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IMPLEMENTATION OF THE WATER FRAMEWORK DIRECTIVE IN THE PROVINCE OF POMERANIA

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Summary. The objective of this report has been to trace the management of water resources and to assess the environmental effects achieved owing to the implementation of the Framework Water Directive in northern Poland. The following analysis has been performed for the Province of Pomerania (1999–2009) and contains the information on tasks whose aim is to limit water use and remove water pollutants, based on the statistical data of the Central Statistical Office. It was observed that during the analyzed decade in the Province of Pomerania, the investment projects in the water and wastewater management sector had a noticeable effect on the improved living standards of the local residents and better condition of the natural environment.

Key words: Water Framework Directive, water pollution, water protection, water management

INTRODUCTION

The main objective of the Polish water management strategy was to adopt the European Union water policy included in the Water Framework Directive [Directive 2000/60/EC]. The Directive provides for sustainable end integrated management of surface, ground and coastal waters. Environmental considerations form the basis of the WFD, with the ultimate aim of achieving „good ecological status" in all waters by 2015. The guidelines of WFD were incorporated into Polish law (Water Law 18.07.2001; Environment Protection Law 27.04.2001) and they are currently being implemented in accordance with the timetable provided in this directive [Błaszczak 2005].

Water Framework implementation is difficult and require to compile a clear local implementation strategy i.e.: environmental protection programs, development strategies or small retention programs, including all legal, institutional, economic, social and planning aspects.

The objective of this report has been to trace the management of water resources and to assess the environmental effects achieved owing to the implementation of the Framework Water Directive in northern Poland.

MATERIAL AND METHODS

The following analysis of the implementation of the resolutions originating from the Water Framework Directive has been performed for the Province of Pomerania. This is the eighth largest province in Poland (18.31 thousand km^2) and has a population density of 122 persons per km^2. The Province of Pomerania is highly urbanized, with very diverse land use. Around 50% of its total area is covered by agricultural land, with considerable dominance of arable land; forests and woodlands cover over 37% of the total area [Enviroment Protection 2010]. Apart from the coastline stretching for 316 km to the north of the province, another feature which distinguishes it from the remaining Polish provinces is the rich hydrographical network and large resources of both surface and groundwater. The hydrographical axis of this area is the Vistula river, which carries water, alongside contaminants, from over 60% of the area of the country. The province is characterized by the highest lake density in Poland – 0.5% [Environment Protection 2010], and the total number of lakes is over 18,000. Moreover, there are 17 Major Groundwater Reservoirs in the province, which contain Poland's strategic supplies of groundwater [Report 2010].

This report has been drawn on the statistical data of the Central Statistical Office, available online in the local data bases [www.stat.gov.pl], and contains the information on tasks whose aim is to limit water use and remove water pollutants which were implemented in the Province of Pomerania in 1999–2009.

RESULTS AND DISCUSSION

Attaining good quality of water requires a series of treatments, whose overriding purpose is to limit the influx of contaminants but another objective is to use water supplies in a more rational manner. In the Province of Pomerania, the water use for purposes of the national economy as well as by individual households decreased by 15% during the time period analyzed in this study (Fig. 1), falling down to 198.0 hm^3 in 2009. Most of that water was used by industries, but the total amount was 10% lower than in 1999. Likewise, the contribution of groundwater used for industrial purposes declined by around 5%.

The industrial use of water declined mainly as a result of the requirement to implement new technological solutions in line with the principle of the *best available technology*. Another cause was the elimination of low-profit, high water-consuming technologies.

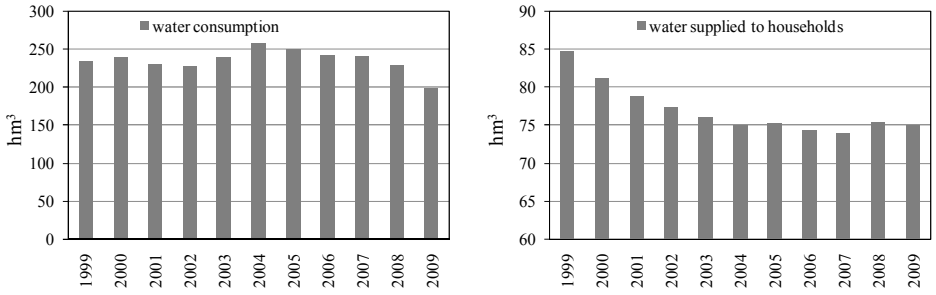

Fig. 1. Changes of water consumption for national economy needs and population by Province of Pomerania [www.stat.gov.pl]

Despite considerable improvement of the living standards, especially in the rural areas of the province, where, for example, the total length of water mains increased by 40% and the total number of people supplied with water from the water-pipe network rose by 5%, the amount of water supplied to households in the whole province decreased by nearly 15% (Fig. 1). The main reason is probably the widespread introduction of certain economic measures, such as water meters in households, and a constant increase in the water unit price. Although the highest percent decrease in the water consumption was observed in agriculture and forestry (less by 64% compared to 1999), the actual amount of saved water is around 18 hm^3 as these two branches of the national economy do not consume much water.

Limiting water consumption, despite obvious environmental benefits, does not entail more efficient removal of water pollutants. The environmental standards in this respect largely depend on the capacity of sewerages, including water treatment facilities. In 2009, the total amount of industrial and municipal wastewater and sewage which required treatment generated in the whole province was 126.6 hm^3, being 40 hm^3 (24%) lower than in 1999 (Fig. 2). What seems even more important is that the amount of untreated wastewater and sewage discharged to water reservoirs or to the ground declined 10-fold during those ten years and at present it is just 1% of the generated wastewater which needs treatment. Moreover, the quality of wastewater treatment technologies has improved considerably.

The share of wastewater which undergoes mechanical treatment alone to the total amount of treated wastewater fell by about 1.5%. The most essential changes, however, occurred in the case of wastewater treated biologically with improved removal of biogenic substances. The percentage of municipal and industrial wastewater treated with more efficient nitrogen and phosphorus reduction technologies increased from 34% in 1999 to 53% in 2009. The improvement in the wastewater management was achieved by constructing new WTPs and refurbishing the old ones, raised in the early 1990s (for example, the enlargement and refurbishment of the wastewater treatment plants in Słupsk or Ustka).

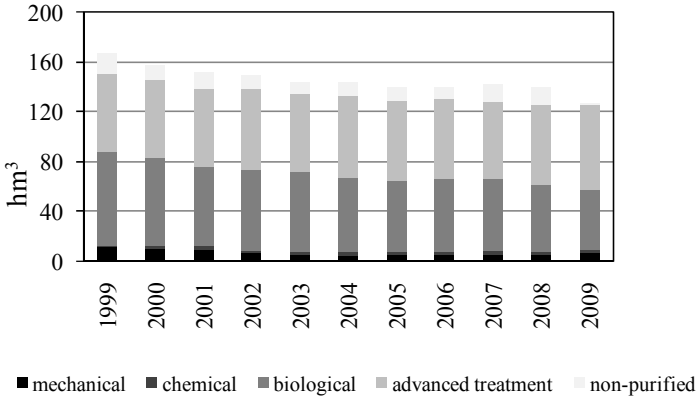

Fig. 2. Industrial and municipal waste water requiring treatment and the type of treatment [www.stat.gov.pl]

In the late 1990s, there were 243 WTPs operating in the Province of Pomerania, including 21 with enhanced removal of biogenic substances. In 2009, there were 268 WTPs, of which 52 had technologies for better removal of biogenic substances. Another reason why anthropogenic pressure on water resources was alleviated was the extension of the sewerage network. Ideally, each water connection should correspond to one sewage connection and the ratio of water pipes to sewage pipes should be close to 1, but in practice the existing sewerage network is much smaller than the water mains. However, each year, this disproportion is diminishing in the Province of Pomerania owing to the constant increase in the total length of the sewerage network. The ratio of the sewerage system to water mains rose from 0.35 in the late 1990s to 0.53 at present, and the length of the sewers doubled during the analyzed decade (Fig. 3).

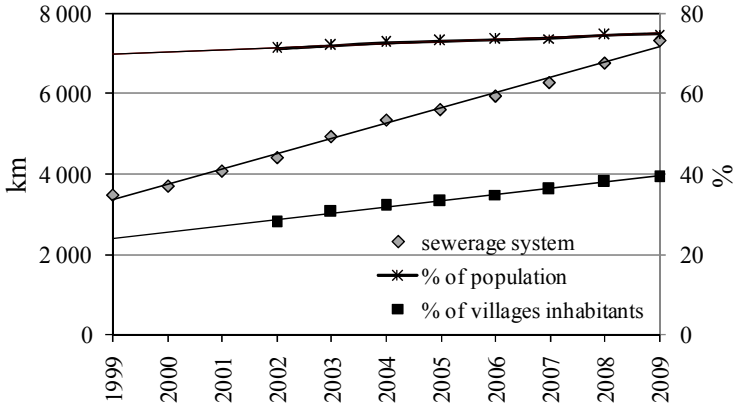

Fig. 3. Changes of the length of sewerage system and percentage of household connected to sewerages in the Province of Pomerania [www.stat.gov.pl]

Moreover, this increase occurred mainly in rural areas. In 2002, just 27.8% of inhabitants of villages in the Province of Pomerania had their household connected to sewerages; the percentage rose to over 39% at the end of 2009.

At the same time, the percentage of rural population who could use communal wastewater treatment plants increased to nearly 39% (19% in 2002). Another important component of the wastewater management is the development of a rainwater sewer system, which measured 32 km at the end of the 1990s but rose to over 72 km.

Due to an observable increase in losses caused by floods, which may be evoked by natural factors or, perhaps even more evidently, human action (e.g. development of upland areas, undesirable agrotechnical treatments, etc.) [POŚ 2005], certain investment projects have been planned in the province, including repairs and modernization of flood banks and small water retention reservoirs [Retention Program 2004]. However, the projects completed until the present day are far from being adequate to ensure good flood protection and water supply during ground drought. According to the Report on the Implementation of the Development Strategy for the Province of Pomerania [Report Strategy 2010], the flood embankments require urgent repairs. Their number is likewise far from sufficient. Although on average 17 km of new embankments were built every year in 1999–2009 (with the largest investment projects completed in 2003–2004 and 2006–2007) [www.stat.gov.pl], so that their total length in the whole region is now 660 km and they can protect from floods 141 thousand ha of land, about 28% of their total length need to be either rebuilt or modernized. Moreover, some 25% of water pumps and 30% of other hydroengineering facilities need repairs [Report Strategy 2010].

During the analyzed decade, considerable amounts of money were allocated to the construction and modernization of the technical infrastructure, especially the facilities needed for environmental conservation. Since 1999, the total financial outlays in the Province of Pomerania allocated to tangible fixed assets have reached around 2.5 billion PLN, and over 60% of that amount has been allocated to sewerages (around 1.2 billion PLN) and rainwater sewer system (0.4 billion PLN). The remaining money has been spent on modernizing and building wastewater treatment plants. The outlays on water management reached around one billion PLN during that time period. The capital invested in small water retention projects between 2003 and 2009 equalled about 2.3 billion PLN.

One of the effects of the performed work and invested capital is that the load of pollutants in treated sewage and wastewater has been reduced (Fig. 4). By raising the share of wastewater submitted to additional removal of biogenic substances, the total phosphorus content in treated municipal wastewaters was reduced by around 80%, from 296 to 59 t year^{-1}.

Analogously, the total nitrogen content was limited by 50%. The BOD was reduced by about 60% compared to the late 1990s. Furthermore, should we assume that untreated wastewater and sewage contain on average 35 mg N dm^{-3} of nitrogen and 2.5 mg P dm^{-3} of mineral phosphorus [Dymaczewski 1997], by re-

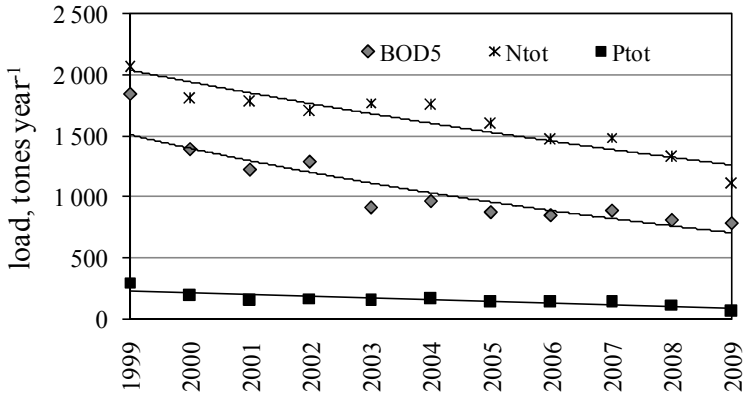

Fig. 4. Load of pollutants (in tones year^{-1}) in treated municipal wastewaters [www.stat.gov.pl]

ducing amounts of untreated wastewater and sewage discharged to water bodies or to the ground by nearly 14 hm^3, we were able to limit the supply of biogenic substances by *ca* 500 tons of N and 35 tons of mineral P.

CONCLUSIONS

The investment projects completed in 1999–2009 in the water and wastewater management sector in the Province of Pomerania (Tab. 1) had a noticeable effect on the improved living standards of the local residents and better condition of the natural environment. The percentage of the local population who take

Table 1. Effects of the Framework Water Directive implementation in the Province of Pomerania [www.stat.gov.pl]

Parameters	1999	2009
Water consumption, hm^3 year^{-1}	234.3	198.0
Length of water-line system, km	9883.3	13794.0
Length of sewerage system, km	3475.1	7308.1
Industrial and municipal wastewater requiring treatment, hm^3	166.6	126.6
Untreated wastewaters, hm^3	15.5	1.5
Wastewater treatment plants, object – with increased nutrient removal	243 21	268 52
Pollutant load in municipal wastewater discharged after treatment, tones year^{-1}:		
– Ntot	2058.1	1099.9
– Ptot	296.1	59.1
– BOD	1845.3	776.8

advantage of the sewer system has risen (up to 74.9%), being much higher than in whole Poland (61.5%). By analogy, the ratio of sewerage system to water mains improved considerably (0.53) and is now much higher than in the rest of the country (0.37). Similarly, the percentage of the population whose households are connected to wastewater treatment plants is now higher – in 2009 it reached over 80% of the total population of the province, with Poland's average of 64%.

During the analyzed decade, the amount of untreated wastewater and sewage discharged directly to water reservoirs or to the ground fell ten-fold. At present, such wastewater and sewage make up around 1% of the generated waste which needs to be treated (in Poland, the respective percentage is 6%).

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REALIZACJA ZAŁOŻEŃ RAMOWEJ DYREKTYWY WODNEJ W WOJEWÓDZTWIE POMORSKIM

Streszczenie. Celem opracowania było prześledzenie zmian w gospodarowaniu zasobami wodnymi oraz oszacowanie efektów środowiskowych, płynących z wdrażania Ramowej Dyrektywy Wodnej w Polsce północnej. Prezentowane analizy, oparte na danych Głównego Urzędu Statystycznego, dotyczą województwa pomorskiego (1999–2009) i obejmują informacje na temat realizacji działań na rzecz ograniczenia zużycia wody i ograniczania zanieczyszczeń. Stwierdzono, że przeprowadzone w omawianej dekadzie inwestycje w zakresie gospodarki wodno-ściekowej na terenie województwa efektywnie wpłynęły zarówno na poprawę standardów życia mieszkańców, jak i ochronę środowiska.

Słowa kluczowe: Ramowa Dyrektywa Wodna, zanieczyszczenia wód, ochrona wód, gospodarka wodna