

Preconditions of and perspectives for integrating wetland conservation and sustainable use into river basin management in Estonia

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Abstract

Wetlands are a common feature in the Estonian landscape, covering approximately 30% of the country's territory. Different wetlands have a number of vital functions connected with the hydrological characteristics and water quality of a particular catchment area. In accordance with EU policies, water resource management plans for 3 river basin districts and 8 sub-districts in Estonia must be established and implemented by 2009. Integrated river basin management is a useful tool that offers new possibilities for integrating prudent wetland use and conservation into environmental management and planning.

Several recommendations are made concerning how to better implement ecotechnological measures, including wetlands use, in watershed management practice.

Keywords: constructed wetland, natural wetlands, nature conservation, sustainable use, riparian wetlands, river basin management plans.

1 Introduction

One of Estonia's principal environmental policy goals is the protection of surface water bodies and coastal seas. For about 15 years, EU and national policies have been adopted to decrease the nutrient load and danger of eutrophication in the Baltic Sea. On the other hand, dramatic changes in agricultural policy and practices have taken place in the eastern part of the Baltic Sea drainage basin since the beginning of the 1990s. Despite all of these measures, the quality of the waters of the Baltic Sea has not significantly



improved. In particular, the ecological quality of estuaries and coastal lagoons has not improved despite the reduced nutrient loads in the catchments and the decreasing riverine loads [1]. Therefore, additional measures have been planned by several authorities. Of these, sustainable agricultural practices (the wider practicing of ecological agriculture and the implementation of environmentally-friendly crop rotations [2]), and changes in agricultural practices (high-tech solutions such as GPS-supported fertilisation schemes; the implementation of the shallow injection technique when using liquid manure [3]) can be mentioned as measures designed to decrease loading in the catchments. Several ecotechnological measures will help to control nutrient flows from catchments to water bodies [4, 5].

Wetlands have an important impact on the hydrology and water quality of a catchment area. Of the many functions of wetlands, the most vital are ground water recharge and discharge, the ability to immobilize and transform a wide range of environmental contaminants and nutrients, water holding capacity supporting flood control, and the stabilisation of banks and shores [6, 7].

The maintenance, sustainable management and restoration of wetlands is a widely used ecotechnological practice at catchment level [8, 9, 10, 11]. Jansson et al. [12] have calculated that existing natural wetlands in the Baltic Sea drainage basin can annually retain an amount of N which corresponds to about 5-13% of annual total (natural and anthropogenic) N emissions entering the Baltic Sea. Likewise, the existing wetlands can significantly decrease P emissions [8]. Constructed wetlands play an important role, effectively retaining both N and P from both diffuse and point sources of pollution [10]. Constructed wetlands can also help in terms of stabilising the balance between N and P in purified wastewater, while relatively cheap and widely used P sedimentation in conventional purification systems has increased N transport to the Baltic Sea [13, 14]. Nitrogen removal using the conventional technique is, however, a very costly measure, the benefits of which are not always reliable [15].

Complex riverine buffer zones including wet meadows and wet forests are considered important regulators of nutrient fluxes, protecting rivers and lakes against diffuse pollution [16]. Likewise, constructed wetlands are important elements in the ecotechnological management of rural catchments [17]. It has also been stated that constructed free water surface wetlands have structural and functional attributes that can even enhance the quality of the landscape. Restoring and enhancing degraded wetland systems can provide compensatory benefits for the loss of wetland functions caused by human development activities [18].

Pursuant to EU policies for managing water resources, Estonia is introducing a system of water management by river basin areas.

The Ramsar Convention on Wetlands, ratified by Estonia in 1993, emphasizes the critical linkage between wetlands, water and river basin management, and urges all contracting parties to give priority to integrating wetland conservation and wise use into river basin management [19].



The purpose of this article is to introduce the perspectives of integrating wetland conservation, sustainable use practices and ecotechnological measures into river basin management.

2 Diversity of natural wetlands

Wetlands are an important part of the Estonian landscape, covering approximately 30% of the country's territory. Glacially-formed flat surface topography with hills and slightly undulating plains and a humid and relatively cool climate are preconditions for extensive peat accumulation. The total area of peatlands (incl. peatland forests) is about 1,010,000 ha, i.e. more than one fifth of the country's territory [20]. Various coastal wetlands are connected with the long and diverse shoreline. All Histosols and Gleysols together cover more than 60% of Estonia's territory (Fig. 1).

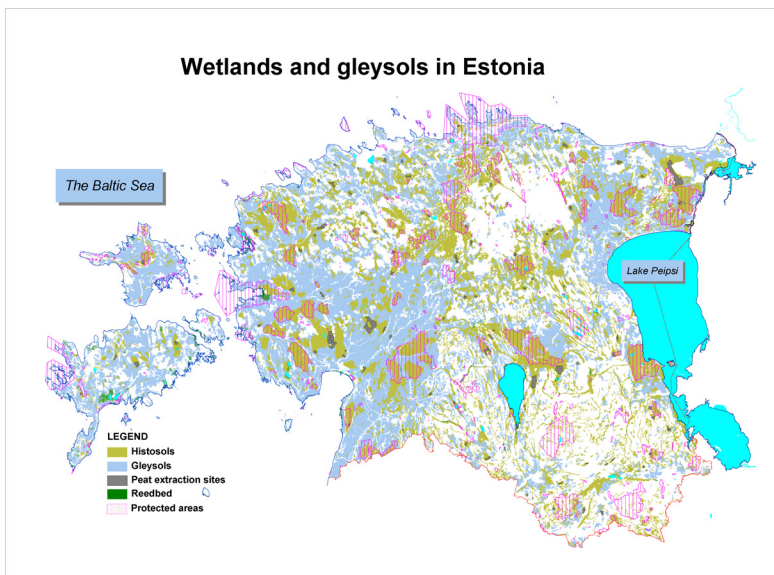


Figure 1: Wetlands (Histosols) and Gleysols as potential wetland areas in Estonia.

There is no comprehensive knowledge of total wetland coverage, despite a number of detailed inventories of different wetland types. In the most recent and comprehensive overview of wetlands [21], several wetland types were excluded, and also protected wetlands were not assessed. The estimate of wetland coverage at 1,452,500 ha by Wetland International [22] is derived from various references and should be considered to be quite approximate.

The diversity of Estonian wetlands is high [2123], and 19 wetland type groups and 30 site types can be distinguished.

Peatlands, which are recognized as a special and underrepresented wetland type by the Ramsar Convention, are still common, and are distributed over the whole territory of Estonia. The typological variation of mires is relatively large. Throughout history, vast areas of peatlands have been drained. According to expert opinions [21], about 70% of peat-covered lands have been drained or influenced by drainage to an extent which no longer allows peat accumulation. The area of untouched or virgin mires is estimated to be approximately 300,000 ha. The majority of these are ombrotrophic bogs, which in several places form large and complicated systems [24]. Minerotrophic mire types are seriously affected by drainage, and their area has decreased drastically [25].

Wet forests are also influenced by drainage, but are still widespread. Several forest types (mesotrophic and oligotrophic bog forests) are among the most common in Estonia, and at the same time floodplain forests have survived only very fragmentarily [26].

Estonia's river network is dense, and the rivers are generally small. Wet floodplain grasslands cover extensive areas along the lower courses of rivers. The differences in ecological conditions between the drainage basins determine the diversity and distribution of floodplain grasslands. Floods are more common and floodplains are abundant in the river basins of west-southwest and eastern and southeastern Estonia. According to experts, the total area of floodplain meadows is about 20,000 ha, the more valuable of which cover 12,500 ha [27]. For instance, the floodplain meadow of the Kasari River delta (4000 ha) is one of the biggest open wet meadows in Europe, 2500 ha of which are actively managed.

Lakes are usually not treated as wetland types in the Estonian scientific literature. However, many small lakes are shallow, and several transitions between aquatic and wetland communities can be observed. In total, Estonia has about 1200 lakes with a surface area of more than 1 ha, which occupies ca 4.8% of the total territory. Large waterbodies such as Lake Peipsi, Lake Võrtsjärv and the Narva Reservoir, which take up the overwhelming part, are also shallow.

There are also many coastal wetlands in Estonia, as the shoreline is long (3790 km), and the coast is rich in shallow bays and peninsulas. Along the shoreline, wet coastal grasslands are located as narrow belts (usually with a width of less than 100m). The total area of coastal meadows is estimated to be 18,000 ha, 5100 ha of that with higher nature conservation value [27].

3 Wetlands conservation

Due to the long and vital tradition of nature conservation in Estonia, a significant proportion of wetlands are under protection. Various wetland communities and landscapes have been protected during the last century, and wetland protection perspectives connected to the requirements of international conventions and directives have become reality during the last decade. The establishment of the protected area for seabirds on the Vaika Islands in 1910 is the beginning of



traditional nature conservation in Estonia. An important step was taken in 1957, when several wetland reserves or reserves including wetland habitats were founded, for example Matsalu (floodplain and coastal grasslands), Nigula (bog) and Viidumäe (spring fens) nature reserves, Muraka (bogs), Nehatu (*Cladietum marisci* fen) and Nätsi (bog) botanical-zoological reserves. In 1971, Lahemaa National Park and Vilsandi Nature reserve were established, and several wetland habitats were taken under protection. Fundamental changes in approach took place after the decade-long discussion between scientists and ameliorators about wetland values in the 1970s. As a result, in 1981, twenty-eight mire reserves were established, and Muraka and Nätsi reserves were expanded and reorganized.

In the 1990s, several events stimulated wetland conservation. The Ramsar Convention was ratified in 1993. Two large protected areas, containing the largest untouched bogs and floodplains – Soomaa National Park (370 sq. km) and the Alam-Pedja Nature Reserve (260 sq. km) – were established.

In 1997, a specified wetland inventory was carried out, and as a result, it was recommended that large amount of wetlands (99 mires, 6 floodplain grasslands and 21 coastal grasslands) be taken under conservation.



Figure 2: Nature protection areas, proposed EU Habitat Directive areas (Natura 2000 sites; as of 2004) and wetlands in Estonia.

A considerable proportion of wetlands will also be protected up to 2007 as Natura 2000 sites (Fig. 2). A preliminary analysis of the Natura 2000 database of the Ministry of the Environment shows that after the complete implementation of the whole network, at least 31 wetland habitat types (classified according to the system agreed by EU) covering more than 300,000 ha will be protected. It is

characteristic that different types of mires, especially bogs, transitional mires, and alkaline fens, bog woodlands, swamp forests, and also shallow seawater areas, floodplain and coastal meadows are among the types that, in terms of area, dominate the Estonian part of the network. The whole network of Natura 2000 will cover 1.4 million hectares (16% of Estonia's territory).

4 Perspectives on wetlands use and management

Despite conservation successes, Estonia's natural wetlands are continuously threatened by the growing influence of urban development, agricultural, forestry and mining activities. Therefore the integration of wetland management into environmental planning is an important issue.

Estonia has adopted the EU Water Framework Directive, and is introducing a system of water management by river basin areas. The Water Act amended in 2000 requires the establishment and implementation of river basin management plans by 2009. Although Estonia's river network is dense, the majority of rivers are small. Their catchment areas are too small to justify having a basin management concept developed for each of them. Therefore, for planning purposes the country is divided into 3 river basin districts and 8 sub-districts. The process of drafting management plans offers the opportunity to analyse the role of wetlands in water resource management, the possible effects of various wise use practises, and the potential and need for wetland restoration. In two management plans drafted recently, these opportunities are used in a limited way.

There is a clear need to increase understanding of the importance and potential benefits of wetlands for water resource management. The water-related ecological functions of wetlands should be given due consideration. The main principles of the Estonian wetlands management strategy proposed by wetland experts [21] form an excellent basis for further steps. General management principles, recommendations for management (incl. proposals concerning the buffer zones of different wetland types) and various measures for reducing conflict among different interests are presented. It is emphasised that the destruction of wetlands should be avoided in the catchment areas of rivers that are likely to cause damaging floods. Special care should be given to the protection and proper management of wetlands in or near watercourses with high loads of nutrients and other pollutants.

Wetlands are potential areas for energy biomass production. A wetland-based energy production scheme appears to be a promising source for small-scale central heating plants (CHPs) as well as micro-generation systems. Depending on the presence of nutrients in the wetland, dry biomass growth will be from 1 to 3 kg m⁻² yr⁻¹ [28]. Natural dehydration after the vegetation period amplifies the energy content of biomass up to 3.7 MWh per tonne. The low density of wetland biomass restricts the feasible transportation distance to an energy production facility. However, a portable charcoal production unit could be a usable energy concentrator to increase the energy content of biomass by increasing density by up to 1100 kg m⁻³ [29]. Based on the average biomass production of reed and



cat-tails ($1.5 \text{ kg m}^{-2} \text{ yr}^{-1}$), the estimated energy value of one hectare of energy reed-bed is approximately 200 GJ. If used for wastewater treatment, the dry leaf mass can achieve $3\text{--}4 \text{ kg m}^{-2} \text{ yr}^{-1}$. The biomass of reed and/or cat-tails from 300,000 ha of energy reed-beds provides about 44,000 TJ energy a year. This is about 83% of the current thermal energy consumption in Estonia [29].

Drained wetlands are the second largest source of unbalanced carbon flow in Estonia. According to estimations, the average rate of decomposition of sphagnum in drained wetlands is about $4.3 \text{ t CO}_2\text{-C ha}^{-1} \text{ yr}^{-1}$, whereas the fixation rate of carbon due to the formation of sphagnum is only $0.9 \text{ t CO}_2\text{-C ha}^{-1} \text{ yr}^{-1}$. The amount of decomposed sphagnum exceeded the amount of sphagnum formed by about 2660 thousand tons of $\text{CO}_2\text{-C}$ annually. According to data from the beginning of the 1990s, the carbon flow originating from drained wetlands alone exceeded the environmental space of Estonia about 4 times, and was 6.7 times higher than the global average per capita emission of carbon from land use changes [29].

5 Conclusions

A large portion of Estonia's natural wetlands are preserved, and an essential part of them are protected. Due to their ecological and hydrological functions, wetlands are an intrinsic part of the water resource system, and thus the sustainable use of wetlands is an important aspect in sustaining and enhancing water quality and environmental stability. The introduction of a system of water management by river basin areas is a new challenge for wetland management and conservation. It is important to raise the understanding of the values and benefits of wetlands and to incorporate wetland management more effectively into water resource management.

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