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DANUBE STUDY ON POLLUTION TRADING AND CORRESPONDING ECONOMIC INSTRUMENTS FOR NUTRIENT REDUCTION

COMPLETION REPORT
April 2005
Approved by UNDP/GEF Danube Regional Project 26th May 2005

NIRAS
In association with
Institute for Water Quality and Waste Management, Vienna University of Technology
and Jürgen H. Lottmann, Frankfurt

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FOREWORD

This Report comprehensively reports and sums up the Study entitled *Danube Study on Pollution Trading and Corresponding Economic Instruments for Nutrient Reduction*, which was commissioned by the *Danube Regional Project* to a consortia of consultants lead by the Danish engineering and consultant company NIRAS. The Study was conducted from December 2003 to February 2005.

The main aim of the Study was to review international experience in relation to pollution trading. Based on this the Study should assess the feasibility of applying such concepts to the nutrient discharges to the Danube River System, which is largely responsible for the eutrophication problems of the North-western Black Sea.

This Report builds on a sequencing of reporting, which illustrates the progressing information and knowledge gathering and feasibility assessment by the Study:

- ***The Inception Report*** dated January 2004, which define the scope and content of the Study.

- ***The Review Report*** dated October 2004, which includes the comprehensive review of the nutrient, legal and regulatory and economic aspects in relation to possible nutrient trading for the Danube River System.

- ***The Feasibility Report – Conceptual Assessment*** dated February 2005, which assesses the feasibility in relation to the Danube River System for possible introduction of nutrient trading.

- ***The Draft Workshop Report*** dated February 2005, which was prepared for a basin wide Completion Workshop held 25th of February 2005 im Baden bei Wien. This report summed up the results of the Study in strategic terms, and based on this identified a number of policy and strategy questions to be addressed at the workshop.

- ***The Final Workshop Report*** dated April 2005, which reports the results and outcome of the workshop, and is an amendment of the Draft Workshop Report.

These above background reports are available on request from the Danube Regional Project Office (*UNDP/GEF Danube Regional Project. Vienna International Centre. D0418 Austria. Tel. + 43 1 26060/5767. Fax + 43 1 26060/5837. www. icpdr.org/undp-drp/*).

This report is structured in a way that the **cursory reader,** who only needs to know what was the outcome of the decisive Completion Workshop im Baden bei Wien 25th of February 2005, and consequently what is likely to happen with nutrient trading in the Danube, can stop with **Chapter 3**.

If more background information is needed **Chapter 4** provides that.

For the reader who wants to see the full conceptual feasibility assessment it is provided in **Chapter 5**. The three component background reports, which the conceptual assessment builds on, are attached as respectively **Appendix 1, 2, and 3,** for the reader who wants to have all the background data and information.

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ABBREVIATIONS AND ACRONYMS

DaNUbs	Nutrient Management in the Danube and its Impact on the Black Sea (5th EU Framework Programme Scientific Project)
DRB	Danube River Basin. The full catchment area of the Danube
DRP	Danube Regional Project. The implementing unit for i.a. this assignment
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GHG	Green-House Gases
ICPDR	International Commission for the Protection of the Danube River
N	Nitrogen in all its forms and compounds (Total Nitrogen)
NIRAS	The Danish company NIRAS Consulting Engineers and Planners A/S. The lead consultant for this assignment
NWBS	The North-western Black Sea, which is the target area for this Study
P	Phosphorous in all its forms and compounds (Total Phosphorous)
Study	This Study: *Danube Study on Pollution Trading and Corresponding Economic Instruments for Nutrient Reduction*
UNOPS	United Nations Office of Project Services. The contracting agency for this assignment

1. INTRODUCTION AND BACKGROUND

This Study is part of the overall and comprehensive UNDP/GEF Danube Regional Project (DRP), which started in December 2001, and which is scheduled for completion in December 2006.

The main aim of the DRP is to assist the Danube Countries (except Austria and Germany, which are co-operating countries within the DRP) in increasing their capacities for developing effective mechanisms and means for co-operation for the protection of the Danube and its final recipient the Black Sea. The DRP complements the activities of the ICPDR (International Commission for the Protection of the River Danube) to strengthen regional co-operation for solving transboundary water pollution problems.

The 13 (11 plus 2) Danube Countries are schematically outlined in Chart No. 1 below.

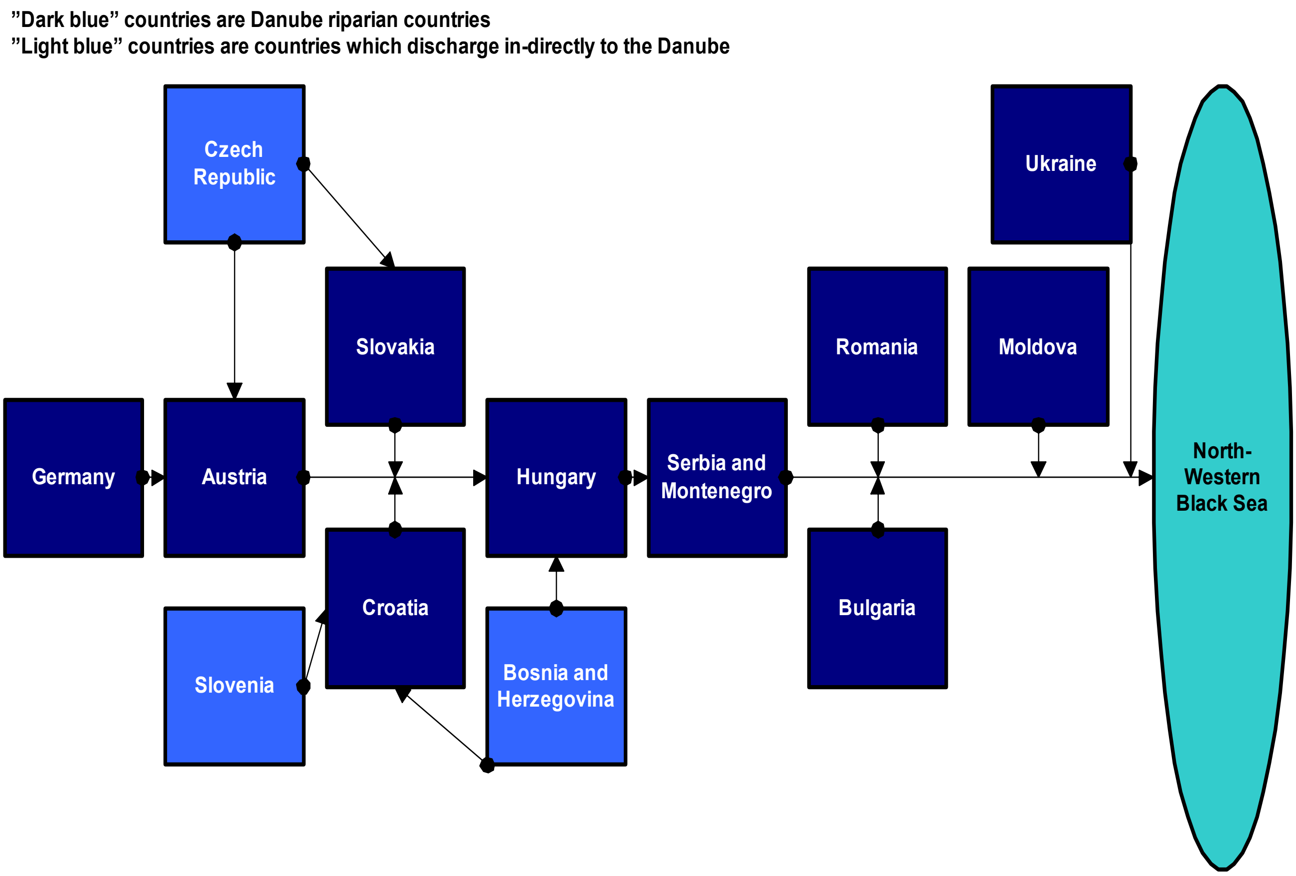

Chart No. 1: Schematical Presentation of the Danube with the 13 Danube Countries

Due to the regional and transboundary character of the water pollution problems in the Danube and the Black Sea, there is a need to consider the application of regional means and measures to solve the pollution problems of the Danube and its final recipient.

A major regional water pollution problem is the eutrophication ("over-enrichment" with nutrients, which leads to degradation of water quality and aquatic life) of the North-western Black Sea due to the discharge of nutrients by the Danube. In this connection it could be considered to introduce the concept of "nutrient trading", well known from air pollution abatement, as a means of solving the eutrophication problem economically and co-operatively.

Based on this it has been decided within the DRP to investigate this further by a Study entitled *Danube Study on Pollution Trading and Corresponding Economic Instruments for Nutrient Reduction.* The scope and content of the Study, which has been contracted to NIRAS with associates based on a tendering process, is described in the *Inception Report* dated 8 March 2004, which was approved by DRP 2 April 2004.

The Study was organised in four components, as given in Chart No. 2 overleaf.

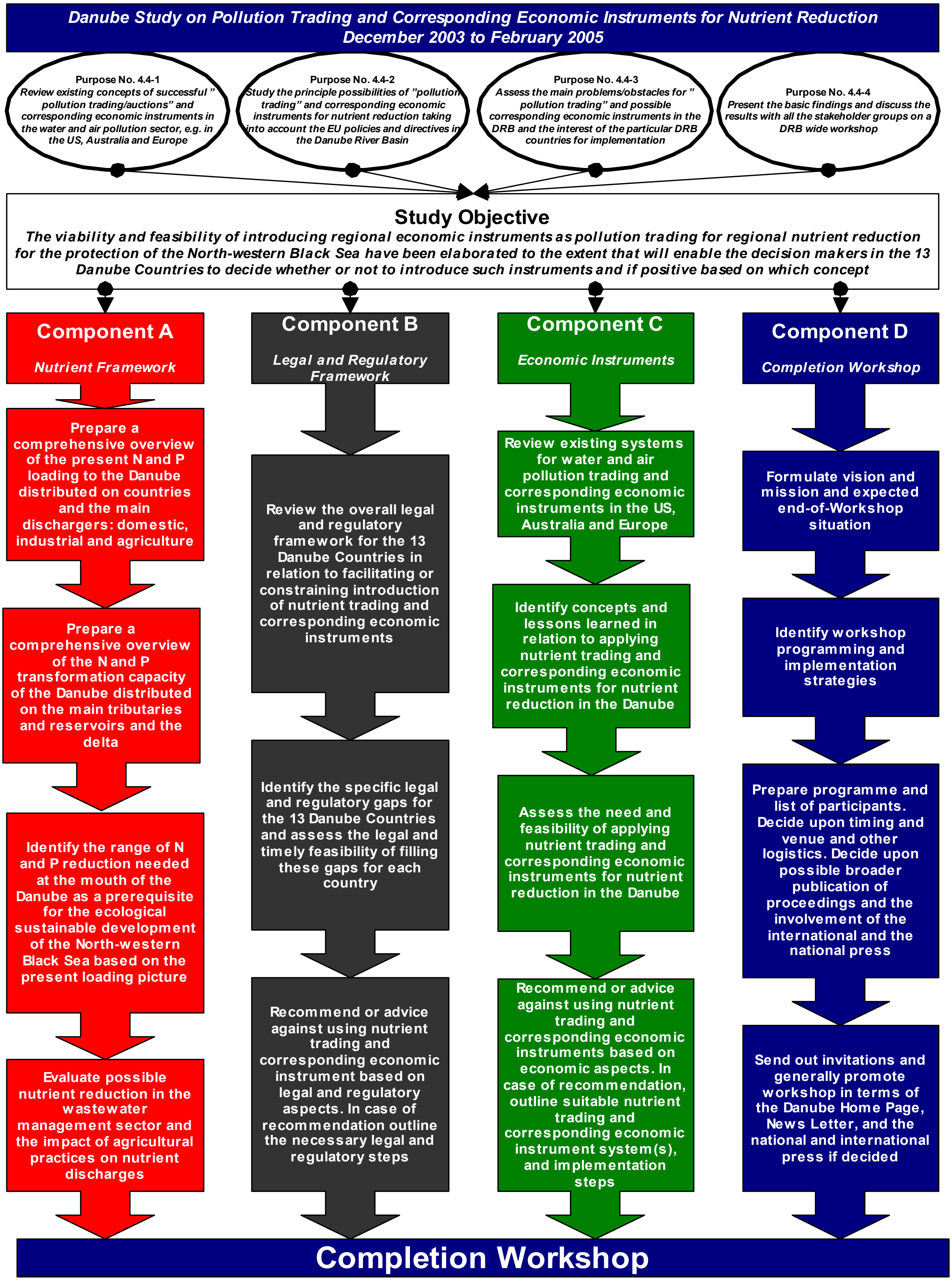

Chart No. 2: Study Objective, Components, and Outputs

2. STUDY QUESTIONS AND ANSWERS

In accordance with Chart No. 2, the Study set out to answer the following questions as grouped in the following three main groups:

- ***Nutrient Framework (Component A of the Study):***
  - a. *What is the present N (total nitrogen) and P (total phosphorous) load to the Danube, and how is it distributed on countries and the main dischargers: domestic, industrial and agriculture?*
  - b. *What is the present N and P transformation capacity distributed on the main tributaries and reservoirs, and the delta?*
  - c. *How much N and P reductions are needed in order to achieve the necessary water quality of the North-western Black Sea?*
  - d. *How will the impact be on the discharges of N and P of improved wastewater management (which will decrease discharges) and increased and changed level of agricultural activities (which, if not counter acted, will increase discharges)?*

- ***Legal and Regulatory Framework (Component B of the Study)***
  - a. *To which extent will the present legal and regulatory framework of the 13 Danube Countries facilitate or constrain the introduction of nutrient trading?*
  - b. *Based on this, which specific legal and regulatory gaps for the 13 Danube Countries can be identified, and how is the feasibility of timely filling these gaps for each country?*
  - c. *Is it based on the legal and regulatory analysis advisable or not to introduce nutrient trading, and if yes what will be the necessary main legal and regulatory steps?*

- ***Economic Instruments (Component C of the Study)***
  - a. *What is the US, Australian and European experience and lessons-learned with pollution trading of air pollutants, green-house gases, and water pollutants?*
  - b. *How can the above concepts and lessons-learned in principle be applied to the specifics of the Danube?*
  - c. *Based on this is there an advantage in applying pollution trading as a means for nutrients reduction for the Danube River System, and if yes how could it be applied on the conceptual level?*
  - d. *Is it based on the economic instruments review and analysis advisable or not to introduce nutrient trading, and if yes what will be the necessary main implementation steps?*

In the following is given short cursory answers to these questions as drawn from the results of the Study. The more elaborated findings and assessments are given in the following chapters.

- **Nutrient Framework (Component A of the Study):**
  - a. The present P-load (total phosphorous) and N-load (total nitrogen) distributed on countries and the main discharging elements (point sources, agriculture, background and others) is given in Appendix 1 in respectively Figure 5 on page 13 and Figure 8 on page 15.
  - b. The present N and P transformation capacity distributed on the main tributaries and reservoirs, and the delta is given in Appendix 1 in Figure 2 on page 8.
  - c. Basically a "freeze" of the present loading should be pursued.
  - d. The impact on the discharges of N and P of improved wastewater management (which will decrease discharges) and increased and changed level of agricultural activities (which, if not counter acted, will increase discharges) is described in Appendix 1 in Chapter 4.

- **Legal and Regulatory Framework (Component B of the Study)**
  - a. The present legal and regulatory framework of the 13 Danube Countries neither facilitate nor constrain the introduction of nutrient trading.

b. The legal and regulatory gaps for the 13 Danube Countries are mainly the transposition of the EU legal and regulatory framework, especially the Water Framework Directive with daughter and sister directives, into national legal and regulatory framework. For EU member countries in the Danube (Germany, Austria, Czech Republic, Slovakia, Slovenia, and Hungary) and for the 2007 Accession Countries (Romania and Bulgaria) the timing is given in the Water Framework Directive. For the remaining Danube Countries (Croatia, Bosnia and Herzegovina, Serbia and Montenegro, Moldova, and Ukraine) the timing and feasibility is difficult to assess, except for the fact that all of these countries would like to be member of the EU.

c. ***Based on the legal and regulatory analysis within this Study it is assessed feasible to introduce nutrient trading. The necessary main legal and regulatory steps will be alignment with EU legal and regulatory framework especially the Water Framework Directive.***

- **Economic Instruments (Component C of the Study)**
  a. The US, Australian and European experience and lessons-learned with pollution trading of air pollutants, green-house gases, and water pollutants is mixed.
  b. The above concepts and lessons-learned can only with difficulty be applied to the specifics of the Danube due to the complex nature of the Danube
  c. There could in principle be an advantage in applying pollution trading as a means for nutrients reduction for the Danube River System in conjunction however with traditional command and control measures. However, this will need further investigations and feasibility assessments taken into account the complexity of the Danube.
  d. ***Based on the economic review and analysis within this Study the feasibility of introducing nutrient trading is questionable. It needs further elaboration as stressed above before the economic feasibility can be fully assessed.***

3. OUTCOME OF COMPLETION WORKSHOP

The results of the Study were presented at a Completion Workshop im Baden Bei Wien 25th February 2005. 28 participated in the workshop representing Hungary, Croatia, Germany, Austria, Moldova, Bulgaria, Serbia and Montenegro, and Slovakia. Further the ICPDR and the UNDP/GEF DRP was represented, and the full Study Team participated. The target audience of the workshop was set up as top decision makers and senior policy advisors within the field of water. This was only met to some extent.

The Draft Workshop Report, which included a cursory overview of the study results as well as an identification of five policy elements and ten policy and strategy questions to be addressed at the workshop, was forwarded to the workshop participants before the workshop. The work at the workshop was structured around group work and presentation and discussion in plenum. The 5 Policy Elements and the 10 Policy and Strategy Questions, as well as the result of the group work and the outcome of the workshop, can be found in the Final Workshop Report dated April 2005.

The general and overriding conclusion of the Completion Workshop was that the time is not ripe for discussing possible introduction of nutrient trading by the 13 Danube Countries. The major part of the countries, especially the new EU Member Countries and the EU Accession Countries, are fully occupied in the field of water of transposing and implementing the EU Water Framework Directive with sister and daughter directives. There is neither regional nor national capacity available for further assessing the feasibility of nutrient trading, which would be very complicated given the complex nature of the Danube River System in terms of "nature" as well as institutional and cultural environment and capacity. In this connection a clear-cut case of complications in relation to "upstream" and "downstream" problems, obligations and rights, were demonstrated at the workshop.

4. CURSORY OVERVIEW OF STUDY RESULTS

In the following the overall findings and conclusions of the Study are summarised in the context of application of policies and strategies. The cross cutting assessment of conceptual feasibility is given in the following Chapter 5. Chapter 5 builds on Chapter 6, 7, and 8, which gives the results of the component work covering respectively nutrient framework, legal and regulatory framework and economic instruments.

1. **The Danube River System is the main controller** of the eutrophication of the North-western Black Sea (NWBS) as the main load of N and P comes via the Danube.

2. **The NWBS has significantly improved** over the last decade due to the reduction in the nutrient discharge caused by the lower agricultural and industrial activities in a number of the Danube Countries with developing economies. The decrease in economic activities in these countries is caused by the economic crisis following the break down of the former Soviet Union in 1989.

3. **The present ecological status of the NWBS is close to being assessed "good".** Some problems remain with the fish stock, which is however assessed to be due to over fishing, and not nutrient discharge.

4. **Consequently the present nutrient loading is proposed "frozen" as the sustainable nutrient loading for the NWBS**. The management strategies should thus aim at counter acting possible increase in the load due to increase in agricultural or industrial activities or increase in population.

5. **Phosphorous seems to be the limiting nutrient for the NWBS**, and consequently counter acting strategies should first target the discharge of this nutrient.

6. However, as the Central Part of the Black Sea seems to be nitrogen limited, and as the ratio between phosphorous and nitrogen in the NWBS could be decisive if only phosphorous is targeted, **counter acting strategies should also target nitrogen for the Danube System**.

7. **Consequently a two-pronged strategy is proposed**. First target phosphorous, but keep a close watch on the development in the nitrogen discharge, and especially the relationship between phosphorous and nitrogen in the NWBS. Secondly, if the ratio changes in the wrong direction, counter acting strategies should be applied for nitrogen as well.

8. **The Danube is the main contributor to the NWBS with phosphorous** as 75 % of the load generates from the Danube. In average only 35 % of the phosphorous emissions is directly manageable as it stems from point sources. In average 10 % of the phosphorous emissions are non-manageable as it is so called "background emissions" from nature. In average only 35 % of the phosphorous discharged to the Danube system reaches the NWBS as it is transformed and/or stored in the Danube System on its way to the NWBS due to physical, chemical, biological, and microbiological processes.

9. **The complexity of the Danube River System** in terms of i.a. demography, economy, culture, geology, hydrology, hydraulics, climate, land use, etc. have to be carefully evaluated when applying regional, national and local counter acting strategies for nutrients.

10. Pollution trading of green-house gasses (GHG) is well developed, and with a fair amount of implementation experience, based on the Kyoto Protocol and its implementation mechanisms. As for water the concepts are not that developed, and the experience and case stories are limited. In relation to applying the experience from pollution trading of GHG to nutrients reduction in the Danube River System, **there is a significant contextual difference, which should be taken into account**. It is about the joint benefit. In pollution trading of GHG the basic concept is that everybody will benefit from a better global climate no matter where the reduction is introduced. This joint-benefit-concept is not directly applicable to possible nutrient trading within the Danube in relation to improving the water quality of the NWBS as the countries bordering and with direct access to the Black Sea will benefit substantially more than the upstream countries. However, when taken this into account it should also be taken into account that the 13 Danube Countries through being signatory to the two Conventions are committed to a shared and joint responsibility also for the quality of the Black Sea. Further, they are also committed to the polluter-pays-principle, which is not based on a benefit assessment. In relation to the lesser experience with pollution trading within water another significant contextual difference applies, as the major part of the case studies are within states and nations with the same economic standing. **In this context the Danube is very complex as it is trans-national as well as trans-regional.** Further, it covers a huge range from countries with very high institutional, legal, regulatory and administrative capacity and economic means, to countries with very limited capacity and limited economic resources.

11. At the international level water quality management in the Danube River System is regulated by two conventions: ***The Convention on the Protection and Use of Trans-boundary Water Courses and International Lakes,*** and ***the Danube River Protection Convention***. For at majority of the Danube Countries the ***EU Water Framework Directive*** is a supranational and demanding basic law of water management. These Conventions, and the Directive, neither prohibit nor promote pollution trading. However, the EU Water Framework Directive includes a number of the necessary technical instruments and mechanisms for nutrient trading including the important monitoring programming. EU based legal and regulatory framework has to be addressed carefully as compliance has to be ensured with EU principles concerning e.g. state aid, unfair competition and discrimination. Especially the requirements of the use of BAT (Best Available Technology) and BAP (Best Agricultural Practice) in pollution abatement requires carefully consideration about what should be understood as “real emission reductions”.

12. **The EU Water Framework Directive** is an important and basic instrument for water management in the Danube River System as a majority of the Danube Countries are either EU Member States or EU Accession Countries (Bulgaria and Romania). For the remaining 5 Danube countries it is to be expected that they will follow EU legislation. Consequently it should be investigated more in-depth to which extent pollution trading could be facilitated by the Directive and its sister directives.

13. **A regulatory system** that facilitates a nutrients pollution trading mechanism in the DRB must include requirements on inventories and monitoring mechanism, permitting and approval structure, as well documentation, registration and transfer modalities.

14. **International trading of nutrients** can take place either as state to state trading of non point source pollution from agricultural sources trough balancing of national emission accounts or through trading of credits or allowances connected with emission rights of municipal sources (waste water treatment plants) or industrial sources (fertiliser production, textile and leather industry, food production, slaughterhouses etc.)

15. ***The Helsinki Convention on the Protection and Use of Transboundary Water Courses and International Lakes*** provides a framework for bilateral and multilateral cooperation on emission limitation (nutrients, dangerous substances) and control hereof (establishment of emission inventories, monitoring systems and exchange of information). 13 countries have signed the multilateral Danube River Protection Convention as well as neighbouring countries have entered into several bilateral agreements on water management in the Danube River. The Convention neither prohibits nor promotes pollution trading. It includes some of the needed measures for setting up a nutrients mechanism – e.g. on establishment of emission inventories, monitoring systems, water quality standards as well as emission control based on licensing of waste water discharge and regulation of agricultural activities. Amendments to the Convention are however needed in order to set up and made trading arrangements operational.

16. ***The International Committee on the Protection of the Danube River (ICPDR)*** is the responsible body for initiation and monitoring of joint initiatives of the signatory parties to the Danube River Protection Convention. The ICPDR could if empowered by the signatory parties constitute the intergovernmental body managing a DRB nutrients mechanism within the frames of the Convention.

17. **The Danube River Countries having ratified the Convention** have established national plans and legislation that aim at implementing the programme of the ICPDR concerning limitation and control of nutrients emissions. The Trans National Monitoring Network to which the DRB countries report on yearly basis form an important point of departure for in the establishment of a monitoring facilities supporting nutrients trading. Also, emission inventories covering municipal, industrial and agricultural sources are important tools in context of establishment of a nutrients trading mechanism. The inventories covering agricultural sources are however not yet developed sufficiently. National strategies and investment plans for Waste Water Treatment Plants are under implementation in more countries, hot spots have been identified, as well as programmes for production of phosphate less detergents have been developed.

18. **The driving force in the implementation of the Danube Convention** commitments has however been the approximation activities that have taken place in the countries that became new EU members by May 2004, and in the Accession Countries heading for membership in 2007. Also, the Balkan States of which Croatia has now submitted its application for membership are harmonising their legislation with EU Directive and Regulations. Moldova and Ukraine as EU border-states are in the very preliminary phases of orienting themselves towards the EU system.

19. **The complexes of EU Directives that are relevant in context of nutrients trading in the DRB** is the Water Framework Directive (WFD), the IPPC Directive, the Urban Waste Water Directive, and the Nitrates Directive. The Water Framework Directive is important as it sets the

overall quality objectives and standards for pollutants, including nutrients in surface water, ground water and coastal waters. The achievement of the desired water quality is based on management plans that apply to River Basin Districts. The IPPC Directive and the Urban Waste Water Directive regulate emissions from municipal and industrial sources emitting nutrients, while the Nitrates Directive regulates agricultural activities. The two latter Directives include important provisions on designation of protected areas – Nitrates Sensitive Areas and Nitrates Vulnerable Zones, respectively.

20. **In the new EU Member States and the Accession Countries – Rumania and Bulgaria -** the very dynamic EU approximation process has reached the level where national legislation and institutions are in place implying that the practical implementation of the measures of the Directives are in progress. Most of the New States have however got transitional periods for implementation of the above mentioned Directives. This implies that e.g. that full implementation of the monitoring structures set out in the WFD, the permitting systems of the IPPC Directives regulating industrial activities and the requirements for waste water treatment could only be expected in 2012-2015. In the Balkan States old Yugoslavian legal traditions are gradually replaced by the new nation states, and in Moldova and Ukraine the first step away from old Soviet standards are taken. The fact that the national regulatory systems in the Danube Countries are in a state of flux makes the establishment of a transboundary pollution trading mechanism very difficult.

21. **The number of participants in basin wide pollution trading** is dependent on the choice of trading mechanism – one mechanism is trading of non point source pollution which builds on the principle that nutrients reductions achieved in one country could be used by the buying country. The reduction may be generated through implementation of a project – so-called Joint Implementation projects which are known as a flexible mechanism within the Kyoto Protocol dealing with reduction of Greenhouse gasses.

22. **At installation level credit trading constitutes on mechanisms of pollution trading while Cap and Trade constitutes another.** A Credit trading system may apply to similar installations within a sector (e.g. waste water treatment plants). Credits are generated when an installation manage to emit less nutrients that allowed in permit. The reductions must be monitored by the operator and verified by an independent entity before credits are ready for registration and transfer. Requirements on use of Best Available Technology make it difficult to achieve ‘real reductions´. The idea of a cap and trade system is that a total amount of allowed nutrients emissions (‘the cap’) are distributed to countries that make further allocation of ‘allowances’ to sectors and installations. Installations once a year on the basis of an account of their allowances must buy or (voluntarily) sell allowances. A Danube River Basin wide cap and trade system would be applicable to 35 % of P that is emitted to the Black Sea from municipal and industrial sources.

23. **It seems that a mix of pollution trading with traditional “command-and-control” instruments and economic incentives, will be best suited for and applicable to the complex situation in the Danube River System**. This is mainly based on the complexity of the Danube River in a number of aspects as outlined above, and taken into account that introduction and application of new and untraditional means and measures are resource demanding. Consequently the economic and water quality benefits could be outweighed by the increased administrative costs.

24. Based on the above, four contextual different scenarios could be discussed:

    I. **Business As Usual:** The management and control of P-emissions to the Danube is based on the international and regional Conventions and Directives, and the national legal and regulatory framework in the 13 Danube Countries.

    II. **Regulatory with basic point-source P-trading:** Same as Scenario I but supplemented with P-trading for the point sources, which is carefully formulated and managed, and only introduced where a clear economic benefit can be ensured.

    III. **Regulatory with full-fledged point-source P-trading:** Same as Scenario II but supplemented with as much as possible point source P-trading where the economic benefit is not fully clarified or ensured.

    IV. **Regulatory with full-fledged P-trading:** Same as Scenario III but supplemented with non-point source P-trading.

25. In line with the two-pronged P-strategy introduced in Point 7 above, **a two-phase overall strategy is proposed.** The first phase comprises P-increase counter acting strategies for the Danube River System. This will be premised on a comprehensive P-discharge and transformation monitoring programme with agreed compilation, processing and interpretation of monitoring results. Further, a comprehensive water quality monitoring programme for the North-western Black Sea with as well agreed compilation and so forth. The second phase is presumed to be N-increase counter acting or reduction strategies from the sea shore countries of the Black Sea in relation to the water quality of the Black Sea in the open areas. If the water quality monitoring in the NWBS reveals that the quality is changing to an unacceptable level due to the change in the N/P ratio caused by the second phase N strategies, then it has to be considered to introduce additional measures to limit N-emissions to the Danube River System.

26. **For the Danube River System a two-level strategy is also proposed**. The first level is the P-increase counter acting strategies on the overall regional level with the aim of keeping the discharge of P to the NWBS at the “freeze” level. The second level is P-increase counter acting and possible P-decrease strategies at the country and area specific level in order to solve semi-regional or local eutrophication problems for specific reservoirs and bigger slow flowing areas of the Danube River.

27. In the context of the Danube River System **three basic types of P-trading seems to be interesting and relevant:**
    - Inter-state State Level P-trading, where Danube Countries on the state level buy or sell state allocated P-increase rights and P-decrease obligations;
    - Entity-to-entity Inter-state P-trading, where an entity in one country buy or sell a national allocated P-increase right or a P-decrease obligation to an entity in another Country (it could be wastewater treatment plants or factories producing P rich wastewater as detergent producing facilities).
    - Entity-to-entity National P-trading, where entities within a country buy and sell P-discharges within the National cap.

28. In continuation of the above it is important to take into account, when setting up a possible P-trading facility, the **P-reduction requirements, which comes directly and not imposed by Conventions, from improved wastewater management** due to national legislation and/or EU Directives. Further, it is important in this context to take into account that some P-reduction requirements on wastewater management are “non-tradable” as they address semi-regional and/or local eutrophication problems, and consequently can not be transferred into a regional context in relation to the NWBS.

5. ASSESSMENT OF CONCEPTUAL FEASIBILITY

5.1 Introduction and Summary

In this Study it is found that a nutrient trading system which is based on the generic characteristics of existing mechanisms for trading of Green House Gas (GHG) emissions could be feasible.

Thus it may be concluded that in principle nutrient trading can serve as an economic instrument for regulation of nutrient flow into the North-western Black Sea.

A nutrient trading system for the Danube River Basin may consist of the following elements:

1. **Inventories of emissions of N and P for each country**: Such inventories exist and are part of the implementation of the EU Water Framework Directive. By improving the monitoring systems, the basis for monitoring of traded emissions may also be established.

2. **Allocations of emissions at national level:** Once a common goal for emissions to the Northern Black Sea has been agreed, the future allocation of total emissions amongst the riparian countries can be decided. The changes required by such future allocations are the driving force behind emissions trading.

3. **Allocations within each country** of emissions permits to sectors and/or entities: Based on the inventories, emissions from sectors and entities are known, and the achievement of national targets (from the national allocations) can be apportioned to individual sources (point and non-point). Thereby, emissions allowances are defined for each potential participant in emissions trading.

4. **Mechanisms for trading** of allowed emissions, either project based or simple trading: For participants with specific allowances, trading is a simple matter of monitoring actual emissions and regulating surplus or deficits by trade. If such allowances are not available, project based trades between countries may be an option. Such trades will be based on proven emissions reductions.

5. **Legal framework for trading:** for a basin-wide trading system, it is necessary to establish a system of international recognition of emissions allowances and trades. Likewise, uniform registration and "clearing" of transacted emission allowances is a prerequisite for international trades.

6. **Monitoring systems:** monitoring of actual emissions at installation, project, sector and national levels is a prerequisite for the credibility of a trading system. Monitoring and reporting must take into account both national allocations and registered trades in order to maintain a link to the national inventories.

This Chapter deals with the abovementioned aspects as follows:

- Firstly the general purpose of establishing a trading system and the gains from trading is elaborated.

- Secondly the current situation in the Danube river system and in the North Western Black Sea with respect to legal and environmental issues is described.
- Thirdly a framework for international cooperation on solving the environmental problem is provided. The Danube countries need to agree on environmental objectives, and on a mechanism for sharing the burden with pollution abatement.
- Fourthly a specific outline of the pollution trading system based on the findings in previous chapters is suggested, and the elements of the system are described.
- Fifthly the legal framework for pollution trading is analysed and necessary changes suggested.
- Finally a list of necessary actions in order to implement the system is provided.

5.2 The Concept of Pollution Trading

This Chapter aims at outlining a feasible tradable permit system for nutrient emissions for the Danube River system. It ties together more detailed considerations on the various aspects, i.e. legal, practical, technical, financial, and political aspects in the generic structure.

During the last decade more regulatory regimes have gradually been implemented for the Danube River Countries in order to ensure the achievement of the environmental goals for the aquatic environment of the Danube River Basin and the Black Sea.[1] The latter especially in the North-western part of the sea suffers from eutrophication due to high nutrients loads, transported largely by the Danube.

The development of an integrated water management system in the DRB is based on the use of a wide range of instruments or means of regulation as e.g. water quality standards, emission norms, monitoring and technical norms, designation of protected areas, and exchange of information and cooperation.

The establishment of a nutrients trading system in the DRB could be viewed as a new market based mechanism that together with others of the just mentioned measures should contribute in the mitigation of the Black Sea eutrophication problems (effectiveness perspective).

The overall aim of introducing a nutrients trading system in the DRB would be to ensure that the measures to achieve the predefined environmental goals for the Black Sea ***takes place where the cost reduction is lowest (efficiency perspective).***

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1 In 1997 an ad-hoc Joint Technical Working Group was established between the ICPDR and the International Commission for the protection of the Black Sea. The work of the group has formed the basis for a Communication from the EC Commission COM (2001) 615 final - Environmental Co-operation in the Danube – Black Sea Region. (Parties to Black Sea Convention – Romania, Bulgaria, Ukraine, Georgia, Russia and Turkey).

The legal and regulatory part of the Danube Pollution Trading project deals with the effectiveness perspective of establishing a nutrients trading mechanism in the DRB. Focus of the analysis has thus been on ***how a nutrient trading system could fit into or supplement the already existing overall regulatory systems for water quality management.***

The gains from a market based approach to emission reductions relative to traditional emission standards is best illustrated with a simple example involving two installations, which can be located in different sectors or even states. The installations differ with respect to the marginal costs of reducing emissions – the so-called Marginal Abatement Costs (MAC).

If it is assumed that a standard is set, the MAC of meeting the requirements of the standard for the two installations is shown in the below figure.

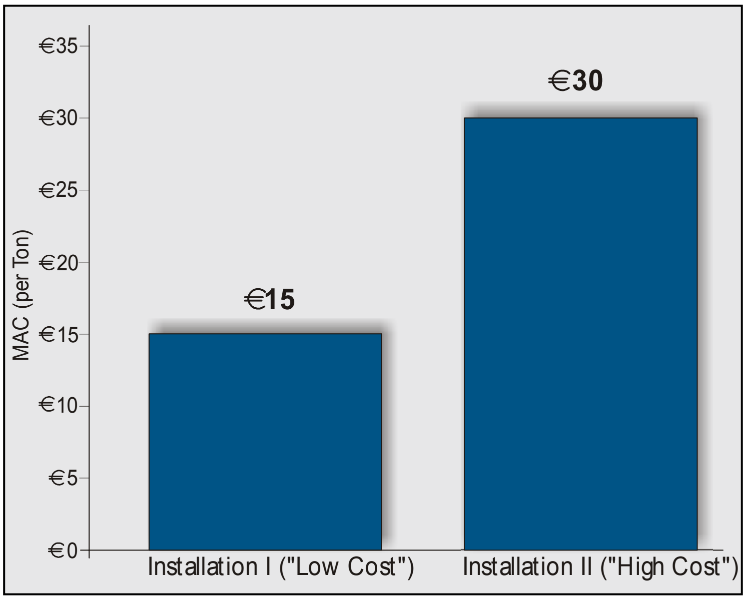

Figure 5-1: MAC for two allocations, emission standard

Installation 1 can meet the standard with a “low cost” marginal cost of € 15 per tonne. Installation 2 on the contrary belongs to the “high cost” segment, and will have to pay € 30 for the marginal tonne removed in order to meet the standard. Clearly in the above situation it would be cheaper for all if installation 1 would carry out the reductions.

Under a cap-and-trade programme the supply of allowances is fixed, and therefore the price is determined by market demand, which in turn depend on the MAC for the respective installations, as described above. The more expensive the reductions, the higher the allowance price, due to the higher demand for emission rather than abatement.

Suppose the market price for an emission allowance is € 20 per tonne, and the two installations are allocated the same amount of allowances as under the hypothetical emission standard assumed above.

In the figure overleaf the gains from the market is illustrated.

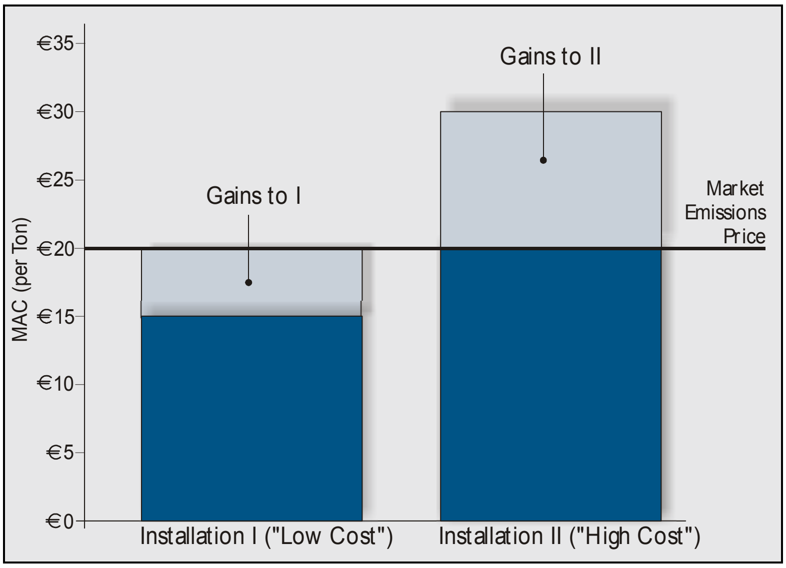

Figure 5-2: Marginal gains from trading

Installation 1 exploits the comparative advantage from the low cost emissions and reduces emissions to a level below the initial standard requirements at a cost of € 15 per tonne. The surplus of allowances is sold to installation 2 at the market price of € 20, which provides installation with a net gain at € 5 per tonne. Installation 2 on the other hand buys the allowances at € 20 per tonne. The avoided cost for compliance is the abatement cost at € 30 per tonne, so installation 2 has a net saving at € 10 per tonne.

This way both market participants have a gain from trading. Figure 2-2 above show the gains from the first allowances traded. When installation 1 start to abate emissions, the marginal costs of abatement are likely to rise. This is illustrated in the figure below.

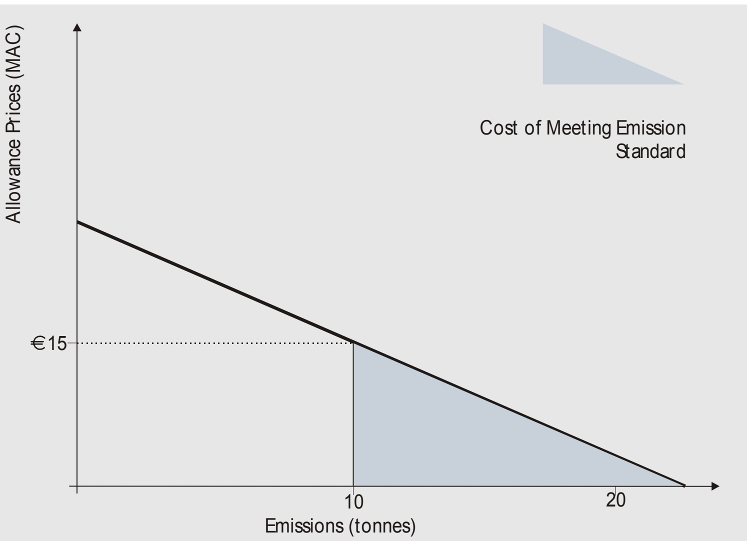

Figure 5-3: Increasing MAC, installation 1

In the initial situation with the emission standard (which is assumed to allow an emission at 10 tonnes) the MAC is € 15 per tonne. The shaded area represents the total compliance costs under the traditional emission standard system. However, if installation 1 under a market system chooses to reduce further, the MAC will increase.

The MAC curve also represents the demand curve for emission allowances. The willingness to pay for an additional allowance is equal to the savings from abating one less tonne. The same situation is illustrated or installation 2 in the figure below.

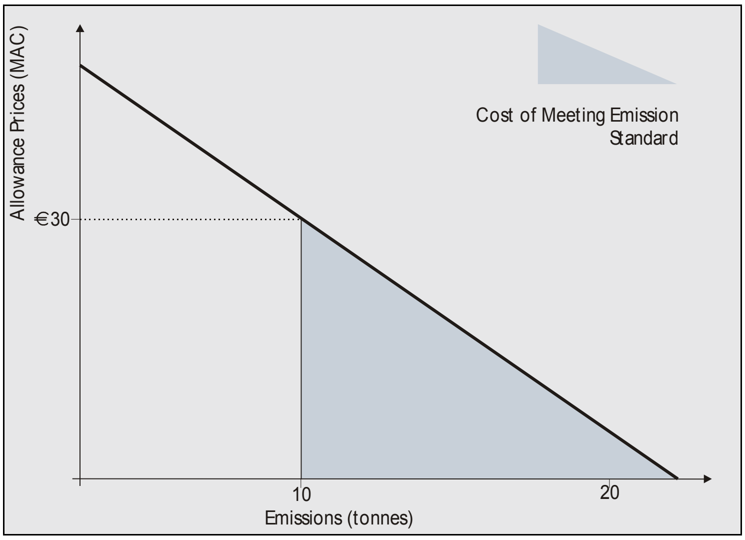

Figure 5-4: Increasing MAC, installation 2

The total costs of the emission reductions under the emission standard system is illustrated by the shaded area, while the marginal costs of meeting the standard is € 15 and € 30 for the two installations respectively.

The trading programme involving the two installations set the cap at the same overall level as for the emission standard system, i.e. 20 tonnes. Under this system installation 1 will reduce emission below the 10 tonnes, and sell the allowances to installation 2 at a higher price than it cost to reduce the emissions. By doing so the MAC starts rising for installation 1.

At the same time installation 2 is buying the surplus allowances from installation 1, and gradually the MAC is falling as the reduction requirements are falling. This is shown in the figure overleaf.

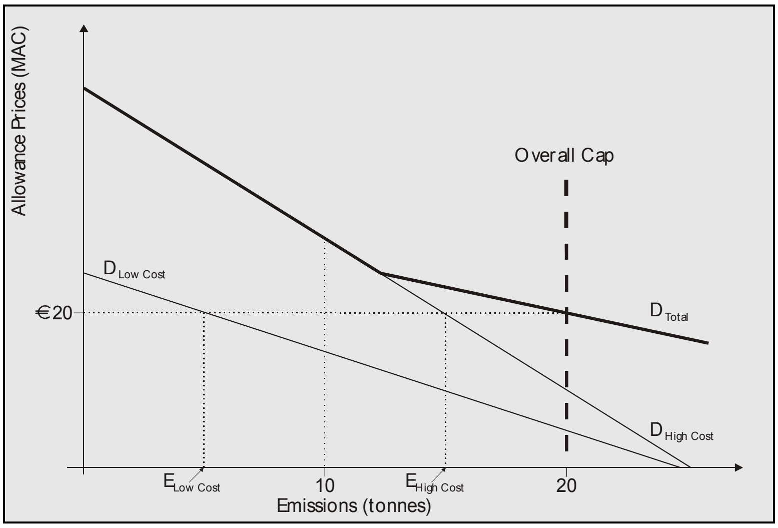

Figure 5-5: Market dynamics

The abatement will continue until the MAC equals the market price at € 20 per tonne. The advantage of the trading system compared to the traditional standard system is illustrated with the shaded areas in the below figure.

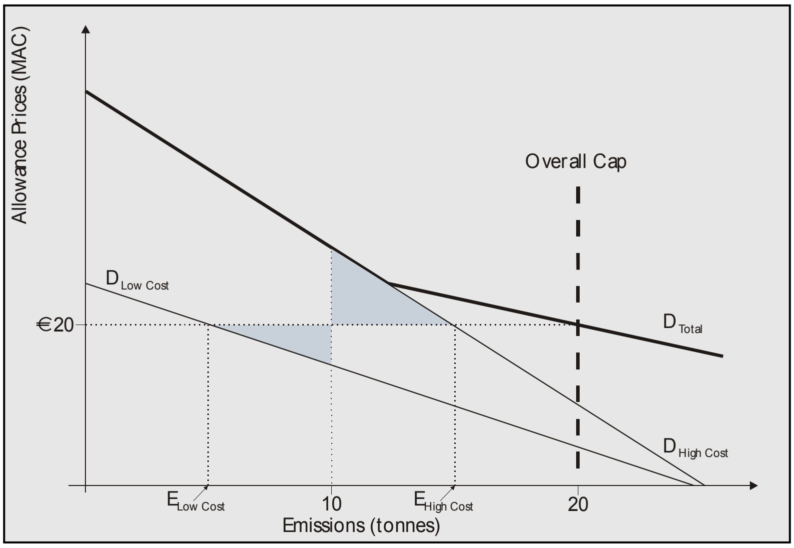

Figure 5-6: Gains from market dynamics

Under the traditional standard both installations could emit 10 tonnes. Under the trading system the low cost installation emit less and sell the surplus allowances to the high cost installation at price higher than MAC, and thereby save an amount corresponding to the left-hand side shaded area in the above figure.

Similarly the high cost installation emits more than the 10 tonnes allowed under the standard system, and by the allowances to the additional tonnes from the low cost installation. This way the high cost installation saves the difference between cost of abating the marginal emission and the market price on allowances. This saving is the right-hand side shaded area in the above figure.

On the above background it can be concluded that:

- A cap and trade system will achieve the emission limitation at the lowest cost to the economy. Some further advantage can be derived from this market mechanism:
    - Since it is possible to sell surplus allowances the system sets up a reduction incentive even for those within the limit. The system thus fosters the search for new technical solutions.
    - The resistance against new or stricter emission limits is softened, if the obliged have the option to buy.

- In comparison with other policy measures it is the general perception that emission trading is:
    - More efficient, i.e. the same effect can be achieved at lower costs
    - More politically acceptable, as those obliged have an alternative to reductions
    - May be a means to finance reduction measures.

5.3 The Environmental Problem

The average inorganic nitrogen and phosphorus content in surface layer of the Danube and Dnieper estuary waters increased from 1958/59 until the end of the eighties 4-6 and 2-4 times respectively, whereas organic forms of these elements increased 2-3 times as compared.

Focusing only on the Western Black Sea about 80% of the N load and about 75% of the total P load is discharged via the Danube.

Human activities have significantly increased the riverine delivery of dissolved inorganic N and P to the coastal zones. The increase of N and P in the Danube is due to the use of fertilizers in agriculture, the construction of sewer system with non-adequate treatment facilities, the use of P-containing washing powders. In some areas in addition emissions are due to direct discharges of manure or industrial discharges (e.g. fertilizer production).

Between 1960 and 1988 the application of market fertilisers in the whole catchment has increased by a factor of about 4 to 5, and there was no big difference between Eastern and Western European countries. After the breakdown of communist economy the use of market fertilisers in the Eastern countries dropped to values comparable to 1967 while in the Germany and Austria it remained nearly constant or showed a slight decrease.

It should be noted that the current level of nutrient pollution in the Western Black Sea is acceptable from an environmental point of view. The challenge is thus to avoid the increasing trend, which will be inevitable in a do-nothing scenario.

The current situation is further more characterised by being P constrained rather than N constrained. While this means that P is the most important pollutant in the Western Black Sea, N should still be monitored.

Figure 5-7 shows the developments for N-fertiliser application in Danube catchment. The development for P-market fertilizer application follows a similar pattern.

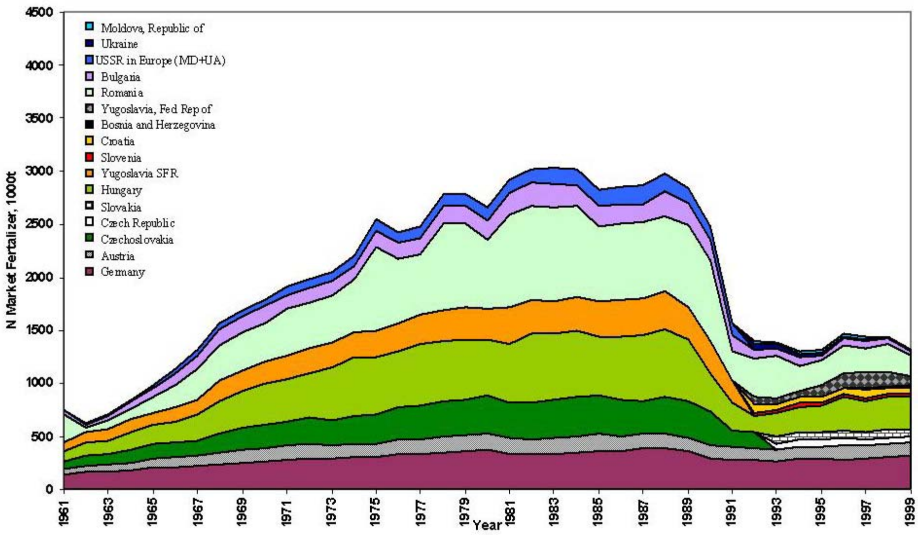

Figure 5-7: N-market fertilizers application in Danube Basin 1960-2000

After the political change in the former communistic countries agriculture has changed dramatically in great parts of the catchment from an economically viable agriculture to a small scale food supply system for the regional population. Land property was redistributed in many areas which have resulted in completely new responsibilities and also due to a lack of investments land use also changed.

In the mid 50ies in Austria and Germany big efforts were undertaken in the development of sewer systems. The waste water was not treated or if treated without nutrient removal (mechanical or biological treatment with C-removal only). This lead to a considerable increase of nutrient discharges into the surface waters. Also in downstream countries the building of sewer systems increased the nutrient discharges to the rivers.

Both Nitrogen and Phosphorus is emitted in the Danube catchment in most countries via non-point sources however the P-emissions from point sources are more important than the N-emissions from these sources. The importance of these sources and for N and P vary considerably in the various riparian countries.

For the present state (period 1998-2000) the model result was that a total of 759 kt/y nitrogen (N) and 68 kt/y phosphorus (P) are emitted by the different pathways. **82 % of N-emissions and 64 % of P-emissions come from diffuse sources.**

The dominant pathway is groundwater for N-emissions and erosion as well as point source discharges for P-emissions with 43 % and 34 %, respectively.

The regionalized analysis facilitates the identification of spatial hot spots for the individual emission pathways. Calculations performed for background conditions have shown that the nutrient emissions were approx. 6 kt/y P and 60 kt/y N. **Consequently, the human impact is about 10 times higher than the background for P and 12 times higher for N. Of the total emissions 32 and 46 % of the P and N-emissions were due to agricultural activities. Urban settlements are responsible for 54 % P and 29 % N.**

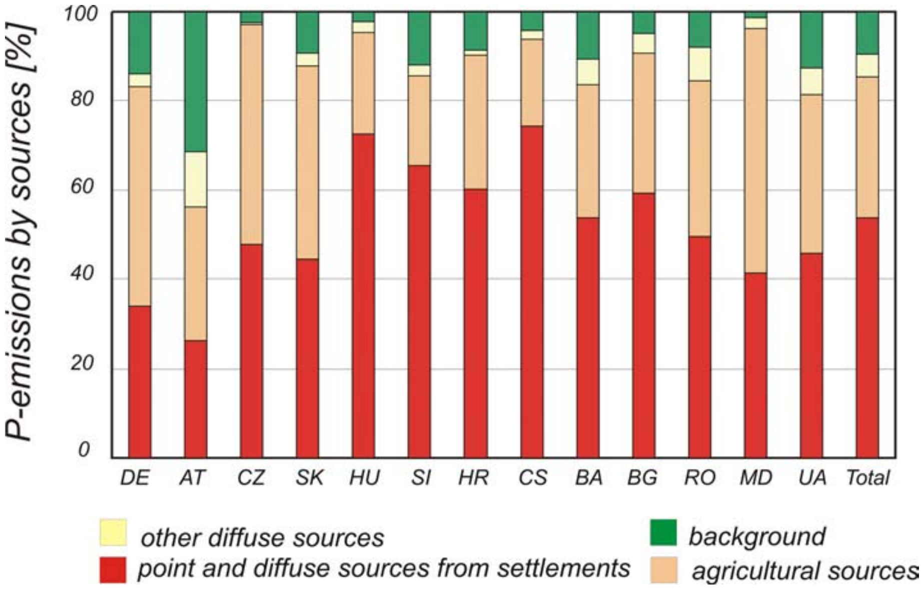

Figure 5-8: Contribution of different sources to the P-emissions in the Danube River System (1998-2000)

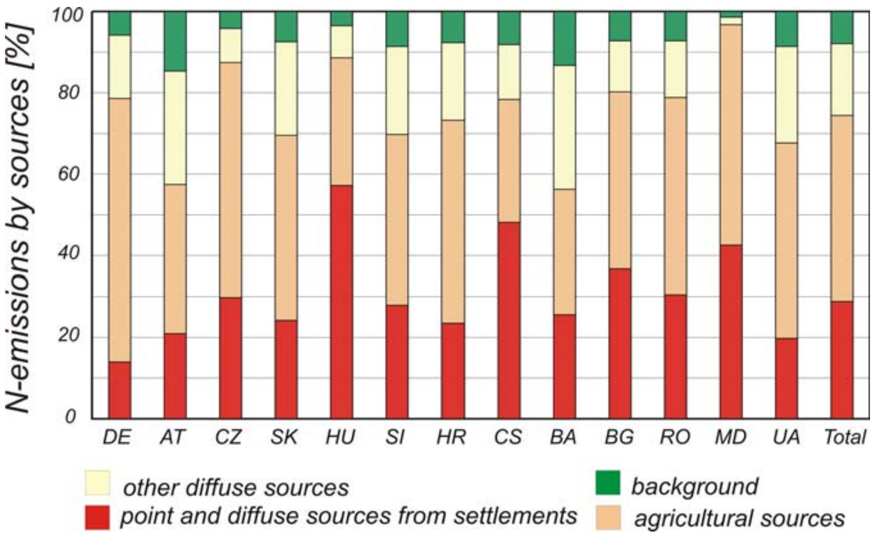

Figure 5-9: Contribution of different sources to the N- emissions in the Danube River System (1998-2000)

Catchments in mountainous regions have higher background emissions due to the occurrence of natural erosion and high precipitation and high surface runoff.

The share of the different sources within the country parts of the Danube differ in a wide range. It is obviously that this differences results in different major task for possible reductions of the nutrient emissions in the countries.

The high portion of the P-emissions from urban settlements for all countries with exception of Germany and Austria indicates that a further improvement of waste water treatment would due to further significant reductions of the total P-emissions in the Danube. For nitrogen it was found out that agricultural emissions are for all countries with exception of Hungary, Serbia and Montenegro and Bosnia and Herzegovina the main source.

The highest amounts of N and P are emitted by Romania -about 25%. For P Serbia and Montenegro is the second largest contributor, followed by Austria and Hungary. For N Germany is second, followed by Austria and Serbia and Montenegro.

In the following figures the sources are subdivided into sectors which can be influenced by management and those which not. Especially for P and to a slighter extent for N in the waste water management as well as in agriculture nutrient emissions can be reduced.

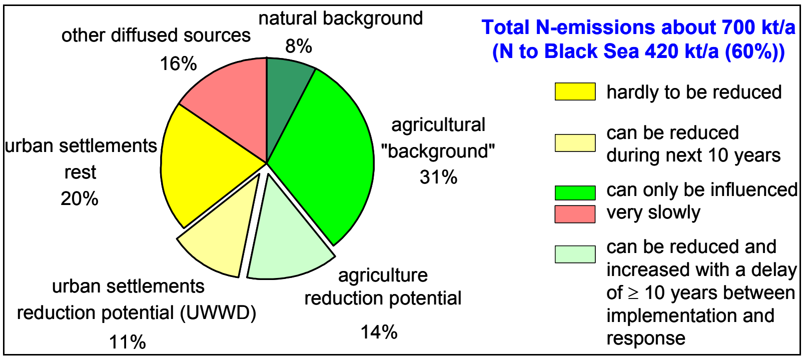

Figure 5-10: Reduction potential of nitrogen emissions (model results)

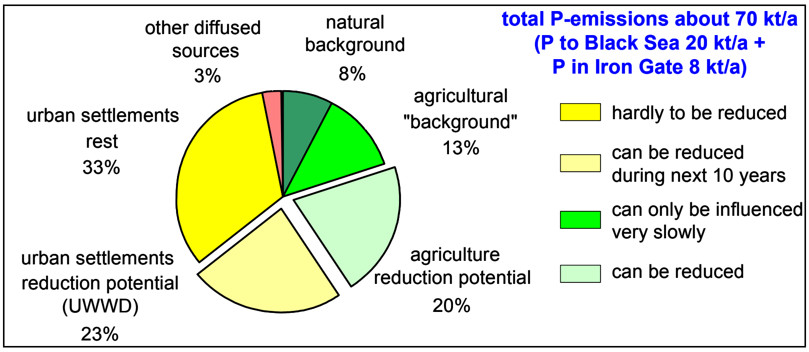

Figure 5-11: Reduction potential of phosphorus emissions (model results)

The monitoring network within the framework of Trans National Monitoring Network (TNMN) builds on national surface water monitoring networks.

In the year 2001 79 monitoring stations are included from the following countries: Germany, Austria, Czech Republic, Slovakia, Hungary, Croatia, Bosnia Herzegovina, Slovenia, Serbia & Montenegro, Bulgaria, Romania, Moldova and Ukraine. The minimum sampling frequency is 12 per year for determinants in water.

The monitoring stations are shown on the map overleaf.

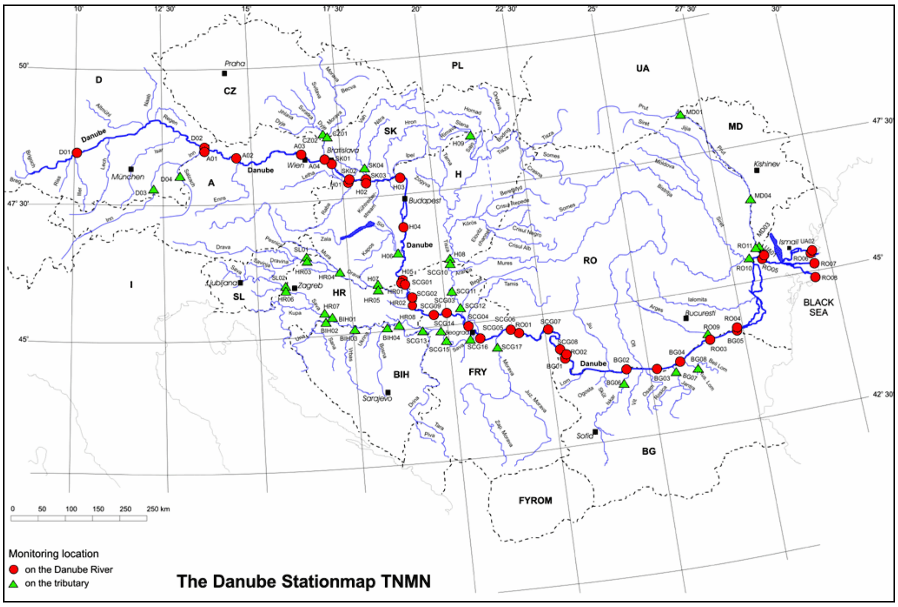

Figure 5-12: The Danube Station map TNMN

A well-designed monitoring system and accurate data on nutrient loads in the river are prerequisites to quantify transport, retention and losses.

Water quality monitoring strategies usually are designed to detect critical concentrations of substances in the river but not for determining nutrient loads. The present monitoring of nutrient loads in the Danube River and its tributaries shows deficits.

The monitoring system has to be adapted to the purpose set by water management. The main objective of TNMN is a structured and well-balanced overall view of the situation and long-term development of quality and loads in terms of relevant constituents for the major rivers in the Danube River Basin.

The international aspect of TNMN is of high importance. TNMN will be considerably influenced in the near future as a result of WFD implementation establishing specific requirements on monitoring of surface water status.

For improving nutrient load measurements in respect to nutrient trading the main questions are:

- Which parameters have to be measured?
- Which sampling time and frequency should be chosen, and
- How sampling should be performed in order to obtain representative samples under different conditions (e.g. especially high flow)?
- Where measurements and samples are taken, especially at border crossing of water flows to establish the quantities of net export/import.

A main item of interest in this context is to differ between that part of the particle-bound phosphorus transport in the rivers that is available for algal growth under certain conditions (and thus important for water quality) and that part of the particle-bound phosphorus that will not be mobilized (and thus negligible for water quality issues).

The current TNMN considers the following N and P-fractions: orthophosphate and total P, Ammonium, Nitrite, Nitrate, organic Nitrogen and Total Nitrogen. For Nitrogen probably the detection of the dissolved and the particulate organic (biogenic) N-fraction would be interesting. The detection of Nitrite is of a negligible importance in regard to nutrient loads. However only a few stations provide total N and biogenic N up to now.

For P, a change of the determinants is suggested: total P should be measured in the filter and the unfiltered sample and not only in the total sample. The detection of orthophosphate shall be continued.

As the P-concentrations at the rising limb of storm hydrographs differs considerably from the concentrations in the receding limb a method has to be developed for a representative sampling during flood conditions. Up to now this method has not been developed in the daNUbs project. Especially the calculation of nutrient loads has to be adapted to the runoff situation (weighted averages according the frequency of the flow conditions).

Furthermore floodplains, dams and impounded river reaches can play an important role in nutrient retention and /or release (mobilization).

Concerning the frequency a biweekly (eventually only in summer biweekly as biogenic activities influence the concentrations of the various fractions considerably) measurement is recommended for all determinants mentioned. High flood events are important at least for the upper part of the Danube and the Tributaries, but of lower importance for the Lower part of the Danube. Therefore, in addition to the regular TNMN for nutrient trading an event oriented sampling during flood events is suggested for the P-determinants.

In summary in relation to the nutrient problem:

- In the North-western Black Sea about 80% of the N load and about 75% of the total P load is discharged via the Danube.
- The current level of nutrient pollution in the Western Black Sea is acceptable from an environmental point of view.
- The increase of N and P in the Danube is due to the use of fertilizers in agriculture, the construction of sewer system with non-adequate treatment facilities, and the use of P-containing washing powders.
- The current situation is P constrained rather than N constrained.
- 82 % of N-emissions and 64 % of P-emissions come from diffuse sources.

A trading system requires an accurate and uncontested determination of the net input of nutrients into the Danube river system. The monitoring of water quality must therefore be improved and extended before trading is operational.

5.4 The Legal and Regulatory Framework

International policies and legislation that aim at establishing water management co-operation in the Danube River Basin have been adopted and developed on continuously basis for more decades.

In recent years the riparian states have established an integrated programme for the basin-wide control of water quality. Furthermore the Danube pollution problems are viewed as problems of European Community importance, since major part of the Danube countries are (new) EC Member States or Accession Countries. At the national levels approximation of international and EC initiatives has resulted in specific national policies and legislation concerning the protection of the aquatic environment.

The existing regulatory framework for the protection of the aquatic environment in the Danube Countries is thus constituted by interplay of international and EU water legislation as well as multilateral co-operation agreements and national legislation in the DRB countries.
International Conventions form the overall legal framework based on which states for many years have committed themselves to take jointly responsibility for environmental problems. The UNECE Helsinki Convention from1992 on the Protection and Use of Transboundary Water Courses and International Lakes has formed the legal point of departure for the adoption of the multilateral Danube River Protection Convention (DRPC) and several bilateral conventions in the DRB.

The DRPC and more programmes and action plans constitute the framework for the multilateral co-operation in the DRB for protection and sustainable use of the river. The parties of the Convention has delegated to an International Commission for the Protection of the Danube River (ICPDR) to elaborate proposals and recommendations addressed to the contracting parties.[2]The parties to the Convention are: Austria, Bulgaria, Croatia, Czech Republic, Germany, Hungary, Moldova, Rumania, Slovak Republic, Slovenia and the EC – Ukraine has signed but not ratified the Convention - Bosnia/Herzegovina and Serbia/Montenegro is observers.

Subjects to the Danube Convention is among other things - the discharge of waste waters, the input of nutrients and hazardous substances both from point and non-point sources. In order to prevent and reduce e.g. the nutrients pollution the Convention sets out that the signatory states should set national or joint water quality standards and emission limits.

The balance of immission and emission levels should be reached through regulation of non point and point source emissions, monitoring and control. Exchange of data and information between parties is one of the core responsibilities of the parties.

The participating states are in general obliged to ensure that legal, administrative and technical measures are applied at national levels in order to at least maintain or improve the water quality of the Danube. *The polluter pays principle and the precautionary principle* constitutes the basis for all measures.

The multilateral cooperation in the DRB has resulted in several initiatives within establishment of monitoring programmes, point source, and non point source control that are of importance when considering a regulatory framework for nutrients trading in the DRB.

[2] *As idem* sub-section 3.2

The driving force in the establishment of regulatory frameworks for water protection and pollution control in the DRB has however been the approximation processes that take place in the new EU Member States and Accession Countries. Also the preliminary EU harmonisation programmes that are being implemented in the Balkan Countries are likely to have impact on the development of coherent water prevention and pollution control systems.

At the EC level a broad debate on water policy have taken place during more than 30 years. The policy developments of the latest years have resulted in the adoption of the Water Framework Directive (WFD), which offers a framework for a sustainable water policy.

The overall philosophy of EC integrated water quality management builds upon the idea that different water quality standards (immission norms) should be met by regulation and control of emissions, production processes and land use. The EC Directives included in the water quality management concept provide instruments for regulation at authorities, sectors as well as operators level.
The Directives that have been adopted and implemented gradually from the 70'ies up to now reflect different approaches to regulation – Traditional command and control regulation form the core of the EC legislation that in the 80'ies was supplemented with legislation providing for self-regulatory and market-based instruments.

The principles and mechanisms of the WFD Directive that apart form the Directive itself involve a number of other directives should be taken into account in the Danube (Black Sea) River basin co-operation, inasmuch as many of the countries are already EC Members as well as the parties to the DRPC have agreed that the WFD principles should govern the developments of the Danube/Black Sea co-operation.

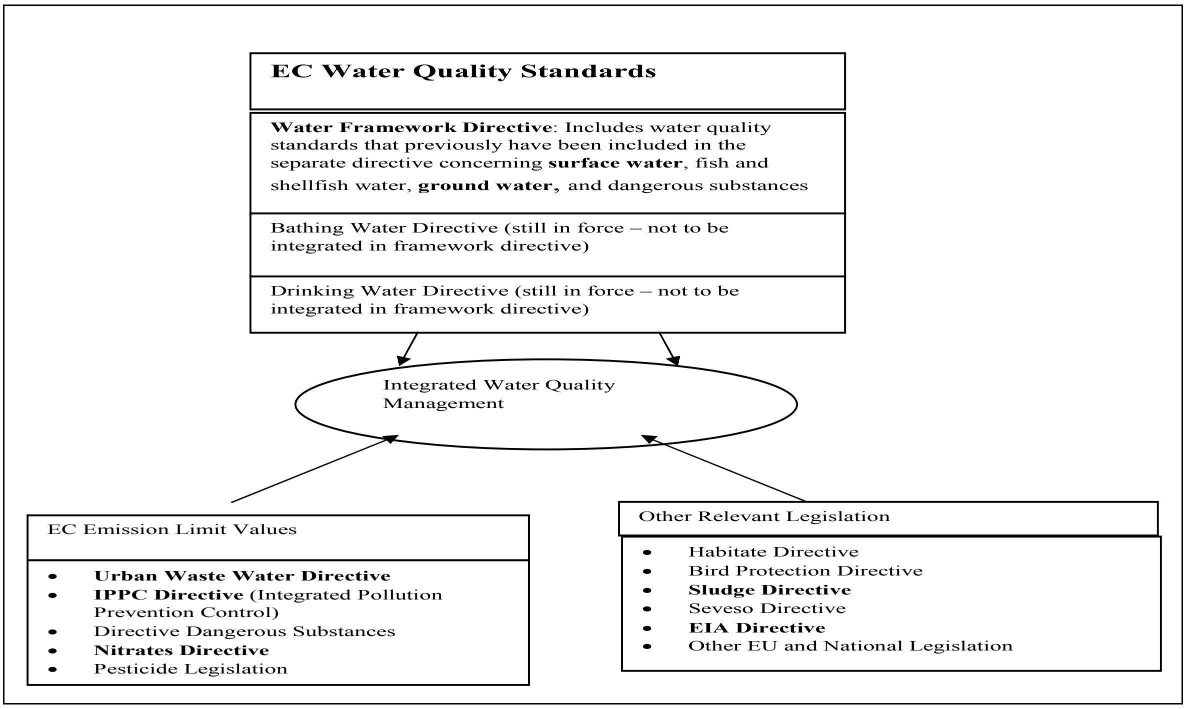

Figure 5-13: Concept of EU integrated water quality management

In context of regulation of nutrients the bold-marked Directives are of particular importance. The EC Member States in accordance with the WFD should achieve good status for all waters within a 15 year time frame (In accordance with Annex 5 concerning surface waters - nutrient conditions are included). The overall environmental goals and quality standards should be met by using the ***so-called combined approach.***

Point source and non-point nutrient pollution must be regulated through (IPPC) permits setting emission limit values (the IPPC Directive Article 10(2) requires that emission control are based on best available technology) and in case of diffuse pollution use of best practices. The surface water quality in a river basin district must be monitored on continuously basis as well as entities must carry out self-monitoring as stipulated in permit and report to relevant authorities. This mechanism allows the river basin district authority to react in the case that general monitoring shows non-compliance with quality standards and when entities exceed limit values for emissions. The latter case of non-compliance usually would be disclosed through site inspection or data and information reported to the authorities.

The IPPC Directive (96/61/EC) in Annex 1 outlines which sectors and installations that are subjects to IPPC permitting. Annex 1 (6) covering 'other sectors' lists installations of a certain size for rearing of pigs and poultry, slaughter houses, treatment and processes intended for food product, treatment of animal raw materials, treatment of hides and skins etc.

The Urban Waste Water Directive (91/271/EEC) sets requirements regarding urban waste water treatment plants, and a newer Directive 98/15/EC clarifies what should be understood as daily averages for the total nitrogen concentration.[3]

The sister Directives - The Urban Waste Water Directives and the Nitrates Directive (91/676/EEC) include requirements on designation and appointment of N sensitive areas and Nitrates Vulnerable Zones, respectively. The Nitrates Directive regulates non-point source pollution from agriculture through N water quality standards, requirements on development of national action plans, preventive measures, fertiliser plans manure storage, records etc.[4]

Since the last part of the 90ies ten Eastern European countries have prepared for and in 2004 finally become EU Member States. Among these are some of the Danube Riparian Countries – the Czech Republic, Hungary, Slovakia, Slovenia, while Romania and Bulgaria are heading for EU membership in 2007.

These countries in their efforts in complying with the *Environmental Acquis Coomunautaire* have aligned their national legislation with relevant EU Regulation and Directives - e.g. within the water protection and pollution control field. The further approximation activities – the practical application in form of institution building and enforcement activities are still going to take place for more years to end of transition periods for full EU compliance – which typically expires between 2010 and 2015 for different activities.

[3] Cf. COM (2001) 685 final on the implementation of the Urban Waste Water Directive.
[4] Cf. COM (2002) 407 final on the implementation of the Nitrates Directive.

In the Balkan countries and also in Moldova and Ukraine the harmonisation of EU legislation is in its preliminary phases – many of the central main environmental national laws are however in the process of being aligned with the EU legislation.

The above described regulatory framework has to be taken into account when considering the establishment of a nutrients trading concept in the DRB, which would typically include the following elements: Inventories, Monitoring, and Approval Mechanisms; Documentation; Registration; and Transfer Facilities.

A trading system requires an accurate and uncontested determination of the net input of nutrients into the Danube river system. The monitoring of water quality must therefore be improved and extended before trading is operational.

The existing regulatory framework for the protection of the aquatic environment in the Danube Countries is constituted by an interplay of international and EU water legislation as well as multilateral co-operation agreements and national legislation in the DRB countries.

The following acts are of especially importance:

- The UNECE **Helsinki Convention** from1992 on the Protection and Use of Transboundary Water Courses and International Lakes has formed the legal point of departure for the adoption of the multilateral **Danube River Protection Convention** (DRPC) and several bilateral conventions in the DRB.

- The participating states are in general obliged to ensure that legal, administrative and technical measures are applied at national levels in order to at least maintain or improve the water quality of the Danube. ***The polluter pays principle and the precautionary principle*** constitutes the basis for all measures.

- The policy developments of the latest years have resulted in the adoption of the **Water Framework Directive**, which offers a framework for a sustainable water policy.

- Point source and non-point nutrient pollution must be regulated through (IPPC) permits setting emission limit values (**the IPPC Directive** Article 10(2) requires that emission control are based on best available technology) and in case of diffuse pollution use of best practices.

- **The Urban Waste Water Directive (91/271/EEC**) sets requirements regarding urban waste water treatment plants.

- The sister Directives - The Urban Waste Water Directives and the **Nitrates Directive (91/676/EEC)** include requirements on designation and appointment of N sensitive areas and Nitrates Vulnerable Zones, respectively.

5.5 Burden Sharing

The starting point for considering the environmental problem outlined above require that the International Committees for the Danube River (ICPDR) and the Black Sea agree on the desired water quality in NWBS.[5] It would then be a matter of the ICPDR to establish a ceiling value for the total emissions of nutrients to the DRB – e.g. per year – that corresponds to the environmental goal.

As was mentioned in the previous section the current nutrient pollution load in the Western Black Sea is acceptable from an environmental perspective. The challenge is to make sure that pollution levels are not increasing. This will be difficult when the countries on the lower and central Danube take an economic upswing, including agriculture. Given the environmental goal the countries have to agree on principles for sharing the burden of meeting the goal. ***Burden sharing is as such a result of political negotiations among the involved countries.*** Agreement on principles for burden sharing provides the background for setting a cap for total emissions for each country.[6] Each country will have a number of policy options to meet its cap, one of which being emission trading.

Principles for sharing the burden – setting the cap[7]**:** One of the major challenges facing the negotiators is to find some scheme of burden sharing that can be generally accepted as "fair" by all or at least most governments. Some studies have identified a fairly large number of distributive fairness principles and rules for the distribution of costs of measures to control emissions. The table below outline some of the commonly discussed fairness principles related to burden sharing.

It is possible on this background to identify a core set of principles that combines at least three different but complementary notions of distribute fairness: equality, equity and exemption. Let us first try to specify each of these notions and then explore how they are combined.

Equality: The default option in international negotiations seems to be the principle that all parties should have equal obligations. In saying that this is the default option we do not imply that it is the one most frequently used. Rather, what we suggest is that this is where negotiations will normally start, and that the burden of proof tends to rest with anyone who wants to argue for a differentiated different approach.

Furthermore, equality can arguably be supported by reference to the sovereignty principle, which in the context of international law states that since all states are equal, they should have equal rights and duties. The principle of equal obligations is open to different interpretations.

[5] A Memorandum of Understanding was agreed by the two Commissions in 1997 and a Joint Technical Working Group. The EU dimension of the aquatic environment in the Danube and Black Sea Region was emphasised by the EU Commission Communication, COM (2001) 615 final on Environmental Cooperation in the Danube – Black Sea Region.
[6] The EU Member States in 1998 entered into a 'Burden Sharing Agreement' for meeting the GHG emission reductions laid down in the Kyoto Protocol. The agreement redistributes targets between the Member States in order to reach the overall 8% reduction goal of the EU. Cf. COM (1999)230 final.
[7] Text in this section is adapted from Ringius et. al.: Burden Sharing and Fairness Principles in International Climate Policy. Kluwer, 2002.

Table 5-1: Various fairness principles for burden sharing

Fairness principle	Interpretation	Example of implied burden sharing rule
Egalitarian	Every individual has an equal right to pollute or to be protected from pollution	Allow or reduce emissions in proportion to population
Sovereignty	All nations have an equal right to pollute or to be protected from pollution; current level of emissions constitutes a status quo right	Allow or reduce emissions proportionally across all countries to maintain relative emission levels between them
Horizontal	Countries with similar economic circumstances have similar emission rights and burden sharing responsibilities	Equalize net welfare change across countries (net cost of abatement as a proportion of GDP is equal for each country)
Vertical	The greater the ability to pay, the greater the economic burden	Net cost of abatement is directly correlated with per capita GDP
Polluter pays	The economic burden is proportional to emissions (eventually including historical emissions)	Share abatement costs across countries in proportion to emission levels

Source: Ringius et. al.: Burden Sharing and Fairness Principles in International Climate Policy. Kluwer, 2002

Attention tends to focus on obligations defined in terms of relative contributions. In the context of pollution control this typically translates into standardized regulations of the format "all parties shall reduce emissions of substance *s* by *x* percent relative to a given baseline (emissions level at time *t*)."

In the climate change negotiations many governments initially argued in favour of applying such a flat-rate or across-the-board approach to all industrialized countries.

The principle of equal obligations has a firm normative basis if all parties involved are equal in all relevant respects. This condition is, however, never met in global negotiations. Even in a more narrow regional setting a substantial range of variance along important dimensions is often found.

Equity: The common denominator for equity principles is that costs and/or benefits be distributed in (rough) proportion to actor scores on some dimension considered to be important. A fairly large number of such dimensions can be identified, but in international negotiations attention seems to focus primarily on two dimensions.

One is the role of each party in creating a problem or providing a good. If some parties have played a significantly or disproportional larger role than others have in causing a problem – e.g., through large emissions – it seems fair that they should also take a correspondingly greater responsibility for "cleaning up the mess." Similarly, if some parties have contributed more to a particular good, it seems fair that they get a correspondingly larger share of the benefits (or have past contributions subtracted from future obligations), everything else held constant.

The other dimension refers to the consequences that a particular obligation or project would have for the various parties. A common notion of fairness requires that burdens be shared in some proportion to capacity (a principle well known from progressive income taxes) and that benefits be distributed in proportion to needs.

Clearly, burden sharing is a matter of distributing costs. However, criteria for distributing costs can be derived indirectly also from principles pertaining to the distribution of benefits.

The principle of capacity requires that costs be distributed in proportion to "ability to pay." The conventional yardstick for determining capacity would be wealth measured in terms of GDP per capita.

Pollution control measures are supposed to bring benefits, at least in the form of reduced environmental damage costs. If these benefits vary substantially, it might appear reasonable to include them in the equation. The general rule would be that costs be distributed in proportion to (expected) benefits. Applied to the Danube nutrient problem, this notion would however tend to run against other salient principles. More specifically, it would often lead us to impose the heaviest costs upon the most vulnerable countries. These would often be impoverished "victims" of pollution emitted by richer and more fortunate countries.

We therefore expect the idea of distributing abatement costs in proportion to benefits – although often referred to in everyday life – to be overruled by other principles in this particular context.

Exemption: The range of variance in terms of dimensions such as "responsibility" or "capacity" is usually so great that even the notion of soft proportionality would lead to unfair burdens upon the poorest "victims." When the latter threshold is reached, attention tends to shift from principles of equity to the simple principle of "exemption"; more precisely, exemption from any substantive obligation for which a party is not (fully) compensated.

This pattern is clearly seen in the global climate change negotiations. Even those who argue that developing countries should make a commitment to contribute, at least in the future, accept that (temporary) exemptions are required for the poorest countries. Any pressure upon these countries to sign would at this stage have to take the form of a request for moral support rather than material contributions involving net costs.

Combining Principles: In the analysis above it has been assumed that the three basic notions of fairness have different domains. The principle of equality applies within groups or subsets that are considered sufficiently homogenous in important respects. The principle of equity applies where the critical differences exceed that threshold – except for the most disadvantaged parties, from whom no material contribution will be required so that they are exempted.

It remains, then, to determine the critical thresholds (indicated by "x" and "y" in the below table).

Table 5-2: A general framework for fairness in burden sharing

Principle	Domain
Equality	Relevant differences $\leq x$
Equity	$x <$ relevant differences $\leq y$ (assumption: $x < y$)
Exemption	Relevant differences $> y$

Source: Ringius et. al.: Burden Sharing and Fairness Principles in International Climate Policy. Kluwer, 2002

It is suggested that in order to qualify as "fair," a burden sharing formula will have to correspond to this general format. Moreover, within the domain of equity, it will have to differentiate obligations according to the principles outlined above – not necessarily responding to all, but at the very least to one.

A burden sharing agreement based on the above principles assume a number of preconditions to be in place if applied to the Danube River System:

- It should be possible to measure the net emissions contribution for all countries involved.
- A monitoring system along the lines described earlier should be in place
- The spatial relation between emissions to the river and impact in the Black Sea should be transparently dealt with.

When the countries have reached a burden sharing agreement a cap is fixed for each country, which in turn can choose between 2 general categories of policy measures in order to be able to meet the cap:

- Command and control measures (CaC).
- Economic measures.

Examples of CaC measures are:

- Physical planning, in particular with regard to siting.
- Bans, of certain substances or activities.
- Commands, i.e. demands by the authorities.
- Permitting of certain activities, always under conditions.
- Norms, setting rules and standards.
- Rationing by authorities.

The common features for this category of policy measures are that the government issues a command; compliance with the command is controlled; and non-compliance is sanctioned.

Generally CaC measures require that to control the regulated units, and that control costs are not too high. CaC measures should be considered when non-compliance can result in critical risks for the society. Also, if the number of units to be regulated is few, CaC measures can be an option.

Economic measures impact the relative prices on the market, and in turn regulate the composition of production and consumption. In particular with respect to environmental regulation, economic measures can internalise the external pollution effects to the price.

Examples of economic measures are:

- Subsidies.
- Taxes/effluent charges.
- Liability insurance.
- Tradable rights (emission trading)

The use of economic measures requires that there is a well-defined consumption- or activity unit that can be subsidised taxed, etc.

Policy measures are usually mixed with each other and across categories. The European States having achieved a reduction of their GHG-emissions, have all done this by a multitude of instruments, ranging from moral suasion to energy taxes and single case emission control. The ETS of the EU can also be considered a combination of a CaC measure and a market.

Based on the above it is recommended to further consider in relation to the Danube River System a core set of principles that combines three different but complementary notions of distribute fairness (equality, equity and exemption) as justified/elaborated below:

- **Equality** is by default that all parties should have equal obligations. This typically translates into standardized regulations of the format "all parties shall reduce emissions of substance *s* by *x* percent relative to a given baseline (emissions level at time *t*)."
- **Equity** involves considerations on distribution of costs and benefits. The conventional yardstick for determining equity would be wealth measured in terms of GDP per capita.
- When equality and equity considerations leads to unfair burdens on the economic weakest countries, the principle of **exemption** can be applied, i.e. exemption from any obligation for which the country is not fully compensated.
- **The three principles can be combined**: The principle of equality applies within groups or subsets that are considered sufficiently homogenous in important respects. The principle of equity applies where the critical differences exceed that threshold – except for the most disadvantaged parties, from whom no material contribution will be required so that they are exempted.

A burden sharing agreement based on the above principles assume **a number of preconditions** to be in place:

- It should be possible to measure the net emissions contribution for all countries involved.
- A monitoring system along the lines described above should be in place.
- The spatial relation between emissions to the river and impact in the Black Sea should be transparently dealt with.

5.6 Elements in a Nutrient Trading System

The business-as-usual scenario at national and entity levels

There should be a direct link between national nutrients targets (the cap) and the (e.g. yearly) maximum of N and P emissions to the Danube. The current yearly national loads of N and P to the Danube could in terms of a nutrients trading mechanism be described as the national business-as-usual (BAU) scenario.

The national P and N emissions to the Danube originate from both point and non point sources. The total emissions from non-point sources form a 'non-point source' BAU scenario, while the point source pollution could be described in terms of sector- and individual enterprise BAU scenarios. BAU scenarios are determined by EU and national legislation. The 'non point source' BAU scenario is a result of EU agricultural policy and legislation as implemented at national levels – e.g. the Nitrates Directive.

Sector and entity BAU scenarios are results of the regulatory measures that apply to various kinds of installations that cause N and P emissions – e.g. waste water treatment plants and activities producing waste water that is discharged directly to surface waters – e.g. food producing industry, textile and leather production. The IPPC permitting system and the Urban Waste Water Directives as implemented by national legislation form the overall framework for individual entities emissions rights.

Trading within a nutrients trading mechanism requires that the selling part can ensure that the set BAU scenario is kept or decreased if a reduction goal applies. Direct trade of emission quota between two states thus requires that the national BAU scenario of the selling part is not exceeded – and vice versa – the buying part can add the quota to its overall account of emissions.

The concept of credit trading implies that enterprises that are able to verify nutrients reductions through measurements against its BAU scenario can have the difference certified as credits. A specific problem is that discharges may attempt to get credits for improvements that are already required to be in place – e.g. application of BAT.

The scope of a credit trading scheme may be defined by a particular sector BAU scenario. Similar activities within a sector may form the part of departure for trading of emission rights within the frames of a set sector BAU scenario – Example of such type of pollution trading is found in Connecticut where public owned treatment plants trade emission rights on the basis of Total Daily Maximum Loads (TDML).[8]

Allowance allocation

Allowance allocation is processed in three steps as outlined in the figure overleaf. The first step is the setting of national targets (the Cap) for the involved countries.

[8] *As idem.*

Principles for burden sharing and fixing the cap were described in the previous section. The cap in each country is based on the national target. The national targets are the result of a negotiation process involving all the parties.

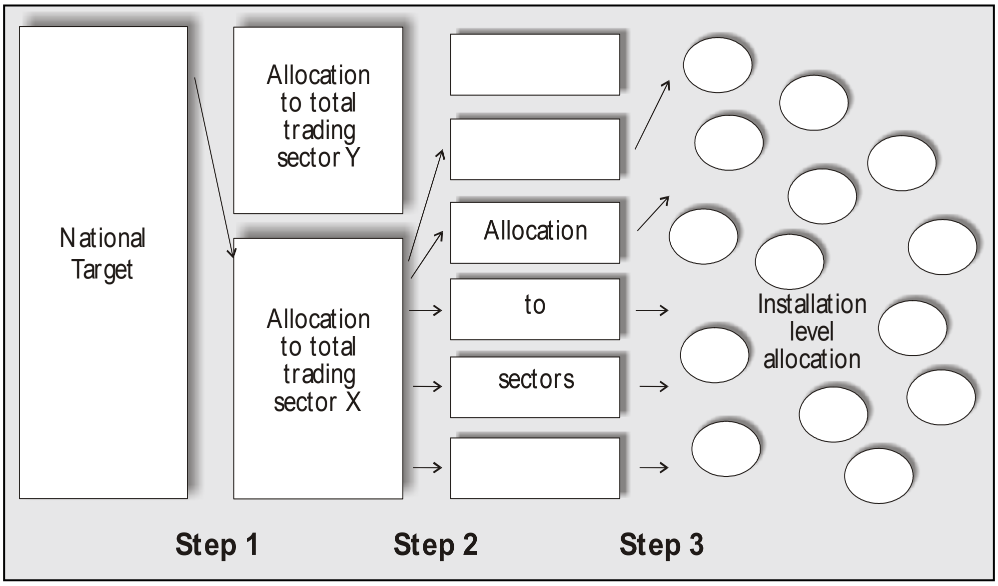

Figure 5-14: Allowance allocation process, grand fathering

Having settled the national targets and the cap, allocations are distributed to the economic sectors or trading groups that should be involved in the scheme. This is done using so-called “grand fathering”, auctioning, or by benchmarking (see next section).
Within each economic sector involved in the system, allocations are further distributed to trading sectors, and finally allowances are distributed to installations.

As is shown in the below figure the allocations in the various steps can be based on different distributional rules.

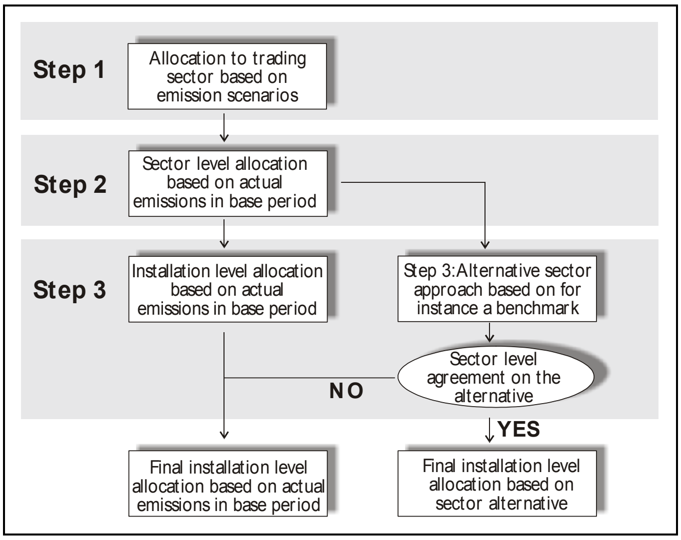

Figure 5-15: Examples of distributional rules

On the trading sector level in step 1 allocation is typically based on macro level emission scenarios. The sector level allocation can be based on actual emissions in a base period. This is the approach chosen in relation to the Kyoto Protocol, where the year 1990 is used as base year for emissions.

In step 3 at the installation level allocations could be based on actual emission in base period, and alternatively on a benchmark approach.

It is precondition for installations to qualify for involvement in the system that emissions can be reliably measured at the installation level. This is the only way to check if the installation is keeping sufficient allowances. The implication of this is that non-point sources can not be included in the cap-and-trade system. This is an important implication as only 36% of the P emissions come from point-sources.

In order for the states to be able to meet the caps, the cap-and-trade system should be combined with other measures addressing non-point sources. One such measure is establishing of a credit trading system. Credit trading, which is described in a section below, makes it possible to include emissions from non-point sources in the trading system. Other measures such as taxes and regulations could also be applied.

Grand fathering or Auctioning

Two different approaches to allocation of permits to installations are usually applied and distinguished between in existing tradable permit systems: The so-called grand fathering approach and the auction approach.

In a system with allocations based on grand fathering companies are given allowances based on certain criteria, e.g. historic emissions or technology specific criteria. This is the situation illustrated in the above section. The main problem with grand fathering is that the approach discriminates against new entrants, unless a reserve is withheld for later use.

If the allocation is based on an auction, the fixed number of permits is allocated to the highest bidders. Auctions typically involve transfers of resources to the government.

In the long run the ultimate allocation will be the same regardless of whether permits are allocated by auction or by grand fathering. The reason for this is that the market assures that permits will accrue to the installations that are willing to pay the highest price. This result assumes that markets are purely competitive and that agents do not show strategic behaviour. This result implies that administrators have a certain leeway in deciding how to allocate permits.

In the short run, however, research has shown that the financial burden born by companies with allocation by auction is large enough to create an in-optimal overall allocation.

Most operating permit systems are based on grand fathering, but often with a small reserve for later auctioning in order not to discriminate against new entrants. This way, often a combination of the two principles is used.

Credit trading

It has become common to distinguish between credit trading and allowance trading (cap and trade). Credit trading allows emission reductions beyond legal requirements to be certified as tradable credits. Credit trading presumes the existence of a baseline, which can be provided by technology-based standards. As such the amount of information required by the implementing authority is relatively high.

Allowance trading is defined in discrete terms (e.g. tons). When the number of tonnes is emitted, the allowance is terminated. Issuing of new allowances is usually done according to specific schedules, e.g. once a year. Allowance trading generally assigns a pre-specified number of allowances to polluters, which typically declines over time. The initial allocation is not necessarily based on technology standards, and in many cases the aggregate reductions implied by the allowance allocations exceed those achievable by standards based on currently known technologies. The amount of information needed by the implementing authority is therefore less than in a credit system.

The allowance system can be combined with a system of credits, which assimilates the JI/CDM credit system in the Kyoto Protocol. The implementing country can reduce outlets in a host country by implementing a project. Credits are issued on project level according to a project baseline, and are deducted from the cap of the implementing country.

Inventory

The inventory is a necessary precondition for being able to keep track on whether or not the obligations (the cap) for each country, which is laid down in the burden sharing agreement, is being met.

An emission inventory is a listing, by source, of the amount of pollutants discharged into the Danube River.

All countries involved in nutrient trading will be obliged to maintain an inventory on discharges on an annually basis. A set of common rules for the inventory should be developed.

Registry

A registry is a necessary precondition for trading with allowances: Trades in allowances have to be registered. A registry does however not make the economic transactions, but will register the results.

A registry works like an internet bank, and once a year allowances are allocated to the companies and put into their bank accounts. When allocated, allowances are the property of the companies, which in turn can decide what to do with them. Accounts can be accessed from internet.

Once a year the companies that have been allocated allowances report on actual emissions. Number of allowances should correspond with emissions. If the number of allowances is insufficient to cover emissions a fee is paid.

Hot Spots

The spatial occurrence of the pollutants is of importance for the way a trading system should work. The easiest case is when the pollutant is uniformly mixed. In this case only one market exists, and the "value" of and emission is the same in the whole system. This is however unlikely to be the case. Environmental sensitive areas – so-called hot spots - within the Danube River will call for a solution where emissions from certain locations should be kept at a low level. One option is to introduce exchange ratios in the system in order to compensate for this. The exchange ratio will make emissions to sensitive areas more expensive than emissions to non-sensitive areas.

Conclusions – Elements in a nutrient trading system

Base on the previous it can be concluded that:

- There should be a direct link between national nutrients targets (the cap) and the (e.g. yearly) maximum of N and P emissions to the Danube.
- The current yearly national loads of N and P to the Danube could in terms of a nutrients trading mechanism be described as the national business-as-usual (BAU) scenario.
- Having set the national targets and the cap, allocations should be distributed to the economic sectors, and ultimately to the enterprises that should be involved in the scheme.
- The trading system could be organised as state to state trading or enterprise to enterprise trading.
- Allocation is should be done using so-called "grand fathering", auctioning, or by benchmarking
- Only point sources could be included in the cap-and-trade system. Only 36% of the P emissions come from point-sources.
- Non-point sources could be dealt with using credit trading. Other measures such as taxes and regulations could also be applied in order to address non-point sources
- Establishment of a registry and an inventory is a necessary precondition for trading allowances.
- Potential hot spots, i.e. sensitive areas could be addressed in the trading system.

5.7 Legal Framework for Nutrient Trading

The Danube River Protection Convention

The Danube River Protection Convention specifically addresses nutrients emissions from both point and non-point sources inasmuch as it promotes establishment of permitting systems in order to regulate waste water discharge from industrial and municipal sources and also promotes regulation of agricultural activities.

The just mentioned features of the Convention together with inventory and monitoring requirements constitute core measures needed for establishment of a pollution trading mechanism. The Danube Convention thus seems to form an adequate point of departure for considerations on establishment of a pollution trading mechanism in the DRB. Neither the Helsinki Convention nor the Danube Convention specifically promote or prohibit pollution trading.

Although the Convention already includes some of the main measures for setting up a pollution trading mechanism it would however need amendments in order to embed a pollution trading mechanism. Also, the empowerment of an intergovernmental authority – e.g. the ICPDR - would be required for setting up and making trading arrangements operational.

What is important to bear in mind is that international agreements, including the Danube River Protection Convention establish rights and obligations for the signatory parties, which are nation states (or international organisations as the European Union). This implies in that only states would be able to transfer tradable emission quotas among each other within the frames of a multinational cooperation agreement such as the Danube Convention.

Requirements on establishment of inventories and monitoring programmes

The Danube Convention includes clauses on the establishment of periodical inventories of point and non-point sources, on prevention and abatement measures as well as the establishment of programmes that provide actual overviews of quality conditions and progress.

The data and information structures that have been established in accordance with the above mentioned provisions on inventories and monitoring during the last ten years (Trans National Monitoring Network) may provide the starting point for tailoring of nutrients trading related inventories and monitoring systems. These are needed for setting ceiling values for total emissions as well as the running of a trading system.

The approximation of EU water legislation which has been part of the preparation for EU membership in the new Member States and Romania and Bulgaria has been the real driving force in the implementation of the monitoring obligations under the Danube Convention, and ***especially the EU Water Framework Directive (WFD) provides important elements in streamlining inventories and monitoring systems for pollution trading.***[9]

The current status of the practical application of the WFD in most of the Danube Countries does imply that the available data and inventories are not yet fully suitable for establishment of overall ceiling value for nutrients emissions to the Danube, division of responsibilities among the Riparian States and establishment of a monitoring facility for pollution trading.

[9] Finding of national study

Establishment of basin wide nutrients trading

Establishing a regulatory framework for nutrients trading within the multilateral cooperation in the DRB implies that the scope of the trading schemes would be basin wide. The choice of trading mechanisms would however imply that the number of active participants in a particular trading scheme could differ significantly.

The establishment of ***a credit based trading mechanism*** within the framework of the multilateral cooperation in the DRB would require that the Danube Convention apart from necessary inventory, monitoring requirements provides structures for approval, validation, verification, registration of nutrients credit generating activities. The participating countries would have to apply the necessary ratification measures, including national legislation.

Trading schemes covering specific sector or installation activities is the most likely scope of credit trading systems. Larger scale credit trading would more be difficult since certification of credits must be based on comprehensive monitoring and verification of emissions reductions.

The emission rights of an installation are usually granted through a permitting system like e.g. the EU IPPC system.[10] The permit sets the conditions for future activities and emissions levels. Each participant of the scheme who does not reach the individually set limits can have the difference certified as a tradable credit.

Credits generated within a basin wide sector trading scheme – covering e.g. waste water treatment plants - may be traded on national basis as well as internationally. International trading would require that the mechanism of credit transfer is facilitated by the state authorities of the involved countries.

A specific challenge is however, that emissions reductions must be additional or go beyond legal requirements already in place in order to fulfil the conditions for credit certification. Inasmuch as both the Helsinki and Danube Convention establish a regulatory framework for permitting based on use of Best Available Technology, the scope for reduction of emissions tends to be very limited.

The modalities of fulfilment of the just described 'additional' requirements are well known from Joint Implementation Projects that are established within the framework of the flexible mechanisms of the Kyoto Protocol.

The joint implementation mechanism involves an investor and a host country that jointly establish a project which generates reductions of emissions. The following description is based on a generic version of CO_2 Joint Implementation according to the Kyoto Protocol.

The starting point for approval of a Joint Implementation (JI) project is a Project Design Document (PDD) that calculates proves the project's emissions reductions and proposes a methodology for monitoring of the reductions. The PDD should be validated by an independent entity before implementation, and forms the basis for a. emissions trading agreement. During the implementation

[10] Emission limit values are not set for nutrients (finding of national studies referred to in sub-section xx).

phase, the project should be independently monitored where-after the documented reductions can be verified and tradable credits issued. National registries are needed for recording and transfer of credits.

One possible example of Joint Implementation of nutrients reduction projects in the Danube may be mitigation of P emissions to the Danube caused by high content of P in Romanian detergents. A JI project aiming at production of Phosphorus free detergents and/or better treatment of household waste water may help the host country in mitigation of hot spot problems, while the investor country (project holder) obtains pollution rights based on the achieved reductions in Romania.

Joint Implementation projects must comply with measures envisaged in national legislation. Inasmuch as the EU Member States have aligned their national legislation through transposition of various Directives, the Best Available Technology requirements of the IPPC Directive apply to all installations covered by the Directive.

The New Member States and Accession Countries have however not fully approximated the EU requirements since the transposed requirements are not practically implemented yet. The new DRB EU members (Czech Republic, Hungary, Slovakia and Slovenia), and the Accession Countries (Romania, Bulgaria and Croatia) have typically negotiated a transitional period for practical application of the EU legislation of five to seven years. A JI project may thus imply accelerated implementation of e.g. the IPPC Directive and WFD due to technology investments. Such acceleration of investments could be considered to fulfil the additional criterion.

Cap and trade system – entity to entity trading

The Danube Convention does not directly provide a legal basis for cross border entity to entity trading. The idea of a cap and trade systems is however to enable entity to entity trading. This implies that the establishment of a regulatory framework for a cap and trading system within the frames of the Danube Convention would require that states undertake to transfer allowances on behalf of the entities covered by a nutrients trading scheme.

This is the case within the EU-ETS, where a transaction registry is superimposed upon the national allowance registries. The feasibility of establishing a complete legal framework for a similar ‘Clearing House’ mechanism for nutrient emissions requires however in depth studies of international law.

Assuming that it is feasible setting up a nutrients cap and trade system covering the point source based P emissions to the Danube, the regulatory set up of the system involves a number of considerations.

Allowance allocation can be based on different approaches such as grand fathering, benchmarking and auctioning as described in sub-sections 5.2 and 5.3. Regardless of the method used, the principles of allocation are determined by some legal instruments.
EU Member States have to comply with the state aid ban and the competition rules of the EC Treaty. Free allocation of allowances potentially implies state aid, which must be avoided by uniform allocation methods, as well as allocation and the trading scheme should allow new enterprises (“new entrants”) to enter the system.

In the distribution of allowances among installations within different sectors discrimination and unequal competitive conditions should be avoided.

The above legal principles have been addressed by the EC Commission in its guidance to Member States on elaboration of National Allocation Plans for participation in the EU CO_2 Emissions Trading Scheme. This Communication may provide valuable information in the considerations on allowance allocation for nutrients trading in the DRB.

A cap and trade system is based on a permit system with corresponding allowances, which have been allocated in accordance with a (National) Allocation plan.

The EU Emissions Trading Scheme system includes a Green House Gas (GHG) permitting system that is conceptually drafted as the IPPC permitting system. This implies that combination of the IPPC and the emissions permitting processes are possible.

The IPPC Directive requires that installations are operated in such a way that all the appropriate preventive measures are taken through application of Best Available Techniques. Normally, the competent authorities should fix emission limit values for pollutants that are likely to be emitted from the installation in significant quantities. Such limit values should be based on BAT.[11]

Emission limit values are usually not set for N and P emissions, but could be included just as described above for GHG. The Allowances that correspond to the emissions permit are not necessarily allocated in accordance with a Best Available Technique principle.

An IPPC permit includes conditions for self-monitoring that should be verified and recorded in national reporting and registry system. These can in principle be extended to cover emission of nutrients.

The trade of allowances is based on a cancellation system that keeps the balances between emissions and allowances at installation level. Considerable fines are imposed in case of non compliance between actual emissions and allowance stock.

Establishing a basin wide scheme for trading of P allowances would as one of the first activities require that an inventory of P emitting installations that should be included in the scheme is elaborated. Activities such as food production, textile industry and other P emitting industry covered by the IPPC Directive would be included. Large farms are also covered by the IPPC Directive. The geographic and spatial location of a specific installation may imply that an 'exchange' rate should apply in trading of allowances of e.g. a German and Romanian installation

Challenges in establishing a nutrients trading system in the Danube river basin

A Danube River basin wide pollution trading system will be constituted by the national systems that are each established in accordance with national legislation. It is thus important that the Danube Convention provides a framework which is easily applicable to different national systems.

A decisive factor in the establishment of an effective regulatory mechanism for pollution trading in the DRB is however that the Danube countries are not only able to transpose international and EU

[11] Cf. Non-paper on synergies between the EC Emissions trading proposal and the IPPC Directive. EC Commission – DG Environment, 2002.

requirements. They must also undertake to establish the institutions and procedures that are needed in to manage an operational pollution trading system.

National studies that have been carried out as part of the present pollution trading study clearly indicate that the complex of EU Directives including the WFD, the IPPC Directive, the Urban Waste Water Directive, and the Nitrates Directive form part of national environmental legislation or are in pipeline in all the Danube countries – including, albeit to a lesser extent in Moldova and Ukraine.

The level of practical application and enforcement of the EU requirements concerning monitoring, quality standards, point source and point source regulation does however vary a lot. This circumstance constitutes a major challenge in the development of a unified and reliable pollution trading system as well as the difficult implementation conditions and risk of lack of effectiveness need to be addressed.[12]

Conclusions

In the evaluation of the legal framework for pollution trading in the Danube the following should be emphasised:

- As overall framework for the development of pollution trading system in the DRB, the Danube Convention:
    - Neither promotes nor prohibits trading
    - Constitutes an appropriate international framework for 'burden sharing'

- The establishment of a regulatory framework for pollution trading requires:
    - provisions of 'tailored' inventories and monitoring mechanism
    - provisions of emission permits and the units to be traded
    - provisions of documentation and registration
    - choice of trading and transfer mechanism(s) of tradable units
    - provisions of enforcement mechanism (which may be difficult to establish)
    - empowerment of responsible overall pollution trading authority

- States are parties to Conventions implying that only states are able to trade within the frames of the DRPC.

- The obstacles constituted by the Best Available Technology and Best Agricultural Practice principles have to be eliminated.

[12] Cf.Tables of summarised national study findings.

5.8 Actions Needed for Implementation

Previously it was concluded that in comparison with other policy measures emission trading is:

- More efficient, i.e. the same effect can be achieved at lower costs.
- More politically acceptable, as those obliged have an alternative to reductions.
- May be a means to finance reduction measures.

These are the core reasons to consider introduction of such a system. In this chapter the steps involved in establishing an emission trading system are summarised.

A trading system requires an accurate and uncontested determination of the net input of nutrients into the Danube river system. The monitoring of water quality must therefore be improved and extended before trading is operational.

Whether or not it is decided to introduce emission trading, international cooperation on solving the environmental problem require the Danube countries to agree on an environmental objective, and on a principle for sharing the burden of meeting the objective.

Burden sharing can be based on a core set of principles that combines three different but complementary notions of distribute fairness: equality, equity and exemption

- **Equality** is by default that all parties should have equal obligations. This typically translates into standardized regulations of the format "all parties shall reduce emissions of substance *s* by *x* percent relative to a given baseline (emissions level at time *t*)."
- **Equity** involves considerations on distribution of costs and benefits. The conventional yardstick for determining equity would be wealth measured in terms of GDP per capita.
- When equality and equity considerations leads to unfair burdens on the poorest countries, the principle of exemption can be applied, i.e. **exemption** from any obligation for which the country is not fully compensated.
- **The three principles can be combined**: The principle of equality applies within groups or subsets that are considered sufficiently homogenous in important respects. The principle of equity applies where the critical differences exceed that threshold – except for the most disadvantaged parties, from whom no material contribution will be required so that they are exempted.

The following elements should be in place in order to initiate emission trading:

- There should be a direct link between national nutrients targets (the cap) and the (e.g. yearly) maximum of N and P emissions to the Danube.

- The current yearly national loads of N and P to the Danube could in terms of a nutrients trading mechanism be described as the national business-as-usual (BAU) scenario.

- Having settled the national targets and the cap, allocations are distributed to the economic sectors, and ultimately to the enterprises that should be involved in the scheme.

- The trading system can be organised as state to state trading or enterprise to enterprise trading

- Allocation is done using so-called "grand fathering", auctioning, or by benchmarking

- Only point sources can be included in the cap-and-trade system. Only 36% of the P emissions come from point-sources.

- Non-point sources can be dealt with using credit trading. Other measures such as taxes and regulations could also be applied in order to address non-point sources.

- Establishment of a registry and an inventory is a necessary precondition for trading allowances.

- Potential hot spots, i.e. sensitive areas can be addressed in the trading system.

In establishing a legal framework for pollution trading in the Danube countries the following issues and considerations should be taken into account:

- As overall framework for the development of pollution trading system in the DRB, the Danube Convention:
    - Neither promotes nor prohibits trading
    - Constitutes an appropriate international framework for 'burden sharing'

- The establishment of a regulatory framework for pollution trading requires:
    - provisions on 'tailored' inventories and monitoring mechanism
    - provisions on emission permits and the units to be traded
    - provisions on documentation and registration
    - choice of trading and transfer mechanism(s) of tradable units
    - provisions on enforcement mechanism (which may be difficult to establish)
    - empowerment of responsible overall pollution trading authority

- States are parties to Conventions implying that only states are able to trade within the frames of the DRPC.

- The obstacles constituted by the Best Available Technology and Best Agricultural Practice principles have to be eliminated.

APPENDIX 1

Nutrient Framework Review Report

UNDP/GEF DANUBE REGIONAL PROJECT

DANUBE STUDY ON POLLUTION TRADING AND CORRESPONDING ECONOMIC INSTRUMENTS FOR NUTRIENT REDUCTION

Component A: Nutrient Framework

Institute for Water Quality and Waste Management, Vienna University of Technology

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July 2004

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1 Introduction

The Black Sea ecosystem, in particular the water quality of Western Black Sea (WBS) coastal waters, is a "reference point" of the sustainability of nutrient management in the Danube Basin. For the Black Sea ecosystem the phenomenon of water quality deterioration has been evident for more than 20 years. It has significantly influenced fishing, aquaculture, tourism and recreation. The unresolved Black Sea ecological problems resulted in enormous economic losses and highlighted the necessity to recommend mitigation strategies.

Among all anthropogenic factors contributing to environmental deterioration, eutrophication has been identified to play a key role in areas subjected to the influence of strong river discharges and other land-based inputs, which is the case of the Western Black Sea (WBS) area.

Recent publications indicate an improvement of the Black Sea environment due to the economic breakdown in the eastern countries and the consequent decrease of nutrient emissions. Probably the economic situation in the transition countries will improve in the future. This will be linked to a higher nutrient turn over in agriculture as well as to an increase of nutrient emissions via waste water, if no adequate treatment is supplied.

This report provides the scientific knowledge as a base for the evaluation of the possibility of nutrient trading in the Danube Basin in order to avoid the deterioration of the Western Black Sea. Within this project no additional detailed research in respect to sources, pathways, sinks and on effects of nutrients in the Danube Basin and the (North)Western Black Sea and the Black Sea was carried out. Only existing knowledge is compiled as a basis for investigations on the possibilities for nutrient trading and other economic instruments. Main sources of information are data from the Danube River Pollution Reduction Program, the EROS project and interim results of the daNUbs project. Following main statements of the report can be summarised.

- Agreement has been reached that phosphorus is the limiting nutrient in the Western Black Sea at present. As the Central Black Sea seems to be N-limited and the ratio of N and P is crucial for the species composition in the marine ecosystem **nutrient trading has to consider both macro-nutrients nitrogen and phosphorus.**

- The ecological status in the Western Black Sea coastal area has significantly improved within the last decade. This development is caused by a reduction of nutrient discharges (especially phosporus). The ecological status is close to "good" now.

- Future management strategies have at least to aim at a stabilisation of the nutrient discharges to the Western Black Sea coastal area at the present low level.

- Danube contributes with about 80 % and 75 % of nitrogen and phosphorus to the discharges to the Western Black Sea and is the main contributor in this respect.

- Economic recovery and development will tend to increase nutrient discharges from the Danube Basin to the Western Black Sea in the future. The challenge will be to keep nutrient discharges low, despite the expected economic development.

- As average value within the Danube Basin about 35 % of P-emissions and 20 % of the N-emissions stem from point sources, the rest from diffuse sources. About 25 % of the nitrogen emissions and 10 % of P-emissions can be accessed to background emissions that can not be influenced by measures. The share of sources of emissions differs significantly from region to region.

- The transformation and retention of nutrients in the surface water system of the Danube Basin has a significant influence on the nutrient discharges to the Black Sea ecosystem. As average over the last 5 years about 65 % of the P-emissions were stored along the water course of the Basin. Only 35 % of the emissions were transported to the Sea. For nitrogen about 40 % of the emissions were removed by instream processes (e.g. denitrification) and about 60 % were transported to the sea. Retention processes are highly dependent on the runoff characteristics of a river and differ significantly between regions. The smaller rivers distributed over the whole catchment are much more effective in respect to retention as the main Danube river. Only the iron gate dam is considered to by a major point sink for phosphorus in the Danube River.

- The sensitivity of areas to the improvement in agricultural management practises in terms of the reduction of N and P inputs to surface waters differs a lot between areas. This differentiation can be found between different subcachments and regions but as well within a subcatchment or a region.

- The annual nutrient transport of a river is highly influenced by the hydrologic condition in the specific year and may significantly vary from year to year. Nutrient loads in a river during one year are hardly representative for longer periods. Especially flood events may influence significantly the P-discharges especially in more upstream parts of the Danube river and in its tributaries.

- Load monitoring along the Danube river and its main tributaries needs improvements in respect to total nutrients.

- In respect to phosphorus it has to be clearly differentiated between emissions in dissolved and particulate forms. Effects in respect to euthrophication are different. Point source emissions are mainly dissolved, while diffuse emissions are particulate to a high extent (erosion).

- The challenge within the main part of the Danube Basin is to increase economic prosperity without endangering the ecological recovery of the Western Black Sea. The possibilities of nutrient trading and other economic instruments to ensure such a development have to be investigated. Obstacles to any reduction strategy are the vast heterogeneity of the catchment area (climate, geology, economy, culture, etc.), the accuracy of the data bases and linked to this the problems of monitoring.

2 Objectives

- Investigation of N- and P-concentrations respectively loads in the Danube and some important tributaries for the most recent year
- Nutrient loads discharged by the main tributaries to the Western Black Sea (WBS)
- Concentrations of N and P in the Black Sea with special focus on the WBS
- Other nutrients and factors influencing the concentrations, the metabolism and the effects of N and P
- "Critical loads" for discharges to the Black Sea
- Sources and pathways of nutrients in the Danube Basin
- Factors transforming nutrient loads in the river beds. E.g. sedimentation of P in flood plains, temporary (?) storage in reservoirs, denitrification in the water course. This means that the emissions to the surface waters are not equal to the discharges to the Black Sea. For the evaluation of these factors results of Danube Water Quality Model application within the daNUbs project will be used. Closely connected to this the total and the net-input of nutrients of the countries within the Danube Basin will be estimated.
- The present state of emission measurements and monitoring the water quality will mainly reflect the work done within the TNMN and the EMIS group. Demands from a load oriented point of view will be postulated as well as a common unit for the relevant substances.
- Agricultural practice and the level of waste water treatment (especially nutrient removal) will be investigated.
- The role of specific regional climatic, morphologic and geologic conditions will be evaluated in order to show that equal management will not result in equal nutrient load reductions.

3 The study area

The total catchment area of the Black Sea is 2 300 000 km^2, entirely or partially covering 23 countries. Almost one third of the entire land are of continental Europe drains into the Black Sea. These include the six littoral states (Bulgaria, Georgia, Romania, the Russian Federation, Turkey and Ukraine) and 17 other European states (Albania, Austria, Belarus, Bosnia and Herzegovina, Croatia, the Czech Republic, Germany, Hungary, Italy, Macedonia, Moldova, Montenegro, Poland, Slovakia, Serbia, Slovenia, and Switzerland). Catchment areas of the largest rivers of Europe - Danube, Dnieper, Don, Dnister, and other rivers are situated in the Black Sea basin. Catchment areas of the main rivers are: Danube 817 000 km^2, Dnieper 505 840 km^2, Don 422 000 km^2, Kizilirmak 78 000 km^2, Dnister 71 900 km^2, Southern Bug 68 000 km^2, Sokavya 65 000 km^2, Yesilirmak 36 100 km^2 [GIWA 2004].

The population amounts to approximately 190 million people.

The Black Sea itself has a surface area of 461000 km^2, out of this 37,555 km² belong to the Sea of Azov which is considered to be a big shallow Black Sea bay. The Kerch Strait connects the Black Sea with the Sea of Azov. This strait is a shallow channel (10 m deep in the north, 18 m deep in the south and 5 m deep in the central section) about 45 km long. Its width varies between 3.7 km and 42 km.

The Sea of Azov is 340 km long and 135 km wide. The main rivers flowing into the sea are the Don and Kuban; they ensure that the waters of the sea are comparatively low in salinity (11-13 psu (practical salinity unit[1])) and almost fresh in places, and also bring huge volumes of silt into the sea. The Sea of Azov is the shallowest sea in the world with an maximum depth of only 13 metres; in fact, where the silt has built up, such as the Gulf of Taganrog, the average depth is less than 1 metre [Nationmaster, 2004]. The average annual influx of fresh water into the Sea of Azov is 40.7 km^3, of which 28.5 km^3 comes from the Don River and 11 km^3 from the Kuban River. Annual rainfall is 15.5 km^3. Evaporation losses are 31 km^3 The Sea of Azov loses 66.2 km^3 of water to the Black Sea and receives from it 41 km^3 annually. The surface current flows from the Sea of Azov to the Black Sea [Ukraine, 2004].

No information on the exchange of nutrient loads was detected.

The Black Sea shoreline is about 4,340 km long (coastlines in various riparian countries: Ukraine: 1,630 km (2780 km including the Sea of Azov), Turkey 1,400 km, Russia 475 km, Georgia 310 km, Bulgaria 300 km, Romania 225 km (GIWA, 2004). About 17 per cent of the Black Sea area is occupied by its north-western continental shelf, which is over 200 km wide with a depth less than 200 m. In other parts of the sea the shelf has a width of 2.2 to 15 km. Near the Caucasian and Anatolian coasts the shelf is only a narrow intermittent strip.

The average depth of the Black Sea is about 1 240 m, the maximum depth 2212 m. 90% of the water mass is anoxic. The hydrographic regime is characterized by low-salinity surface water of river origin overlying high-salinity deepwater of Mediterranean origin. A steep pycnocline centred at about 50 m is the primary physical barrier to mixing and is the cause of the stability of the anoxic interface. The bacteria in the bottom waters quickly consume all the oxygen and the sea is virtually dead below a depth of about 180 metres. Below 150 to 200 m H_2S is present.

The only connection to the world's oceans is the narrow Bosphorus Channel, with an average width of 1,6 km, depth of 36 m and a total length of 31 km (Bakan, Büyükgüngör, 2000). Its width varies between 0.7 and 3.5 km with an average of 1.3 km at the surface. The width gradually narrows towards the bottom of the channel to an average of 500 m at a depth of 50 m. The depth varies from 30 to 100 m with an average of 50 m along the central section of the channel.

The Danube is the main tributary to the Black Sea with an average discharge of about 200 km^3/a out of about 350 km^3/a total discharge of rivers. The flow characteristics of the discharges of the rivers Dnister, Bug and Dnieper to the North Western Black Sea are heavily influenced by anthropogenic activities (damming, irrigation). In Table 1 discharges of various rivers in to the Black Sea are presented.
The freshwater inflow (rainfall + runoff) exceeds evaporation and subsequently dilutes surface seawaters.
The salinity of the surface layer varies from 13 to 18,5 psu while the maximum salinity in deep waters is 22-24 psu at a depth of 2,000 m. As a comparison: Sea water Salinity in the open ocean generally ranges between 32 and 37 (psu), but may be much lower near fresh water sources or as high as 42 in the Red Sea.

[1] psu: defines salinity in terms of a conductivity ratio, so it is dimensionless. Salinity was formerly expressed in terms of parts per thousand (ppt) or by weight; very nearly the same as direct measurements of salt ion concentration in parts per thousand.

Table 1: annual discharges of rivers to the Black Sea in km^3

Rivers	Annual river flow	%
Black Sea basin		
1. Rivers of North-Western part of the Black Sea (including:	**269,2**	**79,04**
1.1 Danube	208	61,07
1.2 Dnieper	47,9	14,06
1.3. Dnister and others	13,3	3,90
2. Rivers of Caucasus coast (including Rioni,Choroh,Inguri,Kodori and other)	43,2	12,68
3. Rivers of Turkey (including Ishil-Iirmak, Kuzul-Irmak an other)	26,3	7,72
4. Rivers of Bulgaria and Romania	1,9	0,56
Total	**340,6**	**100**
Azov Sea basin		
1. Don	27,9	67,88
2. Kuban	11,1	27,01
3. Small rivers	2,1	5,11
Total	**41,1**	**100,00**

Fig. 1: main characteristics of the Black Sea catchment (GIWA 2004)

This study focuses on the catchment of the Danube and the Black Sea shelf area mainly influenced by Danube discharges in front of the Romanian and Bulgarian coastline and covers an area of about 30 000 km2; the mean depth of the shelf in front of the Romanian coastline is less than 70 m, whereas the average depth at the boundary shelf to the continental slope in front of Bulgaria is about 140 m.

3.1 Nutrient discharges to the Black Sea

Different sources provide different loads discharged to the Western Black Sea. It is not possible to compare the various loads, as different measurements, load calculations, etc. have been made. However it can be said that the Danube is the main contributor for N and P discharges to the Western Black Sea. The data base for discharges from other catchments is even more scarce.

The average inorganic nitrogen and phosphorus concentration in surface layer of the Danube and Dnieper estuary waters increased from 1958/59 until the end of the eighties 4-6 and 2-4 times respectively, whereas organic compounds of these elements increased 2-3 times [GIWA, 2004].
According this data source the highest N input stems from the Danube (about 55%) and about 20% from precipitation on the Black Sea surface, for P the respective ratios are 50% and again 20%. However an input of 40 kg P/km^2 via precipitation seems to be very high and the P-input via precipitation probably is smaller.
Also it can be seen that nutrient discharges via smaller rivers from Bulgaria and Romania are negligible.

Table 2: Input of nutrients (nitrogen, phosphorus) into the Black and Azov Seas, in kt/year [GIWA 2004]

Main sources (river flow, atmosphere)	nitrogen	phosphorus
Black Sea		
1. Danube	533,6'*	44,3*
2. Dniester	35,5	1,0
3. South Bug	6,1	0,5
4. Dnieper	80,8	13,4
5. Caucasus rivers	62,6	4,9
6. Turkish rivers	34,2	3,9
7. Bulgarian, Romanian rivers	7,6	1,9
8. Precipitations on the Black Sea surface	198,6	17,2
Total	*964,9*	*87,2*
Azov Sea		
9. Small rivers of Azov region, Ukraine	3,8	0,5
10. Don, Cuban, small rivers of Azov region	128,7	10,7
11. Precipitation of the Azov Sea surface	17,6	1,6
Total	*150,1*	*12,8*
Grand total	***1.115,0***	***100,0***

*The status of the Danube discharges represents the load in the end of the 80ies and has decreased considerably until 2004.

As the impact of river discharges mainly influences the coastal areas a comparison with the precipitation of N and P on the whole Black Sea area is not very meaningful. If the nutrient inputs are related to the western shelf area only (about 10% of the Black Sea area) the input via precipitation becomes negligible. Focusing only on the Western Black Sea about 80% of the N load and about 75% of the total P load comes via the Danube.

Table 3: Input of nutrients (nitrogen, phosphorus) into the Western Black Sea, in kt/year [GIWA 2004; adapted by Lampert]

Main sources (river flow, atmosphere)	nitrogen		phosphorus	
Western Black Sea	ktN/a	% of total	ktP/a	% of total
Danube	534*	79,8	44,3*	73,3
Dniester	35	5,3	1,0	1,7
South Bug	6	0,9	0,5	0,8
Dnieper	81	12,1	13,4	22,2
Precipitation	13	1,9	1,1	1,9
Total	**669**		**60,3**	

*The status of the Danube discharges represents the load in the end of the 80ies and has decreased considerably until 2004.

Similar discharges of the Dnjeper river for P are given in [UNDP-GEF, 2003] (see Table 4). However the N loads presented in [UNDP-GEF, 2003] is by a factor of 4,5 lower. As there is only a slight difference for the P load but a very large difference of the N-load it can not be decided if the N load has decreased or if the differences are mainly due to data uncertainty.

Table 4: Averaged mass flow estimates for the Dnjeper - Kherson[2] section (estuary) based on the 1998-2000 data [UNDP-GEF, 2003]

Parameter	Unit	Sample average technique	Linear interpolation	Probabilistic interpolation		
				Quantile 0.10	Mean	Quantile 0.9
Flow discharge	km^3/year	52.225				
Suspended substances	t/year ×1,000	64.17	53.93	51.26	55.07	59.14
Total inorganic nitrogen	t/year ×1,000	17.12	17.23	16.78	17.17	17.51
Phosphate phosphorus	t/year	6095	6048	6027	6072	6123
Total phosphorus	t/year ×1,000	12.54	12.45	12.40	12.48	12.55

As a conclusion it can be said, that the Danube contributes about 80% of the N and about 75 % of the P to the Western Black Sea.

3.2 Discharges via the Danube

3.2.1 Water discharge

The water discharge of the Danube varies considerably. In the time period 1931-1970 the mean annual flow at Ceatal Izmael (monitoring station upstream of the Danube Delta) amounted to 6550 m^3/sec, the minimum annual flow to 4410 m^3/sec in 1949 and the maximum annual flow to 9410 m^3/sec in 1941. Much higher are the intraannual variations: the highest discharges are recorded in spring/early summer (March – July) and the lowest in the period August – November. In the period mentioned the highest discharges were in May (9040 m^3/sec), the lowest in October (4218 m^3/sec). The highest monthly discharge was recorded in April 1942 with 14520 m^3/sec, the lowest in January 1954 with 1970 m^3/sec [RZD, 1986].

Varying discharges cause also varying nutrient loads transported.
The transported load of

- Nitrogen increases proportional with the discharge,
- total P increases over-proportional with the discharge
- dissolved P remains constant, i.e. concentrations are lower at high flows
- dissolved Silica increases proportional with the discharge

[2] Kherson: river port located in the mouth of the river Dnieper

3.2.2 Nutrient discharge

Measurements of Nitrate and Phosphate at Sulina, the "middle" Delta branch, are available only since 1979 for P and since 1988 for N. Therefore no complete data series are available until the 1960ies. Different authors provide different loads.
[Almazov, 1961] published data for the nutrient discharge of the Danube for the period 1948-1959 with about 12 kt P/a and 140 kt/a DIN (Dissolved Inorganic Nitrogen). [Rojdestvensky, 1968] estimates the Nitrate-N-emissions in the period 1954 – 1961 to 216,4 kt/a, and a significant increase in the period 1962 to 1965 to 342,2 kt/a. The respective loads for dissolved P were 6,6 (1954-1961) and 23,7 kt P/a (1962-1965), which means an increase by 300%.

[Behrendt, 2004] making a backward calculations from current loads using the Moneris model calculates nitrogen loads in the fifties between 200 and 250 kt/a N and about 15 kt/a P.

Behrendt calculates the highest load of nitrogen for the period of 1988 to 1992 (550 kt/a N) and for phosphorus about 42 kt/a P in the period 1983-1987 (causes for the increase see chapter 3.2.3.)

For the period 1998-2000 [Behrendt, 2004] estimates the nutrient emissions to the rivers within the catchment to ca. 68 kt P/a and 690 kt N/a. The emissions are retained partly in the river system itself and in the reservoirs. Especially the Iron Gate reservoir has a strong influence of the retention of the P-load. [Behrendt, 2004] estimates the load retained in the Iron Gate reservoir with 8,4 kt P.
At the end, according Behrendt, only about 450 kt N/a and 22kt P/a are discharged via the Danube Delta into the Western Black Sea.

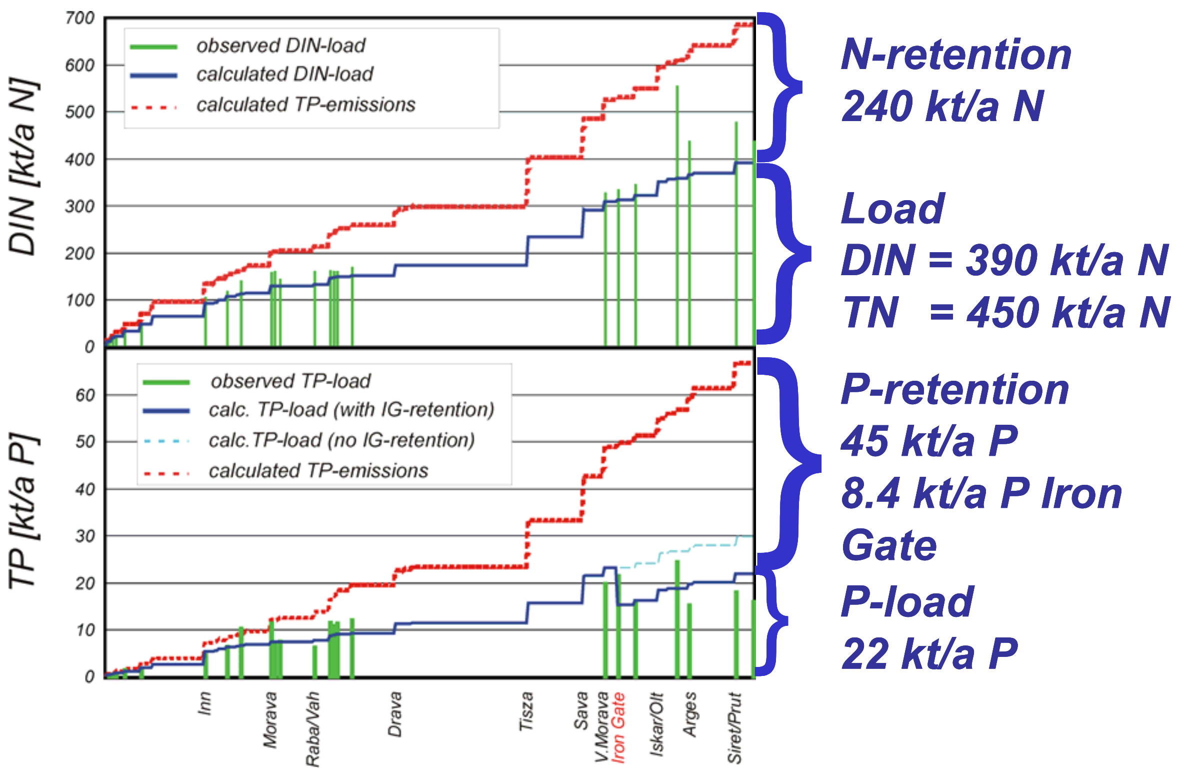


Fig. 2: MONERIS emission and load estimates 1998 – 2000 [Behrend 2004]

Current preliminary load estimations based on the TNMN data base (see chapter 3.4.1) and calculations of the Danube Water Quality Model (DWQM) indicate an annual discharge (period 1997-2001) of about 420 kt N and 21 kt P [van Gils, 2004]. Van Gils estimates the P-retention in the Iron Gate reservoir to be 10,2 kt/a.

Table 5: Nutrient loads in the Danube Basin [van Gils, 2004]

	N (kt/y)	N (%)	P (kt/y)	P (%)	Si (kt/y)	Si (%)
Emissions	687	100	67.8	100	570	100
Retention "small waters"	236	34	36.1	53		
Inflow to DWQM	451	66	31.7	47		
Retention in DWQM	20	3	10.2 (Iron Gates)	15		
To delta (calculated)	430	63	21.5	32		
To delta (observed)	*460 (DIN !)*		*24.5*		*400*	*70*
Retention delta	10	1	0.5	1		
To Black Sea	420	61	21.0	31		

However the retention in reservoirs is limited to a restricted time span. Rough estimations indicate that the Iron Gate reservoir will be filled up with sediments in less than 100 years. Further more it is important to note, that reservoirs are a sink for particulate P but not for ortho-phosphate which is immediately available for biomass production.

3.2.3 Causes of increased nutrient discharges in the last decades

Human activities have significantly increased the riverine delivery of dissolved inorganic N and P to the coastal zones. The increase of N and P in the Danube until the end of the 80ies is due to the increase of fertilizer application in agriculture, the construction of sewer system with non-adequate treatment facilities, the use of P-containing laundry detergents. In some areas in addition emissions were due to direct discharges of manure or industrial discharges (e.g. fertilizer production).

Between 1960 and 1988 the application of market fertilisers in the whole catchment has increased by a factor of about 4 to 5, and there was no big difference between Eastern and Western European countries. After the breakdown of communist economy the use of market fertilisers in the Eastern countries dropped to values comparable to 1967 while in Germany and Austria it remained nearly constant or showed a slight decrease.

Fig. 3 shows the development of N-fertiliser application in Danube catchment. The development for P-market fertilizer application follows a similar pattern.

After the political change in the former communist countries agriculture has changed dramatically in great parts of the catchment from an economically viable agriculture to a small scale food supply system for the regional population. Land property was redistributed in many areas which has resulted in completely new responsibilities and also due to a lack of investments land use also changed.

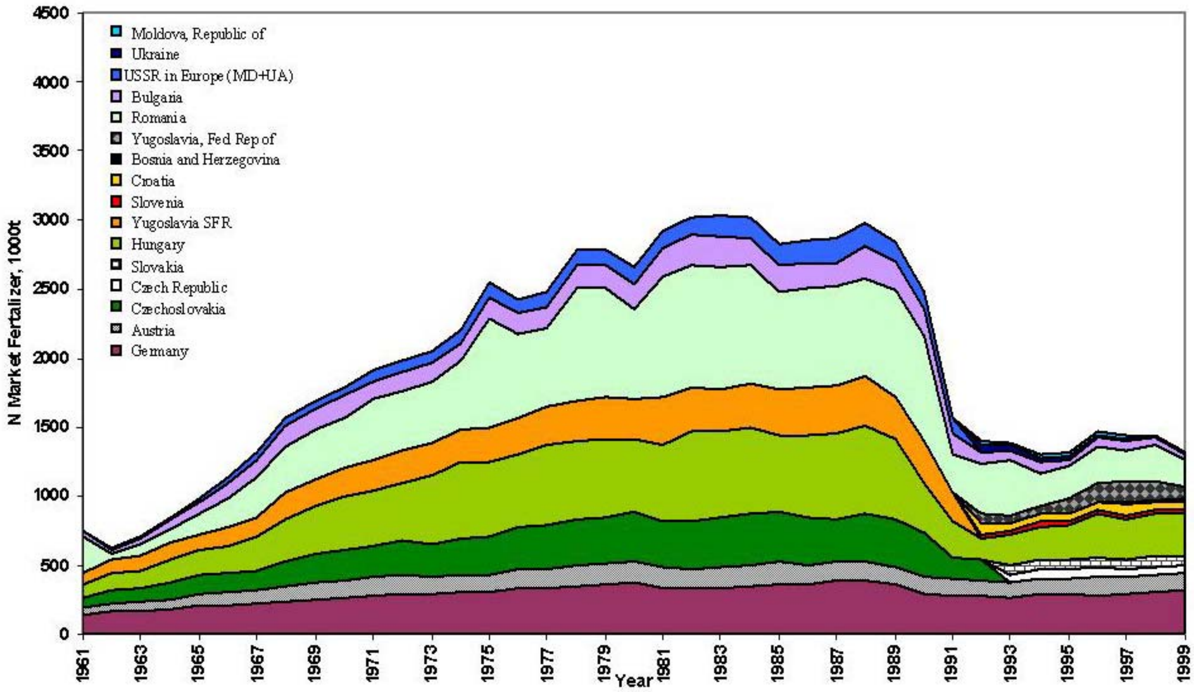


Fig. 3: N-market fertilizers application in Danube Basin 1960-2000

The construction of sewer systems increased the nutrient discharge to the rivers. In the mid 50ies in Austria and Germany big efforts were undertaken in the development of sewer systems. Also in downstream countries the construction of sewer systems increased the nutrient discharges to the rivers. Partly collected waste water was and still is discharged directly to the rivers. Waste water treated only mechanically or biological treatment without removal usually also increases the nutrient load discharged to the rivers. In Germany, Austria, the Czech Republic and partly in Hungary nutrient removal is broadly applied. Significant improvement of waste water treatment in respect to nutrient removal (N and P) started in the late 80ies and early 90ies mainly in Austria and Germany and has reached a high state in these countries by now. This (together with the ban of P-containing detergents) is reflected in the drop of the ortho-phosphate load in the Danube at the Slovakian border from about 10 ktP/a at the beginning of the 80ies to about ca. 2,5 ktP/a at the end of the 90ies.
For the development of sewer systems and waste water treatment the following conclusions can be drawn:

- upgrading of existing waste water treatment plants with nutrient removal
- extension of sewer systems and new waste water treatment plants only with adequate treatment (biological treatment + nutrient removal) of the waste water collected

In addition the use of P-containing washing powder increased the P-loads (up to 2 gP/inh./d only due to laundry detergents). Since the beginning of the 90ies P-containing laundry detergents are not used any more in Germany and Austria but still in many countries of eastern Europe. According the Joint Action Program [JAP] even full compliance with the urban wastewater treatment directive would only yield phosphorus reductions of around 30% as areas where the population is dispersed, and any centres with fewer than 10,000 residents, would not be required to eliminate phosphorus from their wastewater. Therefore the substitution of P-containing detergents would cause a significant reduction of P-emissions.
The ICPDR Secretariat has compiled a summary table with the P loads for all sectors for 2000, where estimation was done by the market research companies on the national total market, regardless where the detergent comes from import or local production. As a result an

estimated amount of 13,184 t of P are sold in the Danube River basin. With an estimated overall reduction of P in wastewater treatment plants by 30% the input into the Danube River catchment area still would amount to 9,230 t P.

In the following table the national consumption of P-containing detergents and the population fraction of the countries in the Danube Basin is given. From the total consumption of 28000 tP in the year 2000 13800 tP are used in the national part within the basin.

Table 6: population and consumption of P-containing detergents in t within the Danube countries in 2000

Country	population within the Danube Basin	Laundry detergents	Automatic household dishwasher products	Industrial and institutional laundry detergents	gP/inh.d total	gP/inh.d laundry detergents	gP/inh.d dish washers
Austria	7766650	0	655	194	0,30	0,00	0,23
Germany	9403880	0	758	402	0,34	0,00	0,22
Bulgaria	4379630	505	4	3	0,32	0,32	0,00
Croatia	3084940	830	132	16	0,87	0,74	0,12
Czech Republic	2763250	735	43	12	0,78	0,73	0,04
Hungary	11757590	2567	86	225	0,67	0,60	0,02
Moldova	1023750	47		4	0,14	0,13	0,00
Romania	20345910	1822	4	9	0,25	0,25	0,00
Slovakia	4921490	738	27	96	0,48	0,41	0,02
Slovenia	1750640	48	149	96	0,46	0,08	0,23
Ukraine	3094380	134		4	0,12	0,12	0,00
Bosnia & Herzegovina	3323810	703	31	15	0,62	0,58	0,03
Serbia&Montenegro*	9120920	2090			0,63	0,63	0,00
TOTAL	**82736840**	**10219**	**1889**	**1076**	**0,44**	**0,34**	**0,06**

*data on dishwasher products and industrial detergents are not available

Even though the use of P-containing laundry detergents is banned in Germany and Austria both countries emit considerable amounts of P stemming from dish washers and P used in industry (about 15% of the total P-emissions of an inhabitant).
In the other countries 0,08 to 0,74 gP/inh.d are used in laundry detergents. Low specific amounts in Moldova and Ukraine, medium in Bulgaria and Romania and higher amounts in the remaining countries. However these "high" specific amounts represent less than 50% of the amounts used in Austria and Germany before the ban (more than 2 gP/inh.d).
As it can be seen the use of detergents in automatic household dishwasher products is important in Austria, Germany and Slovenia. Assuming the same consumption of these detergents (0,23 gP/inh.d) the P-consumption would increase by 5350 tP from 13800 t P to 19150 tP. If this would happen the reduction due to a ban on P free laundry detergents would be compensated by more than 50%.
Assuming

- a constant use of P-containing detergents in Austria, Germany and Slovenia and
- in addition a per capita consumption of laundry detergents of 2 gP/inh.d (amounts used in Germany, Austria before the ban of P-containing detergents) in the other Danubian countries and
- 0,23 gP/inh.d within household dishwasher products

the total consumption would increase to 52000 tP! **This indicates the importance of the use of P-free detergents in the Danube Basin.**

3.2.4 Current Sources of nutrients in the Danube Basin

Both Nitrogen and Phosphorus are emitted in the Danube catchment in most countries via non-point sources however the P-emissions from point sources are more important than the N-emissions from these sources. Point sources includes emissions from treated waste water as well as collected but not treated waste water. The importance of these sources and for N and P vary considerably in the various riparian countries [Phare, 1997; Zessner & van Gils, 2002]. Main data source for our evaluation was the MONERIS (Modelling Nutrient Emissions in River Systems) calculations [Schreiber et al., 2003]. Detailed result (absolute values and relative shares of various sources) can be found in the Annex.

There are some main difference in the sources and between N and P:

- N stems predominately from diffuse sources (N-surpluses in agriculture) (80%) and partly from waste water treatment plants (20%). The respective shares of total P are: 65% diffuse sources, 35% point sources.
- N emitted into the hydrosphere from agriculture is mainly in dissolved compounds (NO_3, partly NH_4); P emitted from agriculture is mainly in particulate form, which is only partly or under certain conditions (like anoxia) available for biomass production.
- P emitted from point sources is mainly in dissolved form, from agriculture in particulate form.

As a consequence: A direct comparison of the P-sources is not possible because effects are different.

An important source is the natural background. Assuming that no human activities would take place the total N-emissions would amount to about 24% of the actual total N-emissions (164 000 tN) and to about 9% of the actual total P-emissions (6000 t P). In general countries with a high portion of alpine area and other high mountainous regions have the highest background emissions (expressed in kg nutrient/ha) due to the assumed occurrence of natural erosion and high precipitation as well as discharges which lead to low retention of natural N-deposition. **Emissions stemming from the natural background can not be influenced by management strategies.**

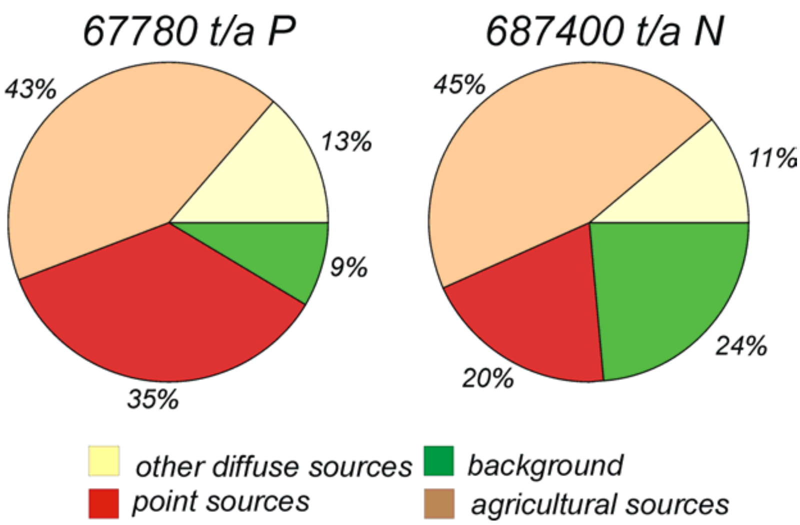


Fig. 4: Total N- and P-emissions into the Danube river system by sources 1998 – 2000 [Schreiber et al. 2003]

Table 7: main sources of N and P-emissions

most important source		
	P	N
Austria	agriculture	background
Germany	agriculture	agriculture
Bulgaria	agriculture	agriculture
Croatia	agriculture	background
Czech Republic	agriculture	agriculture
Hungary	point sources	point sources
Moldova	agriculture	agriculture
Romania	agriculture	agriculture
Slovakia	agriculture	agriculture
Slovenia	point sources	agriculture
Ukraine	agriculture	agriculture
Bosnia & Herzegovina	point sources	agriculture
Serbia&Montenegro	point sources	point sources

Point sources are predominant for P in Hungary, Slovenia, Bosnia Herzegovina and Serbia & Montenegro, in the other countries agriculture is the biggest emitter of P. The contribution of point sources is a result of people connected to sewer systems, to sewage treatment plants and the treatment efficiency. The contribution of this source is low if the number of people connected to treatment plant is low or if the treatment efficiency (nutrient removal) is high. The results obtained range between 20 % in Ukraine and Moldova (high percentage of people not connected, low treatment efficiency, Germany (24% (low percentage of people not connected, high treatment efficiency)) and 60% in Serbia & Montenegro.
The contribution of agriculture to the total national P-emissions ranges from 25% (Serbia Montenegro up to 69% in Moldova.
Looking more in detail on the sources it can be seen that the share of the natural background for P ranges from less than 2% (Moldova) up to 24% (Austria). In Germany, Croatia, Slovenia and Ukraine the background amounts to slightly above 10%, in all other countries below 7,5%.

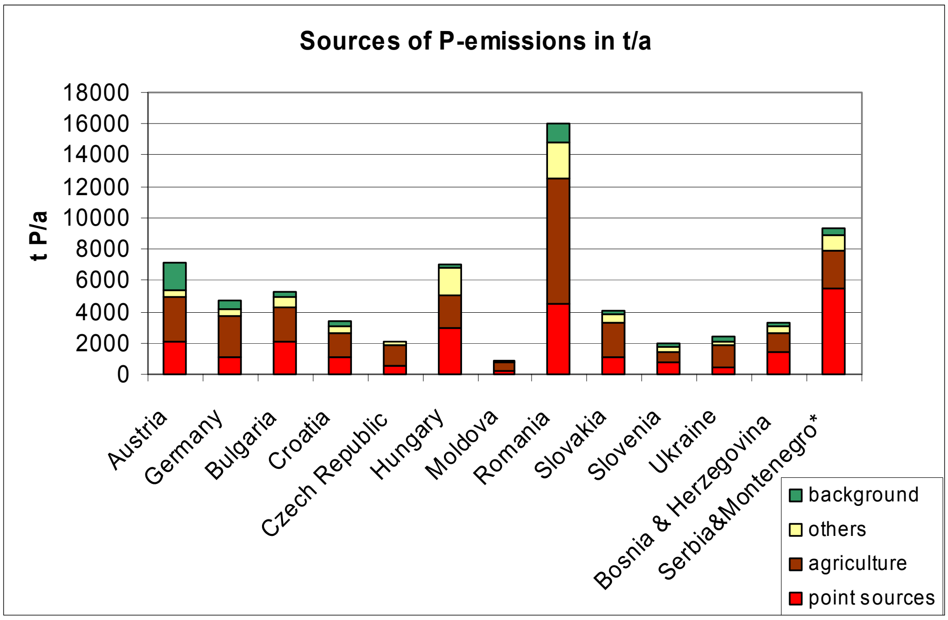


Fig. 5: Contribution of different sources to the P-emissions into the Danube river system [Schreiber et al., 2003, adapted by Lampert]

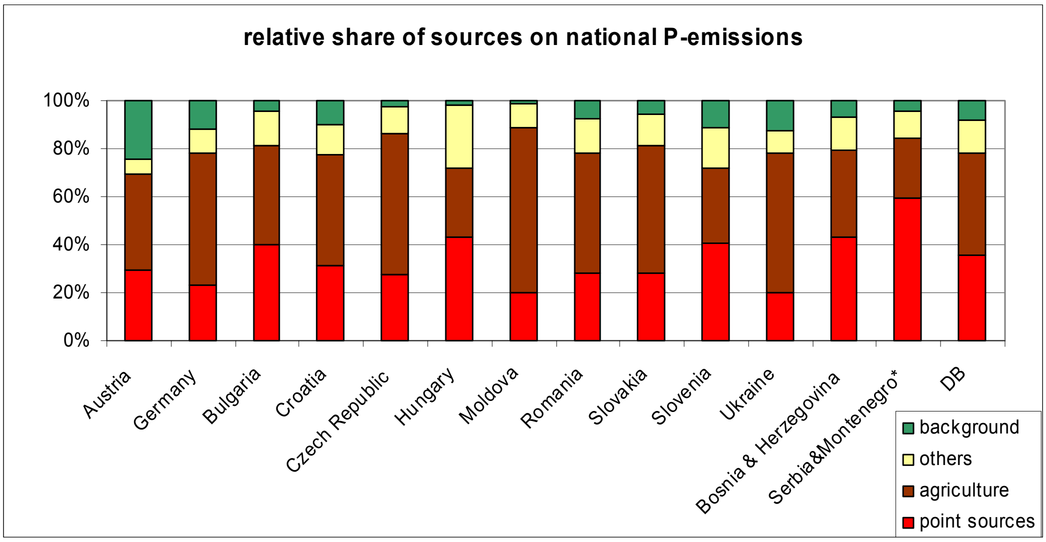


Fig. 6: relative share of sources of national P-emissions [Schreiber et al., 2003, adapted by Lampert]

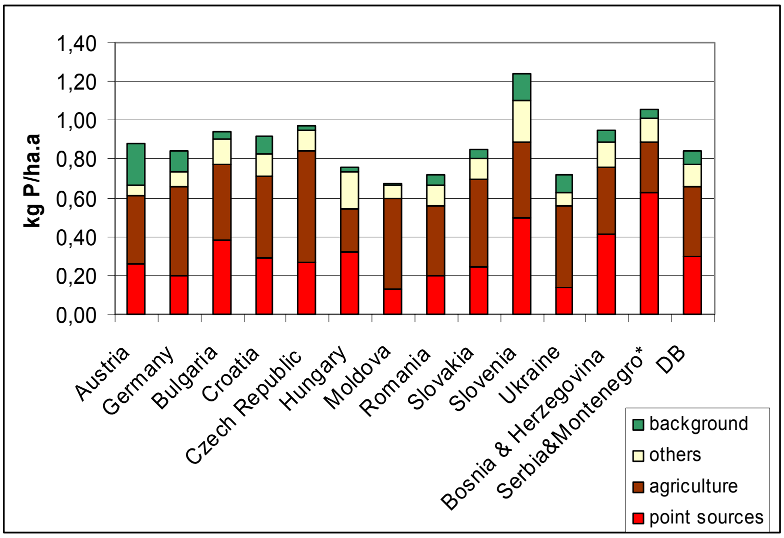


Fig. 7: area specific P-emissions from different sources [Schreiber et al., 2003, adapted by Lampert]

Point sources are the most sources of N in Hungary and Serbia & Montenegro, background is the most important source in Austria and Croatia, in the other countries agriculture is the biggest emitter of N.
The results obtained for point sources range between 6 % in Ukraine, Germany (11%) and 36% in Serbia & Montenegro.
The contribution of agriculture to the total national P-emissions ranges from 22% (Serbia Montenegro) up to 68% in Germany.
The share of the natural background for N ranges from less than 6% (Moldova) up to 43% (Croatia).

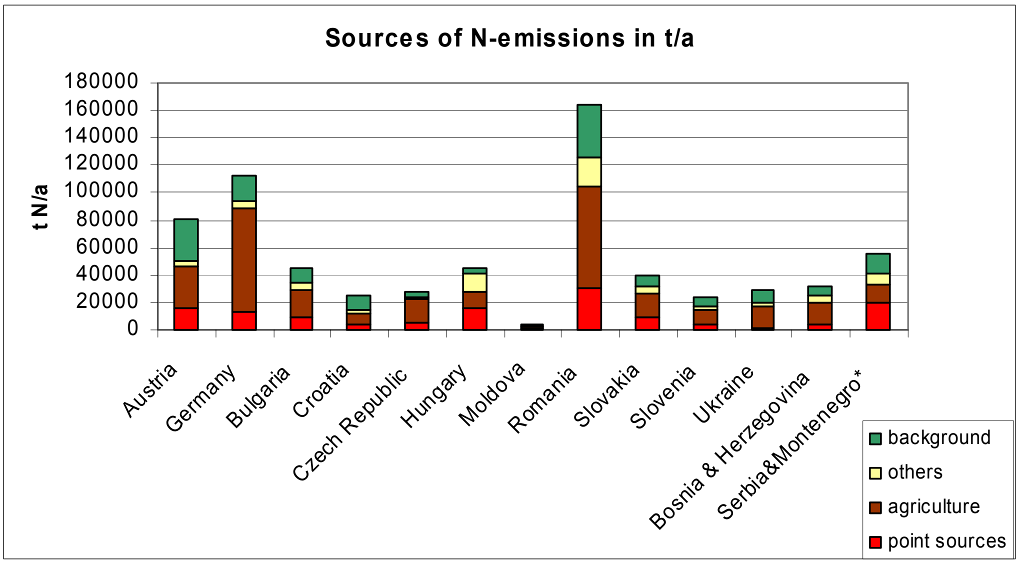


Fig. 8: Contribution of different sources to the N- emissions in the Danube river system [Schreiber et al., 2003, adapted by Lampert]

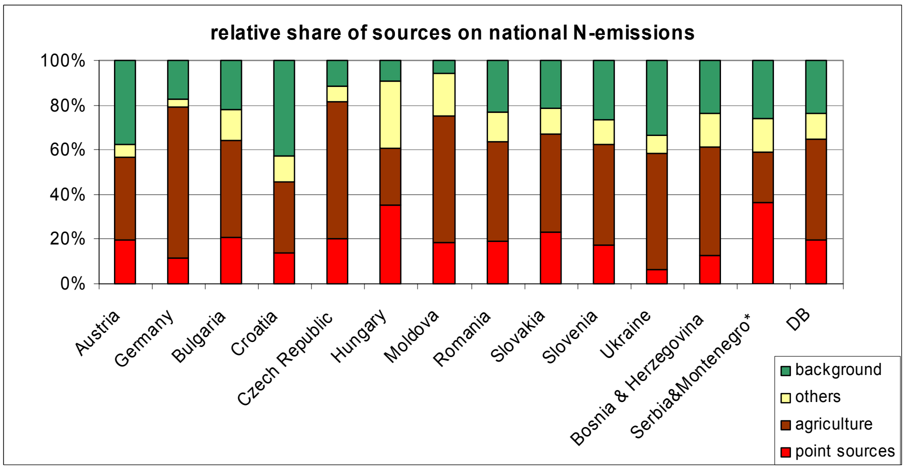


Fig. 9: relative share of sources of national N-emissions [Schreiber et al., 2003, adapted by Lampert]

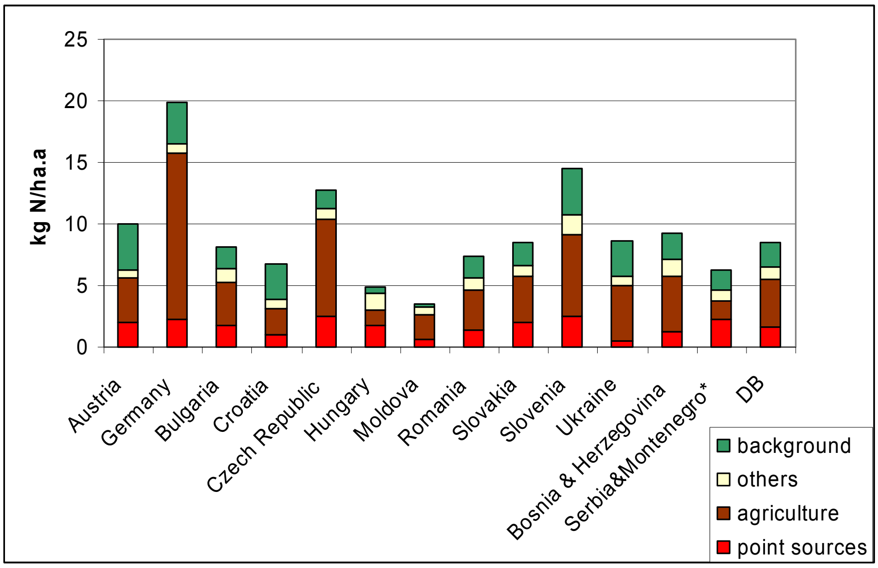


Fig. 10: area specific N-emissions from different sources [Schreiber et al., 2003, adapted by Lampert]

Table 8: Sum of all nutrient emissions into country parts of the Danube river basin in the period 1998-2000 [Schreiber et al. 2003]

Basin	Area	$ESUM_P$	$ESUM_{Pspec}$	$ESUM_N$	$ESUM_{Nspec.}$
	[km²]	[t/a P]	[g/ha·a P]	[t/a N]	[kg/ha·a N]
Germany	56630	4759	840	112800	19.92
Austria	80850	7126	881	80600	9.97
Czech Republic	21690	2112	974	27530	12.69
Slovakia	47210	4012	850	40170	8.51
Hungary	92770	6991	754	45210	4.87
Slovenia	16410	2029	1236	23880	14.55
Bosnia-Herzegovina	34630	3297	952	32200	9.30
Croatia	37600	3454	919	25590	6.81
Yugoslavia	88490	9311	1052	55670	6.29
Romania	222330	16007	720	163530	7.36
Bulgaria	55190	5214	945	44800	8.12
Moldova	12330	827	671	4330	3.51
Ukraine	33930	2429	716	29220	8.61
other countries	2820	213	755	1920	6.81
Total	802890	67783	844	687420	8.56

The highest amounts of N and P are emitted by Romania - about 25%. For P Serbia & Montenegro is the second largest contributor, followed by Austria and Hungary. For N Germany is second, followed by Austria and Serbia & Montenegro.

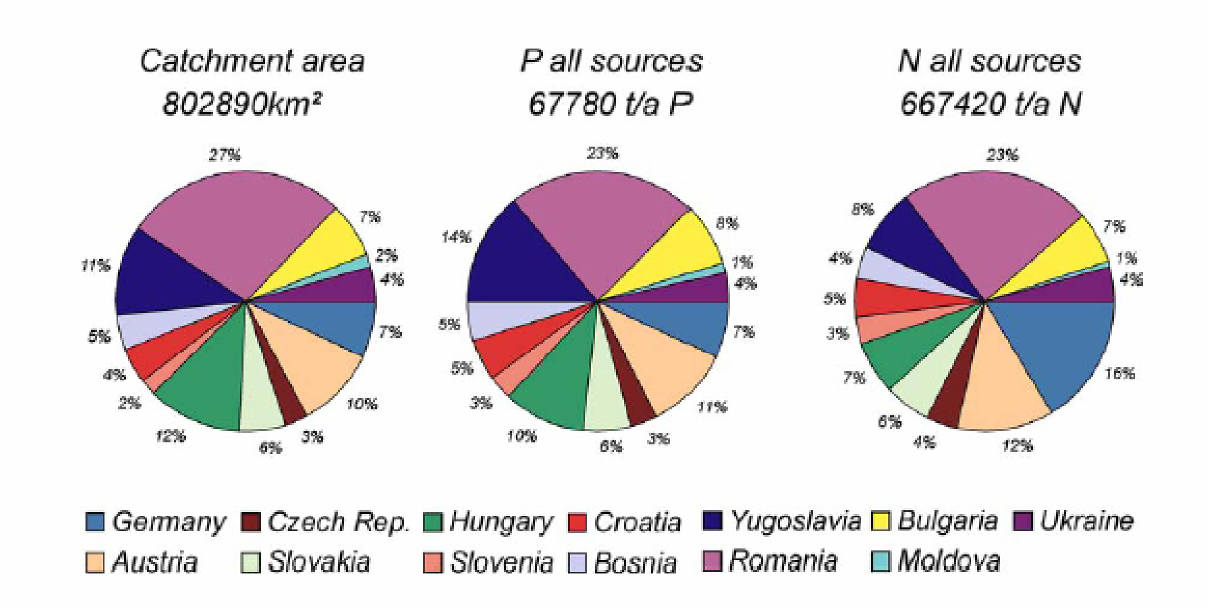


Fig. 11: Proportion of the countries at the total catchment area of the Danube and the phosphorus and nitrogen discharges [Schreiber et al. 2003]

In order to compare various countries the national emissions have to be related to characteristics of the country (population, area, dilution capacity, etc.).
It should be mentioned that specific values, which relate the emissions to country specific characteristics, have certain disadvantages. Relating the emissions to the area (area specific values) includes also emissions by waste water or runoff from urban areas, even though these emissions are independent of the area but dependent on the population density in the region. On the opposite, head specific values (= per capita specific) relate emissions stemming from agriculture etc. to the population. Such a value would make sense in a closed market, where each activity within the catchment is depending on the population number.
An other relation could be the national dilution capacity. This relation would advantage countries with a high precipitation as the dilution capacity would be higher.

3.2.4.1 Area specific emissions

The average area-specific P-emissions for the whole Danube is 844 g/(ha·a) P). The highest total P-emissions occur with more than 1200 g/(ha·a) P in the subcatchments of the Inn, Banat-Eastern Serbia, Iskar and Arges. If the analysis is done for the countries within the Danube basin, the highest specific P-emissions with more than 1000 g/(ha·a) P are caused by Slovenia and Yugoslavia (Serbia and Montenegro). Romania discharging the highest absolute values has an area specific emission that is about 15% lower than the average of all Danubian countries.

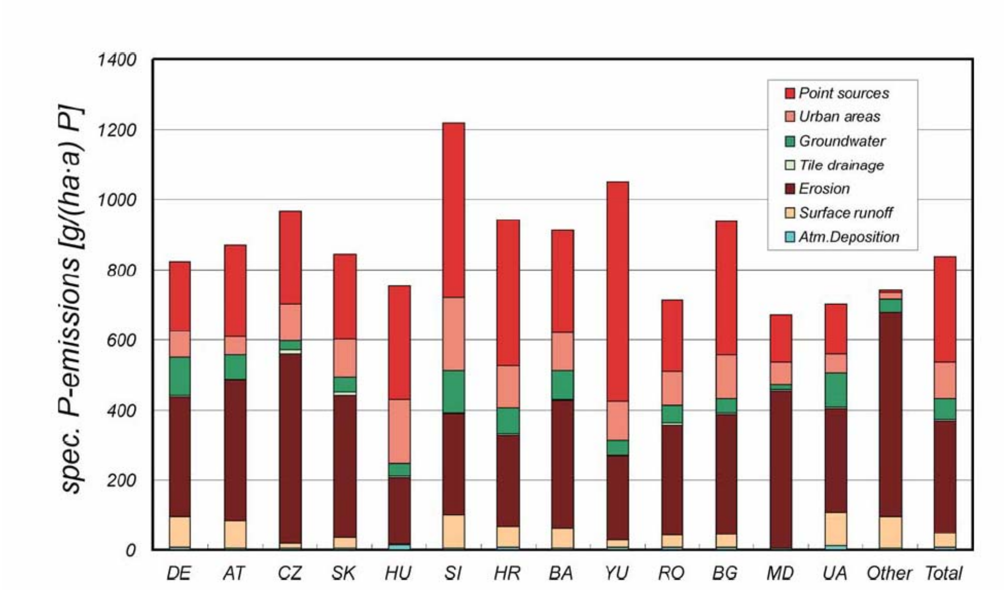


Fig. 12: Specific total phosphorus emissions in the Danube river basin by countries [Schreiber et al. 2003]

The mean area specific N-emission into the Danube river system is about 8.6 kg/(ha·a) N. Specific N-emissions of 10 kg/(ha·a) N or more were estimated for the countries Germany (20.0 kg/(ha·a) N), Slovenia (14.6 kg/(ha·a) N), Czech Republic (12.7 kg/(ha·a) N) and Austria (10.0 kg/(ha·a) N). Romania again is about 15% below the average. For Hungary and Moldova the specific N-emissions are lower than 5 kg/(ha·a) N due to the very low percolation rate of water and high N-retention in the unsaturated zone and in groundwater.

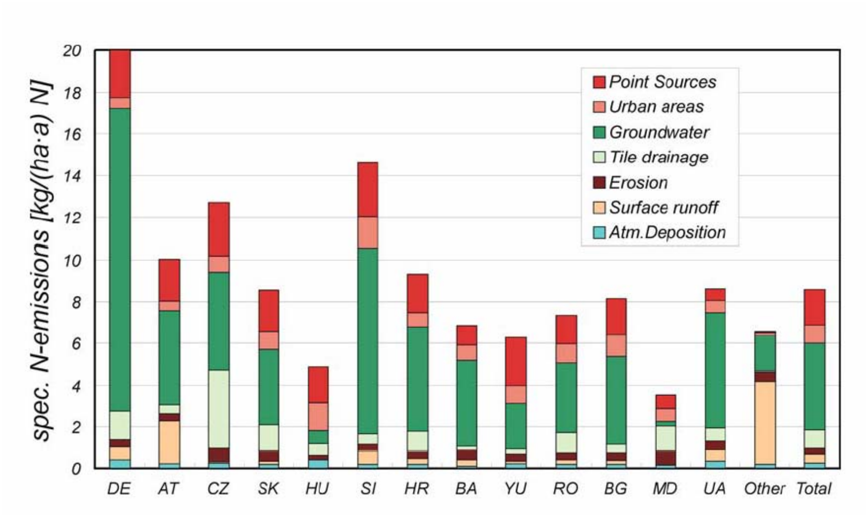


Fig. 13: Specific total nitrogen emissions in the Danube river basin by countries [Schreiber et al. 2003]

3.2.4.2 Head specific emissions

The total emission can be related to the number of inhabitants of a country as the population within the country highly influences the amount of waste water produced and partly the amount of food production. As markets are "open markets" there is no direct dependency on the number of inhabitants and the agricultural area, as produced feed and food as well as animals resp. meat can be exported. In addition the level of waste water treatment influences the head specific emissions.

The highest head-specific P-emissions are obtained for Bulgaria, Slovenia and Croatia (all above 1,1 kgP/(inh a), the lowest for Hungary and Germany (below 0,6 kgP/(inh a)). On average about 0,8 kgP are emitted per inhabitant. Romania is slightly below the average.

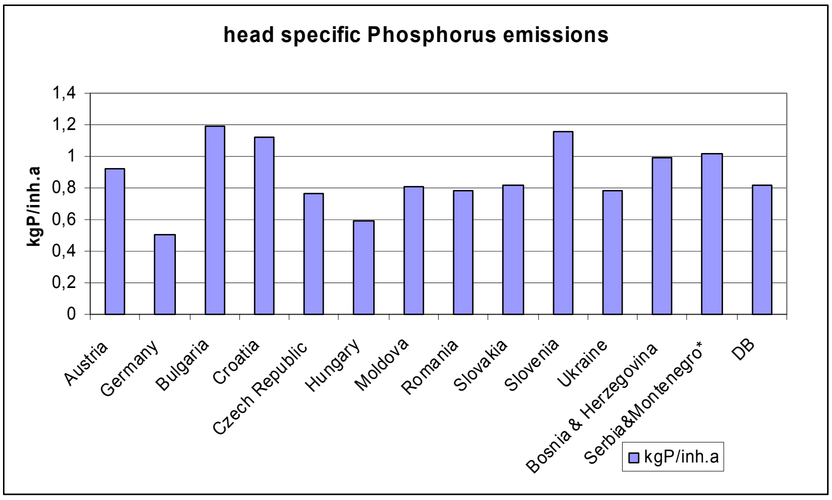


Fig. 14: head specific P-emissions [based on Schreiber et al. 2003]

For N the picture looks completely different: The highest values are recorded for Slovenia (about 14 kgN/(inh a)), Germany (showing the lowest P-emission per inhabitant) is second. The lowest head specific emissions were obtained for Moldova and Hungary (only about 4 kgN/(inh a)). Again Romania is slightly below the average head specific emissions.

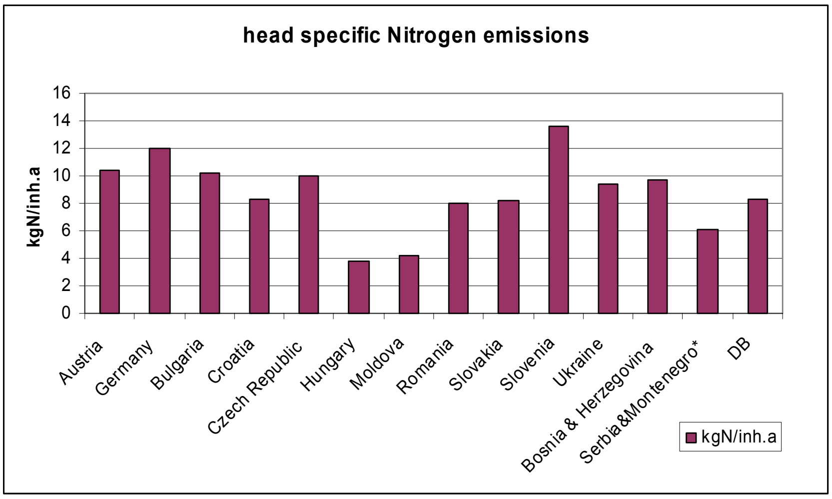


Fig. 15: head specific N-emissions [based on Schreiber et al. 2003]

3.2.4.3 Dilution capacity specific emissions

An further relation could be the national dilution capacity (precipitation minus evapotranspiration). This is a good criteria if only the nutrient concentration in the river system is of interest (ambient water quality approach). This relation advantages countries with a high precipitation as the dilution capacity is higher. As illustrated below, the dilution capacity specific emissions are the highest in Hungary and very low in Austria – there is a factor of about six between these both countries. Data for the national water discharge were obtained from [Phare, 1997] and [UNDP-GEF, 1999], nutrient emissions from [Schreiber et al. 2003].

Table 9: discharge by countries and calculated resulting nutrient concentrations

	km^3/a	gP/m^3	gN/m^3
A	48,4	0,15	1,7
D	25,3	0,19	4,5
BG	7,3	0,71	6,1
HR+BH	31,0	0,22	1,9
H	5,6	1,25	8,1
CZ	3,4	0,62	8,0
RO	37,2	0,43	4,4
SK	12,9	0,31	3,1
SL*	9,2	0,22	2,6
MD*	2,9	0,29	1,5
UA*	10,4	0,23	2,8
YU	23,5	0,40	2,4
DB	217,1	0,31	3,2

*Phare 1997, all other data [UNDP-GEF, 1999]

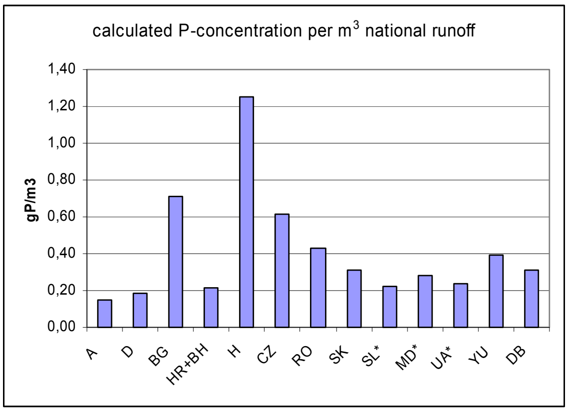


Fig. 16: dilution capacity specific P-emissions

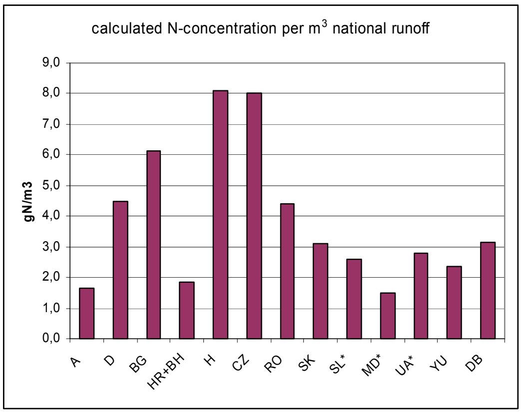


Fig. 17: dilution capacity specific N-emissions

3.2.5 Current pathways of emissions

In the following graphs the source "natural background" is included in the various pathways. The proportion of the different pathways to the total P-emissions varies widely between the countries.

For P the main pathway in the Danube Basin is erosion (ca. 38%) and point sources (35 %). Runoff from urban areas, surface run off from agricultural soils and the groundwater pathway amount to about 10% each, whereas tile drainage and atmospheric deposition are negligible. However the country results especially of point sources (see chapter 3.2.4) and erosion differ very much.
For example erosion ranges between 23% in Slovenia up to 67% in Ukraine, the contribution of point sources range between 20 % in Ukraine and Moldova and 60% in Serbia&Montenegro.

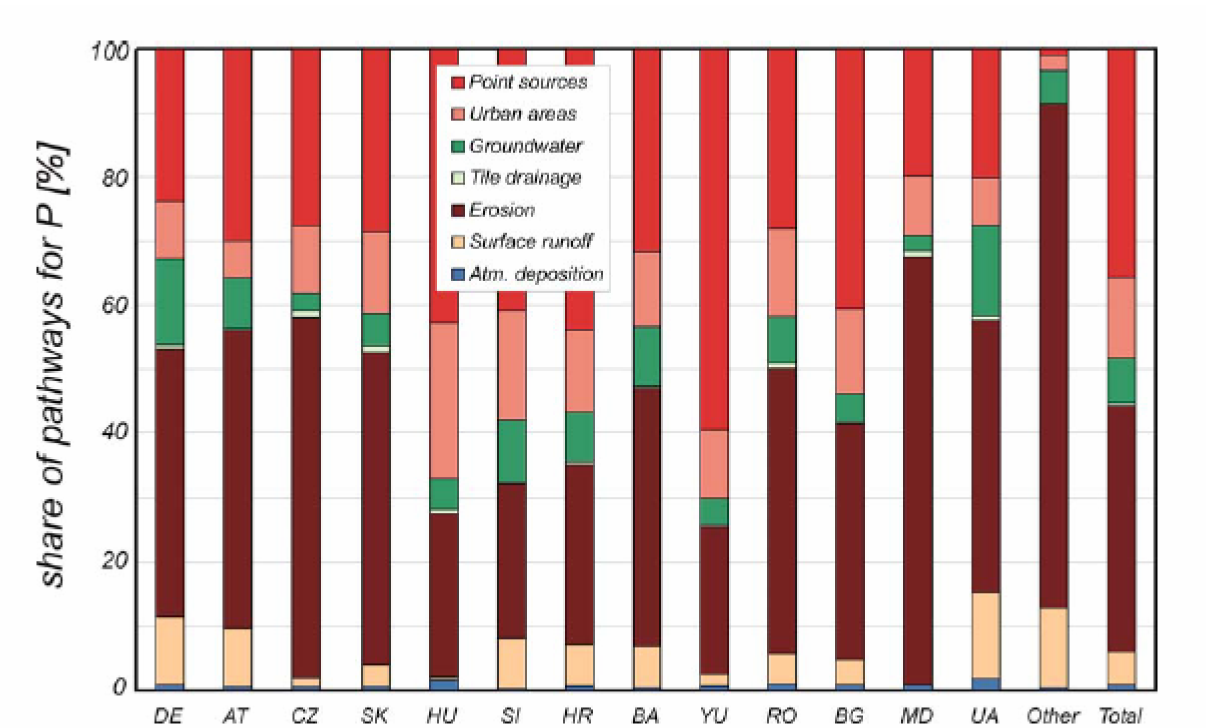


Fig. 18: Share of pathways of the total phosphorus emissions by countries [Schreiber et al. 2003]

For N the main pathway is the discharge via the groundwater (47% of the total emissions). Discharges via Point sources amount to about 20%, emissions via the other pathways contribute 10 or less percent to the total emissions.
Again country results vary considerably. Whereas the contribution via the groundwater pathway in Moldova is less than 7%, in Germany more than 70% are discharged via groundwater. Strong variation scan also be observed in tile drainage (less than 5% up to more than 30%), urban runoff (from 3% to 27 %) and point sources (6% to 36%).

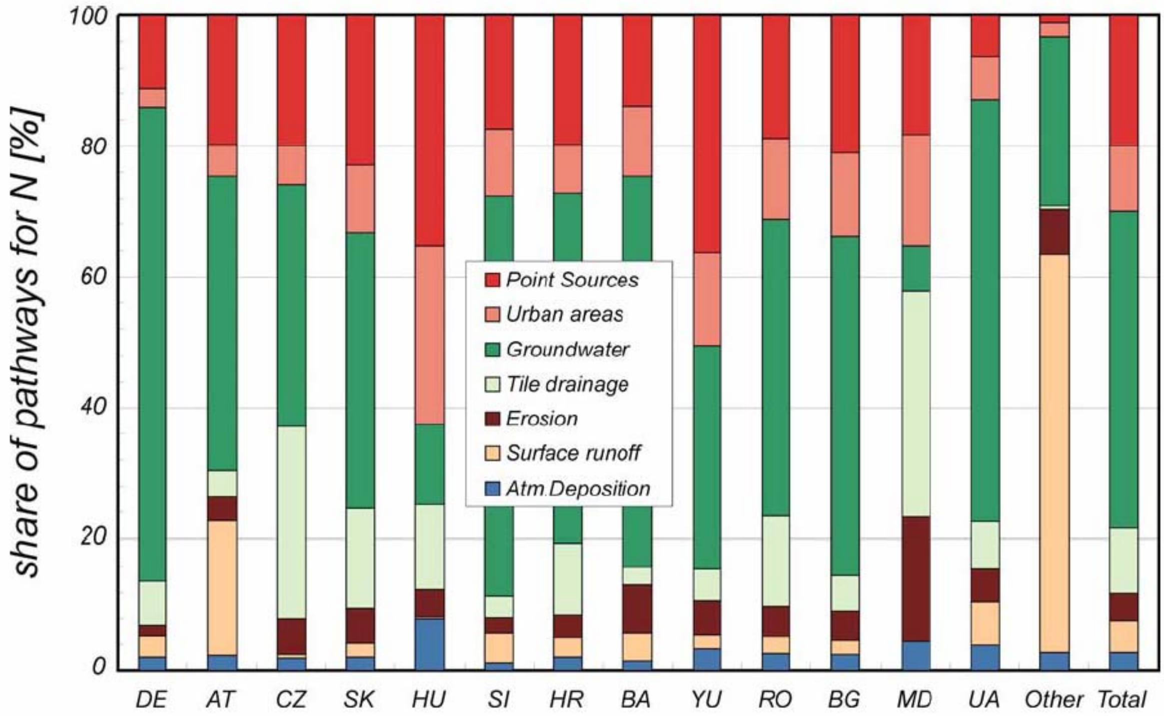


Fig. 19: Share of pathways of the total nitrogen emissions by countries [Schreiber et al. 2003]

3.2.6 Intra-national variations

Up to now only results related to the countries have been presented. However the importance of sources or pathways do not only vary on a country level but also within a country. As illustration the area specific emission of P and N for various subcatchments in the Danube Basin are given.

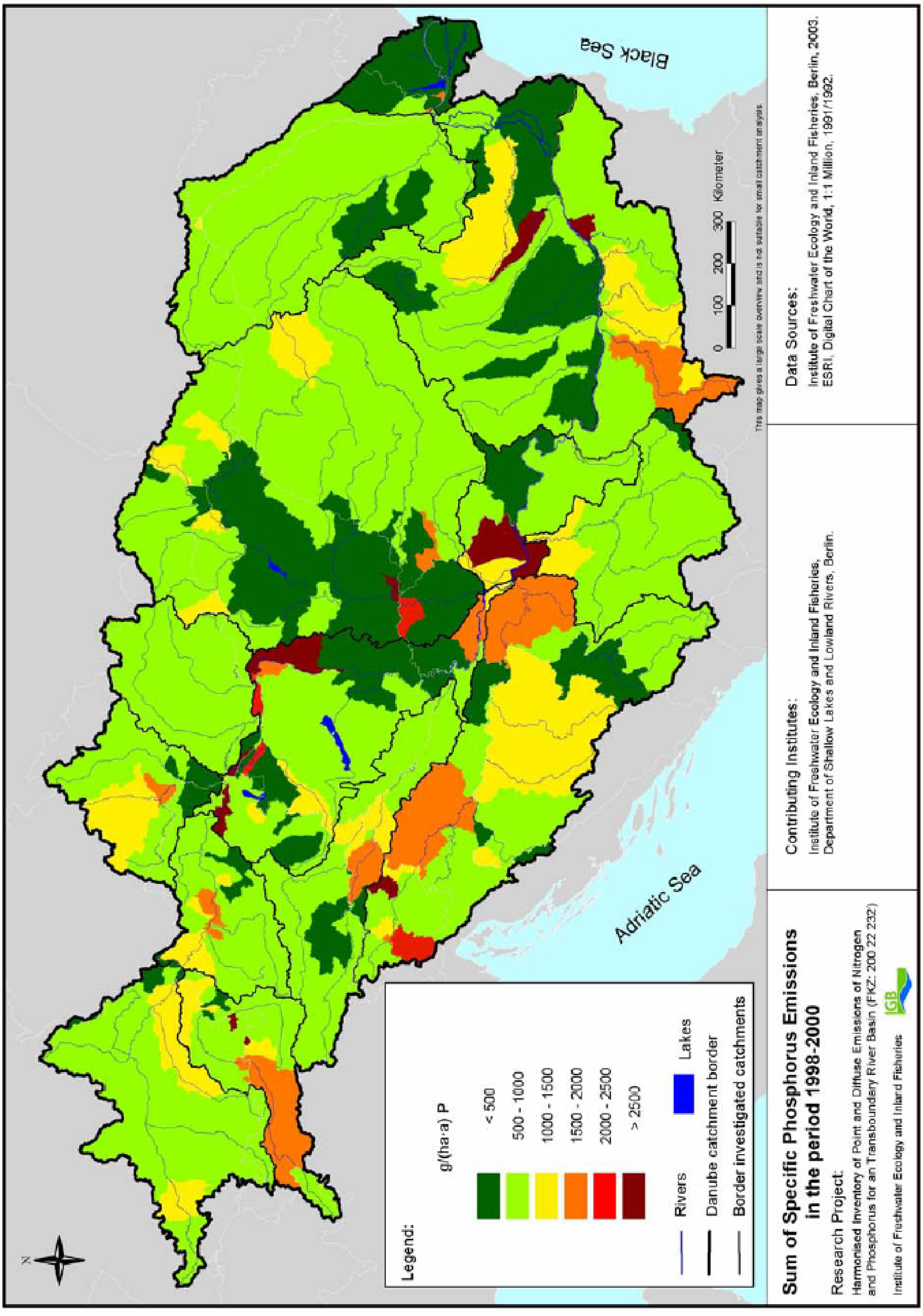


Fig. 20: Total specific phosphorus emissions in the period 1998 – 2000.

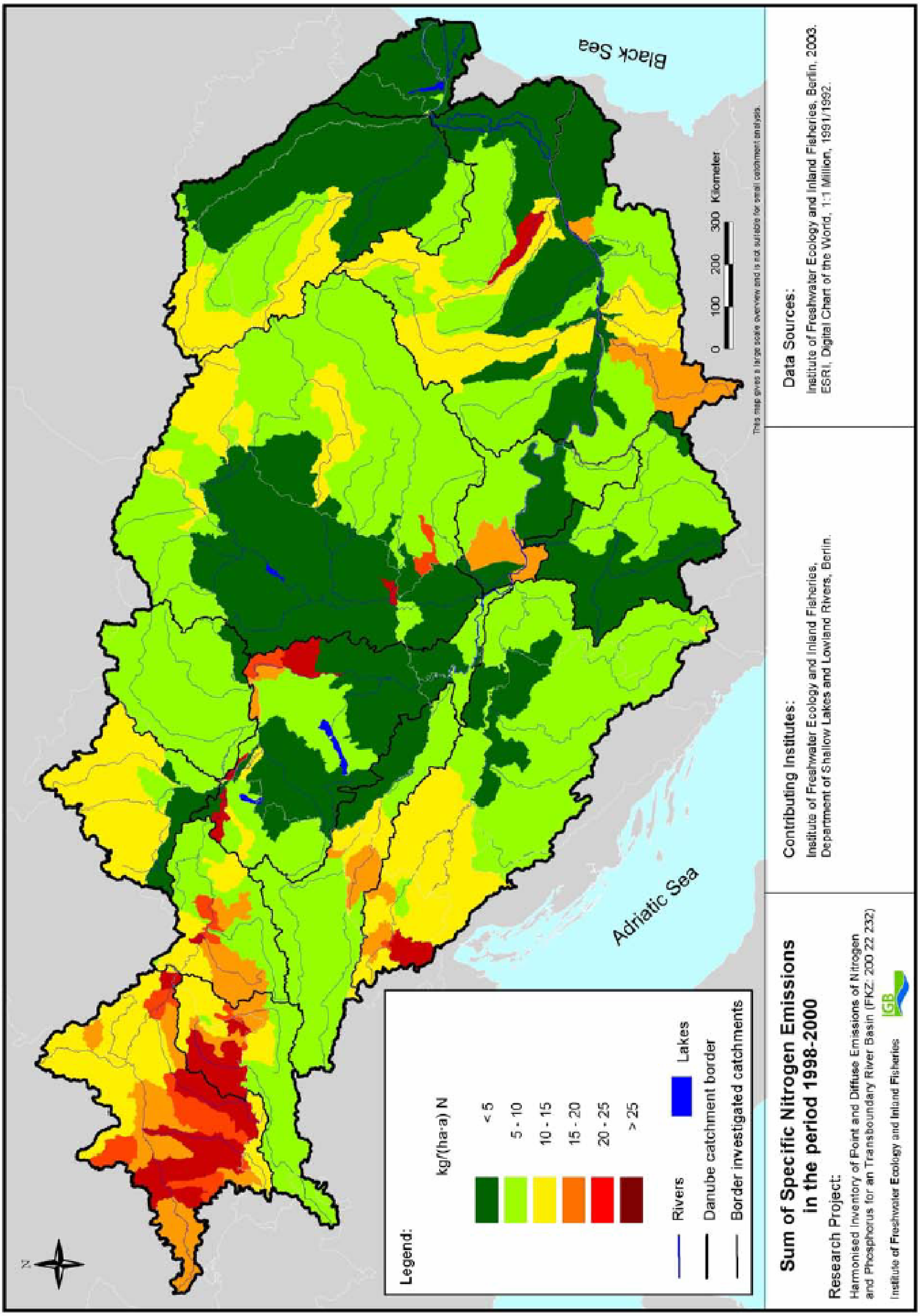


Fig. 21: Total specific nitrogen emissions in the period 1998 – 2000.

3.3 Influence of natural characteristics

3.3.1 Influence of natural characteristics of the catchment

Denitrification in the soil/subsurface/groundwater system is controlling the amount of the input of nitrogen via groundwater and tile drainage to a high extent. Key factors influencing this process are geology, precipitation and groundwater recharge rates as well as residence time in groundwater. Tile drainage activities reduce residence time and increase nitrogen inputs into receiving waters. If tile drainage activities are significant in an area this pathway becomes an important N-input for those cases.

Hydrological aspects control the process of denitrification to a high extent. Groundwater recharge rates determine the input of nitrogen and oxygen into groundwater. Lower recharge rates limit the oxygen input in relation to the nitrogen input which favours denitrification if organic carbon or pyrite is available. Another important factor that controls denitrification is the residence time in groundwater, which again is influenced by hydrogeology and groundwater recharge rates. Higher residence times favour denitrification, thus again lower groundwater recharge rates tend to increase denitrification. Results of investigations within the daNUbs project show much higher denitrification in groundwater in regions with low precipitation as in those with high precipitation. It could be shown that in „dry“ areas up to 90 % of the diffuse N emissions into the rivers stem from less than 25% of the area – from those areas close to the rivers. Therefore, nitrogen inputs into surface waters via groundwater are much lower in more arid regions even if nitrogen surpluses in soils are in a similar size [Zessner et al. 2004]. From the management point of view this means that in respect to ground water protection from nitrate pollution the focus is on regions with low water availability, while in respect to surface (marine) water protection focus should be on regions with higher water availability and in regions with low water availability mainly on the areas close to the river system.

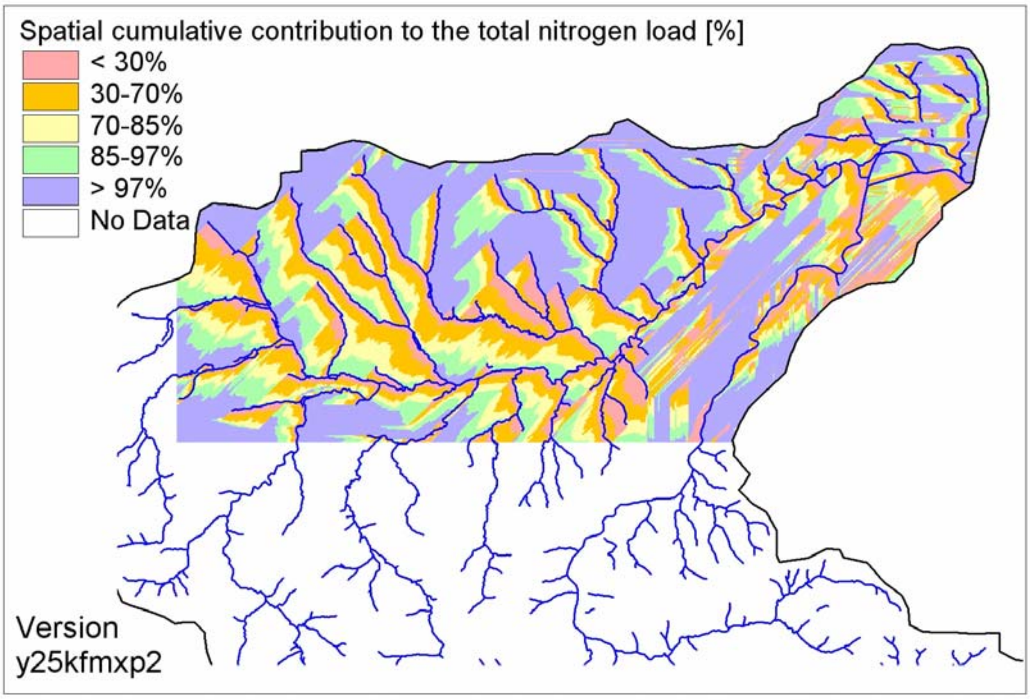


Fig. 22: Spatial cumulative contribution tot the total N-load in subcatchments of the Ybbs [Zessner, 2004]

For P similar conclusions can be drawn: As erosion is a main pathway it can be anticipated, that especially those areas close to the river discharge in to the river.

As a consequence:

- **large areas have to be anticipated which are not sensitive to agricultural management measures in respect to emissions to surface waters and transboundary transport.**
- The impact of the nutrient surplus of agricultural areas on surface waters can be of minor importance or even negligible

Measures taken to reduce emissions will cause different effects in a certain time period: the "reaction time" of measures in agriculture will be much longer due to the long retention time of Nitrate in the groundwater whereas measures taken in waste water treatment plants will show an immediate effect.
Further more the retention in the river system itself has to be considered – emissions to the river systems are retained partly in the river (denitrification, sedimentation). In general it can be said, that the larger the river the smaller is the retention in the river system.

3.3.2 Factors influencing the concentrations, the metabolism and the effects of N and P in the Black Sea

The circulation forcing mechanisms are buoyancy (due to river discharge), wind stress, heat and salt fluxes at the air-sea interface and interaction between shelf and basin.
The magnitude and the direction of the wind forcing are pronounced in different areas and from season to season. The winds are strongest in winter.
Especially for the vicinity of the Danube River plume winds are usually downwelling-favourable but also periods of upwelling favourable conditions exist (mainly in July).
About 80% of the freshwater discharge in the western Black Sea stems from the Danube. The Danube river plume therefore is the strongest. However along the coastal zone a band of low salinity is formed from the blending of all major river plumes. The wind forcing has a prominent role in the transport of low salinity waters. The zone of low salinity is smallest in winter (prevailing downwelling-favourable winds (strong northerly or easterly components), strong wind speeds inducing mixing). Buoyancy effects are diminished even in the vicinity of the Danube. In March wind diminish, and a low salinity band along the coast is formed. The strongest salinity gradients are near and south of the Danube Delta where buoyancy effects become dominant. In May winds near the Danube are almost negligible. There is considerable offshore spreading in late spring when the winds are low and in summer, when stratification due to heat flux allows for faster wind-driven transport on the upper part of the water column. The northwards winds in the southern part of the WBS reverse the propagation of the coastal current, but still low salinity waters reach the coast south of the Delta. By October the seasonal vertical stratification starts to diminish and the zone of low salinity retreats nearshore.

Bulgarian coast: The penetration of Danube transformed waters occurs vertically most intensive up to 10 m depth, and in periods of high river runoff up to 25 m depth. In a long-term aspect the spring minimum of salinity is registered in the aquatories 1-20 miles offshore in front of the Cape Galata and 1-10 miles offshore in front of the Cape Emine. In summer the minimum of salinity could appear in the zone 20-30 miles offshore, especially in front of the Cape Emine. Consequently, depending on the level of the river runoff and the current system, the pathway of Danube transformed waters along the Bulgarian coast seasonally changes and passes at a different distance offshore.

Benthic regeneration of Phosphate and Silica is very important. The benthic recycling of P and Si in the total shelf may be of the same order of magnitude as the input by the Danube: benthic daily recycling (in summer): 1140 t Si, 180t DIN, 85 t P; total daily input by the Danube: 800 t Si, 2000 t N, 80 t P. Since the nutrient loads of the Danube are strongly P-deficient, the sediments are an important source to sustain high productivity. The estimated N:P ratio of the benthic fluxes 1,8 to 7,4 is far lower as the Redfield ratio (16:1) indicating intense denitrification in that area. The hypothetical turnover times for nutrient concentrations in the water column (replacement of the standing stock by the benthic supply only) are for P in the order of days to weeks, for Si and N in the order of 1 month at the delta stations and in the order of several month for Si and years for DIN at the other littoral stations. Benthic fluxes decrease with distance from the coast: within a distance of 20 km to the coast (5% of the shelf area) about 30% of the Si, 60 % of the DIN and 45% of the P is recycled [Friedl et al. 1998]. [Friedrich et al. 2002] estimate that the near shore P and Si recycling account for 50 resp. 35% of the Danube input in summer.

3.4 Eutrophication in the Danube River

3.4.1 TransNationalMonitoringNetwork (TNMN)

The following information on the TNMN was derived from the ICPDR website. The minimum sampling frequency within the TNMN is 12 per year for determinands in water.

Table 10: List of N and P determinands of the TNMN

Determinand	Unit	mimimum likely level of interest	Principal level of interest	target limit of detection	Tolerance
Ammonium (NH_4^+-N)	mg/l	0,05	0,5	0,02	0,02 or 20%
Nitrite (NO_2^--N)	mg/l	0,005	0,02	0,005	0,005 or 20%
Nitrate (NO_3^--N)	mg/l	0,2	1	0,1	0,1 or 20%
Organic Nitrogen	mg/l	0,2	2	0,1	0,1 or 20%
Ortho-Phosphate (PO_4^{3-}-P)	mg/l	0,02	0,2	0,005	0,005 or 20%
Total Phosphorus	mg/l	0,05	0,5	0,01	0,01 or 20%

To ensure the quality of the measured data the QualcoDanube was established, an inter-laboratory comparison in the Danube laboratories. Within QualcoDanube the nutrient determinands are distributed twice in 2001.

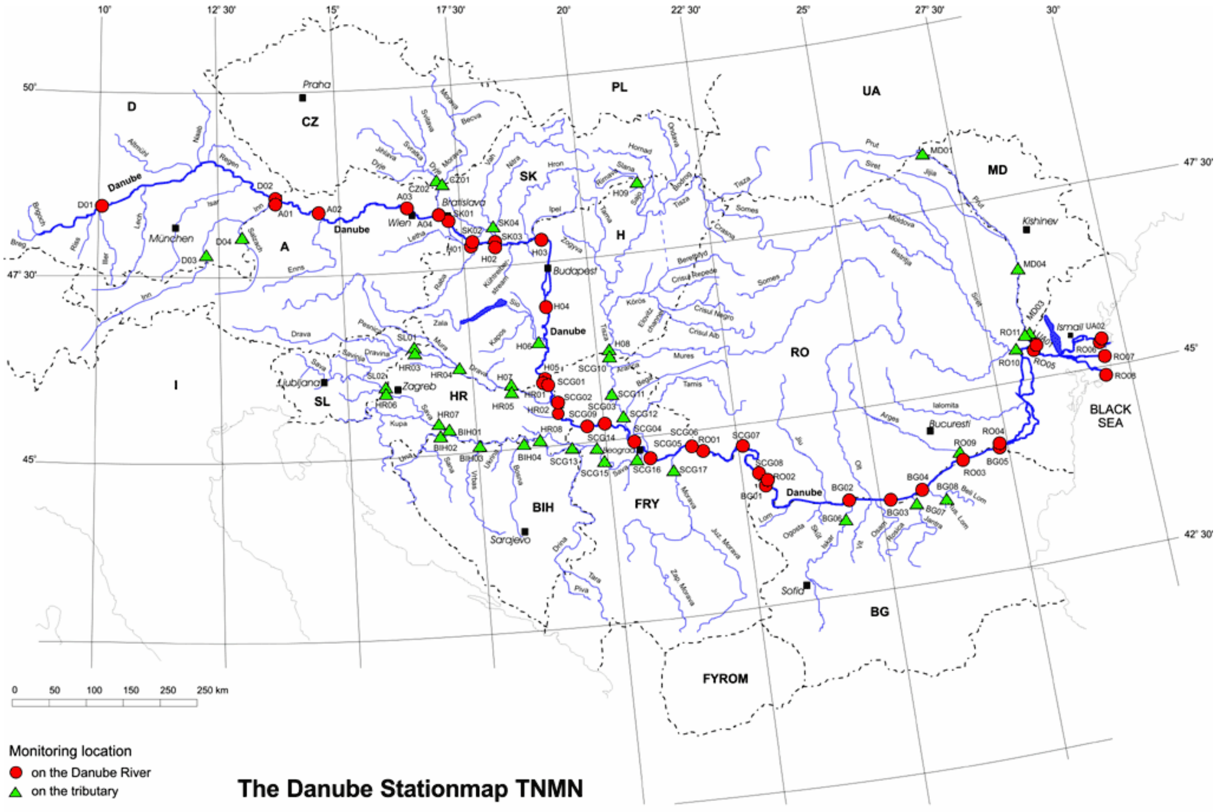


Fig. 23: The Danube Stationmap TNMN

The following graphs from the TNMN yearbook 2001 illustrate the chlorophyll a concentration at the TNMN measuring points along the Danube and some tributaries as an indicator of eutrophication.
The highest mean value is about 30µg/l (Dunafoldvar km 1560). Considering the mean values as well as the maximum values an increase from Wolfsthal (km 1874) to Hercegszanto (km 1435) can be recognised. The chlorophyll concentrations downstream of the Iron Gate reservoirs are very low (only Bulgarian values are available). Considering the tributaries the river Sio exceeds by far the concentrations of the Danube and the other tributaries, the mean value is about 90 µg/l.

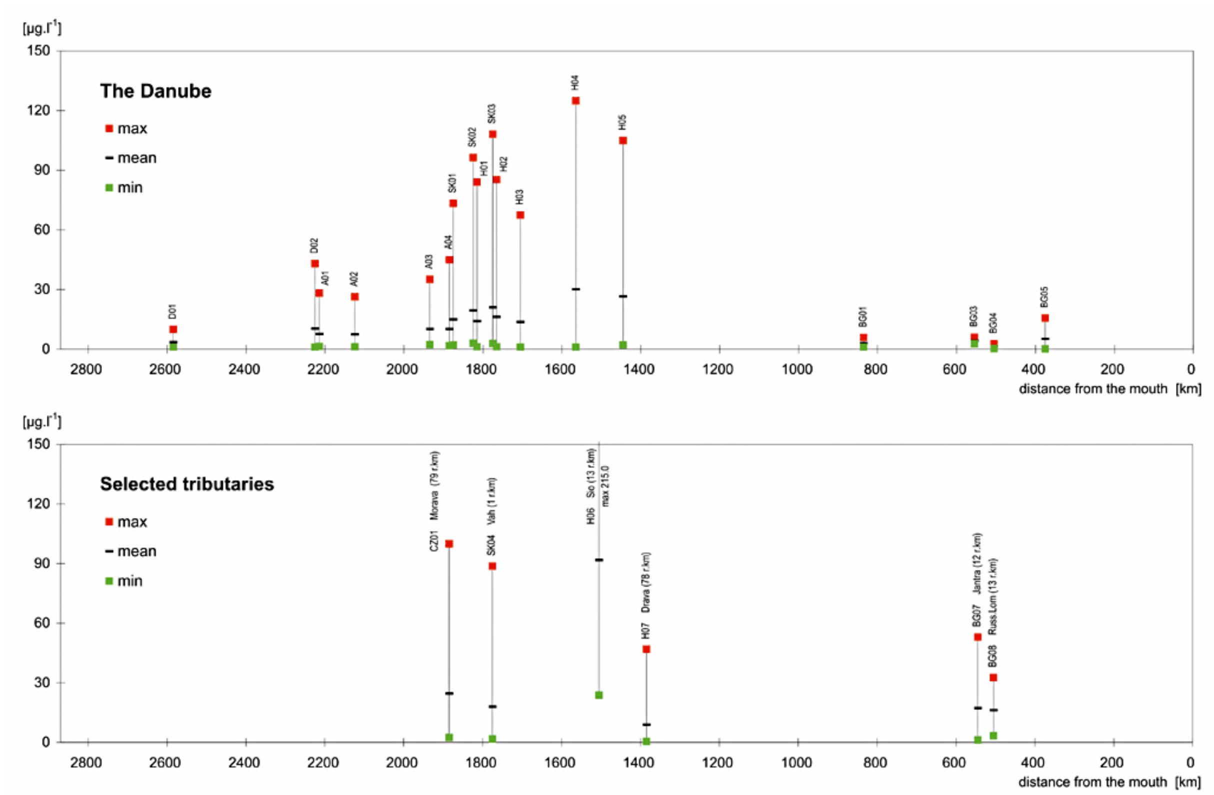


Fig. 24: min, max and mean Chlorophyll a concentrations along the Danube and relevant tributaries [TNMN 2001]

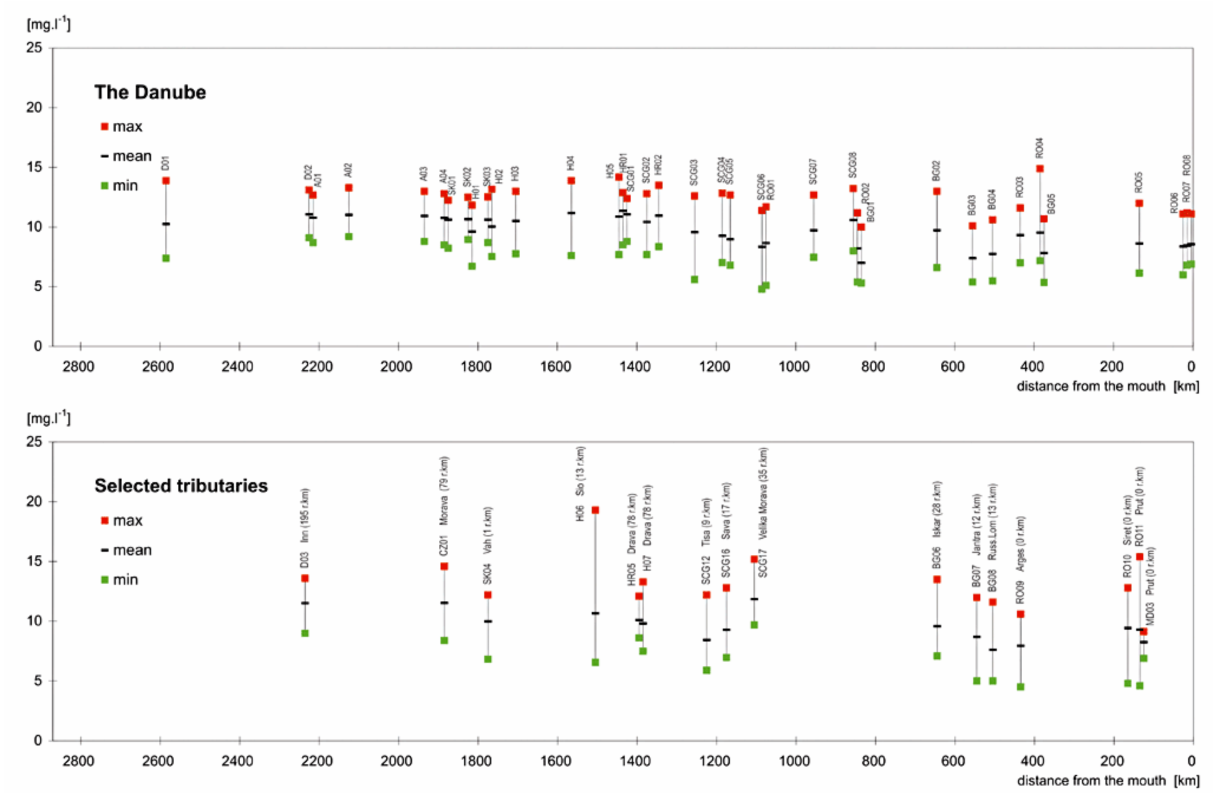


Fig. 25: min, max and mean oxygen concentrations along the Danube and relevant tributaries [TNMN 2001]

In the following diagram the ortho-phosphate values are depicted showing very high values for Bulgarian stations below the Iron Gate even the Romanian values are in line with the values measured above. The discharges via Bulgarian rivers into the Danube are to small to increase the nutrient concentrations considerably. A comparison of the Bulgarian values for ortho-PO_4 with the total P concentration shows in many cases that the TP values are lower as the ortho-PO_4-values which can not be. It has to be anticipated that the Bulgarian values for ortho-P are not correct. However also some of the Romanian values are exceptional high below the Iron Gate section which cannot be explained by the discharge of rivers downstream of the reservoir mentioned. There are big inconsistencies in the data sets for total P as well as for ortho phosphate in the lower Danube river stretch. Data has to be supported/replaced by modelling results obtained by the DWQM.

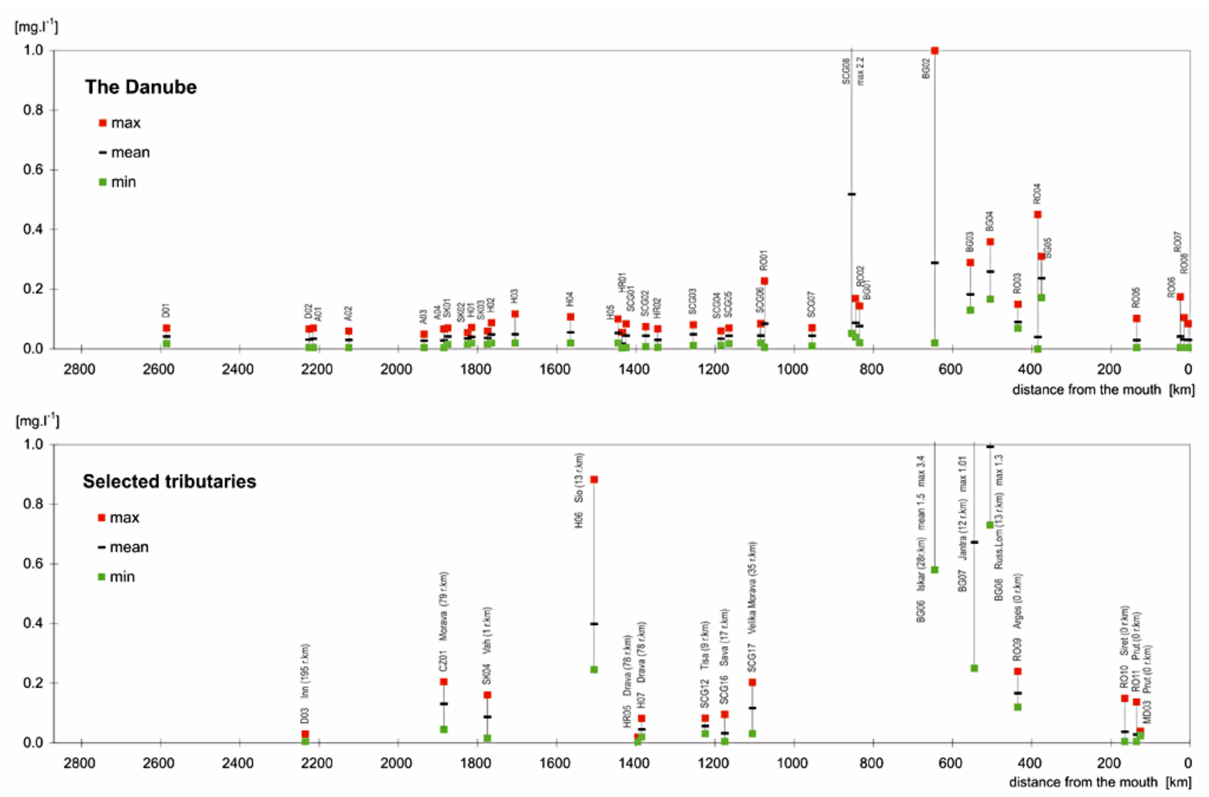


Fig. 26: min, max and mean ortho-phosphate concentrations along the Danube and relevant tributaries [TNMN 2001]

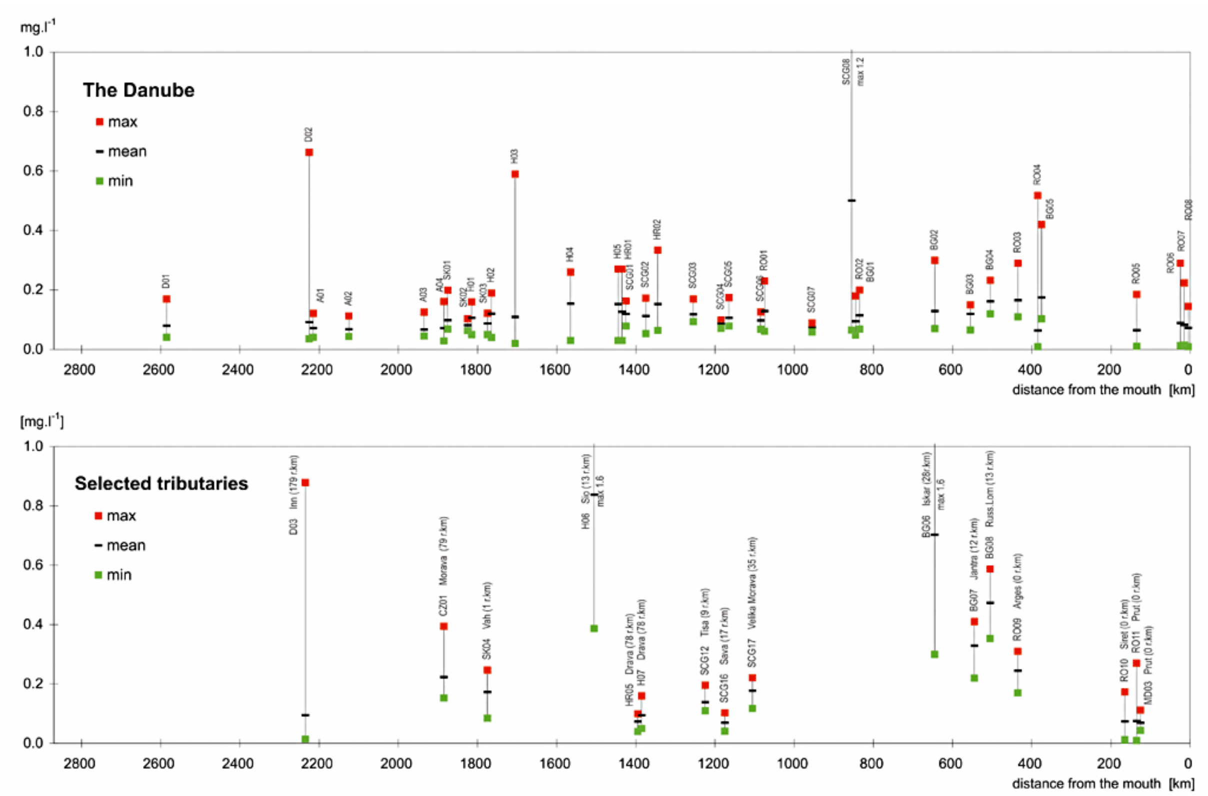


Fig. 27: min, max and mean TP-concentrations along the Danube and relevant tributaries [TNMN 2001]

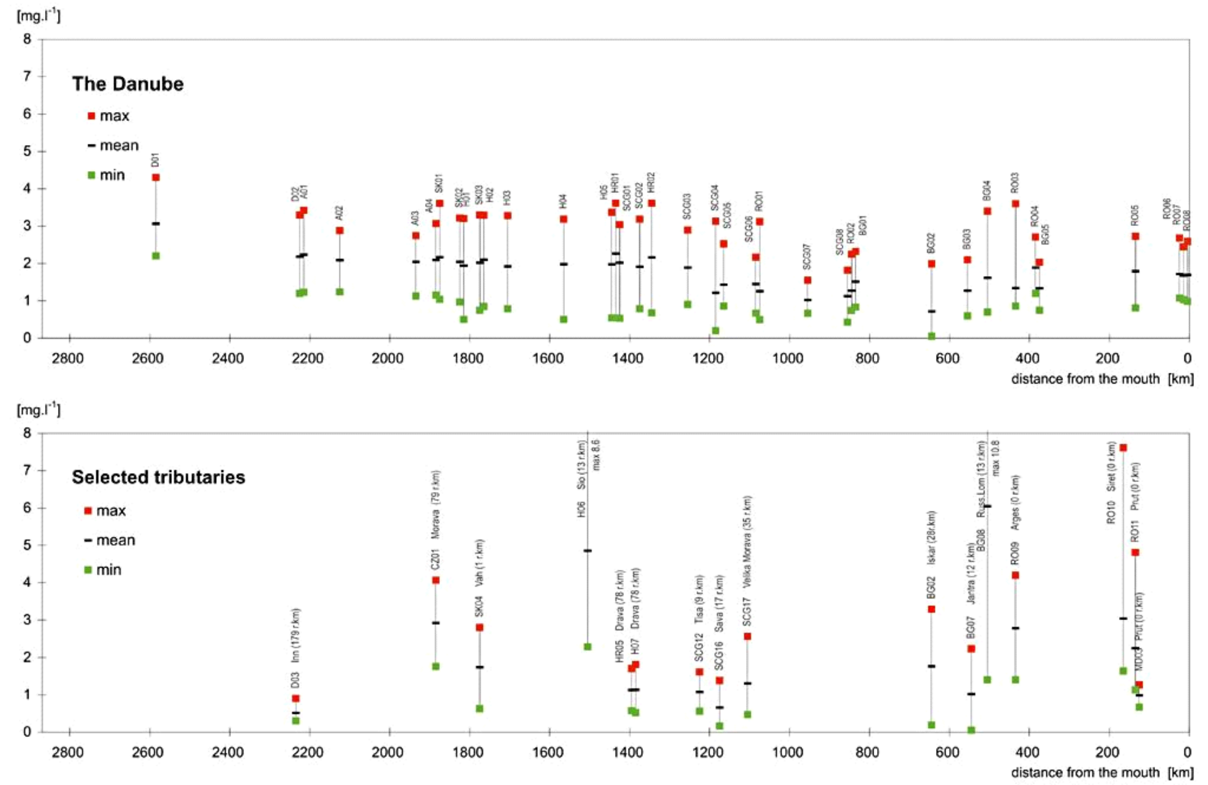


Fig. 28: min, max and mean nitrate concentrations along the Danube and relevant tributaries [TNMN 2001]

In the following diagrams an evaluation of data provided in the TNMN yearbook 2001 is shown. The mean values of chlorophyll a and ortho-phosphate are depicted, illustrating clearly the high concentrations of chlorophyll a downstream of Budapest.

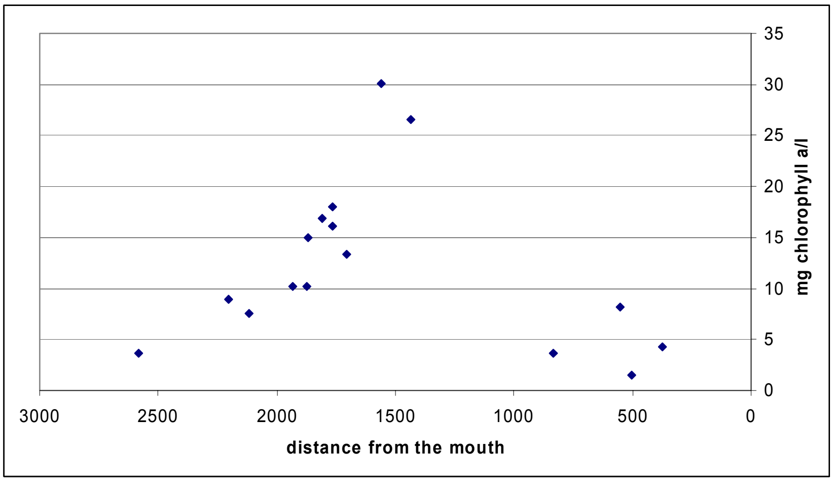


Fig. 29: Mean chlorophyll a concentrations 2001

The highest ortho-phosphate concentrations (excluding the Bulgarian values) are found in Bazias, Pristol/Novo Selo and Upstream Arges. No explanations can be given for these high values.

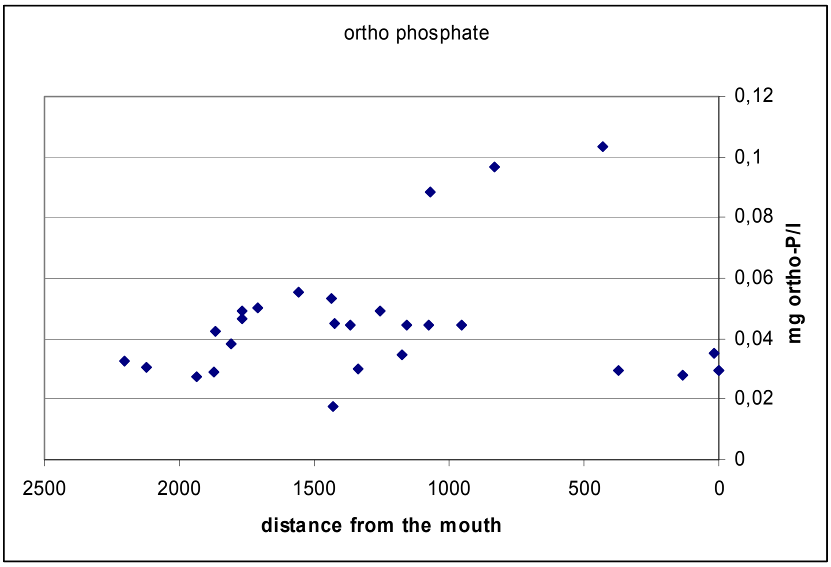


Fig. 30: Mean ortho-phosphate and TP concentrations 2001

A significant correlation exists between ortho-phosphate and chlorophyll a:

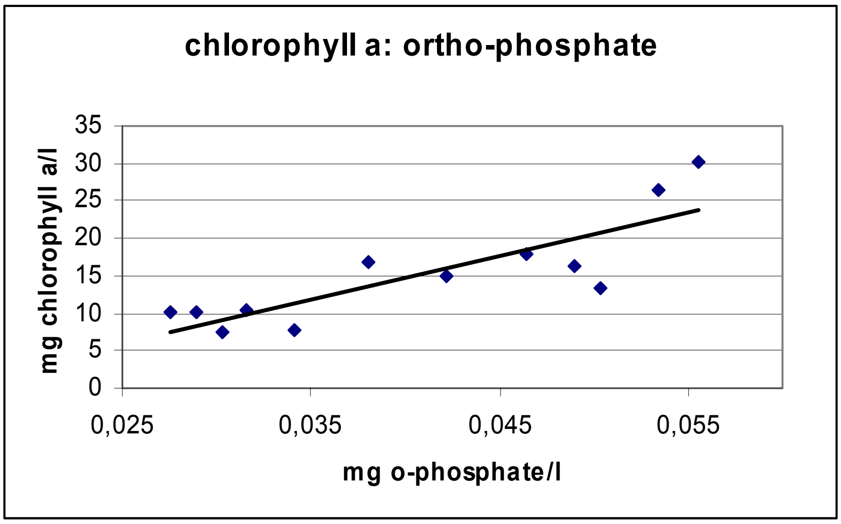


Fig. 31: Chlorophyll a and ortho phosphate concentrations along the Danube in 2001

Nitrate is the dominating N-fraction in the river Danube ranging in general between 1 mg/l and 2,5 mg/l NO_3-N. Ammonia is less than 0,5 mg/l NH_4-N. However, the more downstream the concentration of Ammonium increases.

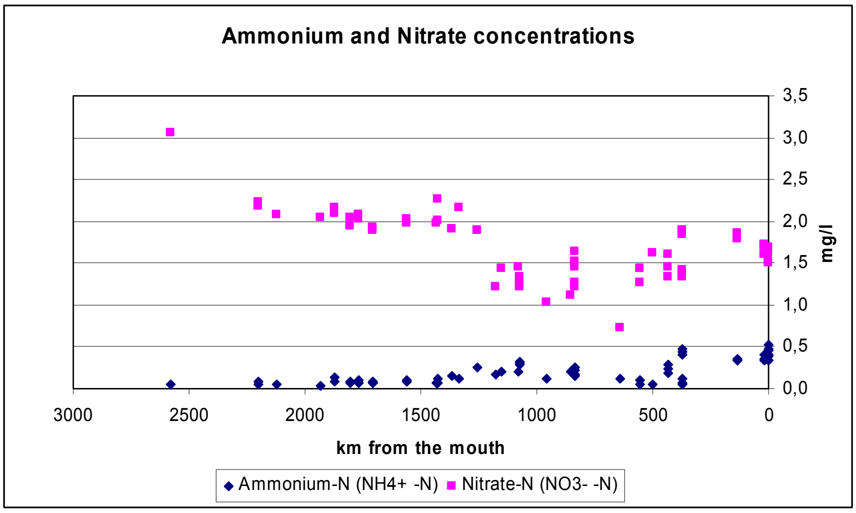


Fig. 32: mean Ammonium and Nitrate concentrations along the Danube 2001

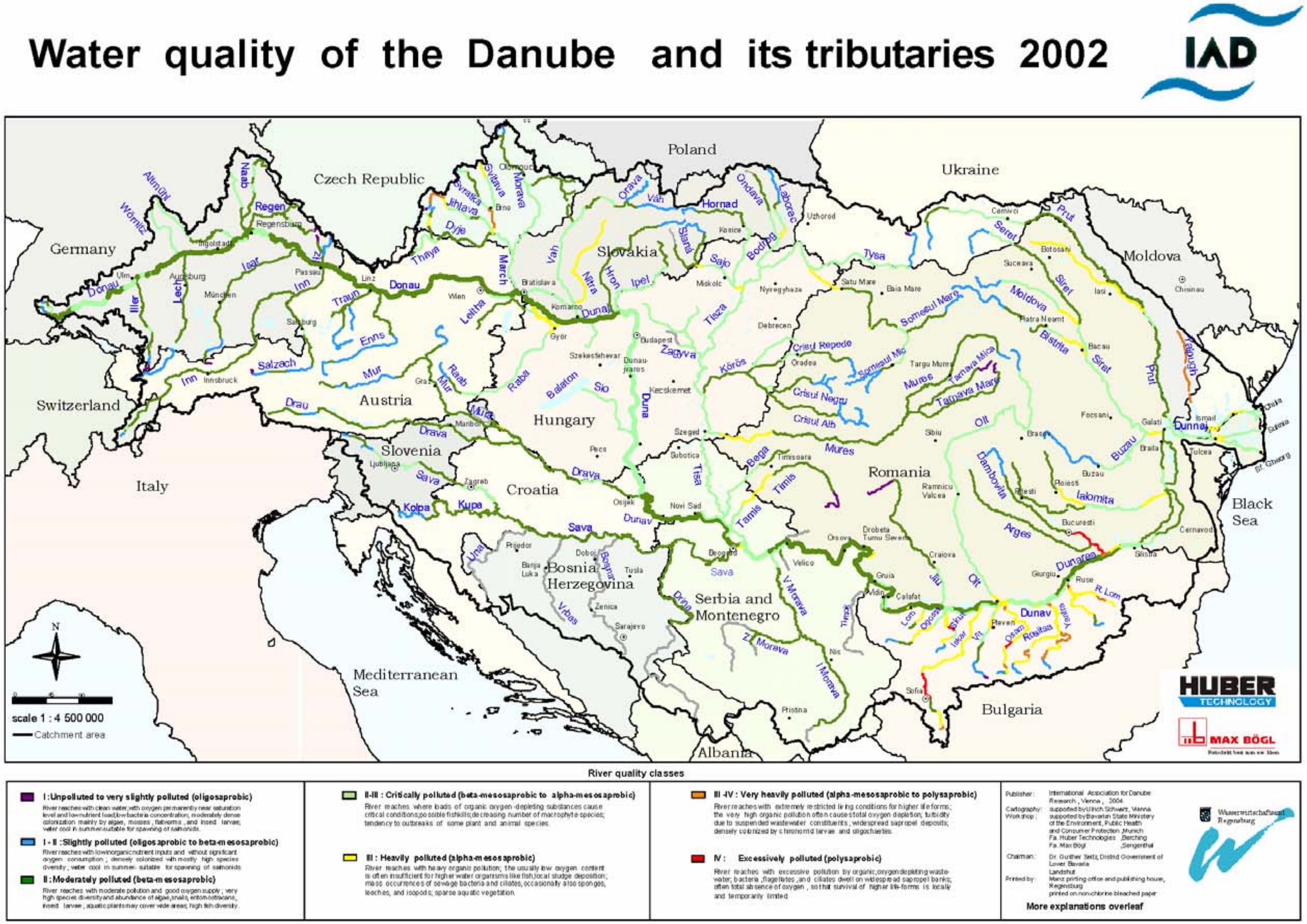
Only about 10 stations provided information on the concentrations of Total N and/or biogenic N. All of them are situated between the river km 1337 (Borovo) and km 1869 (Bratislava). The share of the biogenic N is usually below 20% of the total N. At the station Komarno/ Komarom (km 1768) the share is exceptional high: more than 40% of the total N stems from biogenic N.

3.4.2 Water quality classes of the Danube

The following river quality map published by (IAD, 2004) provides an overview on the state of the River Danube and all major tributaries in 2002. The text was adapted from that source. The classification of rivers into river quality classes is based on the contamination with organic pollutants that are biologically degradable by consuming oxygen (saprobic system). This quantification can't be used to characterize if a river is eutrophic or not.

The process of self-purification in a river-course does not occur in form of quality leaps, but in form of smooth transitions from one quality class to another. For this reason, the definition of the river-stretch where self-purification raises water quality from one class to the next better one is temporally and spatially ambiguous.

The River Danube is mostly moderately polluted (quality class II) in its upper part, but critically polluted (quality class II-III) further downstream. In the Lower Danube numerous tributaries are heavily polluted. Therefore, small stretches of the Danube are classified into quality class III.
In the Upper Danube (length 1000 km) anthropogenic inputs still cause biological quality class II-III in short stretches, above all at low natural discharge. Discharge in the Danube River rapidly increases through the large, moderately polluted alpine tributaries Iller, Lech, Isar and Inn. Therefore, water quality qualifies for class II except for short critically contaminated stretches downstream of Neu-Ulm, Kelheim and Regensburg. The tributaries Wörnitz and Altmühl, as well as the Main-Danube-Waterway are in quality class II-III.
The water quality shows that in Germany and Austria the desired restoration goal of quality class II has been mostly achieved through stringent and uniform minimum requirements for wastewater emissions. Just downstream of Vienna the water quality deteriorates locally to class II-III.
The quality of the transboundary River March (Austria-Slovakia) has been improved to quality class II-III.
The Middle Danube (length 900 km) has mostly quality class II until the contamination gets critical (class II-III) in the Hungarian Danube plains. Critically polluted tributaries, direct input of wastewater and increased primary production as a secondary source of organic carbon all contribute to this deterioration. Both discharge and quality of the River Danube are largely influenced by three main tributaries River Drava (class II), River Tisza (class II-III) and River Sava (class II)
In the River Tisza increased primary production enhanced by the plaintype catchment causes seasonal eutrophication similar to the River Danube.
Wastewater effluents of Beograd and the critically polluted tributaries Tamis and Velika Morava cause critical contamination till the reservoir of Iron Gate (quality class III and II-III, respectively).
The Lower Danube (beginning downstream of Iron Gate, length 900 km) receives large quantities of nearly untreated wastewater directly or via tributaries. However, high discharge and flow-velocity maintain high self-purification capacity of the River Danube, and class III (heavily polluted) occurs only locally. Along the river course moderate (class II) to critical (class II-III) pollution alternate locally depending on the input of wastewater.
In Bulgaria (right bank) and Romania (left bank) many tributaries are heavily to excessively polluted by local emissions from industrial and urban agglomerations. In particular, this concerns the Bulgarian tributaries Skut, Iskar, Vit, Osam, Yantra and Roussenski and the Romanian tributaries Olt, Arges, Jalomita and Siret. These contaminated waters show negative effects on short stretches over the full width of the River Danube. Also the lowest stretch of the River Danube, the three arms of the Danube Delta, is critically polluted (class II-III). In particular, the northern Kilia-branch is locally contaminated by effluents and tributaries from Ukraine (quality class III).


Water quality of the Danube and its tributaries 2002
IAD
Poland
Czech Republic
Ukraine
Germany
Slovakia
Moldova
Switzerland
Austria
Hungary
Slovenia
Romania
Italy
Croatia
Black Sea
Bosnia Herzegovina
Serbia and Montenegro
Mediterranean Sea
Bulgaria
Albania
Donau
Duna
Dunav
Dunarea
Tisza
Sava
Drava
Inn
Mur
Morava
Olt
Mures
Prut
Siret
scale 1 : 4 500 000
Catchment area
HUBER TECHNOLOGY
MAX BÖGL
River quality classes
I :Unpolluted to very slightly polluted (oligosaprobic)
River reaches with clean water,with oxygen permanently near saturation level and lownutrient load,low bacteria concentration; moderately dense colonization mainly by algae, mosses, flatworms, and insect larvae; water cool in summer-suitable for spawning of salmonids.
I - II :Slightly polluted (oligosaprobic to beta-mesosaprobic)
River reaches with lowinorganic nutrient inputs and without significant oxygen consumption; densely colonized with mostly high species diversity; water cool in summer- suitable for spawning of salmonids
II :Moderately polluted (beta-mesosaprobic)
River reaches with moderate polution and good oxygen supply; very high species diversity and abundance of algae,snails, entomostracans, insect larvae; aquatic plants may cover wide areas; high fish diversity.
II-III : Critically polluted (beta-mesosaprobic to alpha-mesosaprobic)
River reaches where loads of organic oxygen-depleting substances cause critical conditions;possible fishkills;decreasing number of macrophyte species; tendency to outbreaks of some plant and animal species.
III : Heavily polluted (alpha-mesosaprobic)
River reaches with heavy organic pollution; the usually low oxygen content is often insufficient for higher water organisms like fish,local sludge deposition; mass occurrences of sewage bacteria and ciliates, occasionally also sponges, leeches, and isopods; sparse aquatic vegetation.
III -IV : Very heavily polluted (alpha-mesosaprobic to polysaprobic)
River reaches with extremely restricted living conditions for higher life forms; the very high organic pollution often causes total oxygen depletion; turbidity due to suspended wastewater constituents, widespread sapropel deposits; densely colonized by chironomid larvae and oligochaetes.
IV : Excessively polluted (polysaprobic)
River reaches with excessive pollution by organic,oxygen depleting waste-water; bacteria, flagellates, and ciliates dwell on widespread sapropel banks; often total absence of oxygen, so that survival of higher life-forms is locally and temporarily limited.
Publisher: International Association for Danube Research, Vienna, 2004
Cartography: Workshop: supported by Ulrich Schwarz, Vienna supported by Bavarian State Ministery of the Environment, Public Health and Consumer Protection, Munich Fa. Huber Technologies, Berching Fa. Max Bögl, Sengenthal
Chairman: Dr. Gunther Seitz, District Government of Lower Bavaria Landshut
Printed by: Manz printing office and publishing house, Regensburg printed on non-chlorine bleached paper
More explanations overleaf
Wasserwirtschaftsamt Regensburg

3.4.2.1 First recommendations for the monitoring system for nutrient trading

A well-designed monitoring system and accurate data on nutrient loads in the river are prerequisites to quantify transport, retention and losses. Water quality monitoring strategies usually are designed to detect critical concentrations of substances in the river but not for monitoring total nutrient loads. The present monitoring of nutrient loads in the Danube River and its tributaries shows deficits.

The monitoring system has to be adapted to the purpose of the monitoring. The main objective of TNMN is a structured and well-balanced overall view of the situation and long-term development of quality and loads in terms of relevant constituents for the major rivers in the Danube River Basin. The international aspect of TNMN is of high importance. TNMN will be considerably influenced in the near future as a result of WFD implementation establishing specific requirements on monitoring of surface water status.

For improving nutrient load measurements in respect to nutrient trading the main questions are:

- Location
- which parameters have to be measured?
- which sampling time and frequency should be chosen, and
- how sampling should be performed in order to obtain representative samples under different conditions (e.g. especially high flow)?

A main item of interest in this context is to differentiate between that part of the particle-bound phosphorus in the rivers that is available for algal growth under certain conditions (and thus important for water quality) and that part of the particle-bound phosphorus that cannot not be mobilized (and thus negligible for water quality issues).

Furthermore floodplains, reservoirs and impounded river reaches can play an important role in nutrient retention and /or release (mobilization).

The current TNMN considers the following N and P-fractions: ortho-phosphate and total P, Ammonium, Nitrite, Nitrate, organic Nitrogen and Total Nitrogen. For Nitrogen probably the detection of the dissolved and the particulate organic (biogenic) N-fraction would be interesting in addition to the inorganic N-forms. The determination of Nitrite is of a negligible importance in regard to nutrient loads. However only a few stations provide total N and biogenic N up to now.

For P a change of the determinands is suggested: total P should be measured in the filtered and the unfiltered sample and not only in the total sample. The detection of ortho-phosphate shall be continued.

As the P-concentrations at the rising limb of storm hydrographs differs considerably from the concentrations in the receding limb a method has to be developed for a representative sampling during flood conditions. Up to now this method has not been developed in the daNUbs project. Especially the calculation of nutrient loads has to be adapted to the runoff situation (weighted averages according the frequency of the flow conditions).

Concerning the frequency a biweekly (eventually only in summer biweekly as biogenic activities influence the concentrations of the various fractions considerably) measurement is recommended for all determinands mentioned. High flood events are important at least for the upper part of the Danube and the Tributaries, but of lower importance for the Lower part of the Danube. Therefore, in addition to the regular TNMN for nutrient trading an event oriented sampling during flood events is suggested for the P-determinands.

3.5 Nutrient concentrations in the western Black Sea

Eutrophication is a phenomenon caused by the over-fertilisation of the sea by plant nutrients, usually compounds of nitrogen and phosphorus. The quality of water bodies affected by eutrophication gradually deteriorates and may result in the development of species with low nutritious value to larger animals including fish. It may also lead to severe oxygen depletion and hypoxia, where no animals can survive, and biological diversity is lost. It has a severe impact on the economy of human populations, amongst other things through fisheries and tourism loss. The Black Sea (i.e. the Black Sea proper plus the Sea of Azov) environment has been severely damaged by eutrophication since the 1970s. Evidence summarised in the present report shows how the structure of the ecosystem was damaged at every level, from plants to fish and mammals.

Romanian Black Sea coastal waters:
Constanta area is located about 130 km south of the Danube Delta and is subject to the permanent fresh water influence. In this respect, the values recorded at Constanta in the shallow waters near shore, reflected the Danube's nutrient load. However it has to be mentioned that this station probably was heavily influenced by the Navodari fertilizer plant. Navodari is located about 15 km north of Constanta. The plant was in operation between 1971 and 1997. Therefore Constanta does not reflect primarily the changes of the P discharge of the Danube.

The PO_4-concentration at Constanta station increased since 1970. Since 1990 the P-concentration decrease considerably (annual average below 2.0 µM (1µM P = 0.031g.m^{-3} P)). Nevertheless, phosphorus content of the coastal water at Constanta stays higher than 1960's period.

Total nitrogen presented relatively constant values ranging from 10 to 15 µM (1µM N = 0.014g.m^{-3} N), almost identical to the period 1980 - 1990. Referring to the three forms of inorganic nitrogen a slight increase of the nitrite and ammonia and a decrease of the nitrates is to be noticed. Data for period 1991 - 2000 indicated ammonia as the prevalent inorganic nitrogen form.

Table 11: The mean annual nutrient concentrations at Constanta in µM (1µM P = 0.031g.m^{-3} P; 1µM N = 0.014g.m^{-3} N))

	1959 - 1969	1970 - 1980	1981 - 1990	1991 - 2000
PO_4-P	0.28	5.59	5.91	1.86
NO_3-N			7.17	5.90
NO_2-N			0.79	1.32
NH_4-N			6.04	7.06

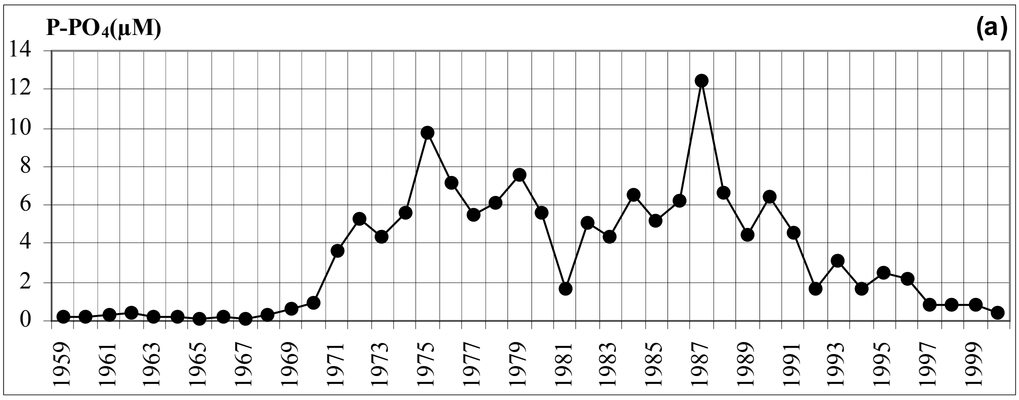


Fig. 33: P-PO$_4$ concentration at Constanta 1959 – 2000 [RMRI, 2002] (1µM P = 0.031g.m^{-3} P)

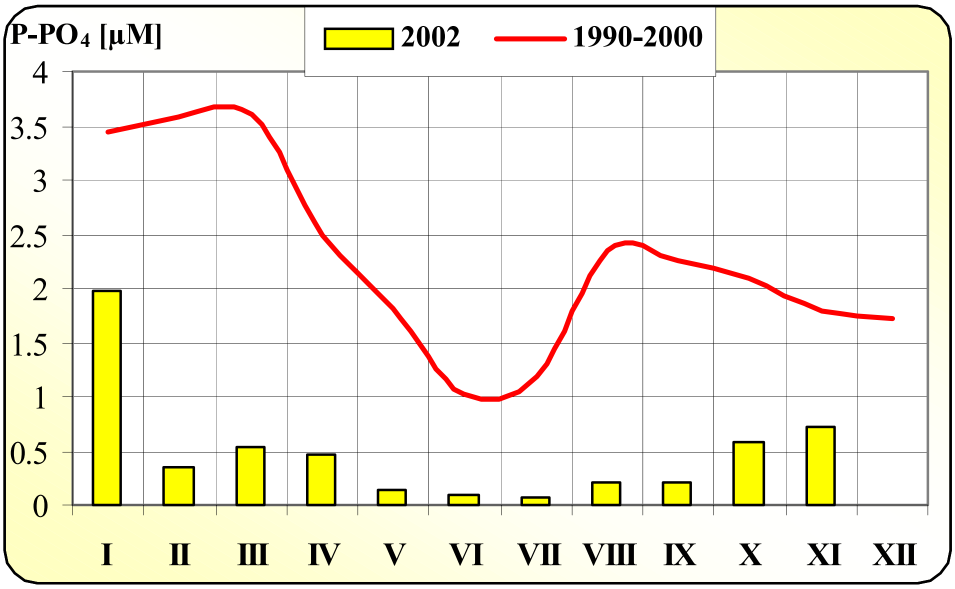


Fig. 34: Monthly averages of phosphates (µM) at Constanta station (1µM P = 0.031g.m^{-3} P) [RMRI, 2003]

In contrast to Phosphate no decrease of the totalN-concentration in the marine water at Constanta can be observed in the last two decades. Notably the total N concentrations were higher until the end of the seventies.

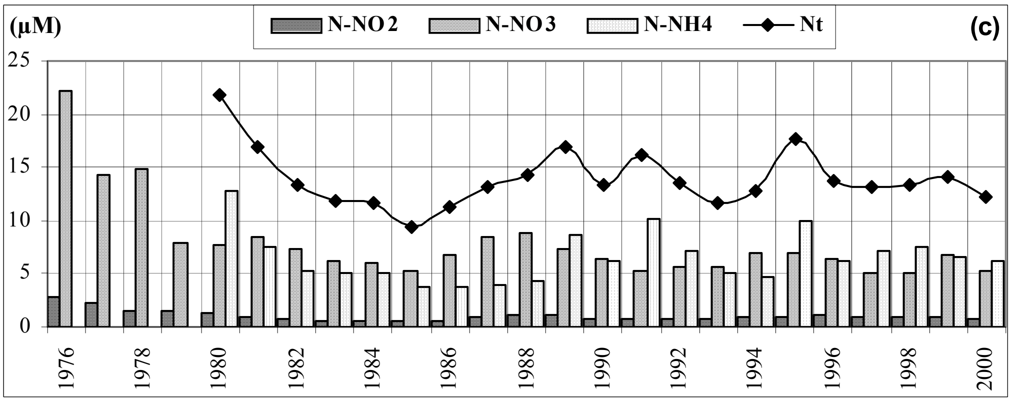


Fig. 35: Evolution of nutrients concentration in sea water at Constanta station [RMRI, 2002]

The nitrate concentration in 2002 are a little bit higher compared to the average in the 90ies. Probably this was caused by the relatively high discharge of the Danube in 2002 (213.6 km^3).

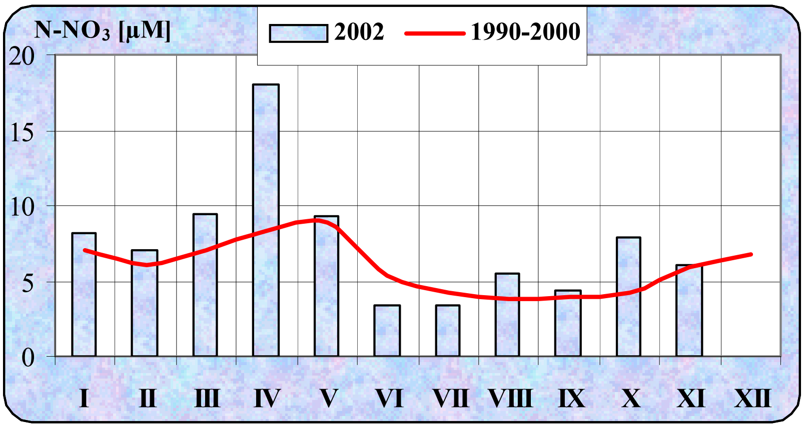


Fig. 36: Monthly averages of nitrates (µM) at Constanta station (1µM N = 0.014g.m^{-3} N) [RMRI, 2003]

Compared to the situation around 1990 Phosphorus loads transported by Danube have decreased to about 50 %.

Bulgarian Black Sea coastal waters:
The concentrations of $N\text{-}NO_2$ and $N\text{-}NO_3$ are maximal in winter-spring and then gradually decrease during summer, showing minimum in July-September. The latter is a consequence both of the intensive production of phytoplankton and decrease in riverine nutrient discharges. The average summer concentration of $N\text{-}NO_2$ is 0.04-0.06 µg/l and of $N\text{-}NO_3$ - 13-26 µg/l. In the late 1990-s very low summer values or even complete absence of inorganic nitrogen in the Bulgarian Black Sea was observed [Velikova, 2003].

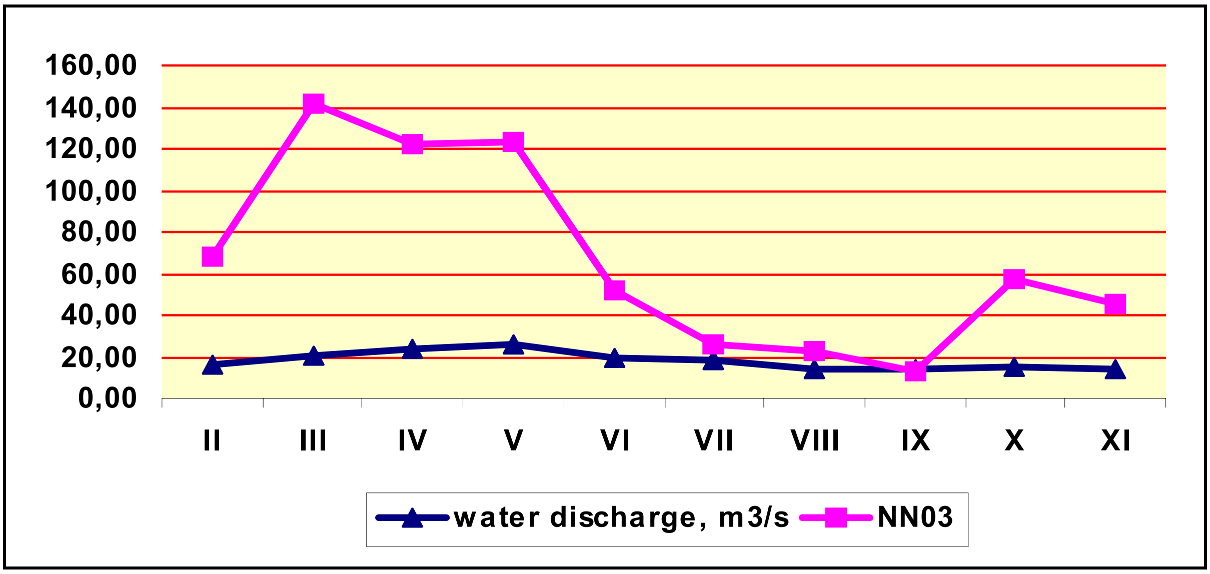


Fig. 37:Seasonal dynamics of Danube runoff (m^3/s) and $N\text{-}NO_3$ (µg/l) in the surface Black Sea waters along the Bulgarian coast (Cape Galata – 3 miles offshore) in the period 1995-2000 [Velikova, 2003].

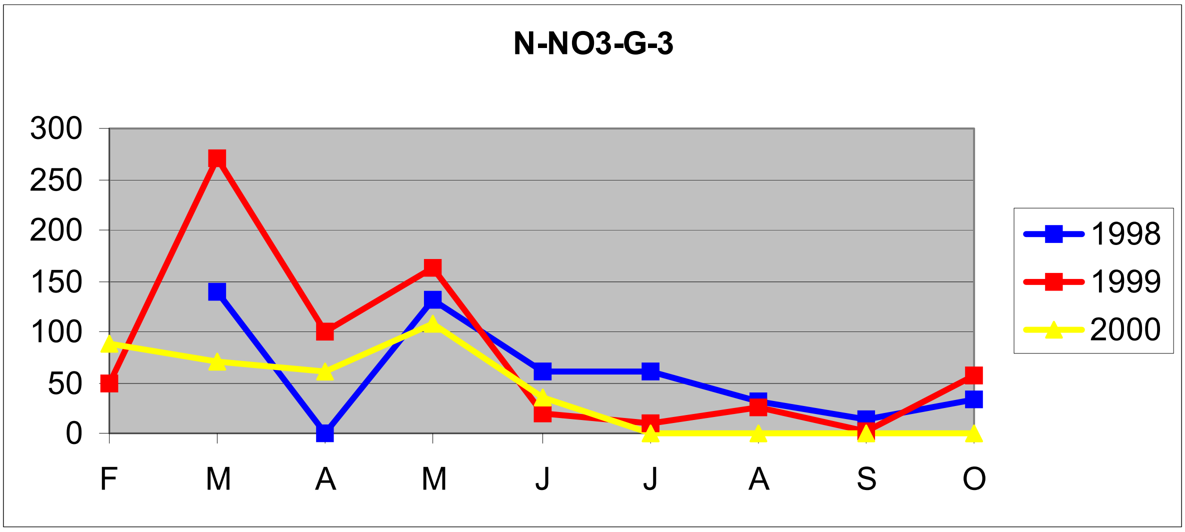


Fig. 38: Seasonal dynamics of N-NO3 (µg/l) in front of the Cape Galata – 3 miles offshore in 1998, 1999 and 2000 [Velikova, 2003]

In 2001 the nitrate concentration at Cape Galata was extremely low (in the period June-November – 5.3-9.5 µg/l)

3.5.1 Impact of high N and P discharges on the Black Sea Ecosystem

Eutrophication may be described as pollution resulting from an excess of nitrates and phosphates that leads to disturbances of the ecosystem such as a shift in the natural species composition or oxygen deficiency near the bottom.

OSPAR definition in 1998: "'Eutrophication' means the enrichment of water by nutrients causing an accelerated growth of algae and higher forms of plant life to produce an undesirable effects resulting from anthropogenic enrichment by nutrients".

Numerous developments have been made to derive eutrophication indicators and indices. However, these indices are either region-specific (biotic criteria) or incomplete (physical sensitivity) and all are geographically restricted (i.e. applied at the scale of a bay or an estuary) due to the necessary input of in situ measurements at the appropriate frequency. Hence, there is a need for the harmonization of criteria and indices in view of a comparison of the status and trends of eutrophication.

The natural Black Sea phytoplankton annual cycle shows spring and autumn maxima. Algal blooms (bloom: > $5*10^6$ cells/l) were registered also before the 50ies of the last century, therefore blooms are natural, however the number of blooms was much lower.

The natural cycle was dominated by blooms of diatom species. Diatoms require unlike other algae large amounts of dissolved Silica which forms the rigid algal cell walls (frustule) accounting up to half of the cells dry weight.

The favourable composition of the marine waters for phytoplankton is expressed by the Redfield ratio (atomic ratios P:N:C = 1:15:105). This ratio was modified slightly by [Richards, 1958] and Silica was added to these ratios: P:Si:N:O = 1:16:16:270.

As can be seen below until 1971 the Si : P ratio at Constanta was above 16:1 which is favourable for Diatoms, but since 1972 the marine water at least at Constanta is Si-limited for Diatoms. With the introduction of mineral fertilizers, the development of sewer systems and P-containing detergents new nutrient sources rich in N and P but poor in Si have been introduced changing the proportions of these three nutrients. Since that time up to the end of the nineties there was a surplus of N and P in respect to the Si. This nutrient surplus was used from non-diatoms causing blooms also in summer time. Light became the factor controlling primary production.

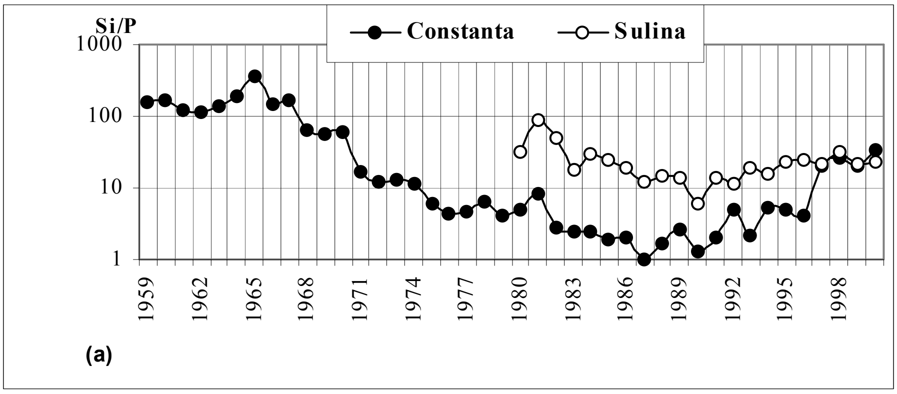


Fig. 39: Si/P ratio at Constanta [RMRI, 2002]

N-measurements at Constanta are available since 1980. According these measurements N is limiting for the growth of diatoms since the middle of the 80ies until 1995 - this explains that the Si-concentration remains quite stable between the mid 80ies and the mid 90ies. As no N-data is available before 1980 and lower discharges of N via the Danube have to be anticipated a N-limitation before this time seems probable.

The natural cycle (spring and autumn maxima) has been replaced by a pattern characteristic of eutrophied waters with several exceptional maxima, the summer one being the highest [Aubrey et al. 1996]. [Cociasu et al. 1996] investigated algal blooms between 1960-1970 and 1980-1990 clearly showing that that the number of blooms and the cell density of the blooms have increased: In the period 1960 to 1970 12 blooms of only 4 species (Skeletonema costatum, Nitzschia delicatissima, Leptocylindrus danicus, Prorocentrum cordatum)) were recorded with a cell density of 6 - 51 $*10^6$ cells/l. In the period 1980-1990 42 blooms with cell densities from 5-1000 $*10^6$ cells/l of 15 species were recorded.

Since the breakdown of the communism in the Danube riparian states the ecological situation of the Black Sea has improved. Since 1995 decreasing tendency of phytoplankton biomass and density was observed in coastal and open sea waters of the Bulgarian Black Sea.

The improvement of the marine ecosystem with reduced Danube nutrient loads can be recognised when observing the near bottom oxygen development during the last 20 years. During the mid eighties, extensive areas with anoxic conditions were observed in the bottom layers of the North Western Black Sea shallow waters [Zaitsev and Mamaev, 1997]. By the end of the nineties almost no anoxic conditions were observed in this region which has been regularly investigated by the Romanian monitoring program.

Recent SeaWiFS data (Sea-viewing Wide Field-of-view Sensor) in comparison to estimated regions of intensive and moderate phytoplankton blooms in the 1980s [Zaitsev and Mamaev, 1997], indicate a significant reduction of the area where extensive phytoplankton blooms occur.

Throughout the period 2001-2002 the level of algal biomass remained especially low in comparison with previous years of observation [Velikova, Petrova, 2004].

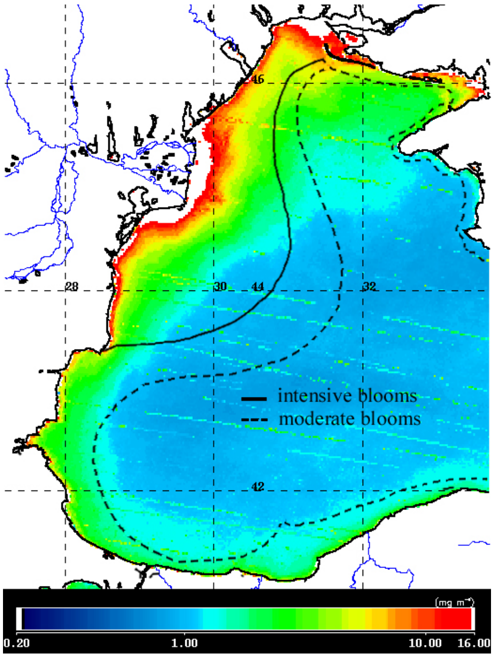


Fig. 40: Recent Chlorophyll a concentrations in the Western Black Sea [[Zaitsev and Mamaev, 1997, Horstmann, 2004]]

The significant increase of macrobenthic organisms from 22 to 38 species in the Romanian waters off the Danube delta show a considerable improvement of the benthic ecosystem during the last 5 years [Domitrake, 2003].

In a period of only three decades, the Black Sea has suffered the catastrophic degradation of a major part of its natural resources. Increased loads of nutrients from rivers caused an overproduction of tiny phytoplankton which in turn blocked the light reaching the sea grasses and algae, essential components of the sensitive ecosystem of the north-western shelf. The entire ecosystem began to collapse. This problem, coupled with pollution and exploitation of fish stocks, started a sharp decline in fisheries resources. To make matters worse, in the mid 1980s, a jellyfish-like species *(Mnemiopsis leidyi)*, which was accidentally introduced to the Black Sea from the eastern seaboard of America in the ballast water of a ship, invaded the Black Sea. Its diet included fish larvae and the tiny animals small fish feed upon. It quickly reached a total mass of 900 million tons. In 1997, Beroe ovata another comb jelly and one of Mnemiopsis's predators established in the Black Sea either by migrating naturally from the Mediterranean or possibly in ship's ballast water again. Initial occupation of coastal areas spread rapidly and by 1999 Beroe populations in the entire northeast region of the Black Sea.

3.5.1.1 Critical loads

Besides the positive effects of reduced eutrophication in the Black Sea, there is still the severe demand for a regeneration of the pelagic food web. Up to now the gelatinous zooplankton and predominately the Medusa Aurelia aurita as well as the Ctenophore Mnemiopsis leydii are determine the predation of meso-zooplankton including fish eggs and larvae and do not allow fish stocks to recover.

For Phosphorus it can be concluded that the current P-emissions ensure a stabilisation of the Western Black Sea.

Still investigation is needed if (i) even higher P-loads as now could ensure ecological stability in the WBS and (ii) if the current N-emissions are to high to ensure ecological stability in the WBS.

4 Current state of Waste water treatment

Inadequate management of municipal waste water has been identified as one of the core problems in the Danube River Basin. This is due to the improper collection of waste water (only 46% of households in the middle and lower Danube regions are connected to central sewerage systems), discharge of 31% of municipal waste water without previous treatment, insufficient capacities of treatment facilities, improper operator performance at treatment facilities and inadequate control of individual waste water treatment (septic tanks).
In the whole Danube Basin 56 % of the population is connected to a sewer system and to waste water treatment.
Detailed information on the current state of waste water treatment in the Danubian Countries is provided by the "National Reviews" of the "Transboundary Analysis" within the "Danube Pollution Reduction Programme" carried out by UNDP/GEF and more recent in „Municipal and Industrial Discharges in the Danube River Basin by Countries" of the Emission Inventory 2000 issued by the Emissions Expert Group of the ICPDR.

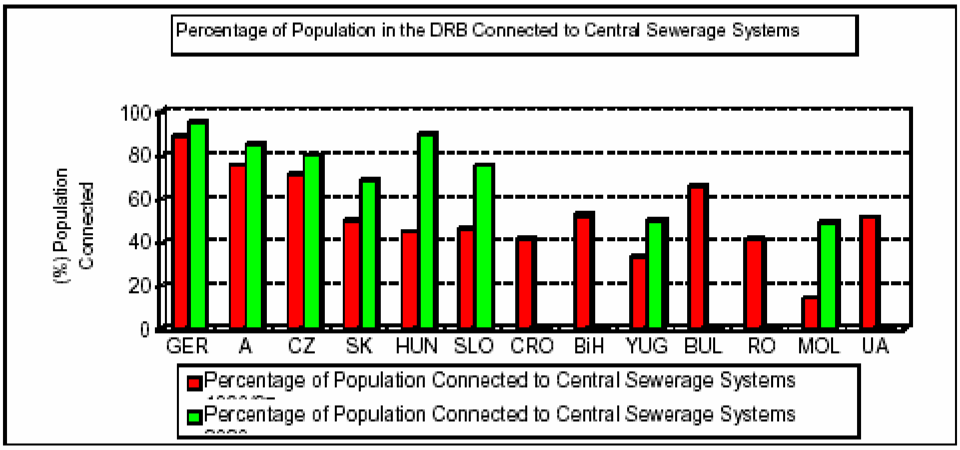


Fig. 41: Percentage of Population in the DRB Connected to Central Sewerage Systems 1996/1997 (red) and 2020 (green) (UNDP-GEF, 1999)

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Table 12: national P- and N-emissions in the Danube Basin 1998-2000 [based on Schreiber et al. 2003]

tP/a	background		point sources		agriculture		others		**total**
	t /a	% of total	t /a	% of total	t /a	% of total	t /a	% of total	**t/a**
Austria	1738	24,4	2108	29,6	2825	39,6	455	6,4	**7126**
Germany	580	12,2	1113	23,4	2606	54,8	460	9,7	**4759**
Bulgaria	233	4,5	2101	40,3	2150	41,2	730	14,0	**5214**
Croatia	351	10,2	1086	31,4	1600	46,3	417	12,1	**3454**
Czech Republic	57	2,7	580	27,5	1240	58,7	235	11,1	**2112**
Hungary	151	2,2	2994	42,8	2036	29,1	1810	25,9	**6991**
Moldova	11	1,3	165	20,0	567	68,6	84	10,2	**827**
Romania	1190	7,4	4462	27,9	8003	50,0	2352	14,7	**16007**
Slovakia	215	5,4	1140	28,4	2129	53,1	528	13,2	**4012**
Slovenia	226	11,1	819	40,4	638	31,4	346	17,1	**2029**
Ukraine	308	12,7	480	19,8	1420	58,5	221	9,1	**2429**
Bosnia & Herzegovina	236	7,2	1432	43,4	1186	36,0	443	13,4	**3297**
Serbia&Montenegro*	387	4,2	5518	59,3	2364	25,4	1042	11,2	**9311**
DB	5683	8,4	23998	35,5	28764	42,6	9123	13,5	**67568**

tN	background		point sources		agriculture		others		**total**
	t /a	% of total	t /a	% of total	t /a	% of total	t /a	% of total	**t/a**
Austria	30110	37,4	16054	19,9	29810	37,0	4626	5,7	**80600**
Germany	19430	17,2	12782	11,3	76430	67,8	4158	3,7	**112800**
Bulgaria	9840	22,0	9417	21,0	19320	43,1	6223	13,9	**44800**
Croatia	10960	42,8	3613	14,1	8110	31,7	2907	11,4	**25590**
Czech Republic	3190	11,6	5502	20,0	16960	61,6	1878	6,8	**27530**
Hungary	4080	9,0	15932	35,2	11380	25,2	13818	30,6	**45210**
Moldova	250	5,8	794	18,3	2470	57,0	816	18,8	**4330**
Romania	37480	22,9	30780	18,8	73240	44,8	22030	13,5	**163530**
Slovakia	8660	21,6	9206	22,9	17780	44,3	4524	11,3	**40170**
Slovenia	6340	26,5	4157	17,4	10800	45,2	2583	10,8	**23880**
Ukraine	9750	33,4	1828	6,3	15210	52,1	2432	8,3	**29220**
Bosnia & Herzegovina	7620	23,7	4157	12,9	15540	48,3	4883	15,2	**32200**
Serbia&Montenegro*	14330	25,7	20216	36,3	12490	22,4	8634	15,5	**55670**
DB	162040	23,6	134438	19,6	309540	45,2	79512	11,6	**685530**

Table 13: Nitrogen emissions via various pathways, their contributions to the total emissions for the Danube and the parts of the countries within the Danube river basin for the period 1998-2000 [Schreiber et al. 2003].

		DE	AT	CZ	SK	HU	SI	HR	BH	YU	RO	BG	UK	MD	Rest	Danube
Groundwater	[t/a]	80540	31870	10050	16650	5580	14280	17010	14740	18720	73250	22910	300	18580	310	324780
	[%]	71.4	39.5	36.5	41.4	12.3	59.8	59.3	57.6	33.6	44.8	51.1	6.9	63.6	16.1	47.2
Tile drainage	[t/a]	7510	3370	8060	6090	5820	810	0	690	2710	22390	2450	1490	2070	10	66970
	[%]	6.7	4.2	29.3	15.2	12.9	3.4	0.0	2.7	4.9	13.7	5.5	34.4	7.1	0.5	9.7
Erosion	[t/a]	1870	2880	1540	2200	1840	540	1180	1870	2830	7340	2040	820	1440	130	28520
	[%]	1.7	3.6	5.6	5.5	4.1	2.3	4.1	7.3	5.1	4.5	4.6	18.9	4.9	6.8	4.1
Surface runoff	[t/a]	4620	20750	220	1030	150	1350	1090	1560	1540	5420	1150	0	2230	1360	42480
	[%]	4.1	25.7	0.8	2.6	0.3	5.7	3.8	6.1	2.8	3.3	2.6	0.0	7.6	70.8	6.2
Atmospheric deposition	[t/a]	2310	1830	500	820	3630	280	660	370	1790	4070	1070	190	1130	50	18680
	[%]	2.0	2.3	1.8	2.0	8.0	1.2	2.3	1.4	3.2	2.5	2.4	4.4	3.9	2.6	2.7
Urban areas	[t/a]	3170	3850	1660	4170	12260	2460	2390	2750	7860	20280	5760	740	1940	40	69320
	[%]	2.8	4.8	6.0	10.4	27.1	10.3	8.3	10.7	14.1	12.4	12.9	17.1	6.6	2.1	10.1
Sum diffuse sources	**[t/a]**	100020	64550	22030	30960	29280	19720	22330	21980	35450	132750	35380	3540	27390	1900	550750
	[%]	88.7	80.1	80.0	77.1	64.8	82.6	77.8	85.9	63.7	81.2	79.0	81.8	93.7	99.0	80.1
Background	[t/a]	19430	30110	3190	8660	4080	6340	7620	10960	14330	37480	9840	250	9750	1380	163430
	[%]	17.2	37.4	11.6	21.6	9.0	26.5	26.6	42.8	25.7	22.9	22.0	5.8	33.4	71.9	23.8
Agricultural diffus sources	[t/a]	76500	29860	16980	17800	11490	10810	12060	8120	12540	73370	19350	2470	15250	460	310550
	[%]	67.8	37.0	61.7	44.3	25.4	45.3	42.0	31.7	22.5	44.9	43.2	57.0	52.2	24.0	45.2
Sum of point sources	**[t/a]**	12780	16050	5500	9210	15930	4160	6370	3610	20220	30780	9420	790	1830	20	136670
	[%]	11.3	19.9	20.0	22.9	35.2	17.4	22.2	14.1	36.3	18.8	21.0	18.2	6.3	1.0	19.9
Sum of all sources	**[t/a]**	112800	80600	27530	40170	45210	23880	28700	25590	55670	163530	44800	4330	29220	1920	687420
	[%]	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Attention: the Columns MD and UA are interchanged!

Table 14: Phosphorus emissions via various pathways, their contributions to the total emissions for the Danube and the parts of the countries within the Danube river basin for the period 1998-2000 [Schreiber et al. 2003].

		DE	AT	CZ	SK	HU	SI	HR	BH	YU	RO	BG	UK	MD	Rest	Danube
Groundwater	[t/a]	611	458	56	202	315	193	243	304	375	1119	222	19	331	6	4455
	[%]	12,8	6,4	2,7	5,0	4,5	9,5	7,4	8,8	4,0	7,0	4,3	2,3	13,6	2,8	6,6
Tile drainage	[t/a]	30	17	23	44	50	4	0	9	32	137	16	8	17	0	407
	[%]	0,6	0,2	1,1	1,1	0,7	0,2	0,0	0,3	0,3	0,9	0,3	1,0	0,7	0,0	0,6
Erosion	[t/a]	1935	3256	1177	1925	1776	475	905	1375	2138	7016	1899	551	1005	164	25597
	[%]	40,7	45,7	55,7	48,0	25,4	23,4	27,6	39,8	23,0	43,8	36,4	66,6	41,4	77,0	37,8
Surface runoff	[t/a]	610	832	41	173	46	192	254	263	206	921	246	0	375	35	4194
	[%]	12,8	11,7	1,9	4,3	0,7	9,5	7,8	7,6	2,2	5,8	4,7	0,0	15,4	16,4	6,2
Atmospheric deposi-tion	[t/a]	38	43	12	23	121	7	22	15	69	163	41	7	42	1	604
	[%]	0,8	0,6	0,6	0,6	1,7	0,3	0,7	0,4	0,7	1,0	0,8	0,8	1,7	0,5	0,9
Urban areas	[t/a]	422	412	223	505	1689	339	421	402	968	2189	691	77	179	5	8522
	[%]	8,9	5,8	10,6	12,6	24,2	16,7	12,8	11,6	10,4	13,7	13,3	9,3	7,4	2,3	12,6
Sum diffuse sour-ces	**[t/a]**	3646	5018	1532	2872	3997	1210	1845	2368	3788	11545	3115	662	1949	211	43779
	[%]	76,6	70,4	72,5	71,6	57,2	59,6	56,3	68,6	40,7	72,1	59,7	80,0	80,2	99,1	64,6
Background	[t/a]	580	1738	57	215	151	226	236	351	387	1190	233	11	308	165	5848
	[%]	12,2	24,4	2,7	5,4	2,2	11,1	7,2	10,2	4,2	7,4	4,5	1,3	12,7	77,5	8,6
Agricultural diffus sources	[t/a]	2606	2825	1240	2129	2036	638	1166	1600	2364	8003	2150	567	1420	40	28805
	[%]	54,8	39,6	58,7	53,1	29,1	31,4	35,6	46,3	25,4	50,0	41,2	68,6	58,5	18,8	42,5
Sum of point sources	**[t/a]**	1113	2108	580	1140	2994	819	1432	1086	5523	4462	2099	165	480	2	24004
	[%]	23,4	29,6	27,5	28,4	42,8	40,4	43,7	31,4	59,3	27,9	40,3	20,0	19,8	0,9	35,4
Sum of all sources	**[t/a]**	4759	7126	2112	4012	6991	2029	3277	3454	9311	16007	5214	827	2429	213	67783
	[%]	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0

Attention: the Columns MD and UA are interchanged!

APPENDIX 2

Legal and Regulatory Framework Review Report

NIRAS

Consulting Engineers
and Planners A/S

UNOPS United Nations Office of Project Services

RER/01/G32 - Danube Regional Project (Output 4.4)

DANUBE STUDY ON POLLUTION TRADING AND CORRESPONDING ECONOMIC INSTRUMENTS FOR NUTRIENT REDUCTION

Review of the Legal and Regulatory Framework for pollution trading in the Danube River Basin

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May 2004

UNOPS United Nations Office of Project Services

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DANUBE STUDY ON POLLUTION TRADING AND CORRESPONDING ECONOMIC INSTRUMENTS FOR NUTRIENT REDUCTION

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May 2004

No.	Revision	Date	Prepared	Checked	Approved
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List of Content :

Excecutive Summary

The review of the regulatory framework for nutrients trading in the Danube includes:

- A description of the legal features and mechanisms of pollution trading systems in order to identify elements that need particular attention in relation to the DRB specific conditions;
- Assessment of international and EU water legislation, and the Danube Convention within witch a potential nutrients trading system in the DRB should be established
- Description of the design and expected results of national assessments of the framework regulating the protection of the aquatic environment

Chapter 2 outlines the main regulatory elements of two existing water and air pollution trading systems by way of describing the features of the American Water Quality Trading Policy and the EC Scheme on Greenhouse Gas Allowance Trading (EU ETS). The just mentioned systems cover trading of certain pollutants or parameters between (legal) entities within defined trading areas, while the Kyoto mechanisms that are also briefly described cover trading of 1) Assigned Amount Units between states through international emissions trading, and 2) CO_2 credits through the project based Joint Implementation and Clean Development Mechanisms.

The main features of existing pollution trading systems are described and the issues that need particular attention in the DRB context are identified in sub-section 2.4. Distinction has to be made between cap & trade and credit trading mechanisms. The EU ETS is a cap & trade system, while the Kyoto JI mechanism is based on credit trading. (The review report on Existing Economic Instruments describes different American credit trading systems).

Credit trading mechanisms builds upon establishment of a relative baseline based on traditional technologies. (business as usual scenario at the national level). Also, individual baselines (business as usual scenario at entity level) need to be set for each user. Every user who does not reach the limit of emissions set for the entity can have the difference certified as *tradable credits.*

Cap & Trade mechanisms are based on establishment of a cap for emissions at state levels. The states allocate *allowances* to the relevant sector, which in turn allocate to relevant enterprises (ex ante allocation). *Trade of allowances* in the EU ETS scheme can take place across borders. Fine systems intend to ensure system compliance.

The nutrients pollution which leads to euthrofication of the North Western Black Sea (NWBS) is caused by emissions from both point and non point sources in the Danube countries. This circumstance from a regulatory point of view implies that the legal framework for regulation of point and non point sources causing nutrients pollution (N/P) should be assessed. Approximately 35% of the phosphorus emissions (as identified by component 1 of the Pollution Trading Study) that contribute to the euthrofication of the NWBS originate from point sources. The possibility of establishing a trading mechanism at national levels for this in theory 'easy tradable pollution' should be tested in context of the EU ETS in the feasibility phase of the Pollution Trading Study.

Viewed in a regulatory perspective a cap & trade system includes the following elements of importance

- A Celing Value (the total amount of emissions that could be emitted throughout the trading area within a certain time period – to be based on inventory of nitrogen and phosphorus emissions in the Danube countries and agreed quality goals)

- Total emission amounts allowed for a certain time period should be distributed among participating countries, subsequently followed by sector wise/entity based allocation of emission rights at national levels (the perspective of burden sharing)

- Trading Permit/allowance system should be established by considering a) the trading area, b) the pollutants and parameters to be traded, c) the units of trade, d) quantification of trading permits/allowances, e) mechanism for determining and ensuring compliance control

Chapter 3 of the review describes the existing regulatory framework for the protection of the aquatic environment in the Danube Countries within which trading mechanism in the DRB should be introduced. The existing regulatory framework for pollution trading is constituted by interplay of international and EU water legislation as well as multilateral co-operation agreements and national legislation in the DRB countries.

Policies and legislation at the different regulatory levels are described in sub- sections 3.1 – 3.5 in order to identify features of the already existing regulatory systems that may facilitate or constitute barriers to the introduction of nutrients trading in the DRB.

At the international level the *Convention on the protection and use of transboundary water courses and international lakes* and the *Danube River Protection Convention* set the overall framework for agreements on water pollution trading. The mentioned Conventions could possibly embed trade related provisions as well as a supranational body could be empowered to handle nutrients trading in the DRB. It should however be noticed that only states are parties to international agreements, implying that only states and not legal entities can commit themselves to trading through international agreements. Cross border allowance trading, thus, can only take place within the convention based framework, if facilitated through state to state trading.

Inasmuch as it has been agreed that the Danube/Black Sea co-operation should build upon the principles of the *EU Water Framework Directive* the principles of the concept of EU integrated water management is described emphasising the functions of various EU Directives having importance to establishment of pollution trading. The EU Directives which are in focus are: The Water Framework Directive, the *IPPC Directive, the Urban Waste Water Directive and the Nitrates Directive*. The whole complex of EU legislation that relate to the agricultural reform or the EU will of course heavily influence the agricultural practices in the EU Member States, which makes it of high relevance to the evaluation of trading possibilities relating to non point source pollution.

It is emphasised that a number of EU law principles may constitute barriers to pollution trading, since pollution trading may include elements of state aid, unfair competition and discrimination. Especially requirements on use of Best Available Technology (BAT) may create obstacles in the establishment of trading systems. The implications of the BAT issue should be addressed in the feasibility phase – e.g. by addressing the transitional periods and the practical aspects of establishment of compliance with the EU and other legislation.

Chapter 4 concerns the design and expected outputs of studies that are being carried out at national levels in the Danube countries. The studies intend to disclose to which extent the countries in the DRB have implemented their international and EU commitments in the field of protection of the aquatic environment of the Danube. The overall assessments of national legislation address the regulation of point as well as non point source pollution in the Danube countries. The findings should help in answering the question of to which extent the Danube countries are prepared to participate in pollution trading in terms of appropriateness of existing institutional and infrastructural capacity.

1. POLLUTION TRADING IN THE DANUBE RIVER BASIN – REVIEW OF THE LEGAL/REGULATORY FRAMEWORK

The main aim of the pollution trading study is to assess the viability and feasibility of 'pollution trading' in the DRB countries and on alternative economic concepts for pollution control.

The activities of the study include: 1) Review of concepts of successful 'pollutant trading/auctions', 2) Study of the principle possibilities of 'pollution trading' and corresponding economic instruments for nutrient reduction taking into account EC policies and Directives in the Danube River Basin, 3) Assessment of main problems/obstacles for pollution trading in the DRB and the interest of the particular DRB countries, 4) Presentation of basic findings on a DRB wide workshop.

The study includes four components on: A) Nutrients Framework, B) Legal and Regulatory Framework C) Economic Instruments, D) Completion workshop

The activities carried out under project component B should contribute to the fulfilment of each of the just mentioned overall project activities. In accordance with Terms of Reference as stipulated in the Inception Report of January 2004 Component B includes 3 outputs and corresponding activities.[1]

- Output B.1: Review of the Legal and Regulatory Framework (international and EU level)
- Output B.2: Gap and Feasibility Assessment at National Levels
- Output B.3: Conclusions and Recommendations

The present review report addresses the issues and activities involved in the production of Output B.1 and partly Output B.2 by :

- Describing the legal features and mechanisms of pollution trading systems in order to identify elements that need particular attention in relation to the DRB specific conditions;

[1] Cf. Annex A to the present report.

- Assessing international and EU water legislation, and the Danube Convention within witch a potential nutrients trading system in the DRB should be established
- Describing the design and expected results of national gaps and feasibility assessments. (Activities related to Output B2.)

1.1 Legal/Regulatory Review – Approach for Assessment

The development of an integrated water management system in the DRB builds upon the use of a wide range of tools or means of regulation as e.g. water quality standards, emission norms, monitoring and technical norms, designation of nitrates vulnerable zones, exchange of information and co-operation requirements.

The establishment of a nutrients trading system/mechanism in the DRB could be viewed as a new market based mechanism. The trading mechanism or instrument together with the already established regulation regimes should contribute to the achievement of the overall environmental goals for the aquatic environment of the DRB and the Black Sea. The latter especially in the North Western part of the sea suffers from eutrofication due to high nutrients loads.

In section 2.1 and 2.2 of this review report the legal features of different pollution trading systems are described in order to identify elements that need particular attention in context of DRB specific conditions.

The disclosure of the existing regulatory context that are presented in sub-sections 3.1-3.4 intends to provide the basis for evaluation of nutrients trading as a regulatory mechanism supplementary to already existing regulation in the DRB.

The existing regulatory context is constituted by interplay of international and EU legislation as well as multilateral co-operation agreements and national legislation in the DRB countries. The descriptions and analyses outlined in sub-sections 3.1-3.4 provide the basis for development of the generic framework that should be used for assessment of national regulatory contexts. The design and the expected outputs of the national studies are presented in sub-section 4.2.

The activities related to the just described assessment of the overall regulatory framework for pollution trading in the DRB are cross cutting in the sense that they as already mentioned should contribute to the fulfilment of all the above described overall project activities. Furthermore the activities need to be interdisciplinary approached, since the interpretation of the existing and legislative and regulatory frameworks should take into consideration the findings of project components A and C.

*the term regulatory system/regulatory context covers systems which are institutionalised through policies and legislation.

2. POLICIES AND LEGISLATION - FEATURES OF POLLUTION TRADING SYSTEMS

Experience with trading of different pollution/emissions rights exists in more parts of the world – e.g. in the US, Australia, Canada, Japan and Europe.

This sub-section of the legal/regulatory review intends to disclose the main regulatory elements of two existing water and air pollution trading system by outlining the features of the American Water Quality Trading Policy and the EC Scheme on Greenhouse Gas Allowance Trading. The just mentioned systems cover trading of certain pollutants or parameters between (legal) entities within defined trading areas, while the Kyoto mechanisms that are also briefly described cover trading of CO_2 credits between states through international emissions trading and the project based Joint Implementation and Clean Development Mechanisms.

From a regulatory point of view the establishment of an overview of the main features of existing pollution trading system provides the basis for identifying particular issues that need special attention in the DRB context. Furthermore an outline of generic elements of pollution trading systems is needed in order to identify elements of already existing regulation regimes and legal systems that may facilitate or establish barriers to nutrients trading in the DRB.

2.1 Water Quality Trading Policy – the American Experience

A Water Quality Trading Policy was launched by the U.S. Environmental Protection Agency (EPA) in January 2003.

The trading policy which includes a number of trading objectives and policy statements should be made operational within the framework of the Clean Water Act (CWA) from 1972. The purpose of the Federal policy is to encourage states, interstate agencies and others to develop and implement (voluntary) water quality trading programmes for nutrients, sediments and other pollutants where opportunities exist to achieve water quality improvements at reduced costs.

In order to establish a setting for the development of credible state trading programmes the Federal water quality trading policy defines a number of objectives that relate to both environmental and economical parameters. Furthermore the policy statement outlines the elements that must be taken into consideration when establishing water quality or other market based programmes.

First of all trading areas and the pollutants and parameters to be traded should be identified and a baseline for water quality trading established. *Secondly* the situations where trading may occur should be considered, and *thirdly* the developed water trading quality regulation/provisions should be aligned with other regulatory mechanism under the CWA.

The American water quality trading policy, which is developed on the basis of pilot programmes covering e.g. trading of nutrients within watersheds, is of course not directly applicable to the DRB conditions and regulatory context. It should however be noticed that the U.S. EPA emphasises that the following elements should be included as general elements in credible and successful water quality trading programs:

1. Clear legal authority and mechanisms are necessary for trading to occur. In the U.S. system the Clean Air Act provides the legal framework for the development of programmes and activities to control water pollution, including trading programmes. The CWA and federal regulations provide authority to incorporate provisions in permits issued to point sources and for trading under total maximum daily loads programmes (TMDL).[2]

The EPA mentions that provisions for trading may be established through various mechanisms including: legislation, rule making, incorporating provisions for trading in permits and establishing provisions for trading in TMDL plans or watershed plans. Provisions may in-corporate or be supplemented by private contracts between sources or third-party contracts.

2. Clearly defined units of trade are necessary for trade to occur. Pollutant specific credits are examples of tradable units for water quality trading. These may be expressed in rates or mass per unit time as appropriate to be consistent with time periods that are used to determine compliance with permit limitations.

[2] Nitrogen trading among publicly owned treatment works in Connecticut – www.epa.gov/owow/watershed/finalpolicy

3. Creation and Duration of credits – credits should be generated before or during the same period they are used to comply with a monthly, seasonal or annual limitation specified in a permit. Credits may be generated as long as the pollution controls or management practices are functioning as expected.

4. Quantifying Credits and addressing uncertainty – standardized protocols are necessary to quantify pollutant loads, load reductions and credits. Procedures should be to account for generation and use of credits in permits and discharge monitoring reports in order to track the generation and use of credits between sources and assess compliance. Where trading involves non- point sources the greater un-certainty in estimates of non-point sources loads and reduction the U.S. EPA has supported a number of approaches to compensate for non-point source uncertainty.[3]

5. Mechanisms for determining and ensuring compliance and control are essential for all trades and trading programmes. This could include a combination of record keeping, monitoring, reporting and inspections. It should be determined who is responsible in case that the quantity of credits that are traded are not generated.

6. Public participation and access to information. Easy and timely public access to information is necessary for markets function efficiently and for the public to monitor trading. The EPA encourages to make electronically available to the public the information on the sources traded, the quantity of credits generated and used on a watershed basis etc.

7. Program Evaluations – Periodic assessments of environmental and economic effectiveness should be conducted and programme revisions made as needed.

In the following the features and elements of the EC Scheme for Greenhouse Gas Emissions Allowance trading is described, subsequently followed by a sub-section that compares air and water pollution trading as well as identifies issues that need particular attention in the DRB regulatory context.

2.2 The EC Scheme for Greenhouse Gas Emissions Allowance Trading (ETS)

The EC Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community places direct emissions of all Kyoto Pro-

[3] Trading ratios between non-point and point sources, using demonstrated performance values or conservative assumptions in estimating the effectiveness of non-point source management practice, using site or trade specific discount factors, and retiring a percentage of non-point source reduction for each transaction etc.

tocol's greenhouse gases from the specified sources within a Community regulatory framework.[4] This framework limits the emissions of the covered sectors and imposes sanctions, including financial penalties, for non-compliance.

EC Emissions trading allows individual companies to emit more than foreseen by any initial allocation it receives on condition that they can find another company that has emitted less than allowed and is willing to transfer its 'spare' allowances.

The rationale behind the Directive is due to the EC Commission that the achievement of a pre-determined environmental outcome takes place where the cost of reduction is lowest. The overall environmental outcome is the same as if both companies used their allowances exactly, but with the difference that both buying and selling companies benefit from the flexibility offered by trading

The EC Member States have agreed to redistribute their targets under the Kyoto Protocol in accordance with the Burden Sharing Agreement as contained in the Council Conclusions of June 1998. If companies trade allowances with other installations within the same Member State, there would be no change to the number o f tonnes that a MS can emit under the Burden Sharing Agreement. If a MS buys allowances from a company in another MS, then there will need to be a corresponding adjustment, recorded by national registries. The MS hosting the 'selling company' loses entitlement to emit the sold tonnes of CO_2, while the MS hosting the 'buyer company' is entitled to the extra tonnes that have been bought.

The EC emissions trading scheme for greenhouse gas emission allowance trading from 1 January 2005 is going to work within a regulatory framework consisting of the following elements:

- National Allocation plans (2005-2007) that set caps for total CO_2 emissions at country level and address the distribution of emission rights to legal entities. In order to decide upon the total quantity of allowances the MS need an inventory covering the total emissions from various sectors and installations/companies.
- Procedures for application for and issuing of gas permits – The ETS system builds upon a system of corresponding gas permits and allowances. The MS grant a greenhouse gas permit that sets an obligation to hold allowances equal to the actual emissions. The companies/legal entities covered by the scheme are outlined in annex to the Directive (approximately 10,000 steel factories, power plants, oil refineries, paper mills, and glass and cement installations. The Gas permitting system should be harmonised with the Integrated Pollution Prevention Control – IPPC Directive system.
- Procedures for monitoring, registration and reporting – the Directive contains basic principles for monitoring and reporting criteria. The Directive includes criteria on verification of emission report however it is up to the MS to decide

[4] Cf. Explanatory Memorandum of Directive Proposal COM(2001)581 final.

whether the verification is done their competent authorities or by an independent verifier. A recent Decision of the European Parliament and the Council establishes a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol. (Decision 280/2004/EC)

- Mechanism of trade and transfer of from entity to entity. The allowances are transferable while the permits itself is attached to a specific company/installation is attached to company or activity/site.
- Registry that provides the basis for accounting, allowance trading and imposing of penalties. The national registries should be linked in a community wide network. Allowances only exist in electronic form. Allowances will only be transferable by those holding accounts in national registries. Detailed rules on the functioning of national registries are expected to be undertaken by means of a separate Commission Regulation.

The period from 2005-2007 is a 'pilot' period – Only CO_2 can be traded. From the next commitment period from 2008-2012 trading with 6 different greenhouse gases are included in the scheme as well as the EC Commission before 2008 should specify a harmonised method off allocation

The EU scheme could be linked to trading schemes in other countries that have ratified the Kyoto protocol – see below sub-section 2.3.

2.3 The Kyoto Mechanisms – International Emissions Trading and Joint Implementation

The above described greenhouse gas emissions trading system is established by the EC and its Member States as a response to the international commitments that are agreed within the framework of the United Nations Framework Convention on Climate Change (UNFCC) and its related Kyoto Protocol and Marrakech Accords.

The Kyoto Protocol establishes three different mechanisms that could be used by the signatories in complying with their commitments under Article 3 of the Protocol. The Article 3 sets out that each party individually or jointly shall ensure that their aggregate anthropogenic CO2 equivalent emissions of the greenhouse gases[5] do not exceed their assigned amounts, calculated pursuant to their quantified emission limitation and reduction commitments.[6]

The Kyoto Protocol envisages three market-based 'flexible mechanisms': emissions trading, Joint Implementation and the Clean Development Mechanism. These are to allow industrialised countries to meet their targets through trading emission allowances between themselves and gaining credits for emission-curbing projects abroad.

[5] The GHG's are the following: Carbon dioxide (Co_2) , methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6)

[6] Each party and signatory to the UNFCCC and the Kyoto Protocol must reduce their overall emissions of GHG's by at least 5 per cent below 1990 levels in the commitment period 2008ø-2012.

- International Emissions Trading is trading of CO_2 credits between states. The Kyoto Protocol and the Marrakech Accords outline requirements as regards the institutional setting of the trading system that the states must comply with in order to participate in international emissions trading.[7]

- Joint Implementation refers to projects a project based mechanism including an investor company and a host company(ies)/legal entities (located in Eastern and Central European Countries) setting up a project which results in real, measurable and long-term climate change benefits.[8] CO_2 credits resulting from JI projects are transferred from host to investor country at state level, since only states can commit and oblige themselves in accordance with the international law principles that apply to international conventions and agreements.

- Clean Development Mechanism refers to projects in developing countries with no targets (Asian, Latin American and African countries).

The rationale behind these three mechanisms is that greenhouse gas emissions are a global problem and that the place where reductions are achieved is of less importance. In this way, reductions can be made where costs are lowest, at least in the initial phase of combating climate change.

2.3.1 *Converting JI Credits into EC Allowance Trading System*

Building on the above outlined JI and CDM mechanisms and the EU emissions trading system, the Commission on 21 April 2003 adopted a Directive that links credits from JI and CDM projects with the EC ETS. Under this Directive, European companies covered by the EU emissions trading system will be allowed to convert credits from JI and CDM projects for use towards meeting their commitments under the trading system. (Governments will be allowed to use credits from JI and CDM projects towards meeting their commitments under the Kyoto Protocol during the first Kyoto commitment period 2008-2012, provided that the Protocol enters into force.)

It is estimated that the linking of project credits to the emissions trading system will lower the annual compliance costs for companies covered by the scheme, which include companies in the ten accession countries, by about a quarter. JI and CDM will also transfer environmentally sound technology to countries with economies in transition (JI).[9]

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[7] Track 1 and 2 eligibility.
[8] The project should fulfil the 'additionality ' criterion implying that the reduction should be additional to reductions resulting from planned regulatory measures.
[9]

The Kyoto flexible mechanisms are supplementary to domestic efforts. It therefore envisages the triggering of a review once JI and CDM project credits equivalent to 6% of the total quantity of allowances issued for the trading period 2008-2012 enter the emissions trading scheme. If and when triggered, this review will consider placing a limit on the credits that can be converted during the remainder of the trading period.

2.4 The main elements of Pollution Trading Systems viewed in context of DRB conditions

In order to assess the viability and feasibility of a potential nutrients trading system in the DRB the 'generic' elements of a pollution trading system should be applied to DRB conditions facilitating the identification of issues and problems that should be paid particular attention in the analyses carried out under the project components A, B and C.

Elements of Pollution Trading System	**The ETS Scheme**	**Nutrients Trading in the DRB**
1. Overall aim of pollution trading system	**Overall aim of system:** Through MS wide CO_2 allowance trading to contribute to the fulfilment of Kyoto commitments **Rationale** : achievement of a pre-determined environmental outcome taking place where the cost of reduction is lowest	**Overall aim of potential system**: Establishment of nutrients trading in the DRB should contribute to efficient achievement of water quality goals in the North Western Part of the Black Sea. **Rationale:** Nutrients trading adds a market-based efficient instrument to the more traditional existing regulatory regimes for water protection in the DRB.
2. Overall policy and legislative framework	**EU level**: EU Climate Change Policies and Programes 'ETS Directive', Linking Directive , other EC legislation – especially the IPPC Directive The principles of the Treaty, and secondary legislation – e.g. state aid rules, BAT principle. **MS Level** Approximation of EC legislation implying that legislation should be transposed, practically applied (institutional development) and enforced.	**International co-operation** The Convention on the protection and use of trans-boundary watercourses and international lakes (Helsinki Convention of 17 March 1992) **Multilateral co-operation in the DRB** The Environmental Programme for the Danube River The Danube Convention **EU Level –** Communication from the Commission on environmental co-operation in the Danube – Black Sea Region EU Water Framework Directive, other 'water protection' Directives **National Level –** National water protection policies reflecting international and EU commitments. National water protection legislation as implementing international and EU obligations. (There is no hierarchically order between the

		mentioned policies. There states are however obliged to align their legislation with their international and multilateral agreement commitment as well as the principles and requirements of EC Law).
3. Legal authority and system elements Entity to entity trading	**EU level** Authority: EC Commission Core elements of trading system Ceiling value/cap at EU level – Reduction goals – 2005-2007 – 2008 -2012 and burden sharing agreement between MS sets the overall framework for the ETS. • National allocation plan - allowances are given for free (90 %)for first period for 2005-2007 - Auctions – states may sell 10 % of allowances • Permits – allowances – fines The ETS Directive sets out installations and activities covered by Directive (point sources regulation) • Monitoring and registration obligations - Verification function • National registries - joint EU transfer mechanism • Mechanism for linking EU trading system with other trading systems **Member States** assign the authorities responsible– permitting, verification, registration etc. Key element in national systems are the environmental permitting/IPPC to which the Gas permitting system should be linked.	Applying core elements of pollution trading system to DRB conditions give rise to a number of questions to be answered and a large number of decisions to be taken Authority: ???? Establishment of overview of the total amounts of nutrients emission in the Danube countries forms the point of departure for establishment of nutrients framework **Cap and Trade system** The determination of ceiling value/Cap on the basis of the **nutrients framework of** the DRB and potential reduction goals *is a political decision.* Allocation of total emission amounts at national levels as well as entity level level requires that **principles of burden sharing a**re agreed between the Danube Countries. In order to establish **permitting system** a number of issues need to be addressed. It is crucial if a potential nutrients trading system covers both **point sources and non point sources nutrients pollution** Application of the nutrients trading instrument to **already existing international/national regulatory water protection systems** requires that already established institutional structures – permitting, monitoring and reporting structures etc. - are utilised as much as possible as well as in order to create coherent regulatory systems **Credit Trading System** Setting of relative baseline based on traditional technologies. Individual access baseline for each user. Every user who does not reach limit can have difference certified as a tradable credit. A **specific problem** is that discharges may attemp to get **credit for improvements that are already required to be in place**. (Application of best available technology principle (BAT)
Supplementary mechanism	**Credit Trading System** Conversion of JI/Credits to the ETS system	Possible development of JI like or state to state trading mechanism in context of the DRB nutrients framework and existing regulatory context Other instruments – e.g voluntary agreements The activities under **the project components A, B and C** in various ways contribute to the

		clarification of the above outlined issues. The activities under component A and C aim at establishing a '**nutrients framework/nutrients profiles'** which provide the basis for an evaluation of the **overall suitability and efficiency of nutrients trading** in the DRB. The legal/regulatory review focuses on to which extent the existing framework facilitates or constitutes barriers to the introduction of a nutrients trading system in the DRB and contributes to evaluation of the **effectiveness** of nutrients trading (fulfilment of environmental goals).
		In the process of defining the scope and content each of the elements in a DRB nutrient trading system the below issues should be central
Definition of trading areas - Pollutants or parameters to be traded	Member State wide trading of CO2 Period from 2005-2007 – only CO_2 Period from 2008-2012 – all 6 greenhouse gases.	Magnitude of trading is going to be determined by number of participating countries and the scope of the trading system (does it cover both point sources and non-point sources pollution) Nutrients - e.g total phosphorus and total nitrogen – question of N/P ratio (The American water quality trading policy introduces a concept of Total Maximum Daily Loads system that have been applied to trading of pollutants between public sewage treatment plants in Connecticut)
Definition of units of trade	ETS Allowance = 1 tonne CO_2	Emission right = ?? – is it necessary to establish exchange rates due to different 'nutrients profiles' in the Danube countries ?
Creation and duration of trading permits	1st. commitment period – 2005-2007 The ETS builds upon a corresponding system of gas permits and allowances. Allowances are distributed for the whole period and can be used throughout the period. The gas permit system must be linked with the IPPC permitting system.	Addressing scope of system - point source – non point source ?? Possible monthly, seasonal and annual limitations to be taken into account (American experience in handling of uncertainty related to trade of 'non point sources' pollution)
Quantifying credits and addressing uncertainty	At company level - linking to IPPC self-monitoring system National account and reporting systems EU -Monitoring mechanism	Standardised protocols are necessary to quantify pollutants loads , load reductions etc. Development of method to account for greater uncertainty in estimates of non point sources loads and reductions ??
Mechanism for determining and ensuring compliance and control	Permits requirements on self-monitoring and reporting Annual accounts at company level Fines (Ordinary inspections - Imposing of sanctions)	Point Sources control – linking with national environmental permitting systems ??? Non point source control – Management practices ???

3. REVIEW OF THE OVERALL INTERNATIONAL AND EU REGULATORY FRAMEWORK FOR NUTRIENTS TRADING

Since the mid-1980's the notably problem with water quality in the Danube River Basin (DRB) has been recognised. International policies and legislation that aim at establishing co-operation between the Danube countries concerning water management thus have been adopted and developed on continuously basis. In recent years the riparian states have established an integrated programme for the basin-wide control of water quality. Furthermore the Danube pollution problems are viewed as problems of European Community importance, since a number of the Danube countries are (new) EC Member States or Accession Countries. At the national levels approximation of international and EC initiatives has resulted in specific national policies and legislation concerning the protection of the aquatic environment.

The existing regulatory framework for the protection of the aquatic environment in the Danube Countries is thus constituted by interplay of international and EU water legislation as well as multilateral co-operation agreements and national legislation in the DRB countries.

In the following overall policies and legislation at the different regulatory levels are described in order to identify features of the already existing regulatory systems that may facilitate or constitute barriers to the introduction of a nutrients trading system in the DRB (including the above outlined system elements). Rules concerning e.g. State Aid, use of Best Available Technology and property rights among others, are expected to constitute possible obstacles to introduction of the concept of pollution trading.

3.1 The Convention on the Protection and Use of Transboundary Water Courses and International Lakes

The Convention on the Protection and Use of Trans-boundary Water Courses and International Lakes (1992) stipulates that the signing parties shall prevent, control and reduce pollution of waters causing or likely to cause trans-boundary impact.

The measures to be taken by the signing parties should be guided by the *precautionary principle* and the *polluter pays principle*. The Article 3 of the Convention lay out that the parties shall develop, adopt, implement compatible relevant legal, administrative, economic, financial and technical measures, in order to ensure that different instruments and measures are applied at national levels.

Among such instruments and measures are:

- Transboundary waters should be protected against pollution from *point sources* through establishment of prior licensing of waste-water discharges and through monitoring and control of authorised discharges – limits for waste water discharges stated in permits are based on the best available technology for discharges of hazardous susbstances (Article 3 – 1 (b, c)
- Appropriate measures are taken, such as the application of the best available technology, in order to reduce nutrients inputs from industrial and municipal sources (Article 3 – 1 f)
- Appropriate measures and best environmental practices are developed and implemented for the reduction of inputs of nutrients and harzardous substances from diffuse sources , especially where the main sources are from agriculture (guidelines for development of best environmental practices are given in Annex II to the Convention)

(Article 3-3 – definition of water quality objectives and adoption of water quality criteria).

The general provisions of the Convention lay down that the Riparian Parties shall cooperate on the basis of the equality and reciprocity, in particular through bilateral and multilateral agreements in order to develop harmonised policies, programmes and strategies covering the relevant catchment area.

The Convention outlines that the bilateral and multilateral agreements that are being adopted should provide a framework for establishment of joint bodies (e.g. river and lake commissions, border commissions) in order to solve a number tasks and to ensure coperation between UNECE conventions related to transboundary waters, industrial accidents, environmental impact assessment, public participation and long range transboundary air pollution.

The specific tasks that should be carried out by a joint body involves:

- Collection, compilation and evaluation of data in order to identify pollution sources likely to cause transboundary impacts
- To elaborate joint monitoring programmes concerning water quality and quantity

- To draw up inventories and exchange information on pollution sources
- To elaborate emission limits for waste water and evaluate the effectiveness of control programmes
- To elaborate joint water quality objectives and criteria
- To develop concerted action programmes for reduction of pollution loads from both point sources (e.g. industrial and municipal sources) and diffuse sources (particularly from agriculture
- To establish alarm procedures

3.2 The Environmental Programme for the Danube River

The Danube passes by numerous large cities receiving the attendant waste of millions of individuals and their agriculture and industry. Recognising the increasing degradation of water quality eight riparians of the Danube already in 1985 signed the 'Declaration of the Danube Countries to Cooperate on Questions Concerning the Water Management of the Danube, called the Bucharest Declaration.[10] The Declaration reinforced the principle that environmental quality of the river depends on the environment of the basin as a whole.

The need for basin-wide co-ordination of regional and integrated approaches to water basin management was emphasised at meetings in Sofia in 1991, in which the riparians elaborated on a plan for protecting the water quality. With this initiative, named *the Environmental Programme for the Danube River Basin*, the participants agreed that each riparian would:

- Adopt the same monitoring systems and methods of assessing environmental impact
- Address the same issues of liability for cross border pollution
- Define rule for the protection of wetland habitats, and define guidelines for development so that areas of ecological importance or aesthetic value are conserved

A Program Work Plan which listed series of actions and activities necessary to strengthen the coordination between the involved governments and between the public bodies and NGO's was adopted in 1992 by an Interim Task Force established in context of the 1991 Sofia meeting. In 1993 a Strategic Action Plan (SAP) for the Danube basin was drafted by a Task Force under the Environmental Programme.

The SAP that was adopted in 1994[11] lays out strategies for overcoming the wa-

[10] www.transboundarywaters.orst.edu/projects/casestudies/danube
[11] Ministers of Environments or their designates signed a Ministerial Declaration supporting the SAP in February 1994.

ter-environment related problems in the Danube River basin. It sets targets to be met within 10 years and defines a series of actions to meet them. The SAP describes a framework for regional action, which should be implemented through National Action Plans. One of the four goals for the environment included in the plan concerns reduction of the pollution loads entering the Black Sea.

At the same time the Danube Environmental Programme was developing the SAP the riparian countries were developing *the Convention on the Cooperation for the Protection and Sustainable Use of the River Danube (the Danube River Protection Convention)*. The SAP and the Conventions interacts in the way that the SAP provides a direction and a framework for achieving the goals of regional integrated water management and riverine environmental management expressed in the Convention. It also aims to provide a framework in support of the transition from central management to a decentralised strategy of regulation and market based incentives.
The SAP is addressed to the officials of national, regional, and local levels of government who shares responsibility of implementing the Danube Convention and other international agreements in which they take part.

Despite the diversity of problems, interests and priorities across the Danube River Basin, the Danube countries have jointly pointed out certain values and principles relating to the environment and to the conservation of Danube nature. Among them are the use of the *Precautionary Principle, Best Available Techniques (BAT) and Best Environmental Practice (BEP), Control of Pollution at Source, the Polluter Pays Principle, regional co-operation and sharing of information*.

3.2.1 *The Danube River Protection Convention*

The Danube River Protection Convention sets the framework for the multilateral co-operation in the DRB for protection and sustainable use of the river.

The Convention in the preamble makes reference to the 1992 International Convention and to existing bi- and multilateral co-operation among Danubian States, and finally the Convention on the Protection of the Black Sea.

The parties of the convention co-operate in the framework of an International Commission for the Protection of the Danube River (ICPDR). The Commission elaborates proposals and recommendations addressed to the contracting parties. The form of co-operation is consultations, joint activities and exchange of information and experiences. A similar committee is established for the Black Sea co-operation.

The Contracting Parties shall strive at achieving the goals of a sustainable and equitable water management, including conservation, improvement and rational use of surface waters and ground-waters in the catchment area as far as possible.

In accordance with Article 5(1) appropriate legal, administrative and technical measures shall be applied at national levels in order to at least maintain and improve the current environmental and water quality conditions of the Danube River and the waters in its catchment area. *The polluter pays principle and the precautionary principle* constitutes the basis for all measures.

The subject to the Convention is a number of planned activities and ongoing measures as far as they cause or are likely to cause trans-boundary impacts - relating to nutrients pollution article 5(2) a point out the following subject:

- the discharge of waste waters, the input of nutrients and hazardous substances both from point and non-point sources as well as heat discharge
- (b,c,d, e)

According to Article 7(1) the Contracting parties shall set emission limits applicable to individual industrial sectors or industries in terms of pollution loads and concentrations and based in the best possible way on low- and non-waste technologies. Emission limits that relate to hazardous substances shall be based on the *Best Available Technique* for the abatement at source and/or for waste water purification.

Article 7 (2) outlines that supplementary provisions for preventing or reducing the release of hazardous substances and nutrients shall be developed by the Contracting Parties for non-point sources, in particular where the main sources are originating from agriculture.

Article 7(3) refers to Annex II that list industrial sectors and industries to which emission limits and other requirements apply. (The list is comparable with the list of installations and activities to which the EC IPPC Directive applies).

The parties to the Convention shall define water quality objectives and apply water quality criteria for the purpose of preventing controlling and reducing trans-boundary impact cf. Article 7. The objectives and criteria should be set at domestic level and jointly where appropriate, and they should be formulated in accordance with the principles set out in Annex III of the Convention.

Article 7(5) sets requirements on national permitting systems that should ensure that national emission limitation is achieved.

Periodically inventories of the relevant point and non-point sources and prevention and abatement measures already taken for the respective discharges form the basis for Joint Action Programmes for reduction of pollution loads and concentration both from industrial and municipal point sources as well as from non point sources cf. Article 8. Also, Article 9 on monitoring programmes sets out that joint efforts should ensure that actual overviews of quality conditions and progress made exist. Through joint programmes and harmonised monitoring methods different qualitative and quantitative dimension of the DRB conditions should be measured in order to establish e.g emission inventories on point sources and estimation of water pollution from non-point sources taking into account Annex II, Part (Guiding list of hazardous substance and groups of substances – (g) – inorganic nitrogen and phosphorus compounds).

Article 10 sets obligations of reporting, while Article 11- 17 set the framework for information, communication and mutual assistance.

(Joint Action Programmes agreed by the ICPDR !!!)

The parties to the Convention are: Austria, Bulgaria, Croatia, Czech Republic, Germany, Hungary, Moldova, Rumania, Slovac Republic, Slovenia and the EC – Ukraine has signed but not ratified the Connvention, Bosnia/Herzegovina and Serbia/Montenegro are observers.

The National Studies that are carried out within the frames of the Danube Pollution Trading Study focuses towards the national action plans and legislation that are adopted as response to the multilateral co-operation commitments cf. subsection 4.1.of the present report.

3.3 The co-operation in the DRB and the Black Sea Region in EC perspective

In 1997 an ad-hoc Joint Technical Working Group was established between the ICPDR and the International Commission for the protection of the Black Sea. The work group in a report described the state of the environment in the Danube and the Black Sea. This description has formed the basis for a Communication from the EC Commission COM (2001) 615 final - Environmental Co-operation in the Danube – Black Sea Region. (Parties to Black Sea Convention – Romania, Bulgaria, Ukraine, Georgia, Russia and Turkey. The European Commission on behalf of the European Community has recently been granted official observer status).

The Communication highlights priority actions required for improvement of the environmental quality and it sets out a strategy for achievement of the environmental protection objectives to be pursued in the region. It also calls for an increased involvement of the EU and its Member States in environmental co-operation within DRB and Black Sea Regions, including co-ordination by all financial instruments working in the region. In July 2000 the Council endorsed a proposal from the EC Commission to pay into an international fund for clearing up the River Danube (Council Decisioin 2000/474/EC). Also PHARE and TA-CIS support has been provide in the Black Sea area.

The Communication emphasises that the main problems affecting the Danube River Ecosystems are: High *Nutrient (nitrogen and phosphorous) loads* (+ competition for available water, overexploitation of surface and groundwater, changes in river flow patterns, contamination with hazardous substances, accidental pollution, degradation and loss of wetlands).

The joint Danube – Black Sea Working Group in 1998 defined overall environmental objective for the Danube and Black Sea: *The long-term goal is to reduce the levels of nutrient and other hazardous substances in order to allow the ecosystems of the region to recover.*

Most countries of the region have adopted national environmental strategies including the Danube and the Black Sea. But most needed economic development should be envisaged in a way that ensure appropriate measures and practices to limit nutrient discharge from point sources (municipal, industrial and point agricultural sources) and non point sources (agriculture).

The intermediate goal is that all countries of the Danube-Black Sea basin establish and implement urgent control measuere to avoid discharges of nitrogen and phosphorous to the Black Sea (including via the Danube) exceeding those levels observed in 1997.

The current level of nutrients entering the Black Sea represents a unique situation resulting from economic depressing in the majority of the coastal countries in the last decade. As a comment to this situation the Communication emphasises that it is of utmost importance that nutrient influxes remain low in any economic scenario.[12]

It is the viewpoint of the EC Commission that other objectives should be in line with the principles of the EC Water Framework Directive.[13]

Recognising that the best model for a single system of water management is by river basin as a natural and hydrological unit, this approach is proposed for an enhanced environmental co-operation in the Danube-Black Sea region. Even

[12] Cf. COM(2001)615 final
[13] See below subsection 3.4.

though that the Danubian Countries that are not EU member states can not implement the EC Water Framework Directive (WFD), which also builds upon the river basin management model, in the strict sense of the word, all member countries of the Danube River Protection Convention have decided to pursue river management following the principles of the EC WFD.[14]
Status of memorandum of understanding between the two international commitees ???

3.4 EC water protection legislation

At the EC level a broad debate on water policy have taken place during more than 30 years. The policy developments of the latest years have resulted in the adoption of the Water Framework Directive (WFD), which offers a framework for a sustainable water policy.

The overall philosophy of EC integrated water quality management builds upon the idea that different water quality standards (immission norms) should be met by regulation and control of emissions, production processes and land use. The EC Directives included in the water quality management concept provide instruments for regulation at authorities, sectors as well as operators level.

The Directives that have been adopted and implemented gradually from the 70'ies up to now reflect different approaches to regulation – Traditional command and control regulation form the core of the EC legislation that in the 80'ies was supplemented with legislation providing for self-regulatory and market-based instruments. Emission trading is one of the newest market based instruments to be included in the EC environmental policy.

The principles and mechanisms of the WFD Directive that apart form the directive itself involve a number of other directives should be taken into account in the Danube (Black Sea) River basin co-operation, inasmuch as many of the countries are already EC Members as well as the parties have agreed that the WFD principles should govern the developments of the Danube/Black Sea co-operation.

The obligations of the EC Water Framework relevant for the Danube/Black Sea Co-operation[15]

- Expansion of scope of water protection to all water
- **Achievement of good status for all waters by a certain deadline**
- **Water management based on river basins**

[14] *As idem* p. 19.
[15] *As idem* p. 19.

- **Combined approach of emission limit values and quality standards**
- Getting the prices right (water supply)
- Getting the citizens involved more closely
- Steam-lining legislation

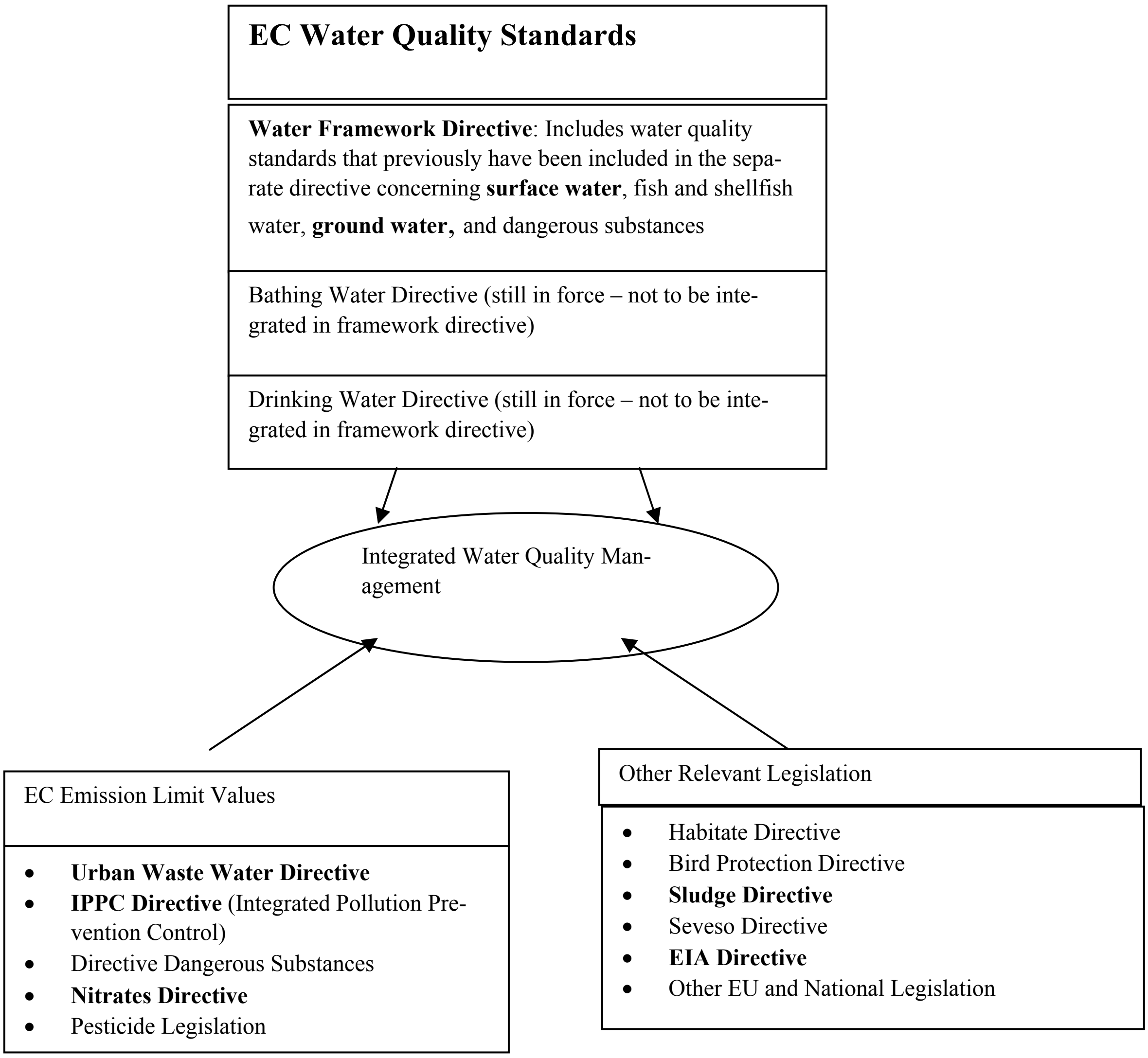

Figure: Concept of EU integrated water quality management

In context of regulation of nutrients the bold-marked Directives are of particular importance. The EC Member States in accordance with the WFD should achieve good status for all waters within a 15 year time frame (In accordance with Annex 5 concerning surface waters nutrient conditions are included). The overall environmental goals and quality standards should be met by using the so-called combined approach. Point source and non-point nutrient pollution must be regulated through (IPPC) permits setting emission limit values (the IPPC Directive Article 10(2)a requires that emission control are based on best available technology) and in case of diffuse pollution use of best practices. The surface water quality in a river basin district must be monitored on continuously basis as well as entities must carry out self-monitoring as stipulated in permit and report to relevant authorities. This mechanism allows the river basin district authority to react in the case that general monitoring shows non-compliance with quality standards and when entities exceed limit values for emissions. The latter case of non-compliance usually would be disclosed through site inspection or data and information reported to the authorities.

The IPPC Directive (96/61/EC) in Annex 1 outlines which sectors and installations that are subjects to IPPC permitting. Annex 1 (6) covering 'other sectors' lists installations of a certain size for rearing of pigs and poultry, slaughter houses, treatment and processes intended for food product, treatment of animal raw materials, treatment of hides and skins etc. The Urban Waste Water Directive (91/271/EEC) sets requirements regarding urban waste water treatment plants, and a new Directive 98/15/EC clarifies what should be understood as daily averages for the total nitrogen concentration.[16]

The sister Directives - The Urban Waste Water Directives and the Nitrates Directive (91/676/EEC) include requirements on designation and appointment of N sensitive areas and Nitrates Vulnerable Zones, respectively. The Nitrates Directive regulates non-point source pollution from agriculture through N water quality standards, requirements on development of national action plans, preventive measures, fertiliser plans manure storage, records etc.[17]

3.5 The international and EC regulatory framework for establishment of nutrients trading in the DRB.

In the following the descriptions provided in chapters 2 and 3.1-3.4 are used as point of departure for an assessment of to which extent the existing regulatory framework for water protection in the DRB facilitates or create barriers to the establishment of nutrients trading.

Regulatory Systems at different levels	**Regulatory Framework for establishment of nutrients trading in the DRB**	**Concepts, principles and provisions of importance**
The interna-		**Overall features of the international legal system**

[16] Cf. COM(2001) 685 final on the implementation of the Urban Waste Water Directive,.
[17] Cf. COM (2002) 407 final on the implementation of the Nitrates Directive.

tional level		**Principles:** *The principle on state sovereignty, obligations of states not to cause damage to environment beyond their jurisdiction* (Convention on the Law of Sea – UNCLOS 1982), *obligation to cooperate, to inform and to consult with other states* – **Relevant terms:** *Shared natural resource, common property, common heritage of mankind* (resources and property under jurisdiction of several states) – **Binding and non-binding regulations- Settlement of Disputes** through negotiations, arbitration and the International Court of Justice **Only States are parties to international agreements** **Trade related provisions in multilateral environmental agreements** (CITES Convention (flora and fauna), Montreal Protocol (Ozone Layer), Basel Convention (import and export of hazardous waste), Kyoto Protocol (climate change). Trade restrictions on non-parties The status of international law in national legal systems is determined by whether the legal system builds upon **the monistic or dualistic tradition.**[18]
	International co-operation The Convention on the protection and use of trans-boundary water-courses and international lakes (Helsinki Convention of 17 March 1992) **Multilateral co-operation in the DRB** The Danube River Protection Convention	Both the Helsinki Convention and the Danube River Protection Convention provide the basic infrastructures needed for the establishment of pollution trading systems at the international level - Inventories of emissions - Monitoring and reporting system - Regulation of point and non point pollution through emission limits and best practices The establishment of a joint nutrient trading system in the DRB requires that *a supranational body is appointed as overall responsible* (e.g. the ICPDR.) Amendments to the 1992 Helsinki Convention may be needed, however most amendments should be developed as part of the multilateral agreement. *Trade related provisions* should be developed– different state responsibilities may be imposed Within the framework of international and multilateral agreements *trade can only take place between states – (*The Kyoto Protocol provides mechanisms for state to state trading and project based JI credit trading –the latter builds upon agreements between investor country and host company, however the transfer of credits still take place between states) The Convention on the Protection of the Danube River may provide *the basis for establishment of national nutrients trading systems (based on permits, allowances)* however international law lacks the necessary implementation and enforcement instruments that are needed in the case of pollution trading. Also mechanisms/instruments for transfer of credits from entities in different countries constitute a major barrier to establishment of trading system within the frames of the multilateral co-operation in the DRB.

[18] Basse, Ellen Margrethe; 'Environmental Law – From International to National Law', Gad-Jura, Cph.,1997. This anthology includes a number of articles addressing the problems and challenges in international environmental law. The further work on legal/regulatory component of the pollution trading project will draw upon the detailed analysis provided in this book.

		The Helsinki Convention and partly the Convention on the protection of the Danube River requires that *emission limit values* are based on *use of best available technique*. This constitutes a problem in a credit trading system, where individual baselines are set for each participant- credits can't be issued for reductions that are already required. In cap trading and allowance systems the BAT challenge may be easier to overcome. Traditional settlement of disputes can't be used as enforcement system in the case of trading – National enforcement systems are needed.
EU Level	EU Water Framework Directive, other 'water protection' Directives Principles of the EC Treaty and EC environmental law of importance	The EC concept of integrated water quality management must form the point of departure for the development of a regulatory framework in the DRB, since many of the Danube countries are (new) EU members. Also, it has been agreed in the Danube/Black Sea Co-operation that future initiatives should be on the principles and obligations of the EC WFD. Emission limit values in accordance with Article 10(2) no. a of the IPPC Directive should be based on best available technology. State aid ban and competition rules of the EC Treaty should be respected (these elements play a role when considering an allocation plan for cap and trade system).
National Levels	National water protection policies reflecting international and EU commitments. National water protection legislation as implementing international and EU obligations.	The national studies that are carried out in the Danube countries in accordance with the analytical framework as set out in sub-section 4.1 of this report are expected to result in findings that indicate the preparedness of the countries to participate in multilateral co-operation in the field of pollution trading. It is being assessed to which extent the Danube countries have implemented their multilateral co-operation commitments as well as the level of approximation of EC water protection legislation is assessed. Deadline for finalisation of national studies 15 June 2004

Elements of Pollution Trading System		**Relevant existing regulatory frameworks**
Overview	**Cap and Trade system** The determination of ceiling value/Cap on the basis of the **nutrients framework of** the DRB and potential reduction goals *is a political decision.* Allocation of total emission amounts at national levels as well as entity level requires that **principles of burden sharing a**re agreed between the Danube Countries. In order to establish **permitting system** a number of issues need to be addressed. It is crucial if a potential nutrients trading system covers both **point sources and non point sources nutrients pollution**	The national emission inventories, monitoring and reporting obligation that are established as part of the multilateral co-operation in the DRB form the point of departure for establishing an overview of the total nutrients emissions in the DRB. The total emissions should be compared with what is scientifically and politically feasible and a joint reduction goal should be established. **The principle of burden sharin**g is very important from a legal point of view, since the effectiveness of environmental regulation is dependent on the perceived fairness and equity of the regulation. – Concerning principles of allocation – see below Both the **permitting systems** provided for in the Conventions and the EC IPPC Directive may form a point of departure for establishment of '**nutrient permits'**. The EC Urban Waste Directive applies to waste water treatment plants, while the EC Nitrates Directive regulates diffuse agricultural nitrates pollution through a number

	Credit Trading System Setting of relative baseline based on traditional technologies. Individual access baseline for each user. Every user who does not reach limit can have difference certified as a tradable credit. A **specific problem** is that discharges may attempt to get **credit for improvements that are already required to be in place**. (Application of best available technology principle (BAT)	of instruments, including fertiliser plans, manure storage, appointment of vulnerable zones etc. Concerning monitoring, verification, registration and transfer mechanism – see below On the multilateral co-operation level credit trading may be established through the **development of a Joint Implementation mechanism for trading of nutrients** in the Danube Countries. Credit trading could be established at national levels e.g. between municipal waste water treatment plants (American example from Connecticut) Credit trading systems involve more difficult steps and uncertainty than cap trading systems – baseline setting (may be established sector wise), validation and verification processes are comprehensive.
Specific Elements of Trading System		**Existing Regulatory Frameworks**
Definition of trading areas - Pollutants or parameters to be traded	Magnitude of trading is going to be determined by number of participating countries and the scope of the trading system (does it cover both point sources and non-point sources pollution) Nutrients - e.g total phosphorus and total nitrogen – question of N/P ratio	The newly published national allocation plans (EC Guidelines to be followed) concerning EC CO_2 emissions trading scheme have directed focus towards a number of issues of importance: • National caps are set in accordance with the burden sharing agreement adopted by the EC Member States in order to comply with the Kyoto commitments. • The cap is fixed for a certain period and allowances are distributed. The question of access for new entrants should be solved. If allowances are distributed for free the **state aid ban** issue is likely to arise as well as the **competitiveness implications at the national level** • Principles of distribution (grandfathering, bench marking principle, auctions) • The distribution between sectors triggers the principle of **non-discrimination and competitiveness implications at sector level** The scope of the nutrients trading of system: Industrial and agricultural point sources, and municipal waste water treatment plants and non point agricultural sources
Definition of units of trade	Emission right = ?? – is it necessary to establish exchange rates due to different 'nutrients profiles' in the Danube countries ?	The principle of states having different obligations may have to be applied as element of a burden sharing agreement between the Danube Countries
Creation and duration of allowances/trading	Addressing scope of system - point source – non point source ?? Possible monthly, seasonal and annual	Both the Convention on the Protection of the Danube River and the IPPC Directive outline the sectors and industries that should be subject to permitting in a nutrient trading system.

permits	limitations to be taken into account (American experience in handling of uncertainty related to trade of 'non point sources' pollution)	
Quantifying credits and addressing uncertainty	National account and reporting systems Standardised protocols are necessary to quantify pollutants loads, load reductions etc. Development of method to account for greater uncertainty in estimates of non point sources loads and reductions ??	The joint activities on establishment of monitoring and registration that have taken place in the framework of the multilateral co-operation in the DRB form a good point of departure for development of standardised conditions for quantification of load and reductions.
Mechanism for determining and ensuring compliance and control	Point Sources control – linking with national environmental permitting, monitoring and inspection system Non point source control – Management practices ??? Establishment of registration and transfer mechanism IMPEL network	International law does not provide any appropriate mechanism for control and enforcement of the provisions of a Convention as implemented by the parties. National control and sanction mechanisms have to be established The Nitrates Directive establishes a reporting system

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4. OUTLINE OF ANALYTICAL FRAMEWORK FOR ASSESSMENT OF NATIONAL LEGAL/REGULATORY CONTEXTS

The activities that should contribute to the fulfilment of Output B.2 include assessment of relevant parts of the national regulatory frameworks in each of the 13 Danube countries. The assessments should preferable be carried out by national legal advisors.

The Terms of Reference for national assessments in the Danube Countries are the following:

Overall objective: The national assessments of legal/regulatory frameworks relevant to the establishment of a pollution trading system in the DRB should contribute to the fulfilment of Output B.2:

The following sub-outputs to Output B2 should be produced by each of the national consultants:

- Output B2.1: Status of approximation of relevant EU legislation in the Danube country
- Output B2.2: Description of national plans and legislation on nutrients pollution that have been adopted within the framework of the Danube River Protection Convention
- Output B2.3 Draft of brief national report that addresses predefined issues relevant to establishment of pollution trading system in the DRB.

4.1 Method of work

The scope of work and activities are set in accordance with the limited timeframe for conduction of the national assessments.

An analytical framework that intends to facilitate the conduction the national analysis has been developed and should be completed by the national consultants

The framework consists of 3 tables:

- Table 1 : Framework for assessment of status of EU approximation in the Danube Countries regarding integrated water quality management

- Table 2 : Framework for identification and description of relevant national plans and legislation that have been adopted as part of the multilateral co-operation in the DRB (Danube Convention)

- Table 3 : Framework for description of features of national legal system and principles that may facilitate or constitute barriers to establishment of pollution trading mechanisms

Table 1 – Status of EU approximation – Integrated water quality management

- *Firstly* overall relevant policies and legislation should be listed in the relevant column.
- *Secondly* relevant provisions, instruments and authorities should be identified. No accompanying text should be provided in the table.
- *Thirdly* an indication of the level of transposition and practical application of the Directive in question should be given in percentage. Level of transposition indicates to which extent national legislation is in place, while level of practical application refers to responsible institutions and their functions.

In the Danube Countries that are not EC Candidates in a short term perspective the table should identify national policies and legislation that cover topics and issues similar to the ones covered in the EU Directives (Moldova, Ukraine).

The relevant EC Directives can be found at www.europa.eu.int/eur-lex - The EC Commission Communication COM (2001) 615 addresses Danube River pollution problems.

Table 1: Table for assessment of approximation of EU legislation

EC Policies and legislation	*EC Concepts, instruments and provisions relevant to regulation of the aquatic environment*	*Identification of overall relevant national policies and legislation*	*Identification of central provisions, measures and autorities*	*Status of Approximation – indicate % Transposition Practical application*
Water Framework Directive 2000/60/EC	-Surface water – quality standards -Ground water – quality standards -Designation of river basin areas and protected areas - Integrated management plan			
IPPC Directive 96/61/EC	- IPPC Permitting – How are N/P relevant sectors covered - self-monitoring, - reporting			
Nitrates Directive 91/676/EEC	- Emission limit values - Nitrates vulnerable zones -monitoring			

	-Regulation of agricultural practices (e.g. spreading of manure)			
Urban Waste Water Directive 91/271/EEC	Annex 1 -Discharge urban waste water treatment plant -Industrial waste water - Ref. methods for monitoring and evaluation of results			
Sludge Directive 86/278/EEC	- Maximum application of nutrients (to be co-ordinated with manure application) - Maximum amount of sludge from waste water treatment plants applied per hectar/year			

Table 2 – Identification and description of relevant national plans and legislation - multilateral co-operation in the DRB (Danube Convention)

Table 2 should be completed by way of consulting national documents and legislation that have been adopted or are in progress in accordance with Danube River Protection Convention requirements

The Danube Convention can be found at www.unece.org
Policy documents can be found at the homepage of the homepage of the Commission for the Protection of the Danube River (ICPDR)

Table 2: Assessment of national initiatives in framework of Danube River Protection Convention

Multilateral Co-operation in the DRB **Danube River Protection Convention**	**Documents and legislation**	**Comments**
Policies and plans **Strategic Action Plan**	**National plans to identify needed actions and investment – sections on nutrient pollution**	
[redacted]	- -	
Danube River Protection Convention	**National legislation**	
Nutrients relevant: Emission limitation – water		

quality objectives Emission inventories Monitoring – obligation of reporting, exchange of information , information of the public		

Table 3 – National Report – Comments and Conclusions

A brief report should be elaborated on the basis of the tables completed and a review of national legal principles and traditions carried out (Regarding the latter guidance will be provided by the international legal expert in separate document).

Country :	Comments and Conclusions
Comments on status of transposition of EU Directives - Quality Standards (Water Framework Directive) - Emission limit values (Nitrates and Urban Waste Water Directive) - Monitoring and reporting requirements - Regulation of point sources : Industries, waste water treatment plants, agricultural hot spots - Regulation of non point sources: nitrates emission management, good agricultural practice Country specific issues of particular importance to the establishment of pollution trading mechanism	
Danube River Protection Convention : - Emission limitation - Emission inventories - Monitoring issues Country specific issues of particular importance to the establishment of pollution trading mechanism Policy Plans and Programmes – particular issues addresses having importance regarding integrated water quality management	
National legal system – possible obstacles to pollu-	Principles, legislation, administrative/Court Prac-

tion trading Property rights Policy on state subsidies Best Available technology	tice

4.2 Expected findings of national consultants study

The national studies are expected to provide some of the elements needed for answering the question: To which extent are the Danube countries prepared for nutrients trading in terms of institutional and infrastructural capacity.

APPENDIX 3

Economic Instruments Review Report

NIRAS

Consulting Engineers
and Planners A/S

UNOPS United Nations Office of Project Services

RER/01/G32 - Danube Regional Project (Output 4.4)

DANUBE STUDY ON POLLUTION TRADING AND CORRESPONDING ECONOMIC INSTRUMENTS FOR NUTRIENT REDUCTION

Review of Existing Economic Instruments

May 2004

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DANUBE STUDY ON POLLUTION TRADING AND CORRESPONDING ECONOMIC INSTRUMENTS FOR NUTRIENT REDUCTION

Review of Existing Economic Instruments

May 2004

	Final Review Report	June 2004	CaK		
No.	Revision	Date	Prepared	Checked	Approved

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ABBREVIATIONS

ATS	Allowance Tracking System
BAT	Best Available Technology
BMP	Best Management Practice
Btu	British thermal units
CDM	Cleaner Development Mechanism
DRB	Danube River Basin
EPA	Environment Protection Agency
ERC	Emission Reduction Credits
ETS	European Union Trading Scheme
EU	European Union
GAAMP	Generally Accepted Agricultural Management Prac tice
GEF	Global Environmental Facility
GHG	Green House Gasses
ICPDR	International Commission for the Protection of the Danube River
JI	Joint Implementation
NAP	National Allocation Plan
NPDES	National Pollutant Discharge Elimination System
ODS	Ozone Depleting Substance
OECD	
PPP	Polluter Pay Principle
PSWA	Pollution of Surface Water Act
RECLAIM	Regional Clean Air Incentives Market Program
SIP	State Implementation Plan
TMDL	Total Maximum Daily Load
TOR	Terms of Reference
TP	Tradable Permit
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
WTP	Willingness to Pay
WWTP	Waste Water Treatment Plant

1. INTRODUCTION

The focus of this study is the experience with tradable emission permits. This experience shall be relevant in relation to the possible use of tradable emission permits in the Danube River Basin. In the Terms of Reference the purpose for the study is given:

'…

- Review existing concepts of successful "pollutant trading / auctions" and corresponding economic instruments in the water and air pollution sector, e.g.. in the US, Australia and Europe
- Study the principle possibilities of "pollution trading" and corresponding economic instruments for nutrient reduction taking into account the EU policies and directives in the Danube River Basin
- Assess the main problems / obstacles for "pollution trading" and possible corresponding economic instruments in the DRB and the interest of the particular DRB countries for implementation' [1]

This purpose has further been elaborated during the inception and the present review report represents the reporting from the study of economic instruments, Component C1:

> 'Trading systems already implemented will be studied for both successful and non-successful application in order to define possible concepts in the Danube River Basin (DRB). In this connection the particular properties of the DRB will be used for screening of concepts. The perspective will be to identify applicable systems, and draw on the gained experience. A "profile" of DRB will be used for the screening of concepts, which will consist of a number of parameters, including both the environmental objective of controlling the level of eutrophication in the North-western Black Sea,

1 UNDP-GEF Danube Regional Project, Terms of Reference for" Danube Basin study on pollution trading and corresponding economic instruments for nutrient reduction "(Project Output 4.4), page 2

> and the instrumental objective of introducing tradable permits. The profile will further comprise the transboundary character of the DRB. Systems in operation in the US, Australia and Europe will be studied. The review will be reported in the Review Report.'[2]

Tradable pollution permits have been studied for a number of years, and the theoretical studies very consistently emphasise a number of advantages of tradable permits compared to command and control regulation. At the same time the number of practical applications have been limited, and outside the USA, the implemented systems are few.

In this review the experience with systems will be studied with the intention of identifying concepts, which could be suitable for the DRB. The study thus will concentrate on issues, which are dictated by the characteristics of the DRB in order to ensure that the findings will be relevant for considerations of introducing.

The method used is to set up a profile for DRB, a permit trading profile of DRB, which lists a number of characteristics observed for DRB. These characteristics do not sum up to be a model for trading, since the characteristics are ranging over both political, physical and geographical issues without ranking or linking these. The profile may be seen as memory support when assessing observations from other systems.

The aspirations of this study is directed towards practical application and not towards theoretical innovation. It should be noted, however, that due to limited practical experience, also this study must to some extent rely on theoretical work as a source of information regarding tradable permits.

[2] Danube Study on pollution trading and corresponding economic instruments for nutrient reduction, Inception Report, January 2004, page 14.

2. SUMMARY

The studied Tradable Permits, TP, for emission of effluents have been identified based on a description of the characteristics of Danube River Basin specifically with regard to TP, a Permit Trading Profile of the Danube.

The main characteristics included on the profile are that

- the basin comprises many nations and that international regulation will be needed,
- the objectives for regulation are one overall environmental objective, limitation of ambient concentration of nutrients in Black Sea, and a number of possible sub-basin objectives regarding concentrations of the in the Danube catchment,
- the instrumental objectives have an economic dimension, the establishment of economically efficient regulation and a political dimension, the establishment of a politically feasible regulation,
- the target pollutants in the regulation are two, nitrogen and phosphorous,
- the sources of pollution are both point and non-point sources, and attainment of the environmental objective requires both types of sources to be regulated,
- a number of socio-economic characteristics differ among the basin countries, the domestic product per capita, the degree of urbanisation, intensity of industry, development of market economy and agricultural practices.

The instruments considered in the study are focussed on market-based instruments, in particular tradable permits for emission. Other economic instruments included in the study are Joint Implementation and Cleaner Development Mechanisms, which are closely related to tradable permits, more precisely as a part of the Kyoto CO_2 complex of instruments.

As other economic instruments environmental charges, pigouvian taxes, on effluents are also considered mainly as a supplement and basis for comparison with TP. The baseline comparison, however, is command and control regulation, and economic efficiency of TP is consistently compared with command and control.

Assessment of the schemes and programmes is based on conventional evaluation criteria for environmental policies,

- efficacy
- efficiency
- cost effectiveness
- fairness
- incentive structure
- enforceability
- moral precepts

In addition the specific applicability in the DRB is used in assessment.

A number of programmes and schemes have been selected for study using the similarity to DRB Trading Profile as criteria for selection and the extent to which a programme contains original and new elements. Programmes within water based trading have been given emphasis, and CO_2 trading is investigated both in terms of the Kyoto protocol and the EU ETS.

The Acid Rain Programme in the USA has been selected because of interesting properties and because of the number of years in function, in which this programme stands out as one among very few programmes having been in function in sufficient time to gather experience.

A study with a similar scope as this was conducted by the OECD in 1999, and the findings of the study has been included as a reference for experience. For each of the programmes some specific assessment is included in the description of the programme, mainly with regard to innovative aspects of the programme.

To the extent that information on specific experience gathered is available this is also included as part of the description of each programme. Observations with regard to the Danube Trading Profile of special interest include:

- Programmes with international coverage are represented by the Kyoto Protocol, UNFCCC, and the EU ETS. These are very large programmes in terms of geographical coverage and complexity. The programmes are in a pre-implementation phase regarding trade, and experience with trading actually executed therefore only exist in terms of some projects prepared. An exchange with many traders has not been established.

- The selected programmes have objectives, which are similar or comparable to the objectives in the DRB, however, for some of the water-based trading schemes, the instrumental objectives have a very prominent role. In the programmes it is considered important to establish functional schemes, and the attainment of the environmental objectives either are less important or become implicit and not tested explicitly.

- The target pollutant in the water-based schemes for the majority of schemes is phosphorous, nitrogen is less often included, and in few of the schemes the nutrients are combined. The combination is perhaps facilitated by the limited geographical coverage of the schemes compared with the DRB.

- The Acid Rain Programme offers a range of experience, which can be utilised in the DRB. In particular the gradual development of the programme, firstly in terms of precursor arrangements for a variety of pollutants including the SO_2, and secondly in the form of a two-phased implementation, which facilitated the acceptance of the programme by the polluters.

- The Acid Rain Programme is more efficient than a command and control regulation would have been. Savings for the participants are in the magnitude of $1 billion annually.

- Of some concern is the possible development of sub-system objectives or considerations, which will set limits to the degrees of freedom in trading. The consequence is that the establishment of equilibrium will exclude the trades made impossible by the limits set up, and thus the full cost savings cannot be realised. On the other hand the limits set up represent genuine environmental concerns, which are not satisfied by the over all programme.

- The Joint Implementation and The Cleaner Development Mechanisms are formulated in the Kyoto Protocol. Some water-based systems actually resemble these arrangements, where a large point source sets up abatement for a number of non-point sources, and hence acquires credits, which can be used to postpone full compliance for the point source itself.

- In general non-point sources are included in some programmes but represented by proxies, as described above. In some water-based systems it is proposed that associations of non-point sources should be formed and that these could act on behalf of the non-point sources. It is a requirement that improvement in behaviour must be linked with incentives, this is very difficult for non-point sources, which by definition cannot be monitored directly.

Effluent charges are investigated in Western and Eastern Europe and a number of the same problems as encountered with TP are identified, in particular the addressing of non-point sources has similarities in the two economic instruments. One difference between the TP and the charge systems is that the total emission is not inherently capped in the charge systems, while this is the case with the TP.

The charge systems suffer from the problem that the permissible emission is assessed with a charge, which will in general lower the level of economic activity, this does not happen in the TP systems. This bias may be corrected by combining charge and subsidy in establishment of a revenue neutral regulation, which can either be directed towards the (same) polluters or it may include other actors on the market in an attempt to use the subsidies to promote environmental objectives.

An analysis of the programmes studied result in a number of main lessons, which can contribute to the design of TP, charge or combined systems in the DRB.

- TP systems are sensitive to geographical, political and administrative differences in the area of coverage.

- Economic efficiency point in the direction of preferring the TP systems to command and control systems and possibly also to charge systems. The empirical evidence is, however, not impressive, and the main justification of the economic efficiency remains to be primarily of theoretical nature.

- With regard to attaining the environmental objective, the TP if enforced automatically keep the threshold value for total emission also in the long run, in this respect the TP and command and control regulation is similar. Charge systems are sensitive to changing price levels and to economic growth, and will not secure total emission below a specific threshold value without concurrent adjustment.

- Non-point sources are not in their own capacity integrated in any of the existing TP programmes. In one water-based system the non-point sources were creating credits to be sold to large point source in a one go fashion in terms of complying to a specific best practice. A continued action from the non-point sources was not included, and trade between the non-point sources also was not possible.

In one charge system aimed at reduction of nutrients in surface water, spectacular results were attained in terms of emission reduction but from point sources only, the non-point sources over the same time span in fact increased emission. The non-point sources were assessed a charge, however, the charge was based on arbitrary ratios, which had the consequence that changes in behaviour would not change the charge and consequently the behavioural change desired did not materialise.

In the ETS also non-point sources are excluded, however, they might be covered by CDM projects, which will be an instrument under the ETS.

- Fairness in the same way as political interests will have to be addressed in order to establish functional regulation. TP has the potential for addressing some distribution issues in the initial allocation of permits, after which trading between the permit holders will establish economically efficient regulation. In command and control the economic efficiency is jeopardised if the criteria for allocation of permits is dictated by fairness, except in the special case where fairness and efficiency would result in same allocation. Charge systems can include some consideration of fairness by graduation of charge rates and exemptions, there is a rather narrow limit to this before the system in itself becomes dysfunctional.

- The degree of mixing and the spatial occurrence of the pollutants are of importance in the choice of instrument for regulation. The more important the spatial distribution is the less likely the TP will be suitable for regulation. The degrees of freedom, which constitute the main advantage of TP and results in efficient abatement, will potentially concentrate pollutants in detriment of sub-system objectives. The problems can be addressed by introduction of ratios of exchange and additional regulation in the sub-systems, the additional regulation potentially diminishes the TP ability to attain efficiency.

- Enforcement constitutes a problem in all types of regulation. In particular non-point sources, per definition are difficult to monitor and to force into compliance. TP offers an advantage in terms of provoking participation from the polluter in own interest. Neither command and control nor charge systems offer this as an internal feature, charge systems combined with subsides, however, also will constitute an incentive system for the polluter.

- Implementation of the system as a fully fledged and finished regulation from the initial phase is considered important by some of the references used, however, the justification in terms of experience is not convincing.

Rather it seems that a phased implementation, at best based on already existing regulations and institutional set up, is more successful in attaining objectives. In the case of large multinational systems as in the DRB, experience shows that long time of preparation is needed and that pilot systems, or precursor programmes, facilitate the later implementation of the regulation systems.

- In TP systems efficiency is sensitive to the number of traders, who act on the market for the market to establish a clearing price reflecting least cost. In many of the water-based programmes only few traders are covered by the programmes and the risk of speculation in permit price, rather than adaptation in the form of abatement action is apparent. In the DRB this may become a problem if sub-basin trading is introduced.

3. PERMIT TRADING PROFILE OF THE DANUBE

3.1 The use of a trading profile

In order to secure that the experience studied is relevant for the DRB a Permit trading profile has been formulated based on which the systems to learn from have been selected. The profile is also used to keep some order in the lessons learned, and the profile will later be amended with the perspective of formulating scenarios for permit trading in DRB.

The elements of the profile are described below and comprise:

- The international nature of the Basin
- The objectives of trading
- The sources of pollution, point and non-point
- The pollutants
- The socio-economic characteristics of the DRB countries

3.2 International regulation

Regulation of water use or water quality for a multinational river basin will always be difficult. The systems for regulation of pollution must be adaptable to this setting. Ex ante two fundamentally different systems could be considered, one in which an international regulatory body is agreed upon and all regulation then is handled by this body. The other system could be national regulation combined with an international agreement in which certain national obligations are agreed upon.

A continuum of institutional set-ups is possible between a purely supranational construction and then basically national systems linked in an (a set of) agreement(s).

The complexity of this characteristic is further exacerbated by the fact that the DRB countries belong to a variety of international co-operation institutions but that none encompasses all of the countries without also including a lot of other countries (for instance UN).

The EU must under all circumstances be party to any institutional setting, since many of the DRB countries are members of the EU and some are applying for membership. In the EU, water resource management is part of the competency of the EU legislature, and the member countries will have to act in accordance with this body of directives from the EU. The full complexity of this is the object of a separate report for this review of experience, to which reference is made.

3.3 Objectives

Important in the profile are the objectives of the involved parties. In the review two main objectives are naturally imperative parts of the profile.

1. The Environmental Objective:

    - To limit the ambient level of nutrients in the Black Sea area receiving emissions from the Danube Basin

2. The Instrumental Objectives:

    - To establish an economically efficient regulation.

    - To establish a politically feasible regulation.

The Environmental Objective is imperative, so attaining the Instrumental Objectives only makes sense if the Environmental Objective is attained as well. The profile must contain some qualification of the objectives.

Other positive environmental effects of the actions aimed at limiting the ambient level of nutrients may be included as objectives in their own right rather than being positive side effects only. Removal of other harmful substances from effluent streams, in conjunction with the removal of nutrients will be an example of this.

In addition sub-basin objectives may exist or emerge, by which the environmental objective remain to be reduction of the eutrofication in the Black Sea, and that the concentration of nutrients in sub basins becomes objectives as well on par with the stated environmental objective. This has particular importance in a trading system where the spatial distribution of emission permits will be decided by market forces and not by control and command regulation.

The possibility that several modalities of regulation can co-exist will constitute a part of the profile. The co-existence could take the form of subdividing the geographical area and then have different systems of trading, taxation and command and control regulation in different neighbouring areas. It could also take the form that in the same geographical area some of the regulation is handled through one tool while an additional regulation is provided by using another tool.

A special dimension of the instrumental objective should be included in the profile, the possibility that tradable permits offer a politically acceptable regulation modality, which perhaps is more difficult to identify in other instruments. This dimension may be of importance when complex decision making structures exist. This is evident in the DRB, where many national states are represented and where government, private and international interests are involved.

The instrumental objectives include considerations regarding the distribution of cots between states and economic units, which can be directed towards burden sharing in accordance with ability carry the burden.

Among the issues necessary to take in to consideration is that the beneficiaries from the regulation most probably will be a group/population different from the group contributing to regulation.

3.4 Point and non-point sources

Occurrence of nutrients in the Danube Basin is the consequence of emissions from many sources. Wastewater from domestic use is collected and emitted through Municipal Wastewater Treatment Plants, which are characterised as point sources. Other point sources are production plants and large scale animal husbandry.

Emission from agriculture and from domestic sources not connected to treatment plants on the other hand is characterised as non-point sources. This part of the profile dictates that systems should be procured, which either are addressing both different types of sources or which will regulate part of the pollution and allow other systems to regulate other parts of the pollution.

In the DRB there is difference between geographic areas in terms of which of the two different types of sources are contributing most to the emission, further it is expected that this may change over time. Under all circumstances the non-point sources must be considered important and systems of regulation have to include or allow for the regulation of non-point sources in long run, if the environmental objective shall be attained.

3.5 Target pollutants

The environmental objective, reduction of the eutrophication in the Black Sea, will depend on regulation of emission of two pollutants, Nitrogen and Phosphorous. These two pollutants are characterised by differences in a number of dimensions,

- They are emitted by **different sources**, which emit either one of the pollutants or a combination of the two, which differ from emitter to emitter and also differs over time by the same emitter
- The **path way** for the two pollutant are different in which the N easily leaches and infiltrates the ground water, while P is primarily introduced to the water stream by surface run-off.
- The two pollutants have **differences in the way they decay or deposit** in stream and thus the effect on eutrofication per unit emitted is different and has spatial variation.
- Finally the **impact** of the two pollutants once they are emitted into the Black Sea differ.

3.6 Socio-economic characteristics

There are differences in the socio-economic characteristics between DRB countries, which constitute parameters of importance for the choice type of regulation, and the chances of establishment of successful regulation.

Among these differences are the difference in domestic product per capita, the degree of urbanisation, the intensity of industry, the development of market economy and agricultural practices. Limitation of emission of pollutants may have the consequence that the economic burden will be placed on the economically disadvantaged, farmers and urban poor, unless instruments are used, which can establish burden sharing.

The characteristics are not constant and while the differences must be included in considerations regarding regulation. It should also be included that the differences in the longer run possibly will become less distinct and that any long term regulation must be designed for flexibility with regard to the development in socio-economic characteristics.

4. INSTRUMENTS FOR REGULATION

4.1 Relations between instruments

The interest in tradable permits for emission regulation of the nutrients in the DRB is perceived to be primarily of economic nature. Tradable permits are under consideration because they apparently offer an opportunity to attain a certain environmental objective at a smaller cost than traditional 'command and control' regulation of emission.

Regulation can be implemented by *command and control*, by which an authority introduces a cap on total emission of a particular substance, identifies the sources of emission, calculates an allowance for each source, distributes permits in accordance with the allowances and subsequently monitors and enforces the permits.

In the pure command and control action the economic considerations are those which the authority chooses to include, and the considerations are based on the knowledge the authority has or is able to procure, for example from the sources of pollution.

The main problem in the command and control approach is that the authority will not normally have or be able to get access to the information necessary to design economically efficient regulation. A crucial part of the necessary information rest with sources of pollution, and in a market economy they will not have the interest in making this information public, because it would potentially affect its competitive position on the markets for its products negatively.

This has given rise to the formulation of different approaches in which the sources of pollution are regulated and at the same time given a certain degree of freedom as to how they will comply with the regulation. The rationale behind these approaches have been to find modalities of regulation, which will allow the regulated to choose the most economically efficient way of complying with the regulation. The obvious place to look for instruments is the market, which in market economies represent the main allocation mechanism between different uses of resources

The cost of so doing obviously is that the physical results of regulation i.e. the total amount of emission and the distribution of emission can be affected by the freedom granted, and that the authority may have to experiment in order to attain the desired result.

The instruments at the disposal for the regulation of pollution include:

- Tradable Permits
- Charges
- Standards
- Subsidies

Charges, standards and subsidies have been explored by other studies in the Danube Basin. In this study only charges implemented with the intention to influence market behaviour is briefly addressed in the chapter on other economic instruments, because these charges represent both an alternative and a supplement to the tradable permits.

The focus in this investigation is on tradable permits. The rationale of using the instruments is to attain the environmental objectives. In the discussion here it is assumed that instruments are calibrated with success in attaining the environmental objective, unless this is specifically questioned.

The range of other effects than the desired environmental impact will be evaluated using the criteria below. These are concerned with the instrumental objectives. Ideally what would be preferred seen from a regulatory point of view is that the instrument had the desired environmental effect and no other effects. However, this ideal never transpires, instruments will have other effects than the desired, positive and negative, and using instruments will have costs.

A number of criteria for evaluating instruments have been selected and are described below. In order to ensure relevance for the particular Danube Basin setting the adaptability of instruments to the profile described is included and some criteria are taken from literature concerning economic instruments.

4.2 Evaluating instruments for regulation.

Environmental policies can be evaluated according to

- Their ability to reduce pollution reliably and permanently, the efficacy of the instruments
- Their ability to achieve efficient and cost effective reductions in pollution.
- Their fairness
- The incentives they offer to people to search for better solutions
- Their enforceability
- The extent to which they agree with certain moral precepts

4.2.1 *Efficacy of instruments*

With the environmental objective as the imperative, the ability of the instruments to limit pollution becomes imperative as well.

The implication is that if an instrument works well in influencing the behaviour of the regulated and it also performs well on the instrumental objective, then it would qualify for consideration as a useful tool for regulation. However, the behavioural change must have the desired environmental impact, and if has not it cannot qualify as a tool for regulation.

This would for example be the case if a charge on agricultural input of nutrients was introduced, and this reduced the use of fertiliser. However, reduction of the emission of N and P into the Black Sea did not materialise, because the farmers use of fertiliser never resulted in any emission to the Danube in the first place. This could be due to the existing balance of nutrients in the soil, or that the majority of the farming areas were not contributors of pollutants due to geographical location.

In the present review the efficacy will not be assessed. The focus will be on the instrumental objectives, while the environmental objective will be assumed attained. This means that instruments having a positive evaluation as a result of this review may not qualify at all due to low efficacy.

4.2.2 *Efficiency and cost effectiveness*

To the extent that this is possible the cost of regulation will be explored, however, it is important to realise that the efficiency of tradable permits relies heavily on theoretical speculation. The empirical evidence will be very scarce, because the lower cost of tradable permits must be documented by comparing the present cost for many emitters under a regime of tradable permits with a (non realised) cost of other tools for regulation. For a foreseeable period of time empirical evidence will in addition be scarce because only few programmes have been implemented.

Among the most convincing arguments for TP is the observation, that using TP makes emitters act in accordance with their cost (marginal cost) and minimise the cost of complying with the regulation. This is not possible to such an extent under command and control instruments, where the measures are more precisely given by the regulating authority and for this reason alone the TP is expected to establish regulation at lower cost than other instruments.

If this is correct, then the cost effectiveness of TP will be very hard to verify, because the alternative costs are not known to the public/analyst. It will be difficult to have this information made public since this is likely to reveal information to competitors, who may use this to gain preference in the market.

Irrespective of the difficulties in strict documentation, the efficiency of the instruments shall remain on of the main evaluation criteria.

‘An efficient policy is one that moves us to, or near, the point (either of emissions or ambient quality) where marginal abatement cost and marginal damages are equal.’[3]

The point mentioned is where the total cost of abatement and damage is the lowest, moving away from the point will have the effect that one of the costs increases more than the other decreases.

Cost effectiveness takes into account that damages may be difficult to measure, ‘a policy is cost-effective if it produces the maximum environmental improvement possible for the resources being expended or, equivalently, it achieves a given amount of environmental improvement at the least possible cost’[4]

[3] Field BC: Environmental Economics: An introduction, McGraw Hill, 1994 page 181
[4] ibid page 182

In a world with perfect knowledge clearly the efficiency is to be preferred and with less than perfect knowledge an environmental policy should strive as near as possible to this point. If the lack of knowledge regarding measurement of damage, i.e. determining the cost of damage, is so great that it does not make sense to attempt to quantify the cost, then internalising the damage in the equation becomes futile and the second best criteria, cost effectiveness should prevail.

These considerations will be searched for in the review of existing trading systems.

4.2.3 *Fairness*

Distribution of benefits from a successful policy is relevant for the assessment of existing trading systems suited to the setting in the Danube Basin. The issue is complex, and a simple technical analysis will not provide answers to distribution problems, the review and the analysis will provide information to be used for decision making.

The Danube nutrient pollution reduction aimed at reducing concentrations in the Black Sea will entail contributions in terms of abatement from one group of persons and nations, and it will provide benefits to one group of person and nations, which are not identical.

In the Danube Basin further differences in per capita income exist in an almost systematic way in terms of lower per capita income the closer Danube comes to its delta and the Black Sea. Differences in per capita income have the implications that the capacity to carry the burden is different, when the same cost or charge is levied on contributors.

This is not unique to regulation of environmental behaviour is concerned, however, when a negotiated solution is necessary as in the DRB, the issue becomes part of negotiation.

4.2.4 *Incentives for improvements*

Reduction of pollution may be the focus for Governments and thus be part of the performance of public officials, however, it is private actors, firms and consumers, who determine through their decisions the range and extent of environmental impact.

For policies to have effect and tools to work, it is necessary that they contain incentives for the private actors to make the decisions that lead to the desired impact. The degrees of freedom offered in a system of tradable permits gives the polluter room for adaptation to the regulation by using the skills commanded by the polluter. By complying at lower cost, the polluter may achieve a competitive advantage compared to other regulated producers.

If the polluter is not given an opportunity to act and improve production results while staying within the limits of compliance, there is a risk that skills will be used to finding way of improving production results by not complying and avoid control.

In the Danube Basin in particular the non-point sources will be influenced by the incentive contents of the tools applied to achieve pollution reduction due to the difficulties in monitoring and controlling non-points sources.

4.2.5 *Enforceability*

Enforcement entails cost in terms of monitoring and policing. The cost of enforcement is expected to be rather high, because it is concerned with regulation of behaviour in which the regulated often has a notable advantage by escaping enforcement.

As implied above self control is both effective and efficient seen from the point of view of the regulator. Systems containing incentives to self control are therefor very attractive.

For non-point polluters the technical difficulties in monitoring and enforcing regulation can have the consequence that it becomes necessary to attempt control of emission, by regulating application of the medium, which causes emission. For nutrition emission a possibility is to regulate the application of fertiliser, however, the physical monitoring of this may be as difficult as monitoring the emission itself, and it may be an example where a charge becomes the only possible instrument of regulation, which is within the

4.2.6 *Moral precepts*

One obvious moral rule is the Polluter Pay Principle, PPP. The PPP is rather clear when charges are applied, when tradable permits are used the PPP does not automatically come into play.

A moral precept of importance to tradable permits is the notion of the ethical problem of allocating a right/permit to pollute. In practice the moral relies on the assumption that if the right is not given, then the pollution will not be tolerated.

Moral precepts also include the notion that some 'goods' are not suited for market as a distribution mechanism. Health care is an example of this and distribution of permits to harmful behaviour may qualify in the same category. It is a principle in taxation that taxes must be assessed on those who are able to pay, and it may be argued that TP should respect this as well. This would be a consideration to include if permits to emit nutrients are traded on a market including both farmers and large enterprises, where the economic strength is very different.

4.2.7 *Applicability to DRB*

The applicability to DRB will primarily be discussed by using the permit trading profile as a basis and investigate how well the instrument would be suited to the profile. For the existing programme this will be facilitated by discussing how well the setting of the programme correspond to the setting of DRB.

5. EXISTING TRADING SYSTEMS

5.1 Selection of schemes and programmes to study

In this chapter the main focus, Tradable Permits, will be investigated, including JI and CDM and in the following chapter a range of other market based instruments will be explored.

Emphasis has been given to watershed based trading schemes because the subject is similar to DRB. In addition the Kyoto protocol and other trading schemes in greenhouse gasses have been included, firstly because the schemes are multinational, and secondly because enormous resources have been invested in designing and negotiating the CO_2 trading schemes concerned. Basically the schemes are still on a planning stage and little experience has been collected yet.

However, the programmes have been intensively discussed and tested against theory and against conventions, and these discussions are referred. It is obvious that whatever tools may be introduced in the DRB, the framework discussion into which the tools will be introduced will resemble what is discussed in relation to the programmes described below.

The Acid Rain Program in USA has been included because it represents a scheme, which has been in existence for some time, and because the regulated substances have similarities in behaviour to the nutrients in the DRB. The SO_2 regulation also is based on previous programmes, which included trade, and it is thus among the oldest, if not he oldest functioning tradable permit scheme. For this instrument some evidence from implementation is available and it will be referred below.

5.2 Experience in Watershed based trading

Tradable permits to emit effluent in water would constitute a source of experience with a high degree of relevance to the DRB.

Watershed based trading, however, is a not very well developed field. Most experience has been made in the USA. However, even in the USA the experience with tradable permit systems for controlling water quality is limited[5].

Among the sources of information used to identify relevant programmes, the OECD database for 'Policy instruments used to address Water Pollution'[6] has been used. A large number of implemented regulations are listed, primarily using fees and charges, in addition a few tradable permits systems were listed:

- Tradable phosphorous discharge rights Dillon Reserve, Colorado, US
- Tar–Pamlico River nutrient trading scheme, North Carolina, US
- Lower Fox River Trading Scheme, Wisconsin, US

These have been included in the programmes described below. The other water-based programmes described have been identified from other sources of which the USA EPA[7], Environomics[8] (in consultancy for EPA) and Resources for the Future[9] are the most important.

5.2.1 *Dillon Reserve*

Dillon water reserve is the major source of water for the city of Denver in the USA. The reserve was under pressure from nitrogen and phosphorous loading, which increased eutrophication in the reserve. The loading originated from both point and non-point-sources, and the point sources were controlled to best-available technological standards according to the US EPA.

In response to the threat the Colorado policy makers and private stakeholders developed a point–non-point source control programme to reduce the phosphorous flow, mainly from non-point urban and agricultural sources. The programme was implemented in 1984 and was the first point-non-point effluent trading programme in the USA[10]. The programme allowed publicly owned sewage treatment works to finance the control of non-point sources in lieu of upgrading their own treated effluents to drinking water standards.

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[5] Robert Stavins: Experience with market-based environmental policy instruments, Resources for the Future, Washington, November 2001, page 23
[6] http://www1.oecd.org/scripts/env/ecoInst
[7] http://www.epa.gov
[8] http://www.environomics.com
[9] http://www.rff.org
[10] Environomics: A Summary of US Effluent Trading and Offset Projects, prepared for Dr. Makesh Podar, UA EPA, Office of Water, November 1999, page 8

According to estimates from EPA the programme could save as much as $1 million per year, because the marginal cost in the sewage treatment facilities were higher than the cost of controlling a similar emission from non-point sources. The set up is similar to the Cleaner Development Mechanism in the Kyoto protocol, and it addresses the inherent problem of non-point sources that these cannot act meaningfully on a market, because they are not identified as potential economic actors.

One way of initiating projects in the Dillon case is that the administrations of the sewage treatment plants are positioned to make decisions on behalf of non-point sources in accordance with their best knowledge. The result is that a lower cost solution than the straight forward control of the point sources is attained, because the sewage treatment plants will choose to implement only solutions in abatement of non-point emission, if these solutions are less costly than abating in plants themselves.

The cost efficiency is limited to the knowledge available to the stand-in for the non-point source polluters, and for instance even lower cost abatement attained by changing the production methods in agriculture would not be identified. It should be noted also that this solution did not involve co-operation from the non-point sources on their own behalf, and probably higher awareness in this group is therefore not supported.

The solution comprise some difficulties in monitoring and control, it is necessary to establish a baseline for the concerned non-point polluters (as a group for example) have this certified, and thereafter implement abatement and have the impact of abatement monitored/certified.

Another way is that a group of citizens, based on for instance non-point polluters in a geographical area, go together and implements abatement in order to earn credits, which then can be sold to the point sources, sewage plants, and thus save them from installing additional treatment. The requirement for this approach is that the regulation comprises non-point sources and that a solution is found to monitoring and enforcement similarly to the other solution. Another possible incentive could be that the group of citizens had the expectations that credit earned could be sold at a profit, and that this could be sufficient glue to keep the group together and raise necessary capital.

In this approach the knowledge of the participating non-point polluters may be activated and the lowest cost may be attained for a specific amount of reduction in emission.

Two completed trades have been implemented, involving the terminating of household use of septic systems and connecting them to a Treatment Plant. In addition ten projects have generated credits and banked the credits for later use, the projects included collection, detainment and filtration of surface and subsurface storm water, which reduces both sediments and phosphorous.

One treatment plant has accumulated credits in order to allow for increase in discharge from another plant. This arrangement has not been approved because the programme did not include point to point trades

There were a number of reasons for the few projects implemented,

- The cost of additional treatment in the sewage plants turned out to be smaller than expected.
- Other measures were taken to reduce emission from non-point sources.
- A period of relative high regional precipitation diluted the concentrations in the reservoir[11].

The environmental objective thus was met by other means (up to 2000), and perhaps the main effect of the programme was that it forced the treatment plants to find lower cost solutions for additional treatment in the plants. The programme may become more active when population growth or other factors increases the environmental stress in the reservoir, however, the relatively long period credits had been banked does not indicate strong incentive to implement projects.

5.2.2 *The Fox river* [12]

Fox-Wolf Basin Watershed pilot trading project is being developed with the objective of reducing eutrofication through reduction of phosphorous loadings to the Green Bay.

Both point and non-point sources have been discussed but no trades have been made. It is very likely that trading ratios will be applied, but agreement has not been found. The innovative aspect of the programme is that the contract periods for trade cannot exceed 5 years.

A separate study[13] of the Fox rive programme has been made, in which the inclusion of non-point sources is discussed for instance watershed based associa-

[11] Robert Stavins: Experience with market-based environmental policy instruments, Resources for the Future, Washington, November 2001, page 23
[12] ibid, page 35

tions functioning under a group permit could become one way of facilitating the participation of non-point sources in trading. The monitoring and the aspect of ensuring a firm connection between desired behaviour and the rewarding system is addressed.

5.2.3 *Long Island Sound Trading Programme*[14]

The State of Connecticut is developing a watershed based effluent trading programme for reduction of nitrogen in the Long Island Sound. The trading initially comprises 84 point sources in the Connecticut part of the Sound.

Later non-point sources could be included, but no plans for this have been developed. The perspective is to attain a target for Total Maximum Daily Load, TMDL, within a period of 15 years. It has been calculated that savings by the introduction of trading could amount to 20%, approximately 200 million, over the period of 15 years.

In term of trade facilitation the Clean Water Fund, which is a credit bank managed by a trading association, will buy credits from those who create them and sell to those who needing them. The program may mandate that sources not in compliance must buy credits from the Fund.

The programme has several challenges. The TMDL will depend on other sources than the ones in Connecticut, which perhaps may be overcome by the assignment of permits for the identified sources belonging to the areas covered by the trade association. In this case then methodology for monitoring in addition to the TMDL must be developed. The inclusion of the non-point sources is of importance to the extent that these significantly influence the TMDL.

An exclusive trading between the point sources would probably need the identification of a total emission target for the point sources and a distribution of permits among the sources.

5.2.4 *Blue Plains WWTP Credit Creation*

The Blue Plains project is an example of Joint Implementation by the State of Virginia and Washington DC. The objective is to reduce eutrophication in the Potomac River and Chesapeake Bay by reducing the emission of nitrogen.

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[13] available at http://www.fwwa.org/pdf/WisconTradingFinal.pdf
[14] Environomics: A Summary of US Effluent Trading and Offset Projects, prepared for Dr. Makesh Podar, UA EPA, Office of Water, November 1999, page 9

In Virginia a number of Waste Water Treatment Plants are behind schedule in upgrading facilities to meet the Chesapeake requirements, in order to compensate for this Virginia will pay the cost associated with an expansion of the facilities in the Blue Plains WWTP. In this way the Blue Plains will reduce more than required in the Chesapeake requirements.

The duration of the arrangement is intended to be until the Virginia plants have upgraded their own systems. The arrangement has been researched and it is found that a very inexpensive reduction is actually possible through the arrangement.

According to the plans the arrangement will last for 3 to 4 years until plants in Virginia have been upgraded, and the arrangement could be perceived to be a must for Virginia, since it seems that upgrading cannot be made in time. When the project terminates, there are some concerns about the risk of backsliding in the Blue Plains. As a result of the expansion of the facilities the WWTP is capable of reducing the load of nitrogen to 4.5mg/L, which creates the credits needed by Virginia. However, after the termination the WTTP is not required to continue the reduction and may comply with the standard of 7.5mg/L.

It is not clear how the cost of reduction has been calculated, and it possibly the Virginia State of Virginia could have complied with the standard required at less cost if it had upgraded the WWTP in the State in time for compliance. It is probably correct that the cost of expanding the Blue Plains WWT is substantially below the cost of upgrading old facilities. When this cost is incurred under all circumstances, however, the additional cost of advancing the upgrading two to three years may be less than expanding the Blue Plains.

5.2.5 *Chesapeake Bay Watershed Nutrients Trading Program*[15]

The program is on an early stage of development based on several agreements made over the years by stakeholders, the environmental problem is eutrophication of the bay itself and of the tributaries to the bay. It will be implemented in parallel and/or in continuation of a variety of regulatory regimes already established or under development in the tributaries.

Among the programmes covered by the Chesapeake Bay is the above-discussed Blue Plains, which is unlikely to constitute a problem for implementation of a more comprehensive regulation system. Interestingly the programme comprises

[15] http://www.chesapeakebay.net

efforts covering a very large watershed, in which there will be developed a Bay-wide TMDL in addition to several TMDLs covering tributaries. The trading will potentially comprise inter-state and intra-basin or inter-basin trades.

Development of the programme is presently attempted by a negotiation team with 40 members representing affected stakeholders, and the process of establishing a trading programme through a negotiation process involving all stakeholders is in itself characterised as innovative. Balancing all these interests and developing a trading programme is expected to become difficult.

5.2.6 *Virginia Water Quality Improvement act and Tributary Strategy*

The programme is under development and is part of the Chesapeake Bay complex. The idea is develop trade and other market based incentives in conjunction with the Water Quality Improvement Fund grants. The fund is currently targeting only the Potomac-Shenandoah basin but will be active in other basins. The fund aims to provide incentives for point sources to decrease their total nitrogen and total phosphorous discharges below levels established by the tributary strategy.

An innovative aspect of the programme is thus that credits will be created in part by State funds. The programme is initially intended for only point sources as it has been difficult include a provision for non-point sources for both political and technical reasons.

5.2.7 *Tampa Bay Cooperative Nitrogen Management*

Stakeholders in the Tampa Bay region have formed a consortium composed of federal, state and local governments, regulatory agencies and several private interests. The objective is reduction of eutrophication by reducing the emission of nitrogen.

The consortium has an instrumental objective in the form of complying with a TMDL developed by the Florida Department of Environmental Protection through voluntary participation in order to avoid command and control measures.

It is interesting that the consortium’s institutional set-up resemble trading programmes’, however, the intention is to meet shared objectives of pollution reduction without trading and through voluntary arrangements only. The consortium has succeeded in establishment of consensus on a set of measures, which is expected to establish compliance with the TMDL.

5.2.8 *Cargill and Ajinomoto Plants Permit Flexibility*

At the Des Moines River in Iowa a Cargill plant had a permit to discharge up to the stream's maximum capacity for CBOD. At the establishment of a new Ajinomoto plant an agreement was made between the plants, that the effluent stream from the new plant should be channelled through the Cargill treatment facility.

The arrangement is similar to a JI project, where the participants in cooperation comply with a limit by pooling the effluent, treatment and discharge. The advantage of the Ajinomoto plant was that establishment at all was made possible, the Cargill plant had some benefits from the qualities of the Ajinomoto effluent and also avoided a possible dispute over discharge permits, which could ensue if a case was filed.

The arrangement does not entail exchange of permits and it is exclusively based on agreement between two parties. Monitoring of the agreement is easy in terms of the combined discharge. If disagreement between the parties should occur difficulties may develop, among other things on the monitoring due to the fact that the quality of the effluent of one of the parties actually has a positive effect on the effluent of the other.

5.2.9 *Lower Boise River Effluent Trading Demonstration Project*

The objective of this project is to contribute to the reduction of aquatic growth in Boise River and in the Snake River's Brownlee Reservoir, to which the Boise is the largest source of phosphorous loading. The goal is to establish trading within the TMDL for the Lower Boise.

The project developers include seven Waste Water Treatment Plants, three industrial dischargers and 8 irrigation districts.
Due to the composition of the group developing the project three ratios for trading is considered:

- Delivery ratios, employed for reductions from agricultural sources discharging into a drain to reflect the fate and transport of phosphorous through the drain to the outfall to the river.

- Location ratios, employed for NPDES permit holders and tributaries/drains, in order to relate reduction at the point of discharge to the actual effect at the mouth of the Boise River
- Uncertainty discounts, applied to credits generated by a non-point source practice for which monitoring or actual measurements are impractical or in-feasible, to account for variability in the effectiveness of the practice.

The cost efficiency of the regulation is expected to be much better than for a phosphorous reduction established as a municipal treatment facility, however, the estimates are based on speculation because the project is still on the planning stage.

Development of the project to the present stage has required substantial re-sources, and is characterised as expensive by the participants. There is a notable reluctance among the non-point sources in demonstrating reduction capability, probably because it is expected that demonstrated capability quite easily can be translated into required behaviour.

The differences in ratios have relevance to the DRB setting, where differences in ratios could be dictated both of distance to stream, soil quality and distance in stream to sensitive reservoir.

5.2.10 *Kalamazoo River Water Quality Trading Demonstration Project*

The project is addressing algae conditions in Lake Allegan, by introducing non-point source control measures for phosphorous emission. The activities and ad-ditional measures generate credits, which will be available for purchase by point sources or others that may need them to comply with water quality-based efflu-ent limitations.

The potential participants in the project are non-point sources, the Kalamazoo Wastewater Treatment Plant, a number of paper companies and some NGOs. No trading has been effected yet.

The trading ratios are differentiated according to agricultural practice by the non-point source. For sources falling short of generally accepted agricultural management practices (GAAMP) the trading ratio will be 4 to 1, while those already complying with GAAMP and who implement new pollution control measures receive one pound of credit for each 2 pounds of phosphorous re-duced. In this way the program aims for better management practices, which are sustainable, profitable and highly tailored to each farm.

Among the discussions in the programme has been which baseline to use, GAAMP or another standard.

5.2.11 *Tar-Pamlico Nutrient Reduction Trading Program*[16]

The environmental problem addressed is the eutrophication of Pamlico River estuary by reduction of emission of phosphorous and nitrogen.

There are 14 members of the Tar-Pamlico Basin association and more will be admitted in 2004, the members are point sources in the basin. The Association works co-operatively to meet nutrient caps set by the State. If the Association does not meet the goals it must purchase offsets by paying a pre-set price per pound to the State's Agriculture Cost-share Program for Non-point Source Pollution Control.

The Cost share programme pays subsidies to non-point sources for the implementation of Best Management Practices, and the State therefore takes on the responsibility of securing that the offsets are translated into reduced emission form the non-point sources in proportion to the emission reflected in the offsets. The emission cap is based on a TMDL, which was developed based on an estaurine response model.

A trading ratio of 2:1 is used, which allows for some uncertainty in the emission effect of the BMP introduced. Trading rules were fully developed in 1992.

Apparently the members of the Association have met their collective cap since the start of the programme through improvement of own operational procedures and minor capital investment, two facilities have been equipped with nutritional removal process capacity. In addition the Association has purchased and banked credits for future use, but has not yet needed to use them.

According official statements from the Association, reductions achievable in non-point sources would cost less then a seventh of the cost in reduction from point sources, which makes it difficult to understand the trading effected so far, the statement also could be intended to influence the ratio of trading used.

It has turned out to be complex to quantify the impacts of runoff from animal feeding operations. Imprecise language in trading rule has resulted in a controversy over the cost and duration of the credits that have been purchased.

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[16] hhttp://www4.coastalnet.com/community_orgs/civic_orgs/ptrf/ and http://h2o.enr.state.nc.us/nps/tarp.htm

5.3 Kyoto protocol

The environmental problem addressed in the Kyoto protocol is the greenhouse effect, global warming, believed to be caused by the emission of a number of gases of which the CO_2 is the most important due to magnitude of emission.

5.3.1 *UNFCCC and the Kyoto Protocol*

During the 80ties the problems related to energy consumption including emission of gasses were regularly discussed and in May 1992 the UNFCCC (United Nation Framework Convention on Climate Change), the first international treaty addressing global warming was agreed and came into force in 1994. However, already in 1994 it was realised that the action encompassed in the UNFCCC would not sufficiently affect the emission of greenhouse gases, GHG.

In December 1997 the Kyoto protocol to the UNFCCC was approved, which identified limits for GHG emission in the industrial countries and at the same time proposed a number of market-based instruments, which were assumed/believed to reduce the cost of abatement of the GHG.

5.3.2 *The provisions of the Kyoto Protocol*

Six gases were included in the regulation and an average reduction of 5,2%. Below the 1990 level was decided for the first commitment period from 2008 to 2012. The level, ‘cap’, concerned the industrial countries listed in the ‘Annex B’ of the protocol, while the developing countries were not included under the cap.

The Kyoto protocol will come in force when it has been ratified by at least 55 parties to the agreement and the parties ratifying the protocol must include industrialised countries representing at least 55% of the emission of CO_2 in 1990.

In 2001 USA announced that it did not intend to ratify the protocol. In the same year the mechanisms were negotiated and agreement among the parties to protocol was reached.

The protocol has not yet (May 2004) been ratified by sufficient industrialised countries, and only the ratification by either USA or Russia will bring the percentage of emission covered up to the required level.

The trading/economic mechanisms covered in the protocol include:

- Emission trading
- Joint implementation (JI)
- Cleaner Development Mechanism (CDM)

Emission trading is trade of emission rights between the states in Annex B having an obligation to limit their GHG emission.

Joint implementation comprises implementation of projects (reducing the emission) between countries for which a reduction target has been introduced, while the CDM projects are projects implemented in developing countries without an emission target.

Banking of emission credits for later use is permissible, however, the targets for subsequent periods, after 2012, are not specified. The parties to the agreement have full sovereignty in deciding, which domestic instruments they select for meeting the targets. Also of interest for the DRB the Kyoto contain some ambiguous provisions for the use of sinks, in the form of carbon sequestration (afforrestation).

It is obvious that the protocol has had and still has problems in getting accepted and implemented by the parties. The impact of the pollution is shared by all the parties and it is noted that the reasons quoted for not ratifying seems to be centred on:

- The scientific basis for the control effort, i.e. how strong is the impact of the gases on the global warming and what will be the consequence of the increased temperatures.
- The severity of the burden of abatement compared to the severity of the impact.
- The initial allocation of emission rights, this concerns both the basis of 1990, and the inclusion/exclusion under the cap.
- Questions regarding the fairness of the distribution in accordance with market principles.

As compared to DRB all of these arguments may be applicable, and further it should be added that the DRB would have to cope with the non-sharing of benefits from emission regulation.

5.3.3 *Objective of Kyoto*

The main objective of the Kyoto protocol is the limitation of the contribution to global warming caused by the emission of GHG, in particular CO_2. The scientific discussion regarding the direction and strength of the connection between the GHG and the global warming, and indeed whether (more than 'natural') global warming is in fact happening has been ongoing without very clear consensus on strength at least. At the same time the effect of global warming has been discussed and it is very clear that different parts of the world is likely to be affected differently.

It is probably safe to conclude that the beneficiaries of a successful regulation and reduction of the emission GHG will not be the same as the contributors in all aspects of the impact being avoided. This is an aspect of the political incentive for the parties to the Kyoto protocol, which has to be included in an assessment of the implementation of the protocol.

The similarities with the objectives of DRB are obvious, the regulation of the eutrophication in the Black Sea will benefit some but not all of the contributors to regulation and not in the same way.

On the contribution to emission reduction itself, the Kyoto protocol places a cap on the emission from the industrialised countries, with a calculation base in 1990 and no cap on the developing countries. The rationale behind this is clearly that the majority of the emission is effected by the industrial countries, also historically, and that this has contributed fundamentally to the economic development of these countries. It is not ethically or politically feasible to place a cap on the developing countries, and in case this should be suggested the cap could not bed based directly on historical emission in the developing countries.

The application of the Polluter Pay Principle is in the Kyoto complex of thought extended to include a temporal dimension. Those emitters, who have over a long period benefited in terms of economic growth from emission of GHG, should now compensate those who have not emitted and thus not had the benefits from economic growth.

It is a question whether this particular interpretation of the PPP is politically feasible in the Kyoto context. The non-ratification from USA, both presently and historically the largest emitter of GHG, could indicate that PPP interpretation cannot not be extended that far, or that the compensation, which is implicit in the Kyoto protocol has to be negotiated.

The similarity to the Kyoto setting again is obvious, however, the scientific clarity regarding the effect of historical emission in terms of enduring impact on the eutrophication is probably less clear than in the case of the impact of CO_2 on the global warming.

5.3.4 *Pollutants*

The Kyoto protocol is addressing reduction of 6 GHG of which CO_2 is the most important. The other GHG include methane, CH4, nitrous oxide, N_20, hydro-chlorofluorocarbon, CF_4, perflucarbon, HCFC-22c, and sulphorhexaflouride, some of which have a stronger specific greenhouse effect, but occur in much smaller quantities than CO_2. The protocol includes recognised factors establishing a common unit, CO_2 equivalent, at the end.

5.3.5 *Initial allocation*

Initial allocation in the Kyoto protocol is based on national quotas allocated to the industrial countries corresponding to a level 5.2% on average below the 1990 level of emission. The reduction is covering a period from 2008 to 2012 and it is agreed that negotiations on reduction targets for the following period should start at the latest in 2005.

The allocations are national and the protocol explicitly provides for national sovereignty regarding domestic distribution of permits and also which instruments to use for the regulation.

The developing countries are not included under the cap but are expected to be partners in arrangements using the CDM. In order to do so the countries are required to establish baseline studies in which the present level of emission is documented. These baseline investigations could at a later stage serve as basis for regulation.

5.3.6 *Joint Implementation and Cleaner Development Mechanisms*

Joint Implementation, JI, refer to investment resulting in additional CO_2 reduction in a project, where the investor resides in an industrial country and the project is situated in country, which has an emission target. The investor will receive reduction credits created by the project, and this in effect is the rationale behind the project. Implementation of the project will change the cap for the two involved countries, the cap of the investor country will increase, while the cap for the host country decreases.

A project under the Cleaner Development Mechanism is similar, but the host country is a developing country without an emission target.

Whereas emission trading between industrialised countries has the clear objective to facilitate on a national scale lowest cost compliance, the JI and CDM also have the perspective of supporting the transfer of technology and support growth in the countries hosting projects. Especially the CDM is seen as a source of development for the host countries.

There is both classification and monitoring problems in the two types of trade, which partly is related to the use of the terms additional. It is a requirement that the reduction in CO_2 is one that would not have happened without the project, which of course is a difficult phenomenon to define completely. This problem is more prominent in the CDM arrangements, because the host country does not have an emission target, and therefore the transfer of emission rights to the investor country is not accompanied by the surrender of emission rights in the host country.

JI and CDM represent examples of establishment of trade, which can support the recipient in attaining objectives in addition to the environmental objective, which can make international agreements possible and also pave the way for a long term inclusion of all parties in an agreement. The inclusion of the developing countries in the Kyoto protocol as countries without an emission target can easily be seen as a precursor of establishment of emission targets for these countries at a later time.

Although this is contested by the developing countries, the need to establish a baseline in order for projects to qualify for CDM will also serve as an element in future discussions of emission targets for the involved countries.

5.3.7 *Economic efficiency*

The economic efficiency cannot yet be assessed based on empirical evidence.

Some analyses of the Kyoto protocol regarding its potential for providing economic efficient regulation of the emission GHG has been made. In particular the relationship between the trading internationally and the domestic systems is of interest seen from the DRB point of view.

Some principal considerations have been published in an interesting discussion paper[17] in which it is found that the Kyoto in itself does not provide for economic efficiency. The central observation is ‘ although the Kyoto protocol *can* provide for an internally consistent international tradable permit program, a fully cost-effective international emission trading program is not compatible with the notion of full domestic sovereignty regarding instrument choice’.[18]

The paper points to the fact that trade in the Kyoto in itself does not provide for cost efficiency, because the parties to the protocol are free to decide on their own, which domestic instruments they will implement. A number of combinations of instruments are then examined, and it is found that for the majority it is necessary to supplement exchange of quotas with other instruments such as project to project exchange, Joint Implementation arrangements.

It is further observed that the transaction costs involved in JI can become quite high and for this reason this may not be an obvious mechanism for the governments and enterprises to make use of.

It is also observed that the exchange of international allowances will be based on exchange between governments. Firstly the governments may not have economic efficiency as a prominent objective and secondly if domestic regulations does not include tradable permits the governments may not be in possession of the knowledge needed to establish economic efficiency.

The same is principally the case for the JI and CDM, because the exchange of credits will happen on national scale, since only nations can commit themselves to the agreement, private companies cannot do so.

For both trading and JI and CDM, however, the participating nations may choose take the role of endorsing only what buyers and sellers, with adequate knowledge of their respective cost, decide. In this way economic efficiency may be realised, at some possibly substantial transaction costs.

5.4 European Union greenhouse gas emission allowance trading scheme (ETS)

[17] Robert Hahn and Robert Stavins: ‘What has Kyoto Wrought? The real architecture of International Tradable Permit Markets’, Resources for the Future, Washington 1999
[18] ibid p 2

The ETS is established in EU Directive 2003/87/EC and is directly affiliated to the Kyoto Protocol in terms of representing an initiation of regulation of emission of CO_2 for the period 2005 – 2007. From 2008 to 2012 the ETS targets are in conformity with the Kyoto obligations.

The ETS can be seen as a bubble construction under the Kyoto protocol, and it will provide binding regulations for the member states as to both targets and instruments for regulation. The member states will pass the obligations to the owners of the relevant installations

All energy production facilities with a capacity above 20 MW and very energy consuming industries in metal, mineral, paper and offshore activities are covered by the ETS. It is estimated that these facilities and industries in total are responsible for just below half of the emission of CO_2 in EU.

Enforcement of regulation is established by charging for emissions without permit in the magnitude of 40 Euro per ton CO_2 in the first period and 100 Euro per ton CO_2 in the second period. In addition to this the emitter will have to provide permits of the surplus emission in the following year. It is assumed that these charges will effectively be prohibitive for surplus emission.

For the not covered industries and facilities, the directive prescribe, that regulation should be effected in all sectors of the economy. In particular the transport sector and the housing sector should contribute significantly to with the ETS obligations.

5.4.1 *Initial allocation*

The member nations of the EU are obliged to elaborate a National Allocation Plan, NAP, in which allowances to the installations are distributed. The plan was to be submitted to the EU Commission before the beginning of April 2004 for the 15 old EU countries and before beginning of June for the new EU countries. The NAP must be in conformity with approximation to the Kyoto obligations for the first period 2005 – 2007 and in conformity with the obligations for the second period from 2008 to 2012.

In this way the countries are carrying over their Kyoto obligations in the bubble, so the EU as bubble will be responsible for the overall compliance of the sum of Kyoto obligations, and the individual countries will be responsible for their respective Kyoto obligations to the EU.

Based on a preliminary analysis of some of the NAP, it seems that rather liberal allocations to the concerned facilities have been given. This cannot be determined exactly, since the covered facilities are responsible for less than half of the emission and the obligations will be shared with the other emitters. The NAP shall take into consideration cleaner technology. The NAP must also specify how newcomers will be accommodated, which is an issue to all regulation involving a cap, including nutrient regulation as in the DRB.

The permits shall be distributed to the facilities without charge, however, 5% of the total permit-stock in the first period and 10% in the second period can be auctioned and the revenue collected by the government.

5.4.2 *Trading*

Trading shall be an integrated part of the policies and action in pursuance of the Kyoto obligations and under similar conditions. With a status as a bubble under the Kyoto protocol, however, the EU countries may let private market actors from different countries trade between themselves without the endorsement from national authorities of each individual trade.

In addition the Joint Implementation and Cleaner Development Mechanism arrangements can be used in the total package of actions a government implements for the regulation of emission of GHG. The magnitude and conditions under which these mechanisms will be allowed under the ETS has not yet been specified.

The specification will be directed in a separate directive, the ‘links’ directive.

5.5 Experience with the Acid Rain Program

The US Environmental Protection Agency (US EPA) is administering an Acid Rain Program with a homogeneous tradable instrument, the SO_2 emission allowance. The system is established under Title IV of the 1990 Clean Air Act Amendments and was established to achieve reductions in the emission of Sulphur dioxide (SO_2) and nitrogen dioxide (NO_x), which are the primary causes of acid rain[19].

5.5.1 *Clean Air Act*

The history of the Clean Air Act has a bearing on the way the Acid Rain Program was designed and provides some lessons of relevance for regulation of

[19] http://www.epa.gov/airmarkets/arp/allfact.html

nutrients in the DRB. The Act established national air quality standards in 1970, and covered major pollutants such as sulphur dioxide and ozone and less common pollutants such as benzene. The responsibility to implement action plans to meet standards were placed on the states. The plans (State Implementation Plans, SIPs) were approved by EPA, and in the SIPs firms were required to meet certain maximum emission levels for the regulated pollutants.

By mid seventies it was clear that many states would not achieve the air quality targets within the timetable originally set, and Congress empowered EPA to refuse permission for new pollution sources in areas where the national pollution standard had not yet been met.

This created a conflict between environmental policy and economic growth, which formed the basis for the first implementation of tradable pollution permits in the USA. For the initial allocation grandfathering was used, in this way an income effect associated with an adoption of a pollution charge system was avoided. Taxation had proved impossible to impose despite strong lobbying for this from the EPA.

An offset system was introduced in 1977. This allowed new sources to establish in areas, which has not yet attained the national standard by offsetting their own emission against a reduction of emission by an existing source. The reduction is documented in an ‘ emission reduction credit’, which reflect a reduction, which is permanent, enforceable and quantifiable. An exchange rate is introduced requiring 120% credit for a new source.

Other elements refining the policy are introduced, such as a bubble policy 1979, by which existing sources could offset its control responsibility through credit, or by internal offsetting in the same firm with multiple emission points. Also banking of credits is introduced, which will allow a source to save credits for future use.

The history shows a gradual development of trading preceding the SO_2 Allowance Program in 1990 and the details of this programme and its sophistication perhaps would have been impossible to introduce/have accepted without this prior development.

In connection with the 1990 Amendments to the act the existing scheme was analysed and assessed, and there seem to be a general consensus that the scheme resulted in substantial savings to some of the participants. It is notable that the savings are financial saving to individual entities and not economic savings to the society as such, and some observers see the high transaction costs involved in the scheme as both an economic cost and also a reason for a lower than expected volume of trading[20].

5.5.2 *The initial allocation system in the Acid Rain Program*

Every major fossil fuel-burning electricity production facility in the United States fall under Title IV of the Clean Air Act Amendments. The facilities, units, are allocated annual allowances under the SO_2 Allowance Program based on their historic fuel consumption (1985-1987) and a specific emission rate.

Two phases of the program has been implemented, in the first phase the specific emission rate was 2.5 pounds of SO_2/mmBtu (million British thermal units). The first phase lasted to 1999. In the second phase, which began in 2000, EPA expanded the group included in the programme and tightened allocation, setting a specific emission rate of 1.2 pounds of SO_2/mmBtu and at the same time a cap was placed on the allowances at 8.95 million.

The placing of a cap corresponded to a total emission of 8.95 million tons of SO_2 annually, which corresponded to the mandated emissions reductions. The system is a ‘cap and trade’ system, where the initial allocation of allowances are grandfathered. The system then is developed in phase two with a significant reduction in allowances in phase 2.

5.5.3 *The allowances*

An allowance authorises the emission of one ton of SO_2 in or after one specific year. The utility is required at the end of each year to hold an amount of allowances at least equal to its annual emissions. It should be noted that irrespective of the amount of allowances that a particular utility holds, it is never entitled to exceed the limits set under Title l of the Act to protect public health.

In consequence the emission of SO_2 is restricted by more than the Clean Air Act, which is using TP. In this case particular and different restriction on different utilities restrict their emission as well and thus also restrict the free use TP.

Allowances can be obtained in addition from three reserves held by the EPA. During phase one additional allowances could be obtained by installing technology, which removed at least 90% of the units SO_2 emissions. A second reserve is

[20] this historical description is primarily based on Hanley, Shogren and White: Environmental Economics, in theory and practice, Macmillan Press Ltd, London 1997

used as incentive for units achieving SO_2 emissions reductions through customer oriented conservation measures or renewable energy generation. The third reserve contains allowances set aside for auctions sponsored yearly by EPA.

Units that began to operate in 1996 or later are not allocated allowances, instead they have to purchase allowances from the market or from the auctions.

Allowances are traded by any individual, corporation, governing body, broker, municipality, environmental group and private citizen. The primary traders are owners and operators of electric utility plants.

5.5.4 *Facilitation of trade*

EPA is maintaining an Allowance Tracking System, ATS, which records:

- Issuance of all allowances
- How many allowances an account holds
- How many allowances that are held in various reserves for auction etc
- Deduction of allowances for compliance purposes
- Transfer of allowances between accounts

EPA establishes accounts for affected utility units. Each **unit account** consists of a compliance sub-account for allowances that may be used for compliance in the current year and sub-accounts for allowances to be used in future years.

Any person or group, including brokers and investors wishing to purchase allowances may open a **general ATS account**.

Compliance is monitored by the EPA. To cover their emissions for the previous year, units must finalise allowance transactions and submit allowances to EPA by March 1. EPA will clear the accounts and carry forward surplus allowances. If emissions exceed allowances for a unit it will be penalised and must surrender excess allowances the following year. The penalty amounts to $2,000 per ton of emission.

5.5.5 *Analysis of system*

The similarities with the conditions of DRB are many. There is an environmental objective, which is formulated in terms of air quality standards over a large area, and the beneficiaries may not always be the same group, which has to contribute to (suffer under) the regulation. This is a reflection of the fact that the SO_2 is a non-uniformly mixed pollutant and it should be noted that despite this, the trading still is executed at a 1:1 rate irrespective of the origin of the allowance. In order to protect specific areas, the corresponding amount of allowances to the actual emission of a unit is considered necessary but not sufficient condition for the authority to emit.

The instrumental objective comes up in terms of providing the positive impact from pollution on the lowest cost, and especially the political and distributive implications seem to influence the choice of instruments, their design and the need to gradually develop the regulation.

A large share of the 'trading' occurring takes place internally within firms, and it is estimated that very substantial savings have been realised. It is also noted that the cost of monitoring is high, and that this has eroded to some extent the savings realised.

In 2000, when the second phase of the programme started the volume of trading increased, this would be expected since the allowance allocation to the existing units decreased as a result of the decrease in permitted emission per Btu. Prices of allowances did not increase until 2001, and then only up to the level realised in 1999. Later prices dropped gradually in 2001 and 2002 for from 2003 to increase at much higher speed and in the first quarter of 2004 the price is more than double of the price in 2000 when the second phase started[21].

The price development and the increase in volume of trading could indicate that the trading system works as intended, that the units increase trade when regulation is tightened in order to postpone more costly abatement to a later stage. The price increase could be a reflection of the fact that less costly abatement now has been fully utilised, and that the more costly measures are the only alternatives for the units, and therefor their willingness to pay higher prices for allowances increase.

Other explanations of the movements on the market are possible, for instance an increase in production level generally would tend to have the same effect as seen on the market.

Investigations indicate that a robust market has appeared with a continued increase in trade, and with an estimated cost saving of $1 billion annually, compared with the cost under some command and control regulatory alternatives[22]. The increase in volume of trading is given significance, both because the initial

[21] prices and volumes from http://www.epa.gov/airmarkets/trading/so2market
[22] Robert Stavins: Market based Environmental Policies: What can we Learn from US experience (and related research)?, Resources for the Future, Washington, August 2003, page 6

trading in the early years seemed low, lower than expected, and because the volume of trading is a clear indication of (incidences of) savings being made.

From an economic point of view it is important to note also that the regulation has given very large benefits outside the original target problem, acid rain. These benefits are due to positive human health impacts of decreased local SO_2 and particulate concentrations. For the assessment of trading systems compared to command and control it must be expected that the same benefits would be the result of a successful command and control regulation.

An issue of interest, however, is the scepticism regarding the degree of freedom granted in the trading to the units of choosing between abatement and procurement of permits. The concrete result of this is legislation passed by the New York State legislature and signed by the Governor in May 2000[23]. The legislation prevents the electric utilities in New York State from selling surplus allowances to sources in upwind states, such as Ohio. The legislation was driven by the concern that the emission trading programme was failing to curb acid deposition in the Adirondacks in northern New York State.

There are two aspects of the legislation. The is first whether the concern is based on correct assumption, which is less interesting in the DRB context, it is suggested that the assumption is incorrect if the comparison is made with a situation without the Clean Air Act Amendments. There may be marginal increase in acid rain as a result of trading in continuation of the 1990 permit allocation, however, the increase is small[24].

The second and more interesting aspect is that an overall trading arrangement is supplemented by local legislation, which reduces the degree of freedom for the emitters to distribute the burden of abatement, and thus reduces the prospect of attaining economic efficiency.

In the concrete case it is questionable whether the environmental problem, slightly increased acid rain as compared with command and control regulation, justifies large losses in efficiency. In general it is probably necessary to include in large regulation schemes using tradable permits, measures to decide on possible conflict between conflicting objectives for sub-areas covered by the scheme.

[23] Robert Stavins: Experience with market-based environmental policy instruments, Resources for the Future, Washington, November 2001, page 28

[24] in addition to the effect on acid rain, it is actually expected that the ban on upwind trade will increase SO_2 and particulate emission inside New York State with loss in welfare in health as a result.

5.6 The Reclaim Program

The Regional Clean Air Incentives Market program was launched in 1994, covering a four county areas in southern California has addressed the issue of objective conflict by introducing a general rule not permitting trade from downwind to upwind sources.

5.7 General experience in OECD

An important source of information is OECD. The member countries in OECD include the USA, a large number of European Countries (including some of the Danube countries), Australia and a few South American and Asian countries. The OECD thus covers all of the countries specifically referred to in the ToR for this study as targets for investigation.

In a study [25] published by the OECD in 1999 a large number of observations and lessons learned are summarised, which are relevant for the present study. In order to take advantage from the study the following summary of the findings is presented.

In the study a fundamental advantage of Tradable Permits, TP, is emphasised, that the TPs achieve cost-effectiveness in the allocation of abatement effort, and allows the emitters to save abatement cost (TP buyers) or profit from over compliance (TP sellers). The study also qualifies the observation in terms of stating that cost-effectiveness may not be what is searched for. Politicians could be searching for tools, which convince the voters that something is done, and the polluting industry may be more interested in maintaining a public image of being a ‘green industry’.

In addition a large number of specific lessons learned of relevance to the Danube are referred in the study:

- Tradable Permits, TP, remain somewhat controversial, also in USA with a relatively long history with the tool.
- For air pollution abatement systems it seems that new systems, i.e. new comprehensive systems, have more political support than gradually devel-

[25] Implementing Domestic Tradable Permits for Environmental Protection, OECD 1999

oped systems, which for instance start up as ‘bubbles’ and then gradually develops into more complex trading systems.

- For trading in the water sector the opposite experience has been noted, that TP systems are more acceptable, when they are based on pre-existing regulatory and institutional arrangements.

- There are two broad types of TP, those based on emission reduction credits (ERCs) and those based on ex ante allocations (‘cap and trade’). The cap and trade systems seem to be more easily accepted than the ERCs according to experience in the USA. The reason could be that the baselines needed as a reference point for calculation of credits are difficult to negotiate.

- The initial allocation of permits to individual emitters/users is a critical task. In virtually all application ‘grandfathering’ has been used despite a theoretical preference for auctioning. At the same time a great variance in the approach ‘grandfathering’ has been observed in which are large amount of conditions are considered in the elaboration of initial allocation.

- Auction is suggested still to play an important role as a supplementary allocation tool. The consideration is that it has been observed that the actors on behalf of the emitters often are technically responsible employees. They may not have the necessary knowledge of the cost of the emitter (marginal abatement cost) and for this reason the introduction of an auction for even a smaller part of the permits may help in revealing this information for the participants.

- Water use and water quality has less often been controlled using TP. The reason is that water is heavy, which increases transaction cost and therefore water can often only economically be traded in the downstream direction. This is similar to the notion that the effect of abatement theoretically only has downstream beneficiaries. As long as the concern of the upstream emitters include the effect downstream, for instance within the same region or nation, the notion is weakened. This particular notion does take importance when transboundary pollution is considered.

- For water pollution the use of TP was found to be constrained in cases where not only the load mattered and distribution over space and time of the pollutants also mattered.

- In the theoretical literature the risk of strategic manipulation by market participants, who seek monopolistic power and profit seems not to exert a problem in any of the applications researched.

- The issue of accommodating newcomers into a TP system initiated through ‘grandfathering’ seems to be have been addressed through the establishment of a small initial allocation in public hands and letting new comers buy permit from other emitters. The practical experience points to the conclusion that there is no need to special access privileges to newcomers.

- Not surprising it is found that a prerequisite for a successful TP is that the enforcement of regulation is credible.

- It is found that businesses tend to prefer a TP system to a taxation system, because it means lower cost to the businesses provided the initial allocation is arranged through ‘grandfathering’. In this context the fact that the businesses actually increase their assets with the value of the permits plays a role for the businesses. Note that this increase is compared to a situation where for instance taxation is used rather than to a situation where the businesses remained unregulated.

- In one particular instance the asset value increase resulted in large windfall profits, the example is the ozone depleting substance (ODS) quota, in which the CFC producers and importers were expected to receive large profits, which were considered socially unacceptable and therefore charged away by the US congress. It is note worthy that this one of few examples in which the TP and taxation tools are used in combination.

- While the TP approach seems to be preferred in the US by businesses the opposite seems to be the case in Europe.

- Among the reasons for this difference is the extensive body of regulation already existing in Europe. For instance it is considered that the principle of Best Available Technology (BAT) and TP are incompatible. The reason being that the BAT tends to equalise the technologies, while TP attempts to equalise the cost of abatement effort across emitters, leaving the choice of technology to the emitters themselves.

- Most TP programmes in the US related to air pollution have included banking, which has provided additional flexibility in the inter-temporal abatement effort, and also increased the economic benefit by reducing the tendency to large shifts in permit prices.

- In the US RECLAIM programme it proved possible to combine small and large emitters in the same TP, by introducing different monitoring regimes, For the small emitters they were given an opportunity to participate in the TP through a system of estimates, based on proxies. It should be noted that this occurred in a setting with a generally high level of environmental controls to which the TP system was added.

- It was found that there is a trade off between the increased efficiency generated by increasing the size of a TP market and the risk of creating local environmental hot-spots as a result of trading. In addition to solving this problem through restriction of the size of the market approaches involving two tiers of environmental regulation were observed, In the US SO2 programme there is no geographical constraint for trade, but sources are subject to additional local regulation or constraints. This means in practice that holding an appropriate number of SO2 allowances is a necessary but not sufficient condition for emitting.

- In particular from the TP-based land-use management programmes it appears that the stability of local zoning is imperative for the functioning of the TP. This underscores the fact that successful implementation of the TP scheme usually depends on the adequacy of the wider institutional framework in which the system must operate.

In OECD the study was followed up by workshops in which inter alia the reluctance in Europe to adapt TP in comparison with the USA has been discussed. It was found that:

- Key stakeholders should perceive that improved efficiency is likely to be an important part of the solution to the environmental problem addressed;
- The responsible regulatory authority should optimally have to bear some of the cost of not resolving the environmental problem;
- Key stakeholder should be convinced that it is hard to solve the environmental problem by simply amending the current command system;
- Key stakeholders should be convinced that the TPs can actually provide a solution;
- Key stakeholders should be able to form a coalition in order to advocate a policy change;
- The emergence of a strong opposition should be avoided;
- TPs should be perceived as being consistent with the social philosophy prevailing in a given region.

These observations will be followed up in the chapter on analyses together with the findings from other sources and more recent findings. It is worth noting that the study was very comprehensive and that it covered the complete field of relevant experience for the DRB

6. OTHER ECONOMIC INSTRUMENTS

Apart from the tradable permits for emission described above some other market based instruments[26] are available:

- Pollution charge systems, in which a tax on the amount of pollution is assessed.

- Market friction reductions, including
  - creation of markets for inputs/outputs associated with environmental quality, and thus facilitate voluntary exchange of rights,
  - liability rules that encourage firms to consider the potential environmental damages of their decisions,
  - information programs, such as eco-labelling.

- Government subsidies, mirroring the charge system mentioned above, however in practice often promoting economically inefficient and environmentally unsound behaviour.

Considering the DRB setting the main field of interest would be charge systems, primarily effluent charges. The charges are often called Pigouvian tax, and have the twofold objective of reducing the use of harmful production factors and assessing a tax on these factors, which correspond to economic value of the harm caused by using the respective factors. The tax would in this way reflect external cost of an action, which is caused to the society but not covered by the producer.

A number of countries have implemented emission fees to reduce air pollution, it should be noted, however, that most of the charges are assessed on input proxies, possibly because of monitoring and enforcement costs. This is of relevance to the major problem experienced in the DRB with the non-point sources.

[26] 'Market based instruments are regulations that encourage behaviour through market signals rather than through explicit directives regarding pollution control levels or methods' Robert Stavins: Experience with market-based environmental policy instruments, Resources for the Future, Washington, November 2001, page 1

6.1 Effluent charges in Western Europe

In particular carbon charges have been used in a number of OECD countries, including the Nordic countries, however, a variety of exemptions have made effective carbon charge rates lower than the nominal rates and created some scepticism regarding the efficacy of these policies. There seem to have been also some mix between the idea of regulating behaviour through taxation and then creating a revenue source for the government for instance in Italy, which has contributed to the scepticism regarding the effect in terms of regulation.

Other areas where charge has been used is regulation of sulphur and nitrogen oxide, in both fields Sweden has had success in regulation through taxation. For the nitrogen dioxide the tax is revenue neutral, the taxed entities, Energy Plants, with a production of more than 25GWh, were taxed in the magnitude of 5$/kg on emission and received rebates in proportion to energy output.[27]

Using revenue neutral taxation addresses the problem of the ‘dead hand of tax’, which in short means that assessing a charge on emission may regulate behaviour, however, since the permissible emission is taxed, the level of production is affected. The general level of cost in executing the production increases, and the level of activity therefore is expected to be lower than in non taxed activities resulting both in lower general economic activity than what could have been realised and a bias away from the taxed production towards non-taxed production.

Revenue neutral taxation in the Swedish NO_x tax funnels the proceeds back to the taxed industry by giving a subsidy on the finished product produced by the industry. The industry should be able to maintain the production at a level corresponding to non-taxed production conditions, and the abatement or alternative production methods are promoted by increased cost of the production factors emitting NO_x.

In terms of regulation the authority may sharpen the selectivity of the tax instrument. In the concrete case, the revenue generated by taxing the NO_x emitted by large energy plants may be funnelled back to energy production as subsidies to produced energy from hydro-power, wind generated power etc. In this way the efficacy of the combined tax and subsidy is increased either potentially re-

[27] Robert Stavins: Experience with market-based environmental policy instruments, Resources for the Future, Washington, November 2001, page 8

ducing the emission of NO_x further or leaving room for lower taxation, which could make the instrument more politically attractive.

Effluent charges have also been used for water pollution, one of the most extensive experiences is found in the Netherlands, where organic water pollution had reached an unacceptable high level in the late 60ties[28]. The Government responded with the Pollution of Surface Waters Act (PSWA) in 1970, which prohibited unlicensed discharges into surface water and imposed charges on pollution emissions.

All sectors in the society were assessed for discharges, some in accordance with estimated discharge, comprising households both urban and farm and small enterprises. Medium enterprises were assessed based on engineering model estimates and large enterprises were directly measured for emission.

Initially the revenue from the tax was directed at construction of waste water treatment facilities, and the level of charge escalated as the construction cost of facilities mounted. The charges grew to a level where the industry found that their marginal abatement cost was equal or lower than the charges resulting in very significant response in terms of pollution reduction

The overall experience in terms of abatement is that the tax was very successful. In the 20 years period from 1970 to 1990 total discharge was reduced to less than half[29]. The level of charge provoked a market based adaptation on the part of industry in terms of increase in abatement and the proceed from the tax was used for treatment plants, which reduced pollution into surface waterways even further.

The response to the tax, however, is apparently only or mainly to be found on the side of the industry, where changes in behaviour meant savings on terms of tax burden. The private households did not reduce their discharge of nutrients in the same period. The observation points convincingly on the fact that incentives to behavioural change require a vehicle for measuring and responding to the observed change from the authority. In this case the arbitrary assessment of tax based on assigned standard pollution units could not serve this purpose, and the desired behavioural change did not occur.

[28] World Bank: Greening Industry, New roles for Communities, Markets, and Governments, Washington/New York, 2000
[29] ibid page 38

Both in Germany and France similar charges systems are implemented in which the revenue from the charge is earmarked for pollution control programmes and water infrastructure investments.[30]

6.2 Effluent charges in Eastern Europe

In Eastern Europe a number of effluent charge systems exist, however, few are considered effective. In Poland an emission fee system for airborne pollutants increased its charge level dramatically in 1991 in order to maintain a charge level, which could influence behaviour. The fee system is one of few systems, which utilise a basic flat fee rate supplemented with a rising penalty charge for higher emission. This method, rising block tariffs, is often used in water supply, in order to satisfy a number of requirements, including serving basic demand, water conservation, and the need for revenue in the supply institution.

A number of reasons for the ineffective charges in Eastern Europe can be listed:[31]

- Legislated charges have been significantly eroded by high inflation that has accompanied transition.
- Charges typically have been set below marginal abatement costs.
- Pollution limits – the point at which emissions are charged at a penalty rate – are typically set too high to influence firm behaviour.
- Tax rates are often the result of implicit or explicit negotiation between industries and state or regional governments.
- Many countries set upper bounds on pollution charges liabilities.
- Unprofitable businesses are often exempted.
- Regulatory systems are insufficient to support adequate monitoring and enforcement.

It may be concluded that while the charges do not induce abatement for the listed reasons, they do raise revenue, which can be used for environmental projects, and the my also contribute to an increasing understanding of the 'polluter pay principle'

[30] Robert Stavins: Experience with market-based environmental policy instruments, Resources for the Future, Washington, November 2001, page 8
[31] Robert Stavins: Experience with market-based environmental policy instruments, Resources for the Future, Washington, November 2001,

6.3 Effluent charges in other countries

A number of other countries have utilised effluent charges, typically, however, at too low levels to induce behavioural change.

In China effluent charges are levied on 29 pollutants in wastewater, 13 industrial waste gasses and various forms of industrial solid and radioactive waste. The charges are often lower than marginal cost of abatement, for instance for SO_2, the charge should be increased fifty times to equalise marginal abatement cost and marginal social damage respectively[32]. The charges are used to raise revenue, which finances environmental investment, 80%, and the rest finances administration and monitoring[33].

Charges are used in other countries in Asia and in South America, while in the USA the Pigouvian tax is best reflected in a charge system for household solid waste collection, in which the incremental cost of collection and disposal is charged. Several of the charge systems make use of a national standard for the effluent and only when discharge is above the standard a charge is levied, which then is determined based on the cost of treatment.

6.4 Reducing market frictions

In order to make market better suited for environmental protections market creation for inputs/outputs associated with environmental quality can contribute to market based actions in favour of environment.

The main examples are within water allocation and electricity supply. In the western states in the USA cross-market sales of water is promoted in order to transfer water from agricultural use to domestic water supply. The perspective is to avoid the construction of new environmentally disturbing infrastructure in the water supply by moving water from low value use to high value use across the traditional market barriers. Similar actions are taken in Colorado, where differences in market transfer prices have been from $0.06 per cubic meter up to $65 per cubic meter.[34]

[32] World Bank: Greening Industry, New roles for Communities, Markets, and Governments, Washington/New York, 2000
[33] Robert Stavins: Experience with market-based environmental policy instruments, Resources for the Future, Washington, November 2001, page 9
[34] ibid page 34

In USA in the energy sector sales across previous utility company borders have contributed to more flexible supply conditions and thus lower environmental disturbance from electricity generation.

In the Scandinavian countries the co-operation between companies in the electricity generating sector, utilising a common electricity marked 'Nordpool', has resulted in a better utilisation of renewable energy sources, mainly hydropower, which has enabled reduced utilisation of large coal fired generation plants. At the same time the co-operation has postponed or reduced the need to install additional hydropower dams and facilities, because the large coal fired plants could be started up in periods of low precipitation and scarce hydropower.

6.5 Information Programmes

The main examples of information as a factor in market based environmental regulation is the increasing use of eco-labelling, which foster incentives for the producers to add environmental quality to its products.

A large number of labels exist, and only little research has been made in the efficacy of the programmes. Of interest to the DRB the labelling of detergents has been attempted in an effort to reduce the emission of phosphorous. In Sweden for instance the market share of eco-labelled detergents increased from zero in 1990 to 80 percent by 1997, however, analyst did not register major improvement in the environmental quality as a result of the switch to eco-labelled detergents.[35]

An instrument using the same market approach, i.e. influencing consumers, has been introduced in Indonesia. A programme called PROPER was introduced by the national pollution control agency as a response to poor enforcement record. PROPER entails the labelling of industries in accordance with compliance with national standards following a 5 tier label ranging from black, 'no pollution control effort' over red, blue and green, to gold, which was signifying 'clean technology, waste minimisation, pollution prevention'. Both the green and the gold label were above compliance with standards.

In the first rating only few plants qualified for green, and these were publicly lauded, while the non-compliant plants were notified and suggested to clean up before a second rating, after which the ratings would be published. The immediate effect was a strong effort to avoid the black label and less for the red label. The group of plants having been rated black actually contracted with 50% during a short period and the rating further improved in the following ratings.

[35] ibid page 37

The PROPER programme was estimated to have a cost of $100,000 over an 18 months period, which per plant rated/per day correspond to $1[36]. With among other impacts a 40% reduction in organic water pollution in the same period, the economic efficiency of the programme in this particular period must be considered very high, even when the cost of monitoring is taken into consideration.

The long-term sustainability of results still remains to be seen. The programme does indicate that influencing actors on market places can have very significant impact.

A number of conditions have to be met:

- Standard setting and monitoring must be given similar attention as in other regulation modalities.
- The polluter must have a commodity or a brand name, which can be differentiated from other commodities on the market.
- Only commodities with substitutes can be included.
- The commodities closest to final consumption are considered more vulnerable to market place sanctions than raw material and intermediate goods.
- Coverage of the programme must be near total in order to avoid shifts from one polluting commodity to another.
- Markets must be monitored and substitution from one commodity to another must be known on an overall basis.
- A generally high response to few sanctioned commodities/brands at the same time should be attempted in order to avoid decreasing response due confusion and immunity on the side of the market actors.

It is rather obvious that both the eco-labelling and public rating of polluters are instruments, which cannot cover needed action in regulation. However, these tools have positive impact outside the regulation of one particular environmental problem firstly in the form of a general increase in environmental awareness and secondly in the form of increasing the efficiency of other enforcement tools.

There is no doubt that a scenario of a perhaps long lasting market shift away from the products of a polluting industry is much more frightening to an industry than fines and other legal action.

[36] World Bank: Greening Industry, New roles for Communities, Markets, and Governments, Washington/New York, 2000, page 71

7. ANALYSIS OF OBSERVED ISSUES – MAIN LESSONS

7.1 Geographical and political differences

Command and control instruments have been used in most countries, regulation by setting a standard to which all parties must comply is a well known and accepted instrument in all societies. As analyses appeared clearly showing that the command and control instrument in environmental regulation was costly compared to market-based instruments different avenues seem to have been pursued.

In the USA Tradable Permits, TP, have been primarily developed and tested, while charges have primarily been used in Europe.

Against both instruments it has been argued that paying to be allowed to act in a harmful manner was not morally acceptable, and this argument undoubtedly has had an impact in terms of slowing the introduction of both charges and TPs. The moral dilemma most clearly comes forward, when the TP becomes a property right. Charging for pollution does not in same way as issuing permits indicate that the issuer authorise a certain behaviour. If the charged behaviour at a later stage is forbidden, the taxpayer has little argument in a dispute where he claims compensation, if the permit holder has his permit withdrawn, however, it makes sense to claim compensation.

In Europe this difference between the instruments has quite certainly had the consequence that TP has been used very little, and that command and control and to some extent charges have been preferred.

A second but related aspect is how the market distribution of permits is perceived in terms of fairness. In economies less relying on the market forces, the affinity towards effects of market based decision making has been smaller. There has been a tendency for the USA to rely more on markets compared to Europe.

The property right issue could be addressed by letting polluters pay for permits, both down payments and annual fees could be considered. This would constitute an explicit acceptance of the property right, but could on the one hand provide the authority with the means to finance compensation and on the other hand a tool for regulation through changes in fees. TP combined with annual fees would constitute a mixed tool, which potentially had the perceived advantages of both.

In Europe the acceptance of the Kyoto protocol including the flexible mechanism and the active promotion of trade in the ETS is an indication of increased acceptance and interest in the TP systems for environmental regulation.

A political advantage of the command and control instrument is that it offers politicians more opportunity to demonstrate publicly a swift and stern reaction to environmental problems than a market-based instrument does. To a certain extent the command and control instrument both offers the possibility of signalling serious action against pollution and at the same time include exemptions and inadequate enforcement, which make the regulation more acceptable among the polluters.

In addition, politicians are geographically based in their constituencies, the command and control based systems offer an opportunity to demonstrate quantified standards for their geographical base, while the degrees of freedom in the market based instruments have the consequence that pollution will be moved in a not predetermined manner.

A summary of the political lessons is given by Stavins (2003)[37] as answers to three questions:

1. Why was there so little use of market base instruments in the US, relative to command and control instruments, over the last 30 years, despite the apparent advantages offered by market based instruments
2. Once market based instruments were adopted, why has there been such great reliance on tradable permits allocated without charge
3. Why has the political attention given to market based instruments increased dramatically in the recent years

The short answers proposed are:

Command and control instruments have predominated because they offered favours to the main stakeholders: Affected firms, environmental advocacy groups,

[37] Robert Stavins: Market based Environmental Policies: What can we Learn from US experience (and related research)?, Resources for the Future, Washington, August 2003, page 12

organised labour, legislators and bureaucrats. This is in line with the arguments above. One main concern seem to be the feeling of loss of control combined with the fact that command and control can favour some of the parties affected by it.

The preference for TP in USA is for a large part based on the apparent economic advantage these give to existing polluters. The acceptance of a permit for free is more attractive than having a charge assessed on emission, this is probably both a factor for the polluters and for example the environmental advocacy groups, who find it easier to argue for a regulation, which is apparently without cost.

Market based instruments are becoming more attractive as the desirability of 'the free market' has been shared by larger groups. The ideological attraction is considered perhaps just as important as the potential economic efficiency. The apparent success of the SO_2 scheme is considered to be of importance as well. As referred above the scheme is both growing and according to the analyses it also yields savings compared to command and control regulation.

While the SO_2 must be considered a positive element in the development of TP, the role of the Kyoto protocol perhaps is more mixed. The technical and economic arguments for TP have played a role in the Kyoto negotiations, but the overriding issue is establishment of a politically viable regulation of the emission of CO_2 on a global scale. The decision not to use command and control regulation for this purpose may very well have been that the chances of having a command and control system accepted and developed was very small given the number of explicit and well defined agreements this would require.

In this context the TP with the increased degree of freedom and the option of letting the market decide, combined with the possibility of continuously having the prerogative of amending the framework in which trading will take place, offered a politically more viable tool for regulation.

The parallel to the DRB regulation of nutrients is there. There are many differences in the setting, type of pollution, beneficiaries from regulation and more, but the need to find a system to which many nations can agree is similar. In this connection the possibility of deciding on overall objectives and principles and then using systems, which will adapt to continuous amendments and corrections, can be attractive. In the profile set up for this analysis, the lesson refers to the second of the instrumental objectives, the political acceptability of the TP, rather than the economic efficiency, which is the normally accepted and used argument for the superiority of TP compared to command and control.

7.2 Economic efficiency

Although the empirical evidence is not comprehensive, there is sufficient to suggest that the market-based instruments can offer a less costly way of achieving environmental objectives than command and control. The suggestion is based on the observed programmes and a perception of best alternative regulation not as the theoretically best, but the best alternative, which would be implemented in practice.

It should be noted that none of the systems referred to, and indeed no existing system, offer a solid, empirically based proof, that market-based instruments are less costly than command and control. First of all few systems have been functioning for longer periods of time, and the pilot schemes are mainly directed on the testing of the effectiveness of the market-based systems and not on the efficiency. This means that the information recorded does not include the cost an alternative to the market-based system would have incurred.

In particular two types of cost needs to be investigated:

Alternative cost, which is the cost of the compliance to the same level of abatement under another system of regulation in all regulated units/entities. This cost is not systematically considered in the referred programmes, and it is under all circumstances cost, which must be estimated under some degree of uncertainty.

Transaction cost, these costs are both incurred by the emitters, the regulator and in some instances the public/consumers. Transaction cost may be substantial. For command and control systems the regulator may attempt to participate in reducing the alternative cost, which requires the authority to build expertise of a depth and variety regarding production, which would not be employed by governments under other circumstances. For the TP the skills needed for trading may constitute a significant cost for the polluters.

The efficiency of the market-based instruments is still a theoretical construction, which is convincing, and when the comparison is command and control regulation as this is usually implemented also this study suggest, that market-based instruments are more efficient.

The efficiency of charge (price-based) systems compared to TP (quantity based) depends on the pattern of cost and benefits. If marginal cost is very uncertain or the marginal abatement cost is flat and the marginal benefit of abatement falls quickly, then a quantity instrument is more efficient than a price based instrument. In common language this reflect situations where abatement cost is the same over a long range of production, while the benefits from abating quickly become lower, then it is difficult to determine the size of the charge, which will be efficient.

A charge under such circumstances runs the risk of establishing a level of production and abatement, which is not efficient. A charge further has the disadvantage, that it does not in itself target a specific level of emission. Emission is the result of the relative cost of abatement and the charge, which will require a concurrent supervision and perhaps some experiment on the level of charge before the desired level of regulation is attained.

Under a charge system the polluter will optimise abatement in relation to the fixed level of charge. Under a TP the polluter will optimise abatement to a variable market price on permits to emit, which the polluter interacts with other polluters in determining. In the TP system the market for permits provide the optimal price of the permit by itself, no experimenting is needed, under the assumption that the market is working (no hoarding etc).

Charge systems should be designed to funnel back the charge revenue on the emission made by polluters after they have optimised their abatement. This is required in order to avoid the charge becoming a virtual cost, which will lower the level of production, compared to an optimal non-charge level of production. This will result in lower level of productive activity – normally called the dead hand of tax.

Given the situation that the regulator can let the market identify the optimal level of the price for a permit, it is suggested that the cost for the regulator of a TP is less than of a charge and thus the efficiency higher. The regulator can save the cost of experimenting with level of charge and the cost of administering subsidies, which may become complex in structure.

For the DRB both charge and TP systems will require the establishment of institutions presently not existing.

Taxation is normally the prerogative of the national state and sub-state regions/districts, supranational taxation is not a realistic option. Taxation as a regulatory instrument in the DRB will therefore have to be national taxes for each basin country with a forum for discussion of levels of emission on national scale. The national states will subsequently decide which levels of taxation are needed to attain the emission targets.

It is difficult to imagine that a system based on tax alone can establish efficiency for the DRB as a total market. The tax system will consist of national systems at the best internally establishing efficiency and attaining the environmental objective through consultations.

Introduction of some trading of permits across the borders will contribute to establishment of efficiency in the DRB area as a whole, with the same arguments as used for the benefits of international trade. The only parallel systems here are the CO_2 trading in EU and under the Kyoto protocol and these systems do not yet offer any empirical evidence on the efficiency.

7.3 Long term cost effectiveness

The TP has an advantage over the charges in terms of keeping the aggregate level of emission under the stipulated level. This has importance in periods of general price inflation and rapid economic growth where the level of aggregate emission will increase under charge regulation and remain constant under a TP, while the price on the TP will increase.

When the price on abatement technology falls significantly for instance due to introduction of new technology, then emission under a charge system will fall. Under a TP system the level of emission will remain constant, while the price on permits will fall.

In order to maintain the optimal combination of abatement and emission, significant decrease in cost of abatement technology will have to be followed up by a decrease in tax level under a tax system, while the TP system automatically will adjust to the new cost of abatement technology.

The DRB will under all circumstances establish a system in which there will be a lead time from a external impact, like change in cost, is observed an until appropriate action can be taken. It is not unlikely that there will be resistance against starting up a process of adjustments, because under international agreements, this is likely to open other agendas than adjusting to the external impact only.

7.4 Cost differences

The greater the difference of cost of abatement is between the polluters the more favourable a market-based system is likely to be compared to a command and control regulation. This particular lesson seems to have contributed to the success of the SO_2 scheme, because there was big differences between the units in terms of technology, age of plants and proximity to low sulphur coal. The observation may be relevant to the DRB, where the technologies used in the municipal wastewater treatment differ widely.

Tax systems and TP systems will not necessarily differ much in terms of handling differences in cost between the polluters. The rationale behind the TP is exactly its ability to distribute emission permits between polluters with differences in cost. Taxation will tend to make the polluters harmonise their cost for abatement in the longer run and part of this adaptation could be the closure of the facilities with the poorest conditions for improved abatement.

It is possible that the adaptation of the polluters under tax regulation and under TP systems will be similar in the long run, and that the main difference is the speed and perhaps cost at which this happens. One scenario under a TP where the polluters have larger degrees of freedom to let old and relatively costly systems wear out by buying permits another scenario is that the TP will induce the most costly systems to be replaced rapidly in order to release permits for trade.

Specific research in the DRB in the relations between the cost of rehabilitation of plants and the price likely to be established on permits will be needed.

7.5 Point and non-point sources of pollution

Regulating non-point sources has obvious difficulties. Command and control could comprise directing specific practises, like the generally accepted agricultural management practices (GAAMP) used in the Kalamazoo programme.

In the Kalamazoo programme some trading has been planned, by which a change in practice to the better will earn the farmer some credit, which he the can sell to a buyer, one of few point sources in the area.

The planned programme very well illustrate the difficulty in including the non-point sources in TP:

- There will be monitoring problems, the sources are not well defined and the emission itself cannot be measured. Note that monitoring problems relate to other types of regulation as well.

- There cannot be continued market participation from the same non-point source, once a credit is created and sold the active participation in the programme from the non-point source is to continue the directed practice.
- Price setting becomes a unilateral affair between few point sources.
- If a continuous monitoring of emission cannot be established, and thus the result of changes in behaviour on the part of the non-point source cannot be followed, there is little basis for trading. The reason for trading as a regulation instrument namely adaptation of abatement in accordance with price fluctuation for permits becomes futile.

The successful taxation in the Netherlands, which contributed to remarkable reduction in the nutrient concentration in surface water is an illustrative example both of the difficulty in regulating behaviour of non point sources through a tax but also on regulation in general.

In the Netherlands the response to the tax, was mainly to be found on the side of the industry. The private households and agricultural non-point sources did not reduce their discharge of nutrients in the same period. The problem was that since the emission could not be measured, tax was assessed based on arbitrary ratios assigned to the type of source. Improved behaviour would not change the ratio, and hence no incentive existed for reduction of emission.

Using ratios in a regime with TP would yield the same result. The examples of participation of non-point sources referred above mainly rely on a point source behaving in accordance with its own cost profile on behalf of the non-point source, rather than the source itself acting at all.

By making a step backwards in the process of polluting and taking the application of fertiliser, or the number of animal units as the trading in pollution vehicle it may be possible to include the non-point sources in trading in permits to apply fertiliser or permits to keep animals. No examples of trading of this character were found, however, command and control regulation of these activities exists and is used even if the monitoring and enforcement constitute problems.

According to the profile set up for the DRB, regulation of non-point source is essential for the attainment of the environmental objective and it is likely that it will become even more important as agricultural growth takes on in the countries in the lower Danube Basin.

No advice as to how this could be done is indicated by the experience of regulation of emission using market-based instruments. It is necessary to resort to the requirement also stipulated in the profile, that systems of regulation of other sources should not be set-up if they precluded command and control regulation of non-point sources.

In addition it could be investigated and perhaps piloted on a smaller scale, whether a trade between non-point source and some point sources could be made using the JI and CDM approach as described above.

More inventive solutions could be piloting trade in fertiliser application permits, with or without the inclusion of point sources as buyers and sellers on a certain ratio.

7.6 Fairness

Fairness is complex and it is likely that the regulation mechanisms implemented will have to be accompanied by subsidies, compensations or other interventions in order to attain a distribution of burdens and benefits, which is suited to the stakeholders expectations of fairness.

The issue is related to the discussion in paragraph 7.1 on geographical and political differences, and of course perceived fairness of the instruments has some role to play in most of the lessons referred in this chapter.

The command and control systems are directed on regulation, distribution of permits can take into consideration fairness, and it is possible to attain both an over all environmental objective and distribute the permits in different ways according to fairness. However, there will be little flexibility in the system and it is less likely that economic efficiency as a third criterion for distribution can be satisfied at the same time.

The lack of flexibility will have the same consequences as described in paragraph on cost differences.

For a TP the equilibrium allocation and hence aggregate abatement cost is independent of the initial allocations.

This means that the initial allocation debate can be centred on issues concerned with fairness, without jeopardising the possibility of reaching equilibrium (and hence cost efficiency) in the subsequent trading. This is considered a significant advantage in international mechanisms, in which the initial allocation can be designed to take into account differences between the participating nations. This is one of the attractions of the Kyoto protocol, and it could have importance in the DRB as well.

Tax systems can include considerations of fairness by including exemptions, graduated levels and also be supplemented by subsidies. An inherent and well-known risk in tax systems is that the often become very complex, and hence costly to operate and often dysfunctional with regard to the main purpose, the environmental objective.

In the DRB setting, there is a risk of exposing industry and agriculture to very different tax regimes, depending on national location and other considerations included in the design of the tax systems. This in itself may jeopardise the chances of establishing international agreement, and it may under all circumstances make negotiation very difficult and complex.

7.7 Degree of mixing.

The degree of mixing and the spatial occurrence of the pollutants are of importance for the choice of regulation instrument. In part of the literature it is stated that trade of permits is only possible when the pollutant is uniformly mixed. The statement must be qualified by adding that ratios of exchange may compensate for the differences in environmental effects as a result of non uniformly mixed pollutants.

However, the greater the degree of mixing of pollutants in the receiving watershed, the more attractive a market system is likely to be compared to a command and control system. Distribution of emission in accordance with market forces may lead to higher concentrations in ‘hot spots’, which can have environmental undesirable impact. There are possibilities of supplementing the market-based regulation with other instruments as demonstrated in RECLAIM.

The incidence of New York state, however, banning upwind sales of SO_2 allowances demonstrate that subsystem regulation may be problematic, because it reduces the degree of freedom for the market to act, which is at the gist of the market-based regulation.

Differences in environmental impact of the two pollutants concerned in the DRB also could be managed by letting the permits to emit one or the other be exchanged using a ratio. If the impact can be cleared in this manner possible also the differences in pass way between the pollutants could be cleared using ratios of exchange. Attention should be given to the risk of creating a sophisticated system, which could become in-transparent and de facto constitute different markets.

The de facto division of markets is not necessarily a step back in terms of economic efficiency, however, the regulator probably has better chances of designing properly working markets if the eventuality is taken into consideration from the start.

7.8 Enforcement

Monitoring and enforcement constitute a challenge in connection with all instruments of regulation.

One difference is obvious, neither in command and control nor in taxation can the regulator expect any enthusiastic participation from the polluters. This is possible in TP, where the polluters may have an incentive to identify themselves in order to claim permits. When the initial allocation is based on grandfathering, the polluters will further have an interest in supplying information on the volume of emission, which is not lower than actual emission.

It is likely that the involvement of the polluters will make the monitoring more reliable and less costly, compared to the instruments. The trade will often require some form of certified documentation, and this creates a basis for monitoring, which may become more efficient than for the other instruments.

Both in the cases of taxation and command and control the polluter may have an advantage by being passive and let the regulator manage monitoring. Resulting in costly systems and perhaps faulty regulation.

7.9 Gradual development or full initial implementation

Among the observations from the OECD was that for air pollution abatement new comprehensive systems, have more political support than gradually developed systems. For trading in the water sector the opposite experience was noted, that TP systems are more acceptable, when they are based on pre-existing regulatory and institutional arrangements.

It is not quite clear on which basis OECD concludes that in the air pollution abatement, there is a preference for ‘turn key’ systems. The SO2 scheme was designed based on previous transfer systems and it also had two tiered implementation methodology, which may have been planned, but to some extent also signified a preference for the gradually developing regimes.

The Kyoto protocol is comprehensive and complex, but also covering only the period from 2008 to 2012, plus some intentions agreed upon for the subsequent period. It is correct that there was no regulation on a similar scale, but trading will now be introduced in EU as a precursor for the Kyoto trading arrangements.

Under all circumstances for the DRB the lesson seems quite unambiguous, a trading system should probably build as much as it can on existing regulation institutions, which could be interpreted in two directions:

- The existing national institutions should be build upon, trading and supplementary regulation should be anchored in the existing institutional setting and from there be extended in the form of links to other national institutions. In a facilitating role and as a forum for negotiations a multilateral entity could be instituted, for instance based in the existing International Commission for the Protection of the Danube River, ICPDR.

- The systems for regulation could consist of gradually developing phased implementation plans, which are guided by overall agreement of principles and all for adjustment as experience is gathered.

It is with the Kyoto, UNFCCC, in mind that the regulation in the DRB is suggested to take form of a process rather than pre-planned programme, which can be implemented and thereafter is expected to work relatively unchanged for a period of time.

7.10 Competition

In particular for the TP based systems it is usually expected that a sufficient number of sellers and buyers will have to become active on the market in order to establish a clearing price, which reflect economic efficiency.

The inefficient clearing price can be established in two ways. In the monopsony case, the market power firm spends too much on abatement and buys too few permits at low price. The other firms on the market spends to little on abatement and consequently have a too large number of emission permits to exploit. In case of monopoly, the market power firm spends too little on abatement, and other firms spend too much, because the monopoly will keep the prices on permits at a high level[38].

Few of the referred water based systems can claim an impressive number of actors, on the contrary they comprise often few large point sources. In addition these large point sources are often public companies, which are not expected to be guided by economic efficiency alone.

Despite of this the OECD claims that lack of competition does not seem to constitute a problem for the establishment of efficient clearing prices. It is not clear whether the conclusion is based on the SO_2 alone or whether other schemes are considered to be in support of the observation.

For the DRB it is advisable to base expectations regarding size of markets more on the SO_2 scheme than on the studied water based schemes. This may well mean that some potential markets will be two small, at least at an initial stage, if national markets are preferred initially. These areas may then be regulated using other instruments in preparation of a TP instrument at a later stage.

7.11 Stakeholder involvement

A positive characteristic of the tradable permit is the active involvement of the emitters in the regulation. The incentive for the emitters will be to adapt to the regulation at the lowest cost possible, it is considered that this will represent a notion of self discipline, the emitter will behave as desired by the wider society because this is in his own interest.

The expectation relies on the notion that reducing the cost implies fulfilling the requirements dictated by regulation, and this is not necessarily the ‘best’ economic interest of the emitter. Like for other instruments the emitter is probably overall best economically off by evasive action, which means that at best the positive involvement of the emitter and his perception of sharing the objectives of the wider society is probably at best of a psychological nature. If it works the tradable permit has a real advantage as compared to other instruments.

An urge to introduce more abatement at lower cost in order to release permits for sale can constitute a dynamic force under TP systems, which will provoke a dynamic development of more efficient abatement on a more continuing basis. This will lower the prices of permits and thus the cost of emission, the equilib-

[38] Hanley, Shogren and White: Environmental Economics, London 1997, page 143

rium of the permit market will support a higher level of production than before the technological advance.

If new lower environmental targets becomes interesting based on this development, the regulator may establish this by buying permits at the lower price and withdraw the acquired permits. This will be less offensive to the emitters than a change in the command and control regime.

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