COST 869

Mitigation options for nutrient reduction in surface water and groundwaters

Meeting of Working Group 3
18–19 May 2009
Location: Hof van Wageningen, Lawickse Allee 9
Wageningen, The Netherlands

Topic of the meeting:

Implementation of the WFD
River Basin Management Plans (RBMP)
Experiences and problems encountered

Local organizers
Oscar Schoumans & Wim Chardon

Proceedings edited by
***W.J. Chardon* & O.F. Schoumans**

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Contents

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AGENDA

Sunday 17 May

19:00 – 20.30	Registration (lounge) and welcome drink (sports bar, basement)

Monday 18 May

08:00 – 08.30	Registration
08:30 – 08.45	Welcome and announcements *Oscar Schoumans, The Netherlands*
08:45 – 09.15	*Maartje Oonk, Ministry of Agriculture, Nature and Food Quality The Netherlands*. Implementation of the WFD in the Netherlands
	Western Europe
09:15 – 09.45	*UK, Marc Stutter:* Experiences in a Scottish research catchment: Monitored Priority Catchment Project, Lunan Water.
09:45 – 10.15	*UK, Martyn Silgram:* Recent research supporting the development of RBMPs and targeted implementation of the Water Framework Directive in England and Wales.
10:15 – 10.45	*France, Wilfrid Messiez-Poche, Chantal Gascuel:* A local French initiative for water management at the basin scale.
10:45 – 11.15	Tea and Coffee (downstairs)
	Northern Europe
11.15 – 11:45	*Sweden, Martin Larsson:* RBMP for the North Baltic river basin district in Sweden - location of hot spot areas, mitigation options and effects.
11.45 – 12:15	*Finland, Tom Frisk:* Achieving the environmental goals of the WFD in Finland and the role of agricultural water protection measures.
12.15 – 12:45	*Norway, Håkon Borch:* Modelling mitigation effects on agricultural run off in the Morsa catchment. Developing of new tools for choosing strategies in the implementation of the WFD in Norway.
12.45 – 14.00	Lunch
	Central and Eastern Europe
14.00 – 14.30	*Austria, Matthias Zessner:* Quantification of nutrient fluxes on catchment scale as basis for evaluation of the effectiveness of mitigations options in Austria and the Danube Basin.
14.30 – 15.00	*Germany, Michael Trepel*: Nutrient management in the Elbe basin – targets and measures.
15:00 – 15.30	*Czech Republic, Klara Cechova*: Implementation of management measures against pollution of surface waters with nutrients from agriculture in the first RBMP of the Czech Republic
15.30 – 16.00	Tea and Coffee (downstairs)
	Southern Europe
16.00 – 16.30	*Greece, Louis Vardakas / Rania Tzoraki:* The Greek Pilot River Basin Management Plan.
16.30 – 17.00	*Portugal, Jorge Pinheiro*: Eutrophication in the Azores islands.
17.00 – 17.30	*Spain, Antonio Delgado:* Nitrate and phosphorus in Spanish watersheds.
19.00 – 20.30	***Conference dinner at hotel***

Tuesday 19 May

	Session 2
08.30 – 09.00	*Oscar Schoumans*: Conceptual framework for mitigation options.
09.00 – 09.30	*Eila Turtola:* Biologically adjusted P cycle as a measure to reduce P losses, an example for Finnish agriculture.
09.30 – 10.00	*Gitte Rubaek:* Impact of crop management on nutrient losses.
10.00 – 10.30	*Karl Richards:* Implementation of agri-environmental measures in Ireland: Case study of the Rural Environmental Protection Scheme.
10:30 – 11.00	Tea and Coffee (downstairs)
	Session 2 *Continued*
11.00 – 11.30	*Peter Strauss / Antonio Delgado*: Soil erosion control measures, effectiveness and implementation strategies – the case of Spain and Austria.
11.30 – 11.45	*Jaroslav Antal*: Soil water erosion in Slovakia - Problems and solutions.
11.45 – 12.15	*Iggy Litaor*: Wetland restoration of marginal arable land: A Mediterranean experience.
12.15 – 12.45	*Brian Kronvang*: River restoration: Long term experiences from Denmark.
12.45 – 13.45	Lunch
13.45 – 14.45	**Poster session**, authors are asked to be present beside their poster Tea and Coffee will be available in conference room
14:45 – 16:30	**Discussion** *We would appreciate receiving items for the discussion via email before the meeting, or upon registration at the beginning of the meeting*
16:30	Close, drink

POSTERS

1. *Emir Bilaletdin, Finland:* Experiences of using different calculation methods concerning the RBMB work in Finland.
2. *Peter Csatho, Hungary:* Critical evaluation of the first 15 years of the Nitrate Directive - results, failures and urgent tasks.
3. *Sarah De Bolle, Belgium:* River basin management plan for the River Scheldt in Flanders.
4. *Marius Heinen, The Netherlands*: Experimental determination of the effectiveness of unfertilized grass buffer strips in the Netherlands.
5. *Klaus Isermann, Germany:* Actual and future needed contributions of Sciences and Policy in Germany regarding the implementation not only of the RBMP of the EU-WFD for reducing impact of agricultural losses of the nutrients C, N, P, (S) in river basins / catchments.
6. *Gert-Jan Noij, The Netherlands:* Surface runoff of phosphorus from flat fields.
7. *Francisca Sival, The Netherlands:* Phosphorus retention by a constructed wetland.
8. *Dimitranka Stoicheva, Bulgaria*: Leaching of nitrate nitrogen under different growing crops and nitrogen rates from Fluvisols of Southern Bulgaria.
9. *Caroline van der Salm, The Netherlands:* Phosphorus and nitrogen losses from a grassland site on a heavy clay soil in a fluvial plain in the Netherlands.

Abstracts of oral presentations - Presenting author, title page

Monday

Tuesday

Abstracts of poster presentations - First author, title page

ABSTRACTS OF ORAL PRESENTATIONS

Implementation of the Water Framework Directive in the Netherlands

Maartje Oonk
Ministry of Agriculture, Nature and Food Quality, The Netherlands

Water is very important in The Netherlands, with hundreds of thousands km of waterways in a intensively managed, and densely populated country. This leads to a great attention for safety related to surface water, and for water quality.

In the process of implementation the Water Framework Directive (WFD), 3 Ministries, 12 provinces, and 27 Water Boards are involved, and also stakeholders and scientists. An important task lies decentralized with the Water Boards who start their work at a local and regional scale. These plans will build up to Basin Area Management plans.

Legal implementation of the WFD develops via General Governmental Regulations (AmvB), that are aimed to be flexible, and in which monitoring is an important aspect. There is a concern about the elaboration of the WFD, especially about the large number of artificially designed watercourses and the high concentrations of nutrients in surface water. Although these concentrations are decreasing, and we can say that we are heading in the right direction, the goals are not reached. Via frequent "ex ante" evaluations future developments are investigated for the use of nutrients, and their loss to surface water.

In the near future, research programs will start for innovative research on diminishing nutrient losses. Research will be done on the relation between sources of nutrients and the effects in surface water, and measures will be further developed and implemented.

Experiences in a Scottish research catchment: Monitored Priority Catchment Project, Lunan Water

Marc Stutter, Andy Vinten, Martyn Futter, Kirsty Blackstock
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In partnership with: Scottish Environmental Protection Agency and Scottish Agricultural College

The River Basin Management Planning process in Scotland has classified the national water bodies by degree and nature of risk for failing Water Framework Directive standards. The priority is to ensure water bodies at risk of compliance failures improve towards the ‘good’ status. In order to understand the effectiveness of our regulatory tools and additional measures to improve water quality a system of Monitored Priority Catchments (MPCs) has been implemented. Presently, there are three MPCs which are catchments with representative land use issues and current non-compliance in WFD criteria. The MPCs provide a research catchment with aims to: (i) develop a strategy to apply and assess effective and proportional mitigation for human impacts in a catchment, and (ii) investigate the potential for standard and alternative policies for achieving Good Ecological Status for waters.

The Lunan Water MPC is a mixed, intensive farming system in NE Scotland with failures in ground water nitrate and loch total P compliance under the WFD. The project is an inter-disciplinary one (with a strong socio-economic - biophysical linking) between Macaulay Institute (research partner), Scottish Environmental Protection Agency (regulator), Scottish Agricultural College (farming advisory services), a 'focus farm' and other farmer-led and stakeholder groups (fishermen etc). We have a monitoring network, which is currently assessing baseline conditions and highlighting issues. Using this catchment knowledge and farm audits management plans will be agreed to tackle the diffuse pollution issues. There is a multi-tiered approach envisaged with a subcatchment assessing 'basic' mitigation (that outlined by national guidance - our General Binding Rules system), then a 'research subcatchment' where extra voluntary measures will be encouraged and evaluated. Through this MPC initiative we hope to improve our methodologies for quantifying pollutant loads and assessing their sources for mitigation, better understand the effectiveness of regulatory measures and targeted extra measures, public and stakeholder aspirations for water quality and socio-economic barriers to uptake of measures.

Recent research supporting the development of RBMPs and targeted implementation of the Water Framework Directive in England and Wales

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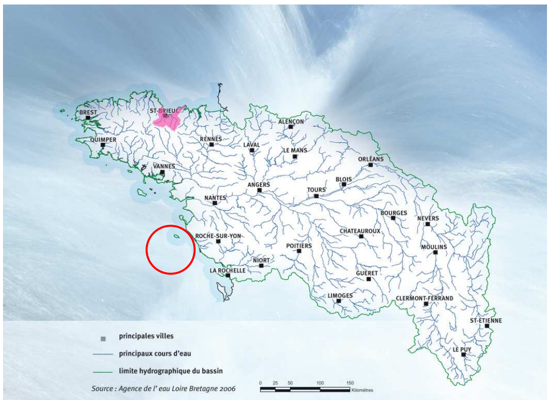
The implementation of the Water Framework Directive requires the development of River Basin Management Plans, which necessitate the spatial targeting of mitigation measures aimed at reducing diffuse pollution losses to water bodies. In the UK, draft RBMPs have recently been published and are currently subject to public consultation. Their development is dependent on sound scientific methods which enable policymakers to consider costs, benefits, and locational aspects associated with different mitigation options.

Recent examples of relevant research in England and Wales include:

- expert knowledge coupled with environmental models and a genetic algorithm approach to identify optimal cost-effective solutions for reducing loads of multiple pollutants
- use of agri-environment data with geostatistical modelling to evaluate cost-effective scenarios for new Catchment Sensitive Farming areas
- geochemical tracing to identify the relative importance of different sediment and phosphorus sources on surface water quality
- a spatial targeting methodology to help promote the wider adoption of on-farm woodland to help mitigate diffuse pollution losses to surface waters

A local French initiative for water management at the basin scale

Wilfrid Messiez-Poche [1] and Chantal Gascuel [2]
[1] *Syndicat Mixte du Pays de Saint-Brieuc, Plerin, France*
2 Institut National de la Recherche Agronomique, Agrocampus, Rennes, France



The **L**ocal **W**ater **C**ommission (*Commission locale de l'Eau – **CLE***) of the bay of St-Brieuc which gathers all the local stakeholders (administration, users, local politics, agriculture, industrial and environmental organizations) is in charge of building the *Schéma d'Aménage-ment et de Gestion des Eaux -SAGE* (Water Management Plan) that will program and fix the local rules of the management of waters on the catchment basin of the bay.

The main challenges of the DCE achievements deals with agriculture (nutrients flows of N, P generating eutrophication phenomena; this bay is the most important site in France for green algae proliferation). Waste waters also impact the bays: bacteriological pollution may severely impact seafood production. This 1 100 km^2 area is composed of 6 different catchment basin programs, which represent the operational scale for the management plan. We work on 3 main coastal rivers that run into the bay and feed it with high amounts of nutrients.

The local water commission (CLE) has been working for 3 years. The present step consists in building alternate scenarios (objectives, means, territorial organization), that will permit to achieve the European Water Framework Directive requirements, in their local transcription and consequences.

The CLE has until now developed a strategy on the identification, the preservation and management of wetlands. The diagnosis that lead to this strategy was based on the following items:

- the wetlands were still disappearing due to urban development and ignorance of their interests, characteristics and locations,
- no common reference was shared between the different stakeholders concerning their identification,
- their hydrological functions are essential to mitigate the nutrient fluxes: a high decrease of this fluxes is necessary to struggle efficiently against the coastal eutrophication,
- no particular or exceptional wetlands are identified for preservation, but numerous, small and tenuous parts of plots are disseminated in the landscape along streams and rivers which are often ignored on maps but have to be managed nevertheless.

This strategy consists in its main lines in:
1) calling the attention of planners (communities), first responsible for projects that may induce the destruction of wetlands. A map has been produced and validated, as precise as possible, of "areas with high probability of finding wetlands": in these areas, local rules have been decided: "projects cannot be drawn without precise localization (meaning detailed field investigations, following a validated method to inventory real (effective) wetlands"
2) building a method that can be used by local stakeholders to localize, describe and delineate precisely the wetlands, in order to preserve them from destruction, but also and mainly to improve their management by farmers, and to build, step by step, the complete wetland map over the entire basin. This action needs a correct understanding of their hydrological functions, linked to their position in the basin.

One of the main conditions in succeeding in this strategy is the skill improvement of all stakeholders (administration agents, communities and agriculture technicians, farmers, politics etc.).

RBMP for the North Baltic river basin district in Sweden location of hot spot areas, mitigation options and effects

Martin Larsson, *North Baltic river basin district, Sweden*

As many as 50 % of the 1120 surface water bodies in the North Baltic river basin district in Sweden are not reaching Good ecological status due to eutrophication, mainly caused by diffuse losses from arable land. For agricultural dominated rivers the reduction goals for phosphorus will be up to 80 % of the anthropogenic load and about 40 % for nitrogen and a wide range of measures is therefore necessary.

To locate heavily eutrophied areas and hot spots, direct measurements of water quality for the classification of ecological status were the primary source. In addition, loads from arable land and other diffuse and point sources were quantified with simulation models. Leaching coefficients for arable land was calculated with the field-scale models ICECREAMDB and SOILNDB for phosphorus and nitrogen, respectively, while nitrogen and phosphorus transport, retention and source apportionment was calculated with the hydrological water quality model HBV-NP.

The part of the draft RBMP declaring the legally binding measures addresses national-, county- and municipal authorities. It has a broad spectrum and only exceptionally are specific physical measures mentioned:

- The Board of Agriculture need to prioritize environmental extension, change the subsidiary program and regulate the diffuse losses from agricultural land. The regulation should especially consider appropriate buffer zones and purification of drainage water.
- The County Boards need to revise the authorizations for activities under licence requirement, need to sanction mandatory environmental control programs, and prioritize measures in areas where Good ecological status is not achieved.
- The municipalities need to prioritize their surveillance to businesses affecting the water status.

The estimation of effect and cost is based on three specific measures: vegetated buffer zones, small constructed wetlands for sedimentation of particles and 'normal' wetlands. These measures are selected due to their cost efficiency, potential, and practicability. The calculated reductions based on these measures are estimated from measurements in Sweden or neighbouring countries. Vegetated buffer zones are estimated to reduce anthropogenic P losses with 2-6 % and N losses with 1 %. Small constructed wetlands encompassing drainage water from 80 % of the agricultural land will reduce the P losses with 10-20 % and N losses with 3 %. Finally, 'normal' wetlands encompassing drainage water from 80 % of the agricultural land will reduce the P losses with 12 % and N losses with 16 %. About 2.5 % of the arable land will be taken out of production and designated to physical measures resulting in a total reduction of up to 20-40 % for phosphorus and 20 % for nitrogen in relation to the anthropogenic gross load.

The estimated effect of the proposed measures is uncertain due to a number of reasons. Reasons, which also partly impedes us from proposing a more detailed mitigation program containing a wider range of specific physical measures. Examples of uncertainties are missing data, uncertain effect of measures and deficiencies in the applied models. Examples of missing data are a poor statistics on when the farmers apply manure (e.g. quantities under less favourable conditions), poor mapping of soil properties such as texture, soil phosphorus and slope. Missing data for calibration of models is also one of the mayor drawbacks.

Important research funding organizations have launched special campaigns directed to the area of phosphorus losses from arable land and national authorities have started to collect appropriate data. This will most likely result in additional cost-efficient mitigation options in the years to come.

References:

The authority for the North Baltic River Basin District, 2009. Draft program of measures for the North Baltic River Basin District. Consultation for the period 1 March to 1 September 2009. The authority for the North Baltic River Basin District and Västmanland county board. (In Swedish). www.vattenmyndigheterna.se/NR/ rdonlyres/0B9871D9-CFEA-4C8F-8DB5-2C267F2313E5/0/Atgardsprogram_Lowres.pdf

Larsson M. and M. Pettersson, 2009. Dominating areas and sources for nutrient transport to the sea from the North Baltic River Basin District. Report 2009:4. The authority for the North Baltic River Basin District and Västmanland county board. (In Swedish). www.vattenmyndigheterna.se/NR/rdonlyres/9F25273F-15B1-422F-8690-812CA7F986F3/0/Rapport_2009_4.pdf

Achieving the environmental goals of the WFD in Finland and the role of agricultural water protection measures

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In river basin management planning, the most important inland waters are the surface waters in which the status is not good as well as groundwater areas under risks. According to the river basin management plans (RBMPs) a good ecological and chemical status will prevail by 2105 in most water bodies in Finland. However, in about one third of them a good status will be achieved only by 2021 or 2027. The reason for that is that technically, economically or socially applicable instruments do not exist or natural conditions delay the improvement of waters. Remarkable additional measures will be needed, particularly for reducing agricultural nutrient loading. In developing the programmes of measures the different options are selected, considering on one hand how well they contribute to achieving the environmental goals and on the other hand how easily they can be implemented in practice. The Water Protection Policy Outlines 2015, accepted by the Finnish government, and its background investigations have created an important basis for water management. To support this management, a number of national guidelines and directives have been given by the authorities. For prevention of eutrophication, nutrient input from all possible sources, particularly agriculture, must be further reduced. Improvement of the status of the water bodies eutrophied by agricultural loading requires more effective and more accurately located measures than today. Optimal use of fertilizers, winter-time vegetation cover, buffer zones, artificial wetlands, and the adoption of farming practices that reduce erosion are among the most central measures. The Finnish agricultural support scheme should be further developed so that the requirements of environmental directives will be better fulfilled. The measures proposed in the RBMPs call for development of different policy instruments. Developing the financing system of agricultural environmental support is in a central position. Among other important instruments there are land use planning, improvement of legislation, general environmental planning, environmental counselling and research. For example, the method of nutrient balances should be widely applied in farms.

Key words: agriculture, eutrophication, nutrients, policy instruments, water protection

Modelling mitigation effects on agricultural run off in the Morsa catchment. Developing of new tools for choosing strategies in the implementation of the WFD in Norway

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The main strategy for reducing agricultural runoff in Norway have been to focus on soil and phosphorus (P)-loss. Mitigation options that have been focused and implemented are:

- vegetation cover in the winter period (reduced tilling etc.),
- vegetation strips along water bodies,
- sedimentation ponds,
- reduced use of P fertilizer (P-AL limits etc.).

Since groundwater is not a major issue in Norway, nitrogen is less focused, but work has been done on optimized fertilising, show how to spread the manure, spreading area, storage of manure for 12 months and spreading in the growing season. Pesticide emission and leaching to water bodies and groundwater have been monitored in a national monitoring program (JOVA).

At Bioforsk we have been working with a new simplified and fast to use model that focuses on the most demanded topics, phosphorus and particles. The model is called AGRICAT-P (Agricultural catchments model – Phosphorus).

Input data from to the model is:

- Norwegian soil map (erosion risk (modified USLE), texture parameter, terrain leveling, (slope length is simplified to 100 m, but will be integrated in later versions).

From a GIS-program the following data are retrieved:

- watershed border,
- actual agricultural practices (when known),
- buffers along rivers/streams if effects of vegetation zone should be calculated,
- existing vegetations zones with influence area,
- sedimentation ponds that are planned and existing ones with watershed area for ponds.

From government subsidy registers we retrieve data about production, subsidies and environmental measures the farmer has been paid for. From a national soil database we collect P-AL analyzes for the last 7 years on each field that are registered. For a typical agricultural municipal this will be 1000 to 3000 analyzes.

Quantification of nutrient fluxes on catchment scale as basis for evaluation of the effectiveness of mitigations options in Austria and the Danube Basin

Matthias Zessner
Technical University of Vienna, Institute for Water Quality

This contribution is going to deal with the actual status of the quantification of nutrient fluxes on catchment scale in Austria and the Danube Basin. Actual efforts will be presented. The strength of the used approaches will be shown and short comings will be discussed.

Actual results show the sectoral and spatial focal points of nutrient emissions. One interesting outcome is that the nitrogen emissions from agriculture into the air exceed the emissions directly to the water system. Related to that, the high importance of the atmospheric deposition on mountainous areas can be documented for nitrogen inputs in the water system of alpine regions in Austria. The area specific nitrogen emissions in some mountainous areas without significant agricultural activity exceed the values from areas with high agricultural activity of the hilly and plain parts in Austria and the Danube Basin. Due to the high transport distances of airborne nitrogen, this means that the location of emission to the air (mainly from husbandry and traffic) is disconnected from the effects on the water system. Future mitigation strategies will have to specifically address airborne nitrogen.

Upcoming research activities will have a special focus on the quantitative assessment of nutrient inputs from mountainous areas into the water system. This contribution will finally address the planned activities.

Nutrient management in the Elbe basin – targets and measures

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Introduction

In accordance with the Water Framework Directive the transboundary river district Elbe has prepared a draft River Basin Management Plan (www.fgg-elbe.de). The draft plan is currently open for public consultation. During the preparation of the plan, it was recognized that the goals set by the WFD can only be achieved if important pressures e.g. nutrient inputs, specific substances and hydromorphology alterations are reduced. To analyze these problems three working groups were installed with the task to develop targets and measures for pressure reduction. The working group results were used during the preparation of the management plan.

Target

A reduction of nitrogen and phosphorus loads from the Elbe basin is required to achieve a good ecological status in all surface water bodies to combat eutrophication effects. The necessary reduction from the river basin to the North Sea was calculated from the chlorophyll a concentration in coastal waters. The current chlorophyll concentration data exceed the concentration at the good to moderate boundary by 24 %. This value is used as the long term target for the nitrogen and phosphorus load reduction.
This goal can not be achieved within short time scales until the end of the first management period. Therefore the load reduction was distributed equally over the three management periods.

Measures

With the MONERIS model, the sources of nitrogen and phosphorus emissions were quantified and are reported on sub-unit level. In the Elbe basin, more than 80 % of the nitrogen emissions and more than 60 % of the phosphorus emissions originate from diffuse sources. These model results are used for identifying the most pathways with the largest input and are considered by the measure planning. Measures are planned individually by each federal state. Base measures include the implementation of the Nitrate directive. All Federal States in the Elbe basin in Germany improve the agricultural advisory services to allow farmers to use best practice. Some states have set up specific advisory programs when the chemical status of groundwater bodies is not good. In addition all states have developed agri-environmental schemes to reduce nutrient losses from agricultural areas. These measures focus mainly on the reduction of nutrient losses due to erosion. Some states use river and wetland restoration plans to improve nutrient retention in the landscape.

Effectiveness

It is assumed, that the measures in the Elbe basin will lead to a load reduction for nitrogen by 7% and for phosphorus by 9%. If this goal will be reached, will be evaluated with the monitoring program. However, quantifying the effect of the measures is highly uncertain due to several factors. It is uncertain, how and when a reduction of nutrient surpluses will have measurable effects in surface water bodies due to long transient groundwater transport times. It is uncertain, how many farmers will apply for agri-environmental funds and how the effect of these measures can be quantified.

Perspectives

From the development of the River Basin Management Plan it became clear, that a significant reduction of point and non-point nutrient sources is required to achieve the ecological goals set by the WFD. Measures planned for the first management period will be important but are only a first step in the direction of the required nutrient load reductions. For the future, it is necessary to consider these environmental objectives in all policy planning at European level, and to focus both on reduction of nutrient inputs from point and non point sources, and to improve nutrient retention in the landscape.

Implementation of management measures against pollution of surface waters with nutrients from agriculture in the first RBMP of the Czech Rep.

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The implementation of WFD in the Czech Republic has been done under the auspices of two ministries, i.e. the Ministry of Environment and the Ministry of Agriculture. The key WFD directives concerning pollution of waters with nutrients like the Nitrates Directive and Urban Waste Water Treatment Directive were included in the national water law already in 2001. Preparations of river basin management plans (RBMPs) started in 2005 when a ministry edict was issued with an outline of required information about basins, monitoring programmes, analyses of water management options etc.. The RBMPs have been elaborated separately by each of the 5 national river basin authorities, however, with mutually coordinated methodological approaches on an informal basis. The RBMPs were not prepared by the authorities themselves but were contracted at consulting companies. Currently, the RBMPs are in the stage of evaluation of comments from the public and approval by regional authorities that will be followed by a SEA procedure. In our contribution, we characterize and analyze agricultural nutrient management issues in the RBMP of the Vltava Basin, the largest basin of the Czech Republic, that concern methods for the evaluation of nutrient pollution to surface waters and direct and indirect measures for its abatement.

Developing a preliminary River Basin Management Plan for the Evrotas River, Southern Greece

Vardakas L.[1]**, Tzoraki O.**[2]**, Skoulikidis N.** [1]**, Economou A.N.** [1] **&. Nikolaidis N.**[2]
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[2]*Department of Environmental Engineering, Technical University of Crete*

The Water Framework Directive 2000/60/EC (WFD) has set tasks to overcome water related problems (socio-economical & environmental) in all Member States. The Directive requires water management plans, programmes of measures and environmental quality objectives to be pursued on the scale of entire river basins. In Greece, there is a slow progress in implementing the Directive, due to structural constraints, lack in environmental information, specifically for biota, due to the inadequate funding for background research. In 2005, a European Life Environment project entitled ‘‘Environmental Friendly Technologies for Rural Development’’ took off in the river basin of Evrotas, southern Greece, which was nominated as Pilot River Basin for Agricultural Development. The main objective was to assist the implementation of the WFD by providing a management plan for the Evrotas River Basin which includes among others a toolbox of environmental friendly technologies for the minimization of pollution sources. This communication presents a preliminary design of the management plan which focuses on the following six axes: *1. Agricultural development, 2. Pollution Control, 3. Irrigation, 4. Drinking Water Supply, 5. Joint action against floods and droughts, 6. Protection of the biodiversity and restoration actions for the riverine ecosystem.*

The dominant pressures in Evrotas River Basin derive mainly from agricultural activities and include overexploitation of water resources for irrigation, disposal of agro-industrial wastes (mainly from olive oil presses and orange juice factories) and agrochemical pollution. Based on the European and national legislation regarding drinking water quality criteria, the chemical status of groundwater bodies was in general in good condition. The surface water ecological status was assessed based on the hydromorphological, physicochemical and biological quality elements (fish fauna and macroinvertabrates). The hydro-morphological status ranged from high to good in the upper parts of Evrotas tributaries and from poor to bad in the middle and lower part of the Evrotas main course. The physico-chemical status ranged between high and moderate, with the majority of samplings sites (74%) classified as good. The ecological status based on macroinvertabrate communities showed high spatial and temporal variability depending on the distribution of point pollution sources. Assessments based on fish fauna showed a generally poorer biological status, with more than half (52%) of the sampling sites classified as bad. This situation was largely the consequence of an unusual drought event which occurred in summer 2007 and, combined with overexploitation of the water resources, resulted to the complete drying of almost all tributaries and about 80% of the main river course. In the remaining part of the river, where summer flow was maintained, the biological status of fish fauna ranged between high and moderate.

The surface and groundwater bodies that form distinct management and functional administrative units were determined. Overall, 41 surface water bodies (seven in the main course and 34 in its tributaries) and 14 groundwater bodies were identified.

Subsequently, specific measures were proposed for each water body in order to achieve and/or maintain the good chemical and ecological status of groundwater and surface water bodies, respectively. The main environmental measures proposed in Evrotas river basin are presented in Table 1. The effectiveness of measures will be assessed in future research projects.

Currently, the Evtotas River Basin Management Plan presents the most integrated research study concerning the implementation of the WFD in Greece.

Table 1. Main environmental measures proposed in Evrotas River basin.

MEASURES		
Axis 1	Modify Farming System	Mixed farming systems[3], Biological farming system[1] Integrated farming systems[3] Establish organised pasture areas[1]
Axis 2	Fertilizer Control & Reduction	Phytoremediation[1], Drainage canals management[1]. Vegetation management on river banks[3] Use of Fertiliser recommendation system[2]
Axis 3	Drip Irrigation and Drainage system	Estimation of the real irrigation needs, Switching irrigation methods, Change Charges for water abstraction[3], Water re-use (municipal and industrial treated wastewater)[3]
Axis 4	Alternative choices for water supply	Inter-municipalities companies of drinking water supply[3], Wise Cost estimate[3].
Axis 5	Estimation zones vulnerable to flooding	Riparian zone stabilazation[1], Measures to prevent forest fires[2], Natural hazards procasting[2], Management plans for drought and flood protection[2].
Axis 6	Biodiversity & Riparian forest protection	River bed protection, Remediation /Protection of flooded areas[1], Ecological effective discharge quantification (during dry period) [3], Extension of protection areas to ensure the integrity of hot spots of biodiversity[3]

[1] active
[2] has studied and actions are ongoing
[3] under discussion.

Eutrophication in the Azores islands – Portugal

Jorge Pinheiro
University of the Azores

Nonpoint source pollution, especially from fertilizer and manure applications in agricultural lands, has been identified in many parts of the world as the major source of nutrients responsible for accelerating the rate of eutrophication, affecting fresh water quality for most of human uses. The recent intensification of pasture production and caw grazing in the Azores archipelago – Portugal, has brought an excess of nutrient loads to the soils and several lakes are currently subjected to an eutrophic condition. In this paper the volcanic crater of Sete Cidades of S. Miguel Island is taken as a case example for the discussion of the eutrophication process in the Azores where pasture-based grazing of milking caws is the dominant agricultural system. As the native P fertility of these soils is low, fertilizer applications by farmers have been increasingly high over the years. The average annual application rates of phosphorus and nitrogen has been estimated as 135 kg P_2O_5 and 750 kg N, respectively. Results of Olsen P soil tests for the entire pasture area of the watershed in 1998 indicate that the excess of P fertilizer application has build up a high soil P load increasing the risk of transport to the lakes. The degree of phosphorus saturation (DPS) analytical correlates well with Olsen P soil test and it is admitted that soil testing programs can become important in the development of the environmentally oriented best management practices (BMP) to be applied at the Sete Cidades watershed in order to reduce P losses from pastures to the superficial water masses.

Nitrate and phosphorus in Spanish watersheds

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Contrasting with the situation in many countries of West and North Europe, phosphorus pollution related to non-point sources has not been described as a problem in Spain. However, nitrate pollution in surface and particularly in subsurface waters has been extensively described. In Andalusia (South Spain), there is not any particular concern about phosphorus in water reservoirs. Authorities (Confederación Hidrográfica del Guadalquivir and Agencia Andaluza del Agua) focus the control of the water in river and dams on human consumption: there is an strict control of nitrates but not of phosphorus (only after urban treatments in vulnerable zones, where P concentration should be less than 1 or 2 mg L^{-1} depending on the population). The application of the European Water Framework is not still completely operative since "the good ecological state of water" is not well defined according to authorities (personal communication from Conf. Hidrográfica del Guadalquivir). Only the limit in the old "pre-drinking" water directive is still considered (less than 0.7 mg P_2O_5 L^{-1} in water for human consumption).

The authority responsible of the water control in the Guadalquivir Valley (around 80 % of the surface of Andalusia) (Conf. Hidrográfica del Guadalquivir, www.chguadalquivir.es; in Spanish), has 149 stations for controlling water quality. Nitrate and phosphorus is determined periodically in dams and rivers, and chlorophyll content only in dams. It has been described total P concentrations in rivers even higher ranging from 1 to 5 mg L^{-1} in areas of intensive animal production (river Guadaira). In the final part of the Valley, usual total P concentrations ranged from 0.05 to 0.65 mg L^{-1}, with mean values around 0.2 mg L^{-1}. These concentrations are not far from those described in rainfall simulation experiments or in the monitoring of small watersheds in representative soils of the area (Torrent et al., 2007; Saavedra and Delgado, 2006). There is a constant trend in P concentrations in the last fifteen years, which reveals that no actions have been adopted to control or reduce this concentration in rivers or reservoirs.

More severe has been the policy controlling nitrate pollution as implementation of the European directive on nitrate pollution from agricultural sources (Council Directive 91/676/EEC) with the definition of "vulnerable zones" and control measures of fertilizer application and crop management (http://www.mapa.es/app/Condicional/Documentos/Nitratos.pdf; in Spanish). In these areas, the "rules of good agricultural practices" are obligatory, and restrictions in timing, rates, manure store and application and crop rotations defined.

Besides the control of water quality in river and dams by Water Authorities (Conf. Hidrográficas) depending on the Spanish Ministry of Environment or Regional Governments, there is not any intensive study of runoff water in watersheds or any demonstrative project focussed on the control of non-point pollution. Studies have been usually performed at plot or field scale in different parts of Spain, mainly focussed on the effect of soil properties and agricultural practices on nitrogen or phosphorus losses and frequently related to erosion studies (e.g. Delgado and Saavedra, 2005, 2006; Ramos and Martínez-Casanovas, 2009). During the last nineties, an intensive study about nitrate export from irrigated watershed was performed in Aragón (North East Spain) and some recommendations about N application and irrigation done in order to decrease nitrate loss from soils (Cavero et al., 2003). A project from the National Research and Development Plan funded by the Spanish Ministry of Education and Research was started in 2006 to study water quality resulting from irrigation in several watersheds from North Spain with no published results yet (Dechmi, personal communication). The most serious program was established by the regional government of Navarra (NE Spain) with an intensive monitoring program of two irrigated agricultural watersheds in 1996 to study erosion and water quality (Casalí et al., 2008).

References

Casalí J., Gastesi R., Älvarez-Mozos J., De Santisteban L.M., Del Valle de Sersundi J., Giménez R., Larrañaga A., Goñí M., Agirre U., Campo M.A. Runoff, erosion, and water quality of agricultural watersheds in central Navarre (Spain). Agricultural Water Management, 95: 1111-1128.

Cavero J., Beltrán A., Aragües R. 2003. Nitrate exported in drainage waters of two sprinkler-irrigated watersheds. Journal of Environmental Quality 32: 916-926.

Ramos M.C., Martinez-Casasnovas JA. 2009. Impacts of annual precipitation extremes on soil and nutrient losses in vineyards of NE Spain. Hydrological Processes 23: 224-235.

Saavedra C., Delgado A. 2005. Iron related phosphorus in eroded sediments from agricultural soils of Mediterranean areas. Geoderma, 125: 1-9.

Saavedra C., Delgado A. 2006. Phosphorus forms in overland flow from agricultural soils representative of Mediterranean areas. Communications in Soil Science and Plant Analysis, 37: 1833-1844.

Torrent J., Barberis E., Gil-Sotres F. 2007. Agriculture as a source of phosphorus for eutrophication in southern Europe. Soil Use and Management 23: 25-35

Conceptual framework to reduce nutrient losses at catchment scale

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Within COST action 869 "Mitigation Options for Nutrient Reduction in Surface Water and Groundwaters" Working Group 3 has the aim to evaluate the potential effect of mitigation options to reduce nutrient losses to surface water. The emphasis is on Phosphorus (P) and Nitrogen (N). In order to structure the different types of mitigation options it was suggested to set up a conceptual framework for the nutrient losses to surface waters and to show in which way mitigation options influence specific processes or pathways. The first note of this conceptual framework was discussed during the meeting in Waidhofen/Ybbs (Austria, 21 May 2008). Based on the discussion and comments a second draft was written that will be discussed during the meeting in Wageningen (18-19 May, 2009).

In order to identify and recommend mitigation options, it is necessary to have an overview of the implied systems and relations we are looking at in practice: 1) the system which produces nutrients, that is to say the factors controlling the sources, and 2) the impacts which determine the factors to be controlled. Many (production) systems within a catchment / river basin will contribute to the nutrient loads of the ecological system observed (e.g. industry, sewage works/urban, scattered dwellings, direct atmospheric deposition, agriculture, nature). This COST action is focused on agriculture, because many other sources have been reduced over time and agriculture becomes one of the most important sources of nutrient loads over the last years. Furthermore, it is difficult to reduce the diffuse nutrient losses from rural areas and to improve the water quality, because of the complex combinations of different type of available diffuse sources, processes and patterns.

The nutrient losses from agricultural land to surface water depend on the available sources of nutrients and the way these sources can become mobile for transport with the water movement over land and through the soil. Within this presentation a conceptual framework will be presented based on information from and discussion within the small discussion group[1].

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Biologically adjusted P cycle as a measure to reduce P losses from Finnish agriculture

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How much would phosphorus (P) losses decrease from cultivated fields, if P was applied in Finnish agriculture according to the actual, biological need of plants and livestock? We estimated the decrease in P transport by taking account the current P status of the cultivated fields. The adjusted P cycle for Finnish agriculture was calculated for twenty years onwards using yield responses to P fertilization according to a recent overview of P fertilization experiments in Finland. The estimation was done for the whole country and different smaller regions having either intensive animal production (Varsinais-Suomi, pig and poultry,; Pohjanmaa, dairy cattle and fur production) or mainly plant production (Uusimaa). We considered plant P uptake, P balances and consequent changes in soil P status, the latter being estimated according to equations from long-term fertilization trials. Fertilization was adjusted in five-year intervals along with changes in soil P status. As manure application is often an important factor behind over-use of P, we further quantitatively estimated possibilities to reduce P content of manure by adjusting livestock diets. The calculations resulted in biologically justified P fertilizer requirements, P contents in manure and P status of soil after 5, 10, 15 and 20 years in the different areas. The potential of dissolved P losses from soils was estimated from soil P status using a simple equation. According to the calculation, the amount of P fertilization at the starting point (in 2005) was over 4-fold compared to the actual need of cultivated plants, and in areas of intensive animal production it was even higher, more than 10-fold. If P fertilization was adjusted according to the biological response, no P in chemical fertilizers would be applied and a substantial amount of manure would be transported out of the latter areas during the next twenty years. If the livestock diets were adjusted towards minimum P contents, P amount in animal manures would decrease by 12%. In twenty years, 49 % of P applied to fields would be saved compared to situation where P fertilization would continue as in 2005. For chemical P fertilizers, the saving would be 90%. Meanwhile, the transport of dissolved P into surface waters from the cultivated soils would decrease by 30-40 %, most in areas of intensive animal production, which contribute to the water quality of the Baltic Sea.

Key words: Livestock, manure, P fertilization, soil P status

Impact of crop management on nutrient losses

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Crop management influences the risk of soil erosion, surface runoff and has direct impact on the size of the various N and P pools throughout the root zone. Crop management therefore has multiple impacts on the risk of N and P losses from agricultural land, and development of productive crop management strategies, with improved nutrient utilisation and reduced losses, are therefore an important topic for research and development in the years to come. The need for new crops and crop management strategies is reinforced by the expected changes in climate, since in many regions climate change will increase the potential for nutrient losses. At the same time, due to the accompanying changes in growth conditions, climate change will offer new opportunities for designing cropping systems with tighter nutrient cycles.

Improved crop management for mitigation of nutrient losses is typically introduced as “second step mitigation” to be implemented when basic nutrient management strategies have eliminated excessive nutrient supply to the fields without reducing nutrient losses sufficiently. In this COST action the mitigation options allocated to the crop management category include options, where improved crop management is used to protect the fields against nutrient losses though erosion and surface runoff (e.g. strip cropping, cover crops), to catch and immobilise nitrogen during the main run-off season in winter (catch crops) or to reduce P content in soils with excessive P status (P mining).

This presentation will describe crop management as a tool to reduce nutrient losses. Relations and interactions with other agricultural management options will be discussed. Focus will be on crop management as a tool to manage soil N and P pools. Possibilities and effectiveness of P mining against P leaching losses will be discussed based on data from a pilot modelling exercise using Danish soil data as input to the Dutch PLEASE model.

Implementation of agri-environmental measures in Ireland: Case study of the Rural Environmental Protection Scheme

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Since the late 1980's improvement of the quality of all waters has been a national priority. Eutrophication and contamination of drinking waters with faecal bacteria, particularly groundwaters, are highlighted as the main water quality issues. The length of Irish river channel classified as unpolluted has increased steadily from 67% in 1995-97 to 71.4% in 2004-06. Nitrate contamination of groundwaters is not widespread in Ireland with only 2% of public water supplies in excess of the maximum admissible concentration although an increasing number of supplies exceed the guideline value. Agriculture has been implicated as one of the main sources of nutrient loss to water and this led to the introduction of the National Nitrate Action plan in 2006. Irelands grassland based agricultural systems have had many benefits to environmental quality often associated with less intensive farming methods and associated traditional farming practices. The growing realization, at an EU level, of the benefits and impacts that agriculture has on the environment led to the introduction of Agri-Environmental Measures to reduce agricultural impacts on the environment and positively contribute to environmental protection and enhancement. They were introduced through a number of EU regulations such as 797/85 EC and 2078/92. In Ireland, the Rural Environmental Protection Scheme (REPS) was established in 1994. This scheme was designed to financially reward farmers for carrying out their farming practices in an environmentally friendly manner and to ensure good environmental practice on farms. REPS places compulsory limits on inorganic fertiliser rates and application timing. The scheme has been expanded over recent years to include additional environmental measures and to bring it up to date with recent legislative changes such as the implementation of the Nitrates Directive. It also contains a large range of other compulsory and optional measures with a strong emphasis on the enhancement of biodiversity. It is estimated that over 54,000 Irish farms received REPS payments in 2007, worth over €310m and accounting for 40% of Irish agricultural land. Measures for the protection of water quality account for 5 of 11 basic measures and 4 of 12 supplementary measures. The presentation will review the water quality related measures as they pertain to the achievement of good status for waters. The efficacy of specific measures in REPS is currently subject to review in a number of research projects nationally and internationally. Further research is currently being conducted to identify new measures for inclusion in the scheme such as manipulation of water course margins and cattle drinking water access.

Soil erosion control measures, effectiveness and implementation strategies – the case of Spain and Austria

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Erosion is a driving process of water pollution and eutrophication across Europe and worldwide. A number of erosion control measures exist to minimize soil losses from agricultural land to aquatic ecosystems. They have however different potential with respect to both their effectiveness and their success of implementation. This presentation discusses the potential of some of the existing approaches to reduce soil and phosphorus losses to water with special emphasis on different environmental conditions as prevailing in Spain and Austria. Practical implementation of different measures through policy initiatives, their success or failure will be an additional topic to discuss.

Extended abstract

Soil Water Erosion in Slovakia - Problems and Solutions

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Abstract
In the Slovak Republic, the moderate up to the extreme potential erosion risk was assessed for 65% of agricultural soil fund. We have analyzed universal erosion control principles, established legislative documents associated with soil erosion control, relationship between water erosion intensity and existence of soil, as well as computing methods, used in erosion control. The results of these analyses show that if the actual legislative acts will be applied in practice, soon or later the soil layer on specific sites will by totally devastated. We have also found out that application of STS No. 75 4501 protects soil better than application of Act No. 220/2004.

***Keywords*:** water erosion, erosion control principles, intensity of soil formation, acceptable intensity of erosion, acceptable length of slope

Introduction

Agriculture, as areally most extended human activity, significantly affects not only the food-supply of population (in former times it was considered the most important function of agriculture), but it widely influences also the environmental protection and management as well as the rural social structure.
Soil, together with water and vegetation, creates the conditions required for existence of life on the Earth. Therefore it is necessary to take care of a soil and to protect and use it not only in such a way that we preserve its present quality and acreage, but also that we will improve potential for a production as well as the other irreplaceable functions of a soil.
To protect soil involves also eliminating its degradation. According to Bielek (1996) there are 7 principal forms of soil degradation. Erosion of a soil is considered to be the most important form of physical soil degradation in Slovakia and water erosion the most significant problem of agricultural soils in Slovak Republic.
According to data presented in Table 1, the moderate up to the extreme potential erosion risk was assessed for 65% of agricultural soil fund of Slovak Republic.

Table 1 Potential water erosion risk for agricultural soil fund (ASF) of Slovak Republic (Ilavská, 1998)

Characteristic of water erosion risk	Acreage in ha	% of ASF
none or low risk	1 065 420	45
moderate risk	473 520	20
high risk	426 170	18
extreme risk	402 490	17

Material and methods

Problems of water erosion in Slovakia and possible management of erosion control and soil conservation in the conditions of Slovak Republic were solved:

a) according to analysis of universal soil erosion control principles,
b) according to serious analysis of established legislative documents associated with soil erosion control,
c) by analysis of relation between water erosion and existence of soil,
d) by comparison of current computing methods, which are necessary for design of erosion control measures.

Results and discussion

a) Soil erosion control principles

According to research and study of processes, which are associated with water erosion of soil, we can declare that the general principles of erosion control, aimed reducing its intensity include(Antal, 2005):

1. protection of the soil surface against the effect of the kinetic energy of rain drops and of the runoff ;
2. increasing the infiltration capacity of the soil to reduce volume and velocity of runoff;
3. improving the aggregate stability of the soil to decrease the soil erodibility;
4. increasing surface roughness to reduce the velocity of runoff ;

increasing the retention and accumulation capacity of the soil surface to reduce volume and velocity of runoff;

5. controlling the runoff from sloping land to reduce the rill and gully formation and safely dispose of excess water.

b) Analysis of actual legislation and regulations

The most important legislative acts aimed at soil conservation in Slovak Republic are:

- Act No. 220/2004-Soil Protection Law,
- Slovak Technical Standard No. 75 4501-Conservation of Agricultural Soils. Basic regulations.

After Slovak Technical Standard No. 75 4501, the erosion-control measures are divided into the following types and subtypes:

1. anti-erosion land organisation, that including mainly:
   - distribution and location of woodland, grassland and cropland;
   - shape, size and position of fields;
   - grazing land management;
   - communication network.
2. anti-erosion agricultural practices, that including mainly:
   - contour cultivation;
   - mulching;
   - crop rotation;
   - tied ridging.
3. biological measures, that including mainly:
   - strip cropping;
   - conservation grassing;
   - conservation forestation.
4. technical (mechanical) measures, that including mainly:
   - terrain regulation;
   - terracing;
   - waterways.

Act No. 220/2004 contains following erosion control measures:

- seeding of special purpose agricultural and protective vegetation;
- contour cultivation;
- changing the crops with protective effect;
- intercrop for mulching combined with no-tillage farming practice;
- no-tillage farming practice;
- conservation crop rotations containing change of crops with protective effect;
- other measures, which will by defined by responsible office according to degree of soil loss .

Another, relevant difference between Act No. 220/2004 and STS No. 75 4501 is in the definition of acceptable soil loss.

c) Water erosion and existence of soil

By the analysis of relation between water erosion intensity and its sustained existence is necessary to regard especially the following facts (Antal, 2005):

1) Water erosion is a natural process, which cannot by stopped by human measures or interventions. The only thing, which can be affected by conscious or unconscious human activity, is the increase or decrease of water erosion intensity.
2) Precipitation, as the most important factor, influencing the water erosion rate, has accidental character. Therefore by the assessment of rainfall characteristics, including the evaluation of erosive effect of the rain have to be used corresponding work (computing) methods, which are for example statistical methods and probability theory.
3) Soil, as another important factor, which influences the water erosion rate, is defined as natural (not artificial) formation. It has a long-term process of formation (soil formation process) and it is not only formed at specific place, but it can also disappear from this place, for example as the action of soil erosion process.

4) Existence of soil is threatened if:

$$i_{EP} > i_{TP} \qquad (1)$$

where i_{EP} - water erosion intensity
i_{TP} - intensity of soil formation process

5) The values of soil formation intensity, expressed as a time, which is required for generation of 1 cm of soil thickness, are in range from 10 to 1000 years.
6) In the conditions of Slovak Republic, that 1 cm of soil is formed in 200 years. From equation (1) results that the soil existence in our condition is threatened when water erosion intensity exceed the value i_{EP}>0,05 mm per year, let us say if the soil loss from 1 ha per year is greater than 0,5 m^3, or 0,7 t (for ρ_d=1,4 $t.m^{-3}$).

Table 2 Values of acceptable and limit intensity of soil water sheet erosion

The depth of soil [m]	**$S_{p,accep}$ [t/ha/year]**	**$S_{p,lim}$ [t/ha/year]**
< 0,30	1,0	4,0
0,30 - 0,60	4,0	10,0
0,60 - 0,9	10,0	30,0
> 0,9	10,0	40,0

- We recommend to compare this value with so-called limit values of soil loss according to Act No. 220/2004-Soil Protection Law($S_{p,lim}$ **)** or with so-called acceptable values of sheet erosion intensity according to STS 75 4501: Conservation of Agricultural Soils. Basic regulations ($S_{p,accep}$ **)** - Table 2.

d) Computing methods
Groundwork for design of erosion control measures is Universal Soil Loss Equation (USLE), which helps us to estimate, if it is necessary, to apply any erosion control measures on the specific field. Mean annual soil loss from a specific field can be computed as:

$$S_P = R.K.L.S.C.P \qquad (2)$$

In Slovak Republic we also use so-called the acceptable length of slope-l_{max} that can be calculated, for example, by the next equation (Antal, 2005):

$$l_{max} = v_k^2 . \square / 87. \square . i . \sqrt{I} \qquad (3)$$

where R, K, L, S, C, P. - factors in the Universal Soil Loss Equation (USLE)
v_k - critical velocity of runoff for the given soil (Table 3) - [m/s]
$\square$ - Basin's roughness coefficient
$\square$ - runoff coefficient
i - rainfall intensity for the design return period (Tab. 3) - [m/s]
I - hydraulic (slope) gradient - [m/m]

Table 3 Estimate values of v_k (STS No. 75 4501)

Soil texture type	**v_k [m/s]**
Sand	0,305 – 0,397
Loamy sand	0,264 – 0,343
Sandy loam, Loam	0,248 – 0,322
Clay loam	0,245 – 0,318

We can find a number of similarities between Equation (2) and Equations (3). In both types of equations are directly regarded rainfall characteristics (R, i), characteristics of soil (K, v_K, τ_K, γ, φ) and slope gradient (S, I). Slope length (L, l_{max}), as well as vegetative cover and erosion control measures (C, P, γ, φ) are also indirectly regarded in both types of equations.

Table 4 The design return period for project of the anti-erosion measures

Type of land use	Return period in years
Field plant production far from settlement	5
Field plant production in contact with settlement	10
Permanent meadow and pasture	5
Special plant production on the slope less than 10 %	5
Special plant production on the slope 10-45 %	10
Special plant production in contact with settlement	20

Conclusions

Requirements for erosion control presented in actual legislative acts and directions are not uniform. In terms of soil conservation it is necessary to apply, at all possible events, the acceptable values of soil loss which are presented in STS No. 75 4501.

Currently used computing methods regards all-important erosive factors, therefore are they in principle equivalent.

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References:

1. ANTAL, J.: 1980. Soil conservation and reclamation. (In Slovak). Bratislava. PRÍRODA, 1980. p. 101.
2. ANTAL, J.: 2005. Soil erosion control. Nitra: SPU V NITRE, 2005. p. 79. ISBN 80-8069-572-5
3. BIELEK, P.: 1996. Soil conservation. Code of correct agricultural practice. Bratislava: VÚPÚ, 1996. p. 54.
4. ILAVSKÁ, B.: 1998. The use of information system in erosion control. In: Sustainable soil fertility and soil erosion control. Nitra/Sielnica: VÚPÚ, 1998. pp. 331-337.
5. Act No. 220/2004-Soil Protection Law.
6. Slovak Technical Standard No. 75 4501- Conservation of Agricultural Soils. Basic regulations.

Wetland restoration of marginal arable land: A Mediterranean experience

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During the 20th century many wetlands in Europe and elsewhere were drained and converted to arable lands. Before drainage, most of these wetlands had functioned as nutrient sinks that protect water quality downstream. The alteration of these wetlands had transformed the natural nutrient sinks into nutrient sources which jeopardize downstream water resources. The removal of this crucial nutrient sink had usually resulted in increased nitrate and phosphorous loading into waterways. Other consequences of the drainage included rapid oxidation of the exposed peat soils which lead to loss of top soil by dust storms especially in dry climate regions of the Mediterranean basin. To reverse some of the negative consequences of the drainage and to minimize nutrient loadings to water resources downstream a reconstruction project was implemented in the mid 1990s which replaced 600-ha farm land with a shallow lake-wetland complex. The main mechanism of nutrient removal using this complex is denitrification of the nitrate-rich water draining into the lake. The phosphorous is partially removed by adsorption onto lake-wetland sediments, alas high sedimentation rates would shallow the lake requiring periodical sediment removal. Nutrients excess that are released from this complex to waterways are partially diverted from the main river system via network of canals and pipes and are pumped back into the surrounding mountains for farming. Decadal monitoring of the lake-wetland complex showed high efficient in N removal. For example, during the first half of 2008 about 30 ton of N were denitrified and removed from the Jordan River, 2.8 ton of N were pumped back to the surrounding mountains while 5.5 ton of N were released downstream. About 2.2 ton of N was unaccounted for and represents the uncertainty in the seasonal N budget. The rate of denitrification has increased in 2008 compared with previous years due to the prolonged draught. Lower denitrification rates were reported in wetter years due to shorter residence time. During the same period about 0.47 ton of P entered the complex while 0.55 ton of P was released. Hence, the lake-wetland complex is shown to act as a P source. Pumping 0.09 ton of P for irrigation in the surrounding mountains had approximately equaled the excess P released during this period. About 0.2 ton of P was unaccounted for and represents the uncertainty in the seasonal P budget. The P loading was highly correlated with suspended material in this system and exhibit high seasonal fluctuations.

Ecological and nutrient retention effects of river and floodplain restoration: experiences from Denmark

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River restoration was allowed in Denmark with the Watercourse Act from 1982. Since then, more than 64 large re-meandering projects have been carried out but only a few have included monitoring of the ecological and nutrient retention effects. In this presentation results from re-meandering projects covering small headwater streams (1^{st} and 2^{nd} order), medium-sized streams (3^{rd} and 4^{th} order) and large streams (5^{th} and 6^{th} order). All three re-meandering projects included pre-monitoring and post-monitoring of macrophytes and macroinvertebrates the longest monitoring period being 19 years after re-meandering. We found large differences in the recovery of macroinvertebrate and macrophyte diversity in the three different stream types. The 1^{st} order Gudenå stream had a poorer ecological quality two years after re-meandering work had finished, the 3^{rd} order river Gelså had recovered after two years, and the 6^{th} order river Skjern had already regained or even improved the ecological quality after one year. The nineteen years of post-monitoring in the Gelså case study show that passive restoration by ceasing stream maintenance (weed cutting) can be as effective a restoration measure as active re-meandering of the stream channel.

Most river re-meandering projects carried out in Denmark during the last 8 years are projects initiated as part of the Danish Action Programme II and III for reducing nutrient loadings to the aquatic environment. We have monitoring data from a number of restoration projects showing that the restored hydraulic interaction between river and floodplain results in significant reductions in riverine nitrogen loadings (39-372 kg N ha^{-1} inundated floodplain), whereas the phosphorus loading can both decrease and increase depending on the iron and P content of the rewetted former agricultural soils. However, research data from inundated floodplains shows that the deposition of particulate P on floodplains (10-70 kg P ha^{-1} inundated floodplain) will reduce riverine phosphorus loadings on a longer time perspective. River and floodplain restoration projects as well as ceased stream maintenance are expected to be widely used as a cost-effective mitigation measure for reducing diffuse nutrient loadings to coastal waters as part of the River Basin Management Plans under the Water Framework Directive.

ABSTRACTS OF

POSTER PAPERS

Experiences of using different calculation methods concerning the RBMB work in Finland

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Agricultural production is a major source of diffuse nutrient loading to lakes and rivers in Finland. Total nutrient load from catchments depends strongly on the proportion of agricultural land. Studies in Finnish agricultural catchments and river basins have indicated only minor reduction of nutrient loads in spite of massive efforts towards environmentally sound management practices including a massive and widely adopted (more than 90% of the farms participating) policy measure for controlling nutrient losses from agriculture. In Finland, researchers and end-users apply various models in order to assess nutrient losses from agricultural and other rural areas. However, few of the models are suitable for catchment scale calculations. In the implementation of the Water Framework Directive a goal is to be familiar with large river basins and to assess the nutrient losses of different loading sectors. Therefore, the most practical way was to integrate some models together and to apply them individually.

After the loading calculations, a very important step is also to use suitable water quality models of lakes in order to get reliable estimations of the effects of different water protection measures. Pirkanmaa Regional Environment Centre (PREC) is one of the end-user agencies, which in practice makes the final calculations of nutrient losses and selects the tools (models) for applications. Relatively simple modelling tools, such as VEPS, have been utilized to identify the river basins susceptible to risk of eutrophication. VEPS calculates potential annual nutrient load (agriculture, forestry, point load, deposition, peat production and natural background load) for all third-level sub catchments in Finland. In order to get more detailed information of agricultural loading, the VIHMA model was used at PREC. VIHMA model is a decision support system developed to be a planning tool for allocation of mitigation measures against erosion and nutrient loading. The selected cultivation methods affect characteristics of the field surface in different ways, key factors being the timing and intensity of tillage, vegetation cover during the winter and the stability of the vegetation cover. In water quality modelling, a linked CSTR mass balance system was used.

Keywords*:* agriculture, nutrient loading, model, VEPS, VIHMA

Critical evaluation of the first 15 years of the Nitrate Directive: results, failures and urgent tasks

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It is now 18 years since the European Union passed the Nitrates Directive, aimed at protecting surface and subsurface waters in EU countries. It is therefore worth reviewing the progress made in recent years in achieving the aims of this major agricultural and environmental regulation. A comparison of changes in the nitrogen (N) and phosphorus (P) balances of the EU15 and NEU10 countries and in the P supplies of the soils over the last 15 years will be used for this purpose.

The negative NP balances and worsening NP status in CEE countries, including those which have recently joined the EU (NEU12), may result in increasingly low yields and in economic and agronomic problems. These trends are in sharp contrast to the practices in some of the EU15 countries, where strongly positive NP balances and oversupplies with NP may lead to environmental and ecological threats, though, there is evidence that the level of oversupply in many of these countries is on the decline.

Co-operation within the European Union should help to solve both the environmental threat facing the Western part of the community, and the agronomic and economic problems in the Central and Eastern part.

River basin management plan for the River Scheldt in Flanders

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Introduction

The Water Framework Directive divides the European rivers in river basin districts. Flanders is involved in two river basin districts namely for the river Meuse and for the river Scheldt. The groundwater and the large surface water systems are taken up in the river basin management plan (RBMP). The river basin district of the Scheldt is almost 36500 km^2 of which one third is laying in Flanders. A brief overview about the RBMP for the Scheldt will be given here containing the measures to obtain good water conditions as enforced by the Water Framework Directive.

How does it work?

The surface water and the groundwater in the Scheldt basin are split up into water bodies in function of specific categories. The surface water bodies are classified in terms of natural or artificial bodies, a distinction which is very important in view of the goals to be achieved. The groundwater is dived into 6 groundwater systems depending on the depth of the water layers. After summing up all the standards that have to be met for good water conditions, each sector that has an influence on the quality is analyzed and ranked.

Analyzes showed that with only the basic measures the good water conditions won't be obtained in 2015. Therefore, a list of additional measures is made which is divided into 8 groups so that the environmental conditions will be obtained.

Before carrying out a measure, a cost/benefit analysis is done to see which way is the best possible one to follow. Also the influences on the involved sectors are being investigated. The follow-up is done by analyzing the water at different points in the water district.

Results

The network of measurements created by the Flemish environmental agency makes it possible to evaluate the effect of measures e.g. manure decree, on the quality of the surface water (since 1999) and the groundwater (since 2004). For the surface water quality a decline is noticed in the percentage of measurements points that were above the limit of 50 mg NO_3^-/l : from 59% in 1999 to 37% in 2008. The biggest improvement was found in the upper and lower Scheldt. The measurements of the groundwater indicate very little changes in the quality of the groundwater.

References

All information is obtained out of documents created by the Flemish environmental agency and the co-ordination commission integral water policy.

Experimental determination of the effectiveness of unfertilized grass buffer strips in the Netherlands

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Like in many other countries, source measures are not enough in the Netherlands, to reduce P loads to surface waters below the required levels for environmental goals. Several alternative measures are being investigated to mitigate P loads. One of the suggested measures is to apply an unfertilized buffer strip. This poster presents experimental data from a research project that was initiated in response to an agreement made between the Netherlands and the European Union. Brussels suggests 5 m wide buffer zones along waterways, but the Netherlands wish to investigate their effectiveness first. P loads to the ditch appear to be highly variable in space and time. This is primarily caused by the discharge (as opposed to P concentration). There appears to be an effect of buffer strips on some locations and in some seasons, but this effect is not (yet?) consistent in time for every field location.

Actual and future needed contributions of Sciences and Policy in Germany regarding the implementation not only of the RBMP of the EU-WFD for reducing impact of agricultural losses of the nutrients C, N, P, (S) in river basins / catchments

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Introduction

The EU-WFD (2000) aims the P reduction in surface waters and groundwater, but N reduction together with the EU-Nitrates Directive (1991) and the EU-Groundwater-Directive (2003) only in respect to human health (Methaemoglobinaemia, stomach cancer) with an supposed critical level of 50 mg $NO_3^{-\cdot}$ l^{-1}. But nitrates preserves, rather than threatens human health (e.g. against bacterial infections by dental caries, gastroenteritis, cardiac infection, cardiac vascular disease, hypertension of blood pressure and gastric ulcers) with needed daily adult intakes of 250-1400 ma $NO_3^{\cdot}$ d^{-1}. Furthermore critical N and P loads esp. for coastal and marine waters are more or less neglected, because the impact of the WFD ends only 1 sea mile away from the costal lines. Those dilution strategies like here against eutrophication of coastal and marine waters will fail without crucial loads and levels concepts.

Methods, main results and conclusions

As described in COST 869 with about 100 factsheets there exist also in Germany similar numerous proposals from sciences to reduce N and P emissions from rural areas to groundwater and surface waters. Since 1983/87 till 1998/2000 the nutrient inputs from agriculture into the surface waters and into the German parts of the seas has decreased related to N only of about -20% and -13% respectively and to P has even increased by +4% and +8% respectively. The shares of agricultural sources in 1998/2000 on total N inputs were 57% and 67% respectively, on total P input 48% and 51% respectively (Behrendt et al. 2003). Since 2000 these N and P inputs into the groundwater and surface waters by agriculture were absolutely more or less the same (German EPA 2000-2008). – The main causes of missing (further) effective reductions in N and P emissions from agriculture and to get developments towards sustainable nutrient balances not only of agriculture but also of the total system nutrition (including also human nutrition) were on the one hand intentional misleading official recommendations esp. in respect to the optimum use of organic fertilizers since the 80ties of former century to maintain a more than 2fold too high animal production (maximum 0.1 $AU^{\cdot}$ $capita^{-1}$) and up to 4fold too high animal densities (maximum 1.0 $AU^{\cdot}$ ha^{-1}). On the other hand corresponding agricultural legislations like the German Fertilising Directives (1996-2007) mainly made by the German Ministry for Nutrition, Agriculture and Consumer Protection dominated by Lobby ➔ Lobbyism (➔ Corruption) of e.g. these officials, farmers organizations, nutrition involved industries etc. to maintain these actual non sustainable nutrient balances, esp. of C, N, P. Additionally actual N surplus of German agriculture increases from 106 kg $N^{\cdot}$ $ha^{-1\cdot}$ yr^{-1} in 2001/2003 to 159 kg $N^{\cdot}$ $ha^{-1\cdot}$ yr^{-1}considering not only N inputs but also the N deliveries by additional atmospheric deposition (+13 kg $N^{\cdot}$ $ha^{-1\cdot}$ yr^{-1}) and esp. by net mineralization through change from grassland to arable land (+29 kg $N^{\cdot}$ $ha^{-1\cdot}$ yr^{-1})

and cultivation of moor land/fens (+11 kg $N \cdot ha^{-1} \cdot yr^{-1}$) (Isermann 2009). The production of biomass (esp. bioenergy) will furthermore increase N and P surpluses of agriculture.

But there are also needs and corresponding (inter-)national and worldwide perspectives in the development of sustainable nutrient balances, not only sectional within agriculture but by a holistic approach for the total systems like here multi-sectional and multi-medium scaled C-, N-, (P-), S-balances for the systems nutrition and biomass (esp. bioenergy). Initiated by Agenda 21 of Rio (1992) and enforced by the EU Strategy for Sustainable Development (2001/2005) Germany starts with a "National Strategy for Sustainability as Perspectives (2002)" and "The Report on Sustainability Indicators (2008)" referring 8 of 21 indicators for "Sustainable Land and Soil Use". One indicator is an unrealistic N surplus for agriculture (farm gate balance) in 2010 of 80 kg $N \cdot ha^{-1} \cdot yr^{-1}$ but a realistic one of 50 kg $N \cdot ha^{-1} \cdot yr^{-1}$ in 2020. Therefore needed land use managements and their implementations are shown here. Correspondingly German EPA developed a multi-medium and multi-system strategy for the needed reductions of N emissions (2008).

Both EU and National German Marine Strategy (2008) aimed good chemical status in coastal waters (also nutrients) at least within the zone of 12 sea miles from the coastal lines. Therefore the average maximum tolerable critical nutrient levels and loads of the streams are only about 2fold higher than their (natural) background (BG) values. This is corresponding in Germany to 2x CBG_N = 1.42 mg $TN \cdot l^{-1}$ and 2x IBG_N = 186 740 t $TN \cdot yr^{-1}$ respectively and 2x CBG_P = 0.068 mg $TP \cdot l^{-1}$ and 2x IBG_P = 7 156 t $TP \cdot yr^{-1}$ respectively (LAWA 1998, Behrendt et al. 2003). – EUROSOIL (2008) shows about 500 indicators referring to sustainable land and soil use, especially in respect to the 11 main threats on soils, 10 of these are essentially caused by agriculture and 5 by their emissions of C, N, P, S. – Partly initiated by BSNLC the following (inter-)national Working Groups (WG) and worldwide activities are actually involved in Sustainable Land Use mainly in respect to the nutrients C, N, P, S:

1. Germany: Association of German Agricultural Analytical and Research Institutes with "WG Sustainable Nutrient Balances in rural Areas" and a.o. "WG Precision/ Optimization of humus balances"; DWA: "WG Sustainable water management in respect of (the fate) of C, N, P, S in the hydrosphere; German Society of Soil Sciences "WG: Sustainable land and soil use".
2. International: WG for long-term field experiments; WG of Soil Fertility; both within IUSS; "WG Lysimeter".
3. Worldwide: IAASTD (2008): "Agriculture and Sustainable Development"; Institute of Sustainable Futures, University of Technology, Sydney (Dana Cordell): Sustainable future in phosphorus flows".

There is a general agreement that without the optimization of humus (C) balances in agriculture there is also no optimization of N, P and S balances with the nutrition and biomass systems. This should also be accepted by COST 869.

Surface runoff of phosphorus from flat fields

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Like in many other countries, source measures are not enough in the Netherlands, to reduce P loads to surface waters below the required levels for environmental goals. Several alternative measures are being investigated to mitigate P loads. One of the suggested measures is blocking surface runoff. Assuming that complete elimination is possible on flat fields, the P load reduction by this measure equals the original surface runoff load. This poster presents the preliminary results for three field locations in the Province of Limburg. A longer research period is necessary to quantify P runoff, because surface runoff is determined by irregular events with high precipitation intensity. On the grassland field we measured > 115 m^3 runoff, during the first winter season of 2007, but this was only 1.6 m^3 during the past winter season. P-concentrations in runoff up to 10 mg/L were measured.

Phosphorus retention by a constructed wetland

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In the Netherlands, like in many other countries, source measures are not sufficient to reduce the P loads to surface waters below the required levels for environmental goals. Several alternative measures are being investigated to mitigate P loads. This poster presents the preliminary results for a constructed wetland since 2006. A longer research period is required for a sound evaluation because the various processes involved (reed development, nutrient uptake, harvesting, organic matter formation, sorption on the wetland soil, etc.) have not reached equilibrium yet. During 2008 average P retention in the wetland was 25-30%.

Leaching of nitrate nitrogen under different growing crops and nitrogen rates from Fluvisols of Southern Bulgaria

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Leaching of nitrates is primarily associated with conditions that allow nitrogen accumulation in the soil profile. The specific aim of this paper is to evaluate nitrate nitrogen and base cations leaching under Fluvisol rooting zone of cereals and vegetables, grown with application of different N rates and water supply. Data was obtained during field experiments: with cereals (wheat, barley, maize) and with vegetables (pepper, beans, carrots, aubergine) during 1999-2005.

The experimental design with cereals included two N fertilizer treatments and one control. The experiment with vegetables included three N treatments: optimal, 50 % below and 50 % above the optimal. Chemical elements leaching through the soil profile was monitored by modified Ebermayer lysimeters type cut into the soil at 100 cm from the soil surface.

An enhanced migration of NO_3-N and Ca^{2+} in dependence with the applied fertilizer rates was observed in all grown crops, but the correspondence between the applied N rates and amounts leached was better in cereals. The highest N leaching was obtained under maize (8 – 33 $kg.ha^{-1}$) and in the experiment with vegetables N losses were the highest under pepper (9-17 $kg.ha^{-1}$).

A good correlation was found between the N rates and Ca^{2+} losses under cereals, while this relationship was not so well expressed under vegetables. NO_3-N concentration in the lysimetric water under the maximum N treatments exceeded the MPCL for drinking water and could turn into a source of groundwater enrichment by nitrates.

Keywords: Fluvisols, N-fertilization, leaching, nitrates, groundwater protection

Phosphorus and nitrogen losses from a grassland site on a heavy clay soil in a fluvial plain in the Netherlands

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Transport of dissolved nutrients by water through the soil matrix to groundwater and drains is assumed to be the dominant pathway for nutrient losses to ground- and surface water in level areas like the Netherlands. In 2003 a study was started to investigate nutrient losses from a grassland site on a heavy clay soil in a fluvial plain in the Netherlands. The site was drained by drains and trenches. Annual N and P surpluses (input minus uptake) were on average 115 kg N ha^{-1} jr^{-1} en 11 kg P ha^{-1} jr^{-1}. The topsoil (10-40 cm) was non-calcareous, with an organic matter content of 5%, a clay content of 57% and a low degree of phosphate saturation (7%). The $CaCO_3$ content increased with depth to 7% at 1 m depth. Amount and composition of the discharge from the drains, trenches and ditches were monitored for five years.

Monitoring results showed that rapid discharge by means of the trenches was the dominant pathway (60-90%) for water and nutrients. Discharge to the groundwater was negligible. The contribution of the drains to the discharge of the plot depended on the existence of shrinkage cracks in the clay soil. At the end of a dry summer (2002), cracks were abundant and discharge was equally divided to drains and trenches. After prolonged wet periods, cracks were absent and discharge by drains was almost negligible.

Average N losses to surface water by trenches was 13.1 kg N ha-1 jr-1, with an average concentration of 6 mg/l. Average N losses by drains was 3.5 kg N ha-1 jr-1 (5 mg/l). Average P losses to surface waters were 2.6 and 0.7 kg P ha-1 jr-1 for respectively the trenches and drains with average concentrations of 1.2 mg/l and 0.7 mg/l respectively. These concentrations are remarkable high considering the low degree of phosphate saturation and low concentrations in the soil solution. Results of the first three measurement years showed that only a small part of the N and P losses were in dissolved inorganic form (25-50%), accordingly a large part of the annual losses are due to the loss of organic, colloidal or particulate N and P. From autumn 2006 to spring 2008 the discharge was analysed for the presence of dissolved organic, colloidal and particulate N and P. Despite the fact that colloidal P was abundant in water extracts of soil samples (Koopmans et al., 2005), colloidal N and P were not detected in the discharge. Particulate N and P forms were abundant and contributed to 41% of the total N and 72% of the total P discharge. Dissolved organic forms contributed to 42% of N and 9% of the P losses.

It may be concluded that rapid discharge of water by trenches is the dominant pathway for nutrient losses on this heavy clay soil, leading to discharge concentrations which are far above environmental standards for surface water. However, large part of the N and P losses are in organic and particulate form, part of these fractions may not by bioavailable.

Koopmans, G.F., W.J. Chardon, and C. van der Salm. 2005. Disturbance of water-extractable phosphorus determination by colloidal particles in a heavy clay soil from the Netherlands. J. Environ. Qual. 34:1446-50.

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