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INTEGRATED WATER RESOURCES MANAGEMENT IN ESTONIA

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Бул статьяда Эстониядагы суу башкаруу сүрөтөлгөн. Чогултуунун процессии жана суу бургучтун калдыктарын иштетүү жанат атмосферанын басырылмасы Европалык Шериктештиктин нормаларынын жана Эстониянын мыйзамдуулуктарын талантарына жооп бериши керек. Суунун көлөүмүнүн физикалык модификациялар иштелип чыккан.

В статье описано управление водными ресурсами в Эстонии. Процессы сбора и обработки отходов водоотведения и атмосферные осадки должны отвечать требованиям, которые установлены эстонским законодательством и нормами Европейского Союза. Разработаны физические модификации водных объектов.

This article describes water resource management in Estonia. Collection and treatment of waste water and storm water should be in agreement with the requirements set up by the Estonian Water Act and the EU regulations. Physical modifications of water bodies are developed.

Introduction

Integrated water management is the practice of making decisions and taking actions while considering environmental, as well as social and technical aspects. These aspects should be incorporated to the management of watersheds that is a focal point for water resources management. This is also a basic approach of the EC Water Framework Directive (WFD). The key aims of the directive include combined protection of all waters to achieve at least "good status" (EC, 2000). It requires water management that is based on river basins and assessment of cost-effectiveness of various measures. One of the aims is to use proper pricing mechanism for water that acts as an incentive for the sustainable use of water resources. Member States should ensure that the price charged to water consumers reflects the true costs for the abstraction and distribution of fresh water and the collection and treatment of waste water.

Water management in Estonia

Estonia is a water rich country. The long term mean precipitation varies from 550 to 880 mm exceeding substantially evaporation that is between 400-500 mm. The mean river runoff (260 mm) forms about 40% of annual precipitation. The water quantity problem arise mainly in dry season, in summertime, when only that portion of the overall recharge that is not needed to support connected ecosystems can be abstracted. This requirement is not always met, for example, when producing hydropower. The ability of water systems to provide needed quality water to produce drinking water, for bathing and to maintain ecosystem services is a major challenge that requires different integrated management options. To achieve key objectives of EC Water Framework Directive (e. g. good status for all water bodies, protection of the aquatic ecology and valuable habitats, protection of drinking water resources and bathing water) require integration of all these objectives for each river basin. The list of the major water management issues in Estonia include:

1. Collection and treatment of waste water and storm water that should be in agreement with the requirements set up by the Estonian Water Act and the EU regulations.

From about 110 million. m^3 of sewage water produced annually in Estonia only about 1 million m^3 is released to the environment without any treatment (Veekasutus, 2007). These waters are mainly pumped out from the mineral extraction sites, even though the majority of waters from oil-shale mining areas are mechanically treated. About 23% of sewage waters are treated biologically and 71 % goes through combined biological-chemical treatment. These levels became possible after upgrading of existing WWTPs and building of new high grade biological and chemical treatment facilities for P and N removal. At the same time renewal of existing sewer pipes and building of new ones in order to connect more households and enterprises to treatment plants has been a focal point. According to the EU Urban waste water directive (EC, 1991) areas where waste water should be collected and conducted to the WWTP had to be defined. In Estonia sufficiently concentrated population areas were defined as agglomerations with more than 50 people in 5 ha of area. In areas where ground water is well protected the waste water should be collected and conducted to an urban waste water treatment plant if more than 20 people equivalents (pe) of pollution is produced per one ha. About 75% of the population in Estonia is connected to the centralised sewer systems (Keskkonnaministeerium, 2008) including 91 % of population in agglomerations with more than 2000 pe. Following the regulation effluent concentrations from point sources should be lower than set up levels depending on the capacity of the WWTP (Table 1).

Table 1. Maximum allowed concentrations in effluents and required treatment efficiencies for WWTPs in Estonia.

	>100 th. pe	Treatment efficiency, %	15-100 th. pe	Treatment efficiency, %	10-15 th. pe	Treatment efficiency, %	2-15 th. pe	Treatment efficiency, %
BOD_7	15.0	≥90	15.0	≥90	15.0	≥90	15.0	≥90
P_{tot}	1.0	≥80	1.0	≥80	1.0	≥80	1.5	≥80
N_{tot}	10.0	70-80	15.0	70-80	15.0	70-80	-	-

The EC Urban Waste water directive is one of the most expensive parts of EU legislation to implement. Therefore Estonia negotiated transitional period until 2010 to renovate/construct sewerage systems and waste water treatment facilities. At the same time considerable financial support by EU has been available. Due to implemented measures the pollution load of BOD and nutrients on water bodies resulting from the waste water of urban areas and from the industry has decreased considerably (Fig. 1). While during the first five years of that period pollution decreased due to the drop in production and water consumption of the population, during the last decade good progress has been made mainly by building new treatment plants and renovating old ones.

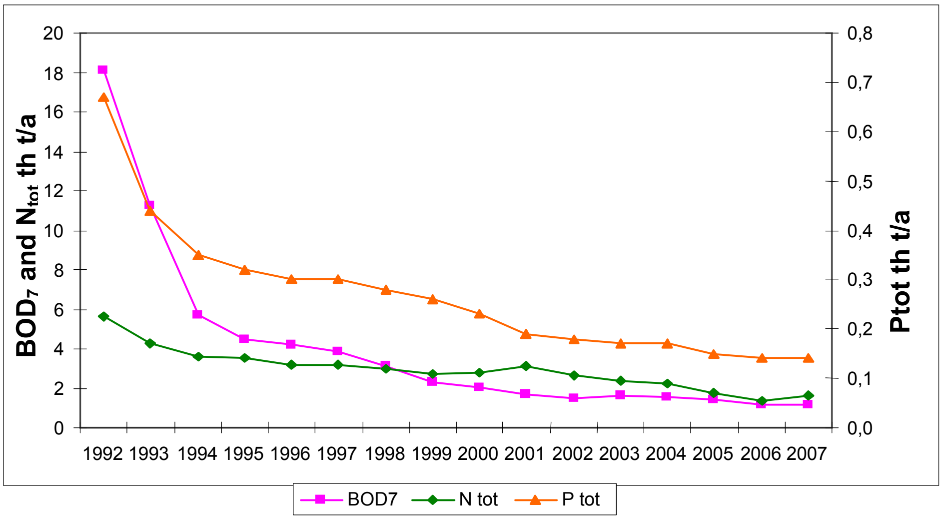

Figure 1. .Pollution load of nitrogen, phosphorus and BOD_7 to Estonian surface water bodies in 1992-2007.

One of the key aims in the WFD is to get water prices right. Following this approach charging system for pollution loads has been in use in Estonia. The water permits require enterprises to measure discharges and pollution load and to report to the Regional Environmental Authority. This self-monitoring provides data for pollution charging. The charge levels are usually revised after every five years. Quite rapid increasing trend of pollution charge has been characteristic during recent years (Fig. 2).

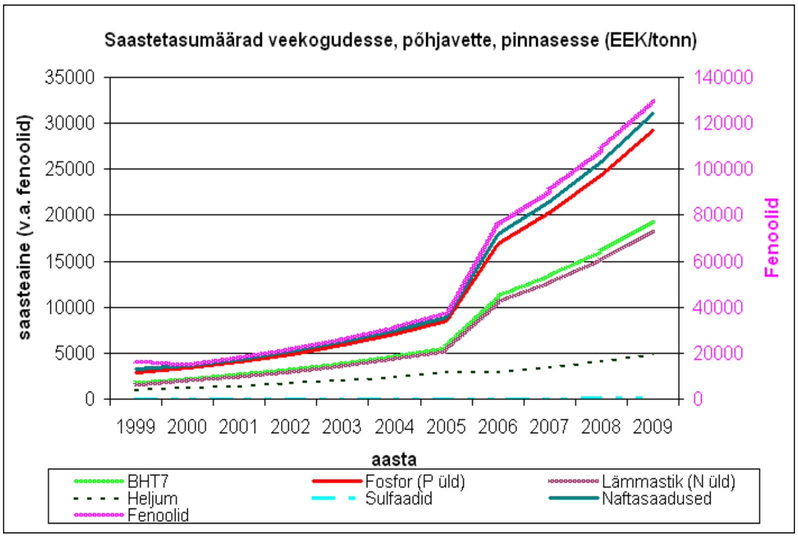

Figure 2. Pollution charges, EEK/tonne of pollutant to the surface water body, ground water and soil in Estonia in 1999-2009 (1 EEK= 0.06 EUR).

2. Diffuse load of nutrients from agriculture

According to the inventory of Estonian water bodies, about 70 were threatened mainly by diffuse sources generated from agriculture (Compliance, 2006). The Member States of HELCOM recently adopted an ambitious action plan to drastically reduce pollution to the Baltic Sea. To achieve this, national targets for reductions in annual nitrogen and phosphorus inputs were proposed. Due to improvements in phosphorus removal from municipal and industrial point sources during recent decades, HELCOM has focused very much on decreasing the diffuse load of nutrients, especially nitrogen from land-based sources. In many countries in Eastern Europe, including Estonia, the highly industrialised and centralised agricultural production system collapsed in the late 1980s, early 1990s. Fertiliser use dropped by six times in Estonia and constituted in 2005 only about 13% of the peak in 1987–1988 (Agriculture, 2006). The decrease in livestock units (LU) was about twofold, the level today being 0.41 LU ha^{-1}, however varying considerably between different regions. These changes have led to decreasing trend on nitrogen concentrations in many rivers including those in agricultural areas. However, agriculture remains the main source of diffuse pollution of inland surface waters, comprising 62% of TN and 43% of TP in 2004 (Oras et al., 2006). It is very likely that diffuse nutrient losses from agriculture is becoming even more important due to improvement of industrial and municipal waste water treatment, especially regarding small settlements. During the last 4–5 years revitalisation of agriculture has been evident. Higher farmer income has lead to an increase in N and P fertilisers use by 21 and 144 percent respectively compared to 1996 (Agriculture, 2006). In addition, more agricultural land is in actual use again. These trends together with warm winters can substantially increase nutrient concentrations in water bodies and runoff of these substances.

The Ministry of Environment of Estonia has in collaboration with the Ministry of Agriculture developed a system to estimate and evaluate the effects of measures especially in Nitrate Vulnerable Areas. The potential effects of different measures have been estimated on the basis of available statistical data, from research, field experiments and runoff data from small agricultural areas, including information from automatic monitoring stations. Diffuse loading from agriculture is estimated by monitoring water quality in small representative catchments in different hydro-geographical regions and land uses, and in shallow ground water bodies and springs. The measured data from selected catchments are used as a reference for areas with no direct measurements. In addition they are used for modelling diffuse pollution from agricultural dominated catchments.

3. Physical modification of water bodies

Physical modification, e.g. damming or de-damming, dredging and other types of modification of water bodies require permit from environmental officials. After intensive land reclamation in the 1960s–1970s, when many streams were dredged and straightened, the majority of the drainage systems have been not maintained properly since the 1990s. Therefore many channels are overgrown with bushes and other high plants prolonging retention period. Longer water residence time favours plant uptake of nutrients and phosphorus precipitation as well as increase of groundwater level when the soil is maintained at saturated or almost saturated conditions for longer time periods leading to anaerobic environments in soils, possible increase in denitrification rates and to lower TN concentrations in open streams. It is very likely that cleaning of amelioration systems will contribute to higher nutrient runoff and input to the recipient water bodies in the future.

4. Water abstraction by municipalities and industries

The overall water consumption in Estonia dropped in the beginning of the 1990s (Fig. 3).

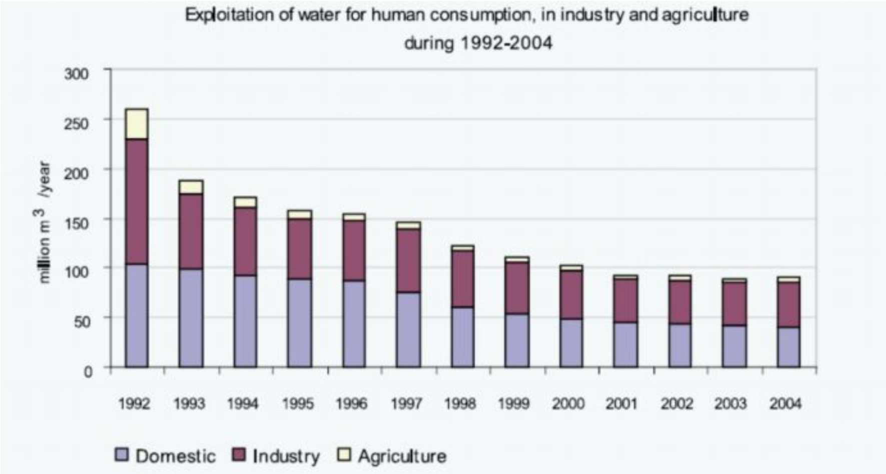

Figure 3. Water withdrawn for human consumption, in industry and agriculture in Estonia in 1992-2004.

Rises in the price of drinking water and wastewater treatment led to a substantial drop in the overall consumption of potable water by the general population. The decrease from 155–175 litres per person and day in 1994/1995 to about 60–70 litres have been typical especially for small and medium size settlements. This, in turn, has resulted in increased concentrations of nutrients in both the wastewaters delivered to WWTPs and the effluents released from those facilities (Iital et al. 2005). Therefore, the mean nitrogen and phosphorus concentrations in the effluents could exceed threshold levels of 15 mg N L^{-1} and 1.0 mg P L^{-1} for the settlements of more than 10 000 pe. All larger water users in Estonia have to apply for a permit for water abstraction. The permit will set up maximum consumption of water and requirements for treatment of waste water and monitoring of environmental pressures and impacts. The charges for use of water depend on the quality and availability of water (Table 2).

Table 2. Charges for use of water (minimum and maximum levels EEK/th. m^3, 1 EEK= 0.06 EUR)

Type or use of water	Minimum and maximum charge, EEK/th. m^3
Surface water	230 and 600
Surface water for cooling	25 and 120
Quaternary ground water	480 and 1100
Devonian –Ordovician-Cambrian ground water	640 and 1500
Cambrian-Vend ground water	700 and 1600
Cambrian-Vend ground water for technological purposes except in food industry	1290 and 3000
Mineral water for drinking	23 000 and 36 000
Mineral water for bathing	2300 and 3600
Pumped out water from open mine	150 and 350
Pumped out water from underground mine	400 and 850

Exceptions for water charging are applied if used for hydro-energy production, for irrigation, for fish farming and in quantities less than 5 m^3/day of groundwater (except mineral water for drinking purposes) and less than 30 m^3/day of surface water.

Integrated management of transboundary water bodies.

Combating above listed problems require combined approach and management of water quality and quantity at the river basin scale. Therefore good management plans to deal both with point pollution sources as well as with diffuse agricultural sources are needed. As a first step all existing technology-driven source-based controls must be implemented. It is important also to integrate water management between different sectors of water users, including drinking water, recreational water use, hydropower, industry, water for fish, etc. There is an increasing need for coordinated management of transboundary water bodies and resources integrating environmental, legislative, social, economic and political issues to reach to the target levels set up by the WFD. A good example is Lake Peipsi that is the largest transboundary lake in Europe located on the border of Estonia and Russia. Intensive eutrophication of the lake started already in the 1970s but the biomass of N-fixing cyanobacteria was still rather low in heavily nutrient loaded lake in the 1980s. After the collapse of intensive soviet-type agriculture in the early 1990s, the loading of nitrogen sharply decreased and a certain improvement of ecological status was noticed at the beginning of the 1990s. This trend was accompanied by the temporary reduction of phosphorus loading from Estonian part of the catchment. In recent years destabilisation of the ecosystem has been observed again. This deterioration has been expressed mainly as intensive blue-green algae blooms and fish-kills in summertime (Nõges et al., 2005). Re-appearance of blooms has been explained by the decreased N/P ratio in the lake due to reduced nitrogen discharge while in some periods increased phosphorus loading could have supported this trend. Eutropfication is stimulated also by release of accumulated phosphorus from the bottom sediments during oxygen deficit periods.

To deal with cross border water issues an Estonian - Russian state level transboundary commission has been set up. The main objectives of the commission are to support common understanding and to develop harmonized principles in assessment of water quality and the status of water bodies, promote sustainable use of water resources and strengthen management capacity over the borders.

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