

Reducing nutrient pollution, challenges in agriculture



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Background paper

Workshop on the Joint Program of Measures

Emilia Kunikova, Water Research Institute Bratislava



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1. Introduction

The purpose of this background document is to prepare the participants of the ICPDR Workshop on Joint Program of Measures (4 – 5 April 2013, Vienna) for the discussion by illustrating the challenges, problems and recommendations for accelerating the implementation of measures addressing nutrient pollution in the Danube basin.

The Joint Program of Measure currently under the implementation in the Danube countries includes measures related to the implementation of the Nitrates Directive in the EU MS and the Best Agricultural Practices in the Non EU MS as the most important measures to reduce nutrient pollution in the DRB by 2015 and also beyond.

Participants at the workshop – experts and decision makers, all acting proactively on water management and financing of measures have the opportunity to gain knowledge on the status of the agricultural measures implementation and its problems, to seize the opportunities through discussions and be the best prepared to deal with remaining challenges to achieve WFD objectives.

2. Nutrient pollution – significant water management issue

Nutrient pollution is one of the main pressures posing the water bodies across the Danube Basin in risk to achieve Water Framework Directive's environmental objectives. This statement is one of the main messages of the Roof Analytical Report developed in the frame of article 5 WFD implementation in 2004.

Based on this conclusion and in harmony with strategy paper for the development of a Danube River Basin District Management Plan (ICPDR DOC 101, 2005) and a corresponding Road Map/Work Plan (ICPDR DOC 110, 2005) the **Document on significant water management issues in the DRB** was developed including **Issue Papers regarding each Significant Water Management Issue**.

This document served as the first outline of the DRBM Plan/JPM - it described its overall scope as well as the approach how to achieve it. The document included visions and operational management objectives for each SWMI, which support the guidance of the Danube countries towards a commonly agreed aim for the DRBM Plan.

2.1. Nutrient pollution – getting inside

Nutrient pollution – particularly by nitrogen (N) and phosphorus (P) - can cause eutrophication¹ of surface waters. Further, their emission and discharge into coastal areas and the marine environment can significantly impact upon the status of those ecosystems. Nutrient pollution is a priority challenge, interlinking the freshwater with the marine environment.

N and P emissions cause eutrophication in many DRBD surface waters and contribute to eutrophication in the Black Sea North Western shelf. For the period 1988-2005, the Danube, as one of the major rivers discharging into the Black Sea, was estimated to introduce on average about 35,000 tonnes of P and 400,000 tonnes of inorganic N into the Black Sea each year.

The level of the total nutrient load in the Danube River system in 2005 was about 35% (N) and 20% (P) higher than in the 1950s, but about 35% (N) and 20% (P) lower than in the late 1980s. The variations are mainly due to variations in point source discharges and levels of agricultural intensification. The increase from the 1950s to the end of the 1980s is approximately a factor 1.7 (TP) and 1.1 (TN). The decrease from the 1990s to the present situation is about 32% (N) and 24% (P). This is due to the political as well as economic changes in the middle and lower DRB resulting in:

- (i) the closure of nutrient discharging industries,
- (ii) a significant decrease of the application of mineral fertilisers and
- (iii) the closure of large animal farms (agricultural point sources).

Furthermore, the application of economic mechanisms in water management (e.g. the *polluter pays principle* also applied in the middle and downstream DRB countries) and the improvement of wastewater treatment (especially in upstream countries) contributed to this decrease.

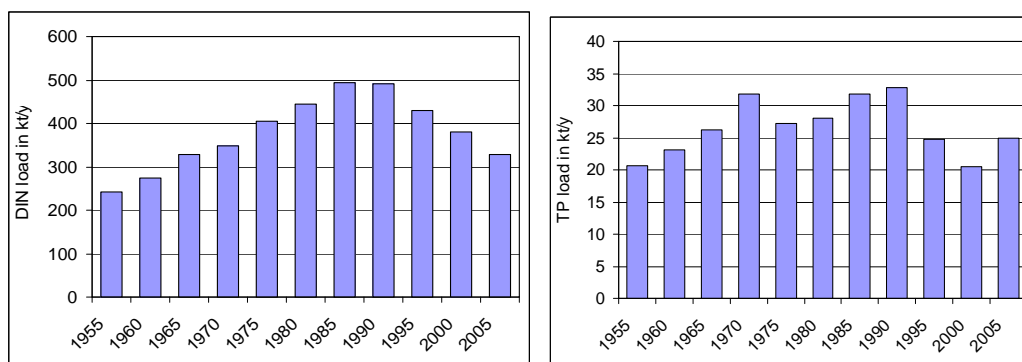


Figure 1: Long-term discharges of nitrogen and phosphorus (1955-2005).

The level of the total Phosphorus load in 2005 that would be discharged to the Black Sea (including the P storage that occurs today in the Iron Gate impoundments²) would be about 20% higher than in the early 1960s (based on modelling results from daNUbs and MONERIS). The Iron Gate Dams (which were built between 1970 and 1986) are a significant factor in reducing the amount of Phosphorous from countries upstream the dams, in the

¹ Definition of *eutrophication*: The enrichment of water by nutrients, especially compounds of nitrogen and/or phosphorus, causing an accelerated growth of algae and higher forms of plant life to produce an undesirable disturbance to the balance of organisms present in the water and to the quality of the water concerned [Directive 91/271/EEC].

² The Iron Gate influences the retention of phosphorus via the sedimentation process and has been taken into account within the MONERIS calculations.

Danube River that eventually reaches the Black Sea. The reason for this is that large amounts of sediment - containing P attached to the sediment particles - settle out in the reservoir behind the dams. Although this P is at present stored in the Iron Gates reservoir it may in future be a significant source of pollution in the case of flood events causing chemical P release. This P release and eventual mobilisation could be a pressure factor for the downstream countries but also for the impoundment section upstream of the Iron Gate Dams.

The previous investigations also showed that the ecological situation in the North Western Black Sea coastal area has improved significantly since the early nineties due to the lower discharges of N and P to the Black Sea. **However, economic recovery in the future, which would potentially result in increasing nutrient loads to the Black Sea (industry, agriculture and increased connection to sewerage), would put the achievement of environmental objectives at risk if not combined with a set of effective measures, especially as required by EU legislation.**

Nutrient pollution is mainly caused by emissions from the agglomeration, industrial and agricultural sectors. Furthermore, for agglomerations, the P emissions via household detergents play a significant role. Regarding nutrient emissions, respective pressures on water bodies can result from (i) point sources (in particular untreated/partially treated wastewaters), and/or (ii) diffuse sources (especially agriculture). The findings of point source analysis have been combined with those related to diffuse sources. The MONERIS model integrates these components and reflects the overall nutrient input in the DRB in total and per Danube country.³

2.2. Nutrient point source pollution

Nutrient pollution from urban wastewater

Nutrient pollution from point sources is mainly caused by emissions from insufficiently or untreated wastewater into surface waters (from agglomerations, industry and agriculture). It should be mentioned that the operation of secondary and tertiary treatment levels at wastewater treatment plants (WWTPs) is of particular importance for the respective elimination/reduction of nitrates/phosphates.

Industry

Many industrial facilities are significant sources of nutrient pollution. The chemical sector is the most important contributor.

Nutrient point source pollution from agriculture

For agricultural point source pollution, data gaps (that mainly exist for Non EU MS as EPER data are available for EU MS) need to be closed in the future in order to perform a comprehensive and more detailed analysis. However, agricultural emissions from diffuse sources are of even greater importance and are analysed by MONERIS.

³ The MONERIS model integrates these components and reflects the overall nutrient input in the DRB in total and per Danube country. SI is using a method based on the OECD method: *Environmental indicators for agriculture. Methods and Results (2006)*.

2.3. Nutrient diffuse source pollution

Diffuse source pollution is caused by widespread activities such as agriculture and other sources (Figure 2). The levels of diffuse pollution are not only dependent on anthropogenic factors such as land use, and land use intensity, but also on natural factors such as climate, flow conditions and soil properties. These factors influence pathways that are significantly different. For N, the major pathway of diffuse pollution is groundwater while for P it is erosion.

MONERIS – a model for point source and diffuse source emissions calculations

The emission of substances from diffuse sources cannot be easily measured. The emissions estimation of diffuse source pollution for large river catchments such as the Danube is only possible by mathematical modelling. In the framework of the DBA and DRBM Plan, nutrient emissions into the river system through individual pathways were calculated/estimated using MONERIS (MODelling Nutrient Emissions in RIVER Systems) model.⁴ MONERIS considers point source emissions and combines them with emissions resulting from different diffuse source pathways. Furthermore, MONERIS integrates various statistical information for different administrative levels, land use, hydrological, soil and hydrogeological data and works for Geographical Information System (GIS) illustration.

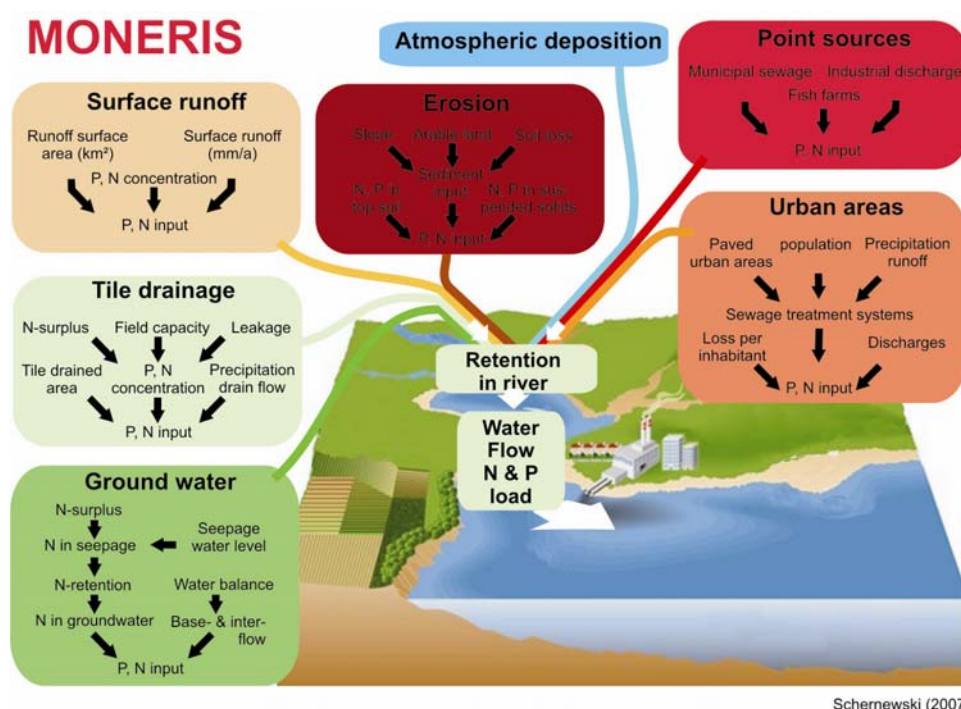


Figure 2: Schematic picture of main processes in relation to sources and pathways of nutrient inputs, including retention, into surface waters (MONERIS model).

Figure shows the MONERIS results describing that altogether 686 kt of N and 61,6 kt of P in total are annually emitted into the DRB. The background conditions presented in MONERIS (7% for N; 9 % for P) represent the pre-industrial situation with very limited airborne

⁴ Behrendt et al. (2007): The Model System MONERIS (2007) – User Manual; Leibniz Institute for Freshwater Ecology and Inland Fisheries in the Forschungsverbund Berlin e.V., Müggelseedamm 310, D-12587 Berlin, Germany.

emissions of reactive N and erosion of soils not yet saturated with P. Consequently, these values are small in comparison with the current DRB emissions. The main contributors for both N and P emission are agglomerations not served by sewerage collection and wastewater treatment. For N pollution, the input from agriculture (fertilisers, manure, NO_x and NH_x) is the most important (totalling 43% of total emissions). For P, emissions from agriculture (area under cultivation, erosion, intensity of production, specific crops and livestock densities) are the second largest source after input from urban settlements. The share of agricultural emissions differs significantly between countries.

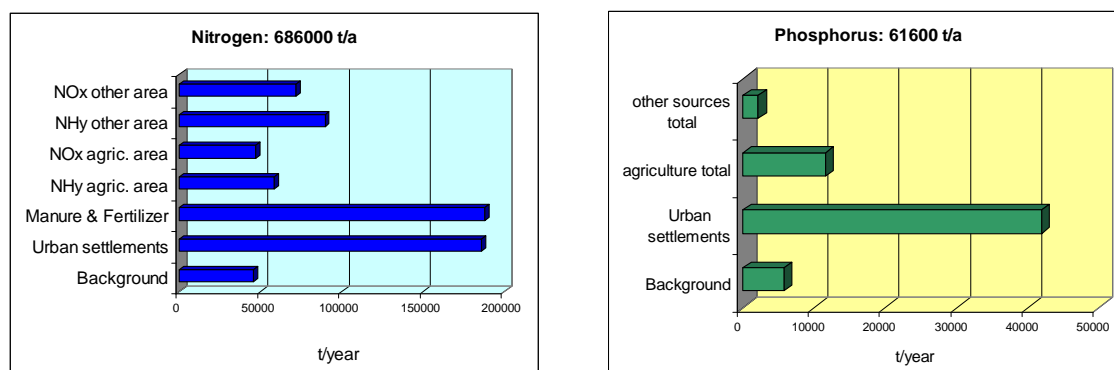


Figure 3: Sources of nitrogen and phosphorus emissions (EU MS and Non EU MS) in the DRBD as of 2005 (MONERIS results).

Phosphate input via detergents

The emission of phosphates via household detergents is significant in the DRB and it is included in the agglomerations contribution to total emissions. In case of no wastewater treatment or treatment without a tertiary treatment the respective P loads find a direct way into the aquatic environment. Currently, only some countries in the DRB have introduced a phosphate ban for laundry detergents, although others intend to follow. P emissions due to laundry and dishwasher detergents in the DRB are estimated at 9,190 t/a. This is 15,7% of total P emissions.

Nutrient input via mineral fertilisers and livestock manure

The use of mineral fertilisers significantly contributes to nutrient pollution in the DRB and it is included in the agglomerations contribution to total emissions. The two most important plant nutrients applied as mineral fertilisers are N and P.

The use of fertilisers dropped significantly after the economic collapse in the early 1990s in almost all Danube countries. This led to a significant reduction in agricultural productivity in the region, including a decline in the use of mineral fertilisers. Data available from the FAOSTAT database⁵ (2004) shows that the use of N fertilisers (kg N/ha) by farmers in the middle and lower DRB countries is far below the EU average and that of upstream Danube countries. In addition, the density of livestock per hectare on farms in lower Danube countries is below the Danube average. It can be expected that the number of livestock will increase in due course leading to an increase in nutrient emissions⁶ if it is not done in a sustainable way.

⁵ FAOSTAT database: Data from the FAOSTAT database of the UN Food and Agriculture Organisation Pesticide Consumption in CEE countries and the EU15.

⁶ Detailed information can be taken from the ICPDR Technical Report on MONERIS to be published in the end of 2009.

The dynamic situation related to agriculture and respective re-thinking in the region could in future significantly affect the extent of nutrient pressure from agriculture on water resources. Summarising the situation regarding nutrient inputs from the agricultural sector, emissions from diffuse sources (such as those from mineral and organic fertilisers and manure) are significant.

Nutrient input via atmospheric deposition

In the DRB, the share of nutrient pollution from atmospheric deposition is also significant. It is diverse in different regions of the DRB and stems partly from sources outside the DRB. The share for N is significant (39%) but less so for P (13%). Contributions to atmospheric nutrient pollution stem from human activities including transport, combustion of oil and derivatives, agriculture (livestock farming) and industry.

3. Vision and Management Objectives for Nutrient Pollution

The Danube countries committed themselves to implement the Memorandum of Understanding adopted by the International Commission for the Protection of the Black Sea (ICPBS) and the ICPDR in 2001⁷ and agreed that *“the long-term goal is to take measures to reduce the loads of nutrients discharged to such levels necessary to permit Black Sea ecosystems to recover to conditions similar to those observed in the 1960s”*. In 2004 the Danube countries adopted the Danube Declaration⁸ in the framework of the ICPDR Ministerial Meeting and agreed that in the coming years they would aspire *“to reduce the total amount of nutrients entering the Danube and its tributaries to levels consistent with the achievement of good ecological status in the Danube River and to contribute to the restoration of an environmentally sustainable nutrient balance in the Black Sea”*. Since Romania is an EU MS, the environmental objectives of the EU WFD are also to be applied to transitional and coastal waters in the Black Sea. Also for the Black Sea, the EU Marine Strategy Framework Directive will be implemented.

As it is mentioned in the chapter 2 the vision and management objectives were defined and published in **Document on significant water management issues in the DRB and Issue Papers regarding each Significant Water Management Issue**.

Basin wide vision for nutrient pollution is formulated as:

“Balanced management of nutrient emissions via point and diffuse sources in the entire Danube River Basin District that neither the waters of the DRBD nor the Black Sea are threatened or impacted by eutrophication”.

As steps towards the vision, the implementation of the following management objectives is foreseen by 2015:

⁷ ICPDR Document IC 027: Memorandum of Understanding between the ICPBS and the ICPDR, 2001 (www.icpdr.org).

⁸ ICPDR Document IC 089: The Danube Basin – Rivers in the Heart of Europe (Danube Declaration), 2004 (www.icpdr.org).

EU Member States, Accession Countries and Non EU MS:

- ⇒ Reduction of the total amount of nutrients entering the Danube and its tributaries to levels consistent with the achievement of the good ecological/chemical status in the Danube River Basin District by 2015.
- ⇒ Reduction of discharged nutrient loads in the Black Sea Basin to such levels, which permit the Black Sea ecosystems to recover to conditions similar to those observed in the 1960s.
- ⇒ Reduction of phosphates in detergents preferably by eliminating phosphates in detergent products as it is already the case for some Danube countries.
- ⇒ Implementation of the management objectives described for organic pollution with additional focus on the reduction of nutrient point source emissions (see above).

EU Member States:

- ⇒ Phasing out – by 2015 at the latest – all discharges for untreated wastewater from towns with >10.000 population equivalents and from all major industrial and agricultural installations, through:
 - ⇒ Implementation of the Urban Waste Water Treatment Directive⁹.
 - ⇒ Where required, identification of construction and/or improvement of wastewater treatment plants according to the ICPDR Emission Inventory by 2015.
 - ⇒ Implementation of the Sewage Sludge Directive (86/278/EEC) and the Integrated Pollution Prevention Control Directive (96/61/EC).
 - ⇒ Increase of the efficiency and level of treatment thereafter when necessary.

Accession Countries and non-EU Member States:

- ⇒ Specification of number of wastewater collecting systems (connected to respective WWTPs), which are planned to be constructed by 2015.
- ⇒ Specification of number of municipal and industrial wastewater treatment plants, which are planned to be constructed by 2015 including:
 - ⇒ Specification of treatment level (secondary or tertiary treatment)
 - ⇒ Specification of emission reduction targets
- ⇒ Implementations of best environmental practices regarding agricultural practices (for EU Member States linked to EU Common Agricultural Policy (CAP)).
- ⇒ Create baseline scenarios of nutrient input by 2015 taking the respective preconditions and requirements of the Danube Countries (EU Member States, Accession Countries, Non EU Member States) into account.
- ⇒ Definition of basin-wide, sub-basin and/or national quantitative reduction targets (i.e. for point and diffuse sources) taking the respective preconditions and requirements of the Danube Countries (EU Member States, Accession Countries, Non EU Member States) into account.

In addition, for EU Member States:

- ⇒ Implementation of the UWWTD (91/271/EEC) as described for organic pollution (see above) taking into account the character of the receiving coastal waters as a sensitive area.
- ⇒ Implementation of the EU Nitrates Directive (91/676/EEC) taking vulnerable zones into account in case natural freshwater lakes, other freshwater bodies, estuaries, coastal waters

⁹ For RO the implementation year is 2018 regarding agglomerations 2.000 - 10.000 p.e.

and marine waters of the DRBD are found to be eutrophic or in the near future may become eutrophic.

4. Joint Programme of Measures for Nutrient pollution

On the basin-wide level, basic measures (fulfilling the UWWTD and EU Nitrates Directive) for EU MS and the implementation of the ICPDR Best Agricultural Practices Recommendation for Non EU MS are the main measures contributing to nutrient reduction.

Implementation of measures regarding urban wastewater treatment

The implementation of the UWWTD by EU MS and the reported measures of Non EU MS significantly contribute to the reduction of nutrient point source pollution. Three different scenarios for UWWT (Baseline Scenario-UWWT 2015, Midterm Scenario-UWWT, and Vision Scenario-UWWT) and therefore the future development and improvement regarding point source pollution were developed and published. It is clear from the results that an additional measure to decrease phosphates in detergents would further contribute to the P emission reduction.

Implementation of the EU Nitrates Directive

A key set of measures to reduce nutrients relate to farming practices and land management. Nitrates in particular, leach easily into water from soils that have been fertilised with mineral fertilisers or treated with manure or slurry. High nitrate levels are one of the greatest challenges facing the WFD implementation in the DRB. Action programmes have been established in the EU MS by either applying the *whole territory approach* or in so called *Nitrate Vulnerable Zones* under the Nitrates Directive. The EU Nitrates Directive aims to limit the amount of nitrate permitted and applied and the resulting concentrations in surface waters and groundwaters.

Implementation of Best Agricultural Practice (BAP)

Within the DRB, a concept of BAP¹⁰ has been developed. This is different but complementary to the existing EU concepts of Codes of Good Agricultural Practice (GAP) under the EU Nitrate Directive and verifiable standards of Good Farming Practice (GFP) under the EC Rural Development Regulation 1257/1999.

To be effective, any BAP must not only be technically and economically feasible, it must also be socially acceptable to the farming community. As such, BAP can be applied as a uniform concept across the whole DRB, but the level of environmental management/performance that can be expected from farmers in different regions/countries will vary significantly according to: (i) the agronomic, environmental and socio-economic context in which they are operating, and (ii) the availability of appropriate policy instruments for encouraging farmers to adopt more demanding pollution control practices.

A key action for successful implementation of BAP is ensuring adequate storage capacity for manure generated on farms and the application of advanced techniques for spreading manure. It is apparent that implementation of BAPs should be linked to the EU CAP. Future reforms

¹⁰ The concept of BAP in the DRB is defined as: "...the highest level of pollution control practice that any farmer can reasonably be expected to adopt when working within their own national, regional and/or local context in the Danube River Basin"

of the CAP, its funds and strategic priorities can also contribute to WFD objectives. In particular, the voluntary agri-environmental measures can be used to address diffuse and point sources of agricultural water pollution (nitrates, phosphates and pesticides) as well as soil erosion.

Implementation of possible supplementary measures to control diffuse pollution

The information provided by countries in the national programmes of measures to control diffuse pollution has been used in the development of the DRBM Plan. Possible measures include: soil and manure sample analysis; a parcel-specific field balance for each growing season and annual farm balance for N and P. These are not costly but require a commitment and proper technical support.

Lack of information at the national, regional and local level on the causes of agricultural pollution and the practical measures available to farmers for reducing the risk of pollution can be addressed. It is important to link the promotion of more environmentally friendly farming methods to economic benefits such as improvements in yield and savings in the cost of agrochemical inputs. The development of appropriate and well written agricultural advisory messages is therefore essential, as are demonstration plots/farms, training for advisors and other capacity building measures for agricultural extension services.

Implementation of this kind of measures is supported by the Rural Development Programme for the period 2007-2013 covering three major policy objectives. These objectives aim to improve:

- i) competitiveness of farming and forestry (Axis 1);
- ii) environment and land management (Axis 2); and
- iii) quality of life and diversification (Axis 3).

Measures under all axes could contribute to reaching WFD objectives as they offer various possibilities to protect and enhance natural water resources. While the measures under Axis 1 and 3 are mainly indirectly linked to water, the measures provided under Axis 2 offer a high potential to support the implementation of the WFD directly. Measures contributing to water protection are mainly contained under Axis 2 of the Rural Development Programmes. In particular, the voluntary agri-environmental measures are used to address diffuse and point sources of agricultural water pollution (nitrates, phosphates, pesticides) as well as soil erosion. Under this second axis, there is also a specific measure allowing farmers to be compensated for income foregone due to WFD implementation (Art. 38).

Introduction of phosphate-free detergents

The ICPDR has initiated a process to support the introduction of P-free detergents in the Danube countries. This measure is part of the **Phosphate Ban Scenario-Nutrients**. The introduction of P-free detergents is considered to be a fast and efficient measure to reduce nutrient emissions into surface waters. For the large number of settlements of <10,000 PE, the EU UWWTD does not legally require P removal. A reduction of phosphate in detergents could have a significant influence on decreasing nutrient loads in the Danube, particularly in the short term before all countries have built a complete network of sewers and wastewater treatment. Dishwashing detergents are an important and increasing source of that pollutant in all Danube countries. Efforts to regulate this source are also likely to be needed.

Scenarios for nutrient reduction

While point source inputs from urban wastewater treatment plants and industry are directly discharged into rivers, diffuse emissions into surface waters are caused by the sum of different pathways that are realized by separate flow components. MONERIS considers seven

pathways regarding inputs into surface waters via pathways. In addition, the retention of nutrients in rivers (divided in main rivers and tributaries) is calculated.

To explore the potential and effect of nutrient reduction measures, the effect of measures are estimated for point and diffuse sources using MONERIS and scenarios for nutrient reduction have been calculated and presented. After exploring the reduction potential of the measures addressing the various sources of nutrient inputs, the **overall Baseline Scenario-Nutrients (BS-Nut-2015)** combines the agreed most likely developments in different sectors (urban wastewater, agriculture and atmospheric deposition) and describes the expected nutrient emissions in 2015. This scenario has been compared to the expected emissions of nutrients based upon application of the management objectives for the basin-wide scale.

The following section presents the calculated results for the overall effects for N and P.

Reference Situation and calculated Baseline Scenario-Nutrients 2015 (BS-Nut 2015)

Nitrogen emissions and loads

Regarding N emissions, Figure 4 illustrates the N loads for both the Reference Situation-Nutrients and the overall Baseline Scenario-Nutrients 2015. The green bar gives an indication of the fulfilment of the management objective regarding "Reduction of discharged nutrient loads in the Black Sea Basin to such levels, which permit the Black Sea ecosystems to recover to conditions similar to those observed in the 1960s.

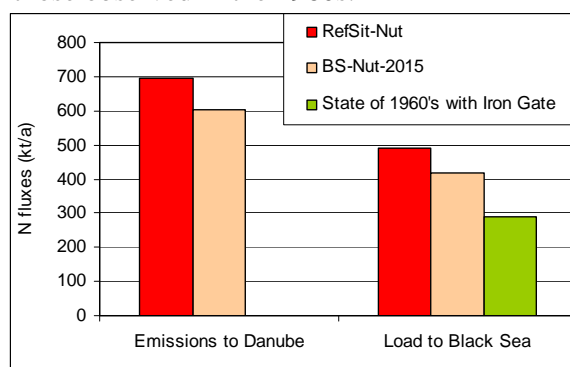


Figure 4: Nitrogen emissions for the Reference Situation-Nutrients (RefSit-Nut), Baseline Scenario-Nutrients 2015 (BS-Nut 2015) and the situation in the 1960s.¹¹

Nitrogen emission sources

Figure 5 shows the main sources of N emission in the DRB. Regarding the **Reference Situation-Nutrients**, about 49 % of the N emissions are related to agriculture (27 % directly due to fertilizer and manure application; 22% indirectly due to NH_y deposition coming from agriculture). Significantly, 41% of the N emissions (NH_y emissions from agriculture and NO_x emissions mainly from industrial incineration processes and traffic) cannot be directly influenced by the Danube countries alone because it is partly due to atmospheric deposition from sources outside the DRB.

With regard to the Baseline Scenario-Nutrients 2015, changes for the share of contribution of each source are expected. This is mainly caused by the fact that with the further development of UWWT within the DRB, the share of N coming from urban agglomerations will be reduced. The share of most of the other sources will correspondingly increase.

¹¹ Both emissions and load values are normalized to the longterm hydrological situation.

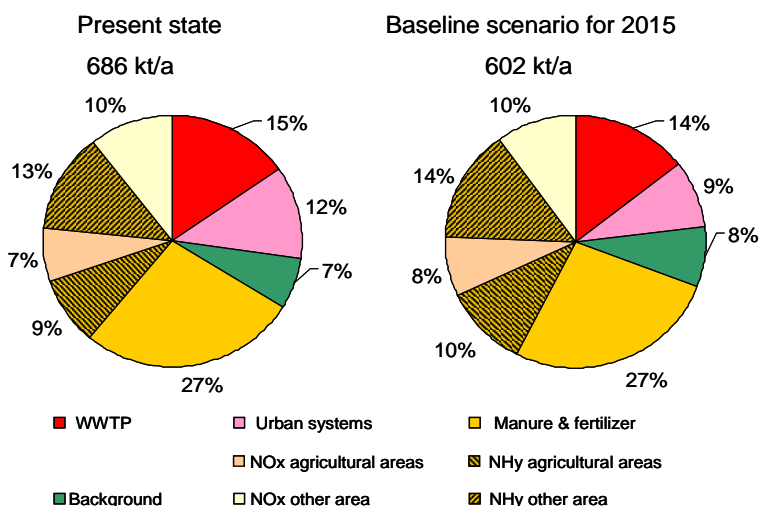


Figure 5: Sources of nitrogen emissions in the DRB for the Reference Situation-Nutrients and Baseline Scenario-Nutrients 2015 (BS-2015).

Basic considerations regarding nitrogen load due to atmospheric deposition

As mentioned above, nutrient emissions via atmospheric deposition in the DRB are significant (41% of the total nitrogen load). These nitrogen emissions, from atmospheric deposition do not exclusively originate from the DRB but come as well from countries outside the DRB. The reduction of this source of nitrogen will require a broader regional approach.

Phosphorus emissions and loads

Regarding P emission, Figure 6 illustrates P loads for both the Reference Situation and the Baseline Scenario 2015. The green bar gives an indication of the fulfilment of the management objective regarding "Reduction of discharged nutrient loads in the Black Sea Basin to such levels, which permit the Black Sea ecosystems to recover to conditions similar to those observed in the 1960s.

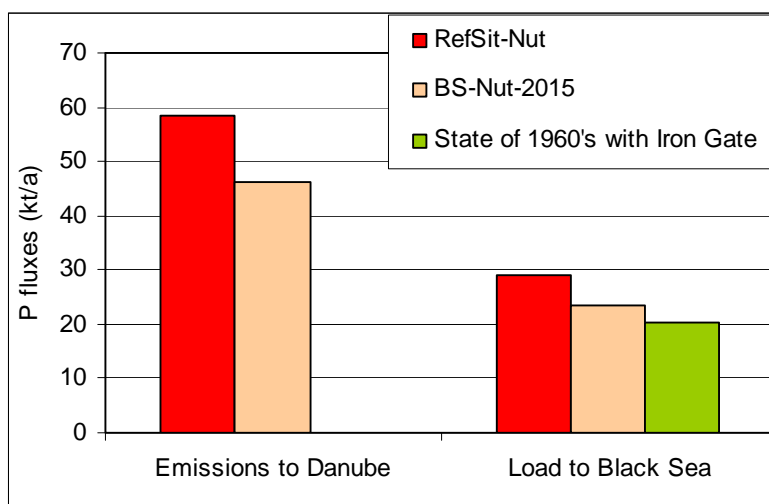


Figure 6: Phosphorus emissions for the Reference Situation-Nutrients (RefSit-Nut), Baseline Scenario-Nutrients 2015 (BS-Nut 2015) and the situation in the 1960s.

Phosphorus emission sources

Figure 7 shows the main sources of P emission in the DRB.

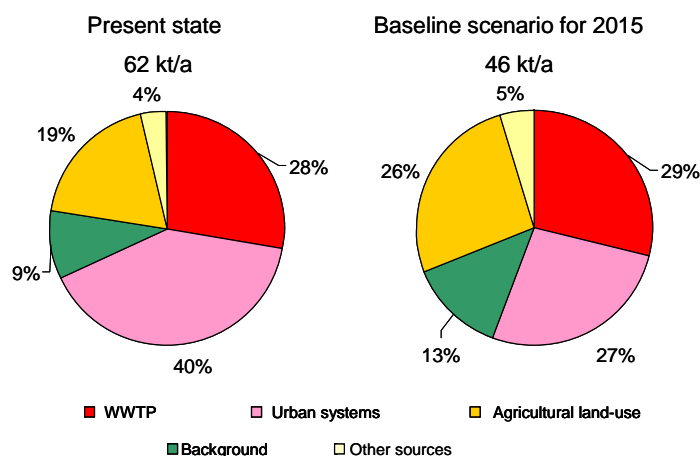


Figure 7: Sources of phosphorus emissions in the DRB for the Reference Situation-Nutrients and Baseline Scenario-Nutrients 2015.

Estimated effects of national measures on the basin-wide scale

- Nitrogen emissions to surface waters in 2015 will, through the planned measures, be approx. 12% lower in comparison with present state (averaging the years 2000-2005). The load to the Black Sea will reach a level that is below the present state but still far above (40%) that of the 1960's. This means that the situation in the DRBD and the Black Sea regarding nitrogen pollution will improve but not ensure the achievement of the management objectives and the WFD environmental objectives on the basin-wide scale by 2015.
- The P emissions to surface waters will, through the planned measures, be in 2015 about 25 % lower. The load to the Black Sea will reach a level, which is still 15 % above the level in the 1960's. Therefore, for Phosphorous the respective management objective on the basin-wide scale will not be achieved by 2015, and this is most likely also the case for the WFD environmental objectives.
- The implementation of the Nitrates Directive in the EU MS and an improved implementation of the concept of BAP in Non EU MS are expected to contribute to reductions in nutrient pollution from agriculture. Nevertheless the reduction potential for the agricultural sector is difficult to quantify due to uncertainties in the future economic development of this sector, mainly in the middle and lower DRB.
- Reductions in nutrient pollution will be achieved as soon as more stringent UWWT obligations with N and P removal for agglomerations >10,000 PE are applied for EU MS. This could reduce the discharged emissions in EU MS of N_{tot} by 37% – 43% and of P_{tot} by 45% - 56% compared to the reference situation.
- The introduction of limitations on P in detergents, i.e. a P ban in laundry detergents in 2012 and in dishwasher detergents in 2015, is seen as a cost effective and necessary measure to complement the efforts of implementing urban wastewater treatment.
- As an important share of nutrient pollution stems from atmospheric deposition of nitrogen (currently estimated at 41%), coordinated measures on a wider scale are needed to tackle this source of nitrogen pollution.

- The knowledge and understanding of the interlinkages between Danube loads and the ecological response in the NW shelf of the Black Sea still need to be refined and improved.

5. Status of JPM implementation

Progress in the measures implementation is summarised in the Interim Report on the Implementation of the Joint Program of Measures in the DRBD.

Agriculture

JPM provides a key set of measures to reduce nutrients related to farming practices and land management - covering input reduction measures, measures addressing diffuse pollution concerning both fertilizer and pesticide use, livestock farming oriented measures focusing on the reduction of impacts from animal rearing, the use of manure as a fertilizer, changes in crop production practices as well as improving drainage systems. Action programmes have been established in the EU MS by either applying the whole territory approach or in so called Nitrate Vulnerable Zones under the Nitrates Directive. In addition, within the DRB, a concept of Best Agricultural Practice (BAP) has been developed. The BAP can be applied as a uniform concept across the whole DRB, but the level of environmental management/performance that can be expected from farmers in different regions/countries will vary significantly. The implementation of BAPs should be linked to the EU CAP.

On the basin-wide level, basic measures (fulfilling EU Directive) for EU MS and the implementation of the ICPDR Best Agricultural Practices Recommendation for Non EU MS are the main measures contributing to nutrient reduction.

Measures related to farming practices and land use management

Afforestation of agricultural land had shown a general increasing trend, even in case there were no legal obligations for such measures. Afforestation of former arable land is currently a common change in land use in many Danube countries. In addition to wood production, the new forests will provide a variety of environmental services, such as carbon sequestration or improved water quality. At the same time there may be negative impacts, such as reduced groundwater recharge on a long term.

The EU adopted a Green Paper on Forest Protection and Information, based on the EU Forest Action Plan. It is important to consider the impacts of climate change on forests, in terms of increase in water stress, risk of storm damage, fire, changes in nutrient balance in soil and migration of tree species as well as other organisms. The result is the loss of carbon and biodiversity.

The **introduction of the Code of Good Agricultural** practices in line with ND requirements is extensively used by the Danube countries, either based on the whole territory approach (DE, AT, SI), or in the Nitrates Vulnerable Zones (CZ, SK, HU, RO, BG). In some countries (HR, B&H/RS, RS, MD), it is under the discussion for its implementation in 2013, or as a recommended action to be considered (UA).

As a low input farming measure, **organic farming** is voluntary. In this category, there is a general increasing trend of the area of organic farming in the basin.

Soil erosion caused by water and wind affects both agricultural production and the environment. Loss of soil through erosion of cultivated land is a widespread problem in rural areas. To decrease the risks of soil erosion and improve soil quality, the Danube countries implemented several supplementary measures, such as **buffer stripes** (such as in DE, AT,

HU, RO, SI, MD or UA) and **erosion-minimizing cultivation systems** (catch crops) reported in DE, AT, HU, BG or CZ. Several measures to reduce nutrient runoff implemented in the basin also have a positive effect on soil erosion.

Establishment of wetlands, through the creation, maintenance and recovery of wetlands is carried out in several countries (SK, HU, SI, HR, RO, BG, MD and UA). The main purpose of these measures is flood protection, water quality enhancement, and to protect wetlands and habitat areas.

On farm Nutrient Balances systems are positive, results-oriented policy initiatives in several countries in the DRB. This approach considers the farm as a whole nutrient system, measuring nutrients that enter (such as fertilizer or feed) and leave (such as animals, milk, or manure) the farm. The number of farmers that choose for themselves how they attain the determined goal is different in various countries, from 2 to 100%.

Besides the several technical measures presented before, several other measures or actions are mentioned in the DRBMP, and reported by the Danube countries. In this category there are non technical measures, such as on **Farm Advice/Extension Services**, which support the implementation of technical measures largely utilized in the Danube countries.

Urban waste waters

The assessment of JPM undertaken at the end of 2012, provided information about a number of 555 UWWTPs which have already been completed by 2012, and 991 are under construction/rehabilitation or planning. All agglomerations above 10,000 PE under construction or planned in the EU Member States contain tertiary treatment technology for N and P removal. Regarding the generated load planned to be reduced by 32,489,601 PE by 2015, 7,063,373 PE have been already reduced by 2012, which represents 22% of the organic pollution reduction.

Detergents

The European Council adopted the Regulation (EU) no 259/2012 of the European parliament and of the Council of 14 March 2012 amending Regulation (EC) No 648/2004 as regards the use of phosphates and other phosphorus compounds in consumer laundry detergents and consumer automatic dishwasher detergents.

The limit value for consumer laundry detergents is set at “0.5 grams of phosphorus per washing process in a standard washing machine” and it will be applicable from 30 June 2013.

The limit value for consumer automatic dishwasher detergents is set at “0.3 grams of phosphorus in a standard dosage” and it will be applicable from 1 January 2017 but is subject to confirmation through a “thorough assessment in the light of the most recent scientific data and taking into account available alternatives to the use of phosphates”.

A recent initiative of Ukraine is a new Law on Detergents. The Ukrainian Ministry of Economic Development and Trade published in March 2013, a draft law that would ban production, import and selling of detergents that contain 17 percent or more phosphorus pentoxide (P₂O₅), starting in 2014.

A reduction of phosphate in detergents is expected to have a significant influence on decreasing nutrient loads in the Danube, particularly in the short term before all countries have built a complete network of sewers and wastewater treatment, and it will not attract additional costs to consumers or governments.

MONERIS

MONERIS was recently reprogrammed in the programming language C# (earlier versions were programmed in Excel-VBA).

The new MONERIS 3.0 version has a more user-friendly interface with a better graphical presentation of results as well as a help function. It runs more stable and faster and has an extended measure catalogue. New calculation approaches, developed in the last years, were implemented in form of modules which facilitate further model developments. The model will be used for review of the Roof Analytical Report developed in the frame of article 5 WFD implementation in 2013.

6. Recommendations on solutions to accelerate the Joint Program of Measures implementation

The results of the 2012 Implementation report show achievements leading to nutrient reduction in the DRB, through the implementation of EU Directives, mainly UWWTD and Nitrates Directive.

Considering the anticipated effects of JPM implementation by 2015 and assessing the achievements of the agreed management objectives, for both N and P pollution in the DRB this means that the management objective by 2015 related to reduction of nutrient load to the level of 1960's will be only partially achieved for Nitrogen and Phosphorus.

Therefore, the countries should intensify their efforts in accelerating the measures implementation to reduce nitrogen pollution.

For the implementation of EU Nitrates Directive in EU MS, respectively the Best Agricultural Practice in Non EU MS, the following key lines of actions are recommended:

- **No new investments without appropriate storage capacities!** Adequate storage capacity is required for manure in order to avoid point source pollution and to allow for spreading of manure only in times of nutrient demand of crops.
- **Build up sufficient storage capacities** for existing farms in line with Nitrate Directive.
- **Advanced techniques** e.g. for manure application in order to improve efficiency of fertilisation, limiting the de-gasing of NH₃.
- **Link the promotion of more environmentally friendly farming methods to economic benefits** (such as improvements in yield and savings in the cost of agrochemical inputs)
- **Provide agricultural advice and ensure that these services sufficiently covers environment protection part** - the development of appropriate and well written agricultural advisory messages is essential (e.g. fertilization guidance, standard designs for setting in place storage capacities, computer programs for management of individual plots of land), and also demonstration plots/farms, training for advisors and other capacity building measures for agricultural extension services.
- **Provide control** - control activities support change of farmer behaviour (Cross Compliance was basis for success for implementation of EU Nitrates Directive).
- **Utilize** future reforms of the CAP, its funds and strategic priorities for WFD objectives. In particular, the voluntary agri-environmental measures to address diffuse and point

sources of agricultural water pollution (nitrates, phosphates and pesticides) as well as soil erosion.

- **Reduce surplus of applied N** with regard to its off-take by crops that is possible to reach through balanced fertilisation (total amount of N, P rate) and timing as well as the use of intercrops during autumn-winter period.
- **Select and apply the efficient measures relevant to the site specific conditions** of given farm.
- **Regular revision of nutrient emission status in DRBD by means of MONERIS model and adapt it according to the needs and demands of the DRBD.**

The challenges that exist during the implementation process cover:

- The need to further reduce nutrient loads to rivers, coastal waters and seas necessary to meet the EU policies goals
- Ensure necessary financial investments
- Clarify how to finance change?

To discuss challenges in association with the expectations related to the WFD objectives, the following issues should be considered:

Costs – considering the trend towards larger units, from wide range of farms (subsistence farms, small and middle sized „family operated farms“ to agro industrial units); market prices driven by market chains, and the implementation of key actions which need investments, that many farms often cannot afford new investments.

Magnitude of costs

The estimates of the European Commission (SCG) indicate that all agricultural measures within PoM in entire EU will cost more than 10 billion Euro until 2015.

As an illustration of the magnitude of costs, Austria per year (out of RD):

- ⇒ 500 million Euro for agri environmental friendly measures (around 200 mil may be allocated to protection of waters)
- ⇒ 60 Mio for construction of stables plus storage capacity
- ⇒ plus few more million Euro for new equipment for spreading of manure

How to finance change?

First of all it is important to ensure the political commitment in place (Danube Declaration)

The countries must intensify efforts which are essential to trigger concrete actions at local level. Past experience with implementation of EU Nitrates Directive has clearly demonstrated the need for financial support out of CAP; in case no support can be provided, then the EU Member States are under huge domestic pressure to keep NVZ as small as possible, and accordingly to keep requirements for storage capacity rather low.

It is advisable to use a step by step approach due to financial restrictions, and start with larger and profitable farm to provide inspiring examples.

Require positive financial contributions from communes and households, to increase commitment and system sustainability.

Working with stakeholders

It is recognized that tackling land management and water issues effectively cannot be solely undertaken by, or the responsibility of, one organization but requires many actors to work in conjunction.

River basin scale operations will help ensure local knowledge is used to drive local change, through:

- identifying and understanding issues within a particular catchment
- involving local groups in decision making
- sharing evidence
- identifying priorities for action
- seeking to deliver integrated interventions in cost effective ways that protect local resources.

All of these activities will emerge from a mutually agreed vision developed by all stakeholders within an individual catchment. It will be captured within a 'catchment plan' which will be a jointly owned, living document that sets out future aspirations and the road map for achieving them through the 2nd RBM cycle.

7. Policy implications and forecast

The assessment of the River Basin Management Plans of the EU Member States conducted by the European Commission in 2012 and the Fitness Check of EU Freshwater Policy highlighted that there still exist some weaknesses in the implementation of the current water legislation as well as conflicts between water policy and other EU policies' objectives.

Improvements in implementation are the first priority, and this can be achieved through better integration in particular with the Common Agriculture Policy (CAP). The CAP is one available tool for the WFD implementation, but significant action at national level is needed. The CAP is improving regarding water protection issues, therefore the Danube countries should make the best use of the CAP tools to complement with national action.

Advanced co-operation with the farmers' community at the different stages of the preparation of the PoM is important as well for mobilizing of the resources, including the participation of all stakeholders and the development of partnerships at regional and local level.

8. References

ICPDR Roof Report

ICPDR DRBM Plan

ICPDR Interim Report on the Implementation of the Joint Program of Measures in the DRBD