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Legislative effects on the development of surface water quality in rural areas in Northern Germany

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Abstract

The objective of this study was to document the development of the water quality in a rural catchment in Northern Germany as a result of the change of environmental legislation designed to achieve protection of water bodies. The selected lowland catchment 'Honigau' (14 km^2) was extensively investigated during two monitoring campaigns from 1972 to 1974 and 1996 to 1998, respectively. The anthropogenically caused pollution level of the brook draining the study area was greatly reduced over time, because the number of households connected to waste water treatment plants was increased. In addition, new and improved wastewater treatment plants ensured a more efficient treatment. Furthermore, state-of-the-art storage capacities for manure at the farms reduced nutrient losses. The results showed that technical progress and an improved legislative framework have a greater effect on the reduction of nutrient losses from point than from diffuse sources resulting in much lower phosphorus concentrations, but there were still elevated nitrate concentrations, particularly caused by the tile-drainage of organic soils.

Keywords: Surface water quality; Rural catchment; Environmental legislation; Eutrophication; Nitrate losses

1. Introduction

The pollution of rivers, lakes and ground water with nutrients became a political issue in the 1960s and 1970s throughout Europe and the United States of America. Looking for possible causes, agricultural emissions were suspected to be the main factor for the contamination of surface and ground water resources in rural areas [1–3]. The intensification and specialization of the agricultural production compared to the older system were increasingly identified to modify the natural nutrient cycles [4]. Indeed, emissions of oxygen depleting substances and the resulting eutrophication were considerable as already shown by early extensive investigations of rural catchments [5,6]. Rural settlements including individual farms with inadequate or lacking waste water treatment were found to be an additional source of pollution. However, livestock farming represented the major polluter since liquid manure as well as seepage from dunghills and fodder silos were emitted into water bodies without proper treatment [2].

The identification of the different sources of pollution led to a complex legislative framework to improve the protection of the aquatic environment. In this study, the development of the legislation at the various levels of administration is exemplarily described for Germany and the federal state of Schleswig-Holstein. Forming the northern part of Germany, Schleswig-Holstein shares a coastline of almost 1200 km (including the islands) with both the Baltic Sea and the North Sea and therefore, plays an important role in the protection of the fragile ecosystem of the continental shelf zones. As a protection measure for the coastal zones, the requirements for the German water quality class II or better should be met by all rivers and lakes (class I = excellent; II = moderately polluted; III = polluted; IV = extremely polluted) [7].

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The objective of the study was to outline the development of the water quality in rural Schleswig-Holstein as it emerged from the struggle between legislative requirements, agricultural change and technological progress. The brook 'Honigau' was extensively investigated during two monitoring campaigns over two years in the 1970s and 1990s, respectively providing a data base which allowed to assess the effects of pollution reducing measures taken over the years.

2. The legislative framework

Agricultural and environmental legislation has a major impact on the development of rural areas. In the context of water quality, most important are those laws concerning nature and landscape conservation, soil protection and, of course, water protection. While in the 1950s and 1960s the legislation was driven by the idea of providing the population with an ample supply of food and clean drinking water and to ensure economic growth [8], the rising environmental awareness and the concern for the protection of natural resources led to the emergence of German as well as European environmental politics and legislation in the early 1970s [9]. In Germany, citizen's pressure groups played an important political role in pushing for improvement of environmental conditions, especially of the water quality [10].

The most important principles of environmental legislation are the precautionary principle, the polluter-pays principle and the cooperation principle, which are also reflected in the regulations concerning water protection. According to the cooperation principle, environmental protection is to be understood as a common task of the public and the private sector as well as the citizens. Compared to other agricultural areas, important additional stakeholders in coastal zones are fisheries, navigation and, increasingly, tourism.

More than 100 years ago, the first bird sanctuaries were established in Schleswig-Holstein on the islands of Sylt and Norderoog, emphasizing the high value of coastal regions for the federal state. These sanctuaries represented precursors of nature conservation areas [11] as later (1987) implemented in the Schleswig-Holstein Nature Conservation Act [12]. This law was revised in 1993 to include holistic protection strategies for biotope networks consisting of valuable biotopes like fens, bogs, heathland and dunes linked by linear landscape elements such as water courses and hedges. Any action that may have an adverse effect on these biotopes or landscape elements is categorically prohibited [11].

Since the 1970s, there have been a number of regulations and guidelines aiming at the long-term protection of soil fertility and productivity, but a law to protect the soil from damaging changes and to enhance the rehabilitation from dangerous wastes was not passed until 1998 (Federal Soil Protection Act). It focuses on the protection from damage especially caused by the deposition of waste and on improved measures to fertilize the soil. The idea to temporally and quantitatively limit the application of industrial and commercial fertilizers was brought about by, among others, the Liquid Manure Ordinance (1989) and the Fertilizer Act (1977)/Fertilizer Ordinance (1996). The Liquid Manure Ordinance Schleswig-Holstein is aimed at the prevention of losses of liquid manure and poultry excrements and in this way protects surface waters [13]. The use of fertilizers as regulated in the Fertilizer Act (1977) and in the Fertilizer Ordinance (amended 2003) should follow the principles of ''good agricultural practice''. The resultant regulations formulated by the Schleswig-Holstein Ministry for Food, Agriculture and Forestry require that the use of fertilizers (type, number and time of application) is determined by the nutrient demand of the plants, the nutrient and organic matter status of the soil as well as by the meteorological conditions of the site and by quality requirements, while expert advice and model predictions have to be taken into consideration as well. This approach is supposed to guarantee that the fertility of the soil is sustained, while the health of people, animals and nature, more broadly, will not be harmed by fertilizers and that conflicts between agriculture and environmental protection will be avoided.

The development of the Water Resources Act (WHG) as a federal law for surface water bodies, coastal waters and ground water reflects the development of environmental legislation and the change of paradigms: In 1965, a first initiative for a water law encompassing the protection of the self-purification capacity of water bodies formed, but this was not based on environmental objectives, but on problems with the use of polluted water. Only the forth amendment of the WHG interpreted the fight against pollution and overuse of water as a task of environmental protection, and according to the fifth amendment, the protection of waters should be carried out because of nature's inherent value, and not only to ensure a fair resource allocation [14]. Since 1986, to keep waters clean and to secure good water quality for the future by reducing the emissions to surface waters have been the most important task of water resources management. The revision of federal laws for the protection of water bodies in 1986 implemented the European Union guidelines into national law and therefore provided the legislative framework for the precautionary protection of the environment and waters [15]. In accordance with the precautionary principle preventive measures should ensure that environmental damage is avoided before its potential occurrence. Generally, the most environmentally sound technology and concepts should be applied, even if it is uncertain according to current scientific knowledge whether these are required to avoid environmental damage [16]. Currently, the European Water Framework Directive (WFD) designed to achieve a ''good ecological status'' of all water bodies sets long-term objectives and surpasses former requirements. In 2004, the WFD was implemented at the National and State level into the WHG and the LWG, respectively.

While the WHG is a framework law and furthermore, it is especially significant for farms in water protection areas, the regulations of the Federal Water Act (LWG) generally apply to the use of ground water for drinking water purposes, the treatment of waste water as well as to the maintenance of brooks and ditches. The maintenance of brooks and ditches must take into account the objectives of nature and landscape conservation. All water polluted by domestic, industrial or