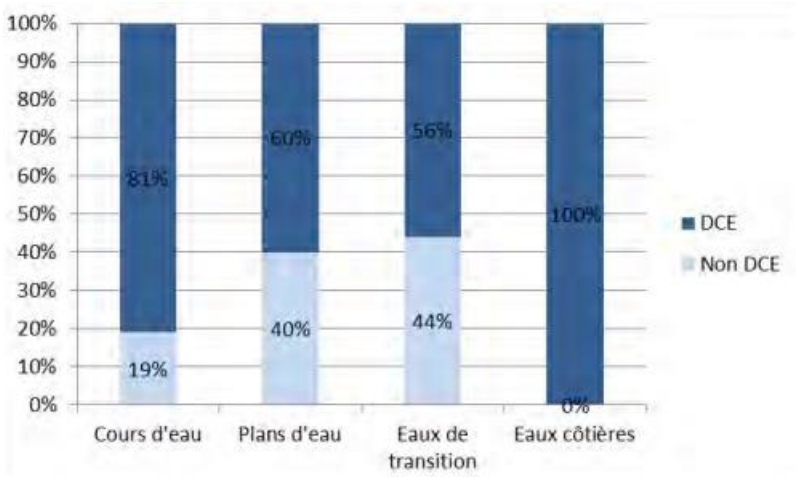
Network developments

→ Effect monitoring networks for the Nitrates Directive (ND) can be used for Water Framework Directive (WFD) purposes

→ ND effect monitoring networks are considered to be complementary for the WFD, but they are not necessarily sufficient to fulfil all monitoring and reporting requirements of WFD



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Points of attention for discussion

→ Collection of agricultural data

- → Are agricultural data collected at the same scale as water quality and environmental data?
- → Which agricultural data are needed?
- → Which problems are encountered and how are they solved?

→ Sampling of water

- → influence the interpretation of measurements as lag time, resolution power, and interfering processes, scale dependency of representativeness of samples, goals and costs of sampling

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Points of attention for discussion

→ How to define and monitor effects on eutrophication?

→ How to monitor effects of Nitrates Directive Action Programme measures for Phosphorus?

→ How to use the same Nitrates Directive monitoring networks for monitoring for other EU directives?

→ Is stakeholder involvement important, and if so, do farmers participate or are they consulted?

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Protection of Waters Against Agricultural Pollution
Through Establishment of a Monitoring and Reporting Methodology for the Nitrate Action Plans

Ilginiz için tesekkürler

Thank you for your attention

REPUBLIC OF TURKEY
MINISTRY OF ENVIRONMENT,
URBANIZATION AND CLIMATE CHANGE

Environment and Climate Action
Sector Operational Programme

REPUBLIC OF TURKEY
MINISTRY OF AGRICULTURE
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