



## Poland

# Assessment of conflicts on the artificial water reservoir Jeziorsko in the rural area without a centralised wastewater treatment plant

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## Abstract

The aim of this case study is to estimate water and sewage management in the basin of Jeziorsko reservoir with special reference to conflicts related to spatial management on the area of scattered housing, with an insufficient sewage collection and treatment system. The Jeziorsko Reservoir plays various functions; it is an important element of a flood control system for cities located in the Sieradz Basin, a reservoir of water used for industrial and agricultural purposes, and it supplies tap water to big urban agglomerations. Owing to a biological role of the reservoir and its effect on regional economy, of special importance is the care for a proper ecological state of this reservoir.

## 1 Introduction

There are some reasons for developing studies on the optimum use and correct management of water resources in central Poland:

- a significant Poland's contribution to the Baltic Sea degradation,
- poor water resources of Poland,
- local water shortages and stepping,
- bad quality of surface waterbody,
- underdevelopment of technical infrastructure and significant anthropopressure,
- requirements for implementation of WFD regulations.

In particular, the necessity to conform to WFD requirements concerning water quality improvement by the year 2012 causes that actions should be undertaken as soon as possible to implement improvement programmes and start investments to ameliorate surface water quality in central Poland.

The area of Jeziorsko reservoir has been chosen for documentation due to the construction of an artificial storage reservoir, which affects the natural environmental and technical infrastructure as well as spatial management and social environment.

The area described is an agricultural land. Arable lands cover approximately 42% of the land's surface, meadows and pastures approximately 14%. Agriculture on the area described has unfavourable agricultural structure. There are mainly small farms, often of an area up to 5 ha.

The second characteristic and important feature of agricultural production on the discussed area is the lack of modern infrastructure of the agriculture market: crops storing and food processing bases, production and distribution groups. It is connected with a low level of education of people employed in agriculture, significantly below the average level.

The area is also underdevelopment as far as the technical infrastructure is concerned: there are poor roads, a small number of public buildings, quite a long period of time without any rural water mains and land reclamation.

The construction of Jeziorsko reservoir brought a positive change in the monotonous landscape of Nizina Południowowielkopolska and made the scenery more attractive. Building of the reservoir made it possible to use the land for recreational purposes and provided new jobs in tourism, farm tourism and fishing. These possibilities are included in the Łódź Region Spatial Development Plan and in the Studies on Preconditions and spatial management trends for each district. The position of the reservoir and its location against Łódź is shown in Fig. 1.

## 2 Background information

### 2.1 General characteristics of Jeziorsko reservoir

#### 2.1.1 General functions

Jeziorsko reservoir was built on the Warta river, one of the biggest rivers in Poland, in its middle course. The Warta originates in the area of Jura Częstochowska and flows in its upper course across highly industrial and urbanised lands. The location of Jeziorsko reservoir is shown in Fig. 1 and Fig. 2.

The documented area, in tectonic respect, is located in the central part of Mogilno-Łódź basin. The geological profile is made of upper Cretaceous sediments from the Tertiary and Quaternary. The oldest sediments found in drills are upper Cretaceous sediments, which form a substratum of the Łódź basin. The Warta valley and partly the Teleszyna valley have tectonic-erosional landscapes.

Contemporary surface features were formed as a result of the influence of complex factors, the main of which was the Warta glaciation. Fundamental elements of the land's morphology are:

- South directed Warta's valley transformed by the construction of Jeziorsko reservoir along with the network of the valleys of the rivers being the Warta tributaries,
- Post-glacial upland plains mainly with glacial till.
- Uplands are flat or undulating ground moraines. Elements of the Warta's natural landscape are two terrace levels: the lower Holocene with meadows and green crops mainly, and the upper sandy Pleistocene, mainly forested, partly agricultural.

The river network is made of Warta – second grade right-bank tributary of the Odra. Right-bank tributaries of the Warta are: the Pichna with the Brodnia, the Jadwiczna and the Urszulanka, third grade tributary, the Niniwka and the Mazur third grade tributary. Left-bank tributaries are: the Teleszyna (its mouth beyond the documented area), unnamed streams around Strachanów and Cielce, the Struga Spicymierska (its mouth beyond the report) and the Potok Niemiecki (Rów Zborowski) and the Starorzecze Niemieckie.

The artificial surface basins are Jeziorsko reservoir on the Warta river and fish ponds in Pęczniew on the Pichna. Old-river beds cut off as a result of the Warta's channel regulation in the area of Skęczniew, Nerki and Piekary are partly artificial, too. To avoid flooding of the valleys, side and back dams were built in the mouth of the right-side Pichna and the left-side Teleszyna and the upper Warta. As a result of side and back embankments, depression areas appeared which are artificially dewatered.

In the documented area there are subterranean waters in the Quaternary, the Tertiary and upper Cretaceous sediments. Subterranean waters in the Quaternary sediments are found on a vast part of the land. There are no Quaternary water-bearing sediments in the area of high lying Mesozoic substratum and in some parts of the plateau where impermeable sediments prevail. The water-bearing level is found in three areas: in the valleys of the Warta, the Teleszyna and partly the Pichna, in the area of previous river valleys, in the area of postglacial plateaus.



Fig. 1. Location of the Jeziorsko reservoir (the line of main watershed of Poland, between the Odra and the Vistula river basins is marked).

The Jeziorsko reservoir is located on the border of Łódź and Wielkopolska voivodeships. On the documented area the structure of land use is as follows: arable lands 42%, forests and forest lands 15%, surface waters 17%, meadows and pastures 14%, other lands (including settlements) 12%. The largest area is occupied by agricultural production. The area has well-developed settlement net. Densely built-up villages dominate. Behind the reservoir the Warta flows again on highly industrial and urbanised lands considered as deficient in water resources. It flows near Konin and Turek coal and energy basin.

Jeziorsko reservoir, completed in 1986, was built as a multipurpose reservoir whose basic aims were: flood protection of the Warta valley and watering of arable lands and green crop. Total capacity of the reservoir at the minimal damming is 30.2 million cubic meters, at the maximum damming 203.8 million cubic meters. The surface is 17.6 square km and 42.3 square km, respectively; the depth 1.7 m and 4.8 m. The total length of the reservoir is 16.3 km, the width at the maximum damming is 2-3.5 km. Basic sets of the reservoir's objects are:

- frontal stage with an earth dam, diversion weir and hydroelectric plant,
- side dams of the Pichna and Teleszyna rivers which protect lands in the valleys of the rivers from flooding,
- backwater dams and the Warta's regulations in the backwater which protect washlands of a total area of 1400 ha,
- embankments protecting a historic church in Siedlątkowo,
- fish ponds in Pęczniewo,
- infrastructure of the areas around the reservoir (pumping stations).



Fig. 2. Location of the Jeziorsko reservoir and the reservoir basin being analysed.

As it was mentioned above, the functions of Jeziorsko reservoir are as follows:

- Flood protection of the Warta valley and towns in the valley,
- Watering of arable lands and green crops on the surface of approximately 57 000 ha,
- Supplying water for industry in coal-energy region Konin-Turek, Śrem and Poznań,
- Satisfying current and future water needs of Poznań based entirely on ground water intake infiltrating from the Warta,
- Increasing of the river flow in low flow periods to improve sanitary and sailing conditions,
- Using the frontal dam for road crossing on the route Kalisz-Rzymosko-Poddębice- Łódź,
- Production of electric energy in a hydroelectric plant (power: 3.08 MW) located in the frontal stage of the reservoir,
- Conducting rational fish farming in the reservoir with the use of a fish stocking centre,
- Creating sport and recreational conditions for the Łódź Industrial Region and Sieradz, Konin, Kalisz, Turek and Poddębice,
- Economy activation of underdeveloped neighbouring regions.

The above list of main functions fulfilled by the Jeziorsko reservoir provides an evidence of the great importance of the reservoir in correct management of modest water resources of this region of the Warta valley. Very significant is also its role in the economic development of the region. Unfortunately, certain errors in designing the reservoir and during its construction had not been avoided. Only after putting it to use and nearly 20 years of exploitation

it was found that several problems arose:

- The geological structure of the ground favours water permeation from the reservoir to underground water,
- The reservoir is shallow,
- The bottom of the reservoir has not been sealed,
- Exploitation of the reservoir causes significant changes in the water level.

Despite these disadvantages the reservoir satisfies its functions in an efficient way, especially in flood protection and guaranteeing adequate water level in the lower Warta river course. Below, in more detail, several basic functions of the Jeziorsko reservoir are discussed.

#### a) flood protection

Water husbandry of the reservoir closes up in an annual cycle. Each year after the reservoir is completely filled with spring rise of water (up to an ordinate 121.5 m above sea level), it is gradually emptied downriver to satisfy the needs of all users until the minimal damming level (116.0 m above sea level) is achieved in autumn. Water is supplied immediately from the reservoir to:

- Water power station Jeziorsko in the amount of 15 m<sup>3</sup>/s to 70 m<sup>3</sup>/s in current discharge, adjusted to the above mentioned tasks,
- Pump station Miłkowice II at Ostrów Warcki for the needs of the power station Adamów at Turek in the amount to 0.8 m<sup>3</sup>/s,
- Fish ponds in Pęczniew, at water level in the reservoir higher than 118.10 m above sea level, in the amount to 1.30 m<sup>3</sup>/s.
- The detailed schedule of water management in Jeziorsko reservoir is as follows (see also Fig. 3):
- 1 December – 31 January: the reservoir is prepared to receive spring flood wave and use the reserves to guarantee basic flow in the reservoir.
- 1 February – 15 April: – filling the reservoir to the level 120.50 m above sea level, so as to use the whole utility volume of the reservoir.
- 16 April – 30 June– keeping a constant level of water lifting achieved during filling the reservoir. In special cases related to guaranteeing the water needs of public utilities or flood hazard (storage of flood wave) it is admissible to change the level of lifting,
- 21 June – 30 November – gradual emptying of the reservoir to 116.30 – 116.00 m above sea level.

Prolongation of the reservoir filling period to 15 April is caused by the fact that high water on the Warta river often occurs at the end of March and beginning of April and in the first half of April. Keeping the stable level of lifting in the period 16 April – 30 June is related to the protection of birds' habitats, to safely hatch in normal hydrological conditions.

When low water smaller than 20 m<sup>3</sup>/s, lasts for longer than 7 days, in the period from 16 April to 30 June, the reservoir can be gradually emptied to ensure normal work of infiltration water intakes for cities, satisfy water needs of the power stations Konin and Pałnów and to improve the sanitary state of the river. Changes of water level in the reservoir in the years 1997, 1999 and 2002 are illustrated in Fig. 3.

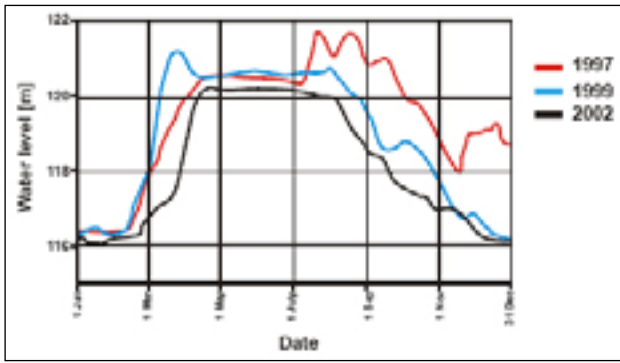


Fig 3. The profile of water level in Jeziorsko reservoir in the years 1997, 1999 and 2002.

It should be emphasised that during a great flood in Poland in 1997 the Jeziorsko reservoir protected important industrial centres such as Konin, Pątnów and Turek against flood. It also reduced significantly the flood hazard in Poznań and its neighbourhood. Additionally, reduction of overbank flows of the Warta enabled agricultural use of so far not embanked Konińsko-Pyzderska valley on the area of about 20 000 ha, which had a favourable effect on the economic development of the region.

**b) watering of arable lands and supplying water for industry**

Jeziorsko reservoir was built mainly as a retention basin for industry in Turek-Konin energy region and for agriculture in Wielkopolska region, which is deficient in water.

At present, it supplies water for arable lands and grasslands on the area of ca. 57 000 ha, in this number on the area located near the reservoir – ca. 5000 ha, in Konin region, in the Warta valley – about 24 600 ha, and in Poznań voivodeship in the Warta valley from Pyzdry to Międzychód – ca. 15 200 ha. Moreover, it supplies water to agricultural grounds located in Leszno and Piła regions and in the Noteć valley.

Construction of the reservoir ensured also that current and future water needs of the city of Poznań, relying entirely

on the intake of ground waters infiltrated from the Warta river are satisfied. Hydrogeological conditions of the Warta bed in the place where water intakes are situated require that the river flow should be supplied with water to the flow level not lower than medium low. It means that adequate level of water in the Warta river, controlled by Jeziorsko reservoir, has a crucial impact on potable water supply for the city of Poznań (~580 000 residents). But on the other hand, poor quality of the Jeziorsko reservoir and Warta waters, permeated into underground level, results in potential hazards of potable water supply.

A proper water level in the Warta river ensures water supplies to industry in Konin, Śrem and Poznań. The highest water requirements appeared in the power station of Konin – for cooling, Pątnów – to complete insufficiencies in the open water circulation in the lakes of the peak position of Ślesiński Channel and power station Turek – in the cooling tower system.

It is worth noting that beside the mentioned functions of ensuring water supply for industry and agriculture, an increase of river flow in low water periods improves the sanitary state of the Warta river and ameliorates sailing conditions on this river.

**c) nature protection areas**

The area of national natural significance is Jeziorsko bird sanctuary established by the government order on 23 Dec. 1998. It covers the area of 2350.6 ha and lies entirely in the cap of Jeziorsko reservoir. The reserve protects among others water-marsh birds sanctuary rarely found in Poland. The sanctuary plays an important role as a preying and resting place for migrating birds. It also fulfils scientific, didactic and landscaping purposes. On the basis of many years of ornithological observation 250 bird species were identified. These main species are: cormorant, grebe, grey heron, swan, grey goose, seagull.

**d) other functions of the reservoir**

Lifted water of the Jeziorsko reservoir is used in the electric energy production in the water power station of power 3.08 MW, situated on the dam. It is equipped with two water turbines of diameter D = 2.4 m, which ensure a maximum water flow reaching ca. 70 m<sup>3</sup>/s. The power station produces annually about 20.3 GWh electric energy used for the region’s own purposes and transmitted to the national power network. It is worth mentioning that the head dam of the reservoir was used as road from Kalisz – Rzymско – Poddebice to Łódź.

The Jeziorsko reservoir is also used in reasonable fish farming taking advantage of the fish stocking centre of the area 220 ha. In the centre, mainly carp (*Cyprinus carpius*) is bred, and the yearly production of this fishing farm is about 50 – 70 Mg fish, which gives the output of 270 kg fish/(ha-year).

**2.1.2 Conflicting functions of the dam**

Multifunctional character of the Jeziorsko reservoir leads to conflicts between these functions. The intensity of conflicts is shown in Fig. 4.

1	Agriculture water supply	1							
2	Flood protection	△	2						
3	Industry - water supply		△	3					
4	Potable water supply				4				
5	Nature protection	△	△	△	△	5			
6	Electricity production		△			△	6		
7	Fishing		△			△	△	7	
8	Recreation/Settlement	△	△		△	△		△	8

	Conflict
△	None
△	Low
△	Medium
△	High
△	Very high

Fig. 4. Assessment of functional conflicts of Jeziorsko reservoir.

### 2.1.3 Ecological status of Jeziorsko reservoir

#### a) flowing surface waters

There were tests to determine the quality composition of surface waters flowing in Jeziorsko reservoir conducted in accordance with "National Programme of Environmental Monitoring in the years 2003-2005" within the statutory tasks of the Provincial Environmental Inspectorate in Łódź. The assessment was made on the basis of four control-measurement points of regional and national monitoring network on the Warta river and on the Pichna river.

Physicochemical quality of water in the Warta below Jeziorsko reservoir meets the demands of the second purity class. The river was unclassified only because of microbiological pollution. Quality deterioration (double increase of phosphorus (P<sub>og</sub>) and phosphates (PO<sub>4</sub><sup>-2</sup>) content was observed in the control-measurement profile directly below Jeziorsko reservoir. As for first purity class waters, phosphorus and phosphates content has risen from a value exceeding the limit value twice to a value exceeding the limit value four times. Phosphorus level in further profile of the reservoir (control-measurement point in Księżę Młyny) stabilised on a level noted in the section before the reservoir but significant rise in phosphates content can be observed in a much further distance.

At measurement points before and behind Jeziorsko reservoir no significant change of BOD<sub>5</sub>, COD-Mn content, ammonium nitrate, nitrate nitrogen and total nitrogen content was observed. In the measurement profile directly below Jeziorsko reservoir a 40% rise of COD-Cr content in relation to control points in the Warta (before the reservoir) and Księżę Młyny (below the reservoir) was observed.

In the Warta reservoir, the Pichna which feeds Jeziorsko reservoir from the east, had the poorest quality parameters in 2003. Sewage from Zduńska Wola, Janiszewice and Szadek was pumped into it which resulted in exceeding pollution as far as mineral, organic, biogenic and microbiological substances are concerned. The quality of the Pichna waters exceeds the limit value of phosphates content (new channel), phosphorus content and Cola titre (old and new channel). In third purity class mercury (old channel), phosphates and proper conduction (old and new channel) were present.

#### b) quality of subterranean waters

Waters of Quaternary stage are characterised by general mineralisation (expressed by the content of dry residue) within the range of 260-480 mg/cu dm. It is usually 350-460 mg/cu dm. Such mineralisation is above the average level (180-250 mg/cu dm), which characterises waters of Quaternary stage not changed anthropogenically. Chloride and sulphate content are considerably below concentrations allowed for drinking water. In general, these concentrations are within the scope of hydrogeochemical background defined for pure waters (7-15 mg/cu dm). The content is locally raised approximately to 50 mg/cu dm, mainly for sulphate contents in a drainage zone.

Ammonia content is usually from 0.0 to 0.03 mg/cu dm. It is locally higher but does not exceed the limit value of 0.5 mg/cu dm. Other nitrogen compound contents are within the limits. Nitrates content is very rarely raised and is directly connected with the pollution source (e.g. the Warta, an area of the former slaughterhouse 4.1 mg/cu dm). These contents do not exceed the limit value of 11 mg/cu dm.

Due to the lack of wide samplings of intakes for the scope of heavy metal contents, it is not possible to assess fully the quality of Quaternary waters. Only five holes have been tested for heavy metal contents. On the basis of

a few tests it can be observed that exceeding of heavy metal contents is connected with municipal sewage (Zn) and agriculture (Cd – organic fertilisers).

To sum up, in Quaternary waters taken from drilled wells no nitrates, sulphurs, chlorides of mainly anthropogenic origin exceed the limit value. Although content of the elements mentioned above is below the limit value, a rising tendency can be observed throughout years. It concerns mainly sulphurs and ammonia.

The waters of upper-Cretaceous stage have lower total mineralisation (dry residue) than the Quaternary waters (250-350 mg/cu dm on average). The waters have slightly alkaline reaction (similarly to the Quaternary waters). Water hardness is diversified from soft through medium hard to medium (approximately 7 mval/cu dm). Sulphurs and chlorides are present in smaller amounts than in the Quaternary waters (below 20 mg/cu dm) within borders of hydrogeochemical background. High values compared to the background were present in the wells where the Cretaceous water-bearing level is quite shallow. Better quality of the upper-Cretaceous waters compared to the Quaternary waters is observed in the intakes in the town of Warta where the chalk level is isolated from the surface.

Underground waters are not degraded, most of them belong to pure waters (unlike surface waters).

#### c) Jeziorsko reservoir surface water

The sources of pollution in the reservoir basin affecting its condition are:

- sewage from towns situated in the reservoir basin area,
- sewage from farms which have waterworks but no purification plants,
- drainage waters of the dam,
- waters dewatering the fish stocking pond in Pęczniew,
- surface flow,
- water birds whose droppings feed water mainly with phosphates.
- In 2003 none of the reservoir's tributaries met standards:
- The Warta – for microbiological and hydrobiological reasons. Physicochemical quality – second class.
- The Pichna (new channel) – because of phosphates and phosphorus content and Cola titre. Phosphates and proper conduction were in the third purity class.
- The Pichna (old channel) – because of Cola titre and phosphorus content. Phosphates, mercury and proper conduction were in the third purity class.
- The Niniwka – because of Cola titre. Physicochemical quality – third class (phosphorus).
- The Urszulanka – because of Cola titre. Physicochemical quality – third class (nitrite nitrogen).
- The Struga Mazur and the Augustynowski channel – because of phosphorus, manganese and faecal Cola titre.
- The tests of Jeziorsko reservoir were conducted in 2003 in three control points:
- Pelagic part – Miłkowice and at the frontal dam (two points),
- Littoral part – bathing beaches in Pęczniew-Wylazłów (one point).
- On the basis of 53 pollution indexes (routinely set) it can be stated that:

- Water temperature and reaction throughout the test period met the health requirements for bathing water.
- Water oxygenation in the reservoir met the requirements for first class purity in the whole water column. The health requirements for bathing water were fulfilled. However, the index did not meet the requirements for fish farming.
- Oxygen demand indexes were in the first and the second class and met the requirements for bathing water and for fish farming.
- Biogens content fulfilled the requirements for the first and the second class except for nitrite nitrogen content. According to the requirements for bathing water the assessment was positive. Nitrites and phosphorus content disqualified the waters for fish farming.
- Identified heavy metal content in most of tested samples was in the first class purity. Mercury (Hg) and Zinc (Zn) very rarely had unclassified concentration.
- Tested specific substances (volatile phenols, aminoactive detergents, aromatic hydrocarbons) were found in typical amounts for clean waters.
- Microbiological pollution determined by faecal Cola titre fluctuated within class II-III standards.
- Occasionally unclassified values were observed:
- In most tests "a" chlorophyll content fluctuated within class I-II standards. The highest concentration was noted in June and July.
- Water transparency fluctuated within 1.0-1.8 m (the lowest in September).

Element	Unit	Min.	Max.	Aver	Status
COD	mg O <sub>2</sub> /dm <sup>3</sup>	10.3	54.3	45.0	poor
BOD <sub>5</sub>	mg O <sub>2</sub> /dm <sup>3</sup>	2.1	12.0	4.0	moderate
N <sub>tot</sub>	mg N/dm <sup>3</sup>	0.8	6.0	3.9	good
P <sub>tot</sub>	mg P/dm <sup>3</sup>	0.05	0.83	0.7	poor
Coli index	amount/100 cm <sup>3</sup>	70	25000	12000	poor
Chlorophyll	mg/dm <sup>3</sup>	3.0	200.0	125.0	bad

Tab. I: gives concentrations of main pollutants determined in the water of Jeziorsko reservoir in 2003.

In 2003 the Jeziorsko reservoir waters did not meet the requirements for the planned first class purity (very good status) in any of the tests. Class II standards (moderate status) were fulfilled only during tests in April. The waters were polluted mainly with faecal Cola bacteria and biogens, which means that they were polluted by domestic sewage. Water quality in the reservoir does not fulfil aims projected during its construction – the water cannot be used for recreational purposes and its usefulness for fish farming is limited.

## 2.2 Description of significant pressures

Surface water pollution in Jeziorsko reservoir basin is caused mainly by:

### 1. Point source pollution:

- municipal sewage disposal (cleaned and unclean) from the towns of: Zduńska Wola, Szadek, Warta (Zduńska Wola, Szadek outside the borders of this report),
- industrial sewage discharged directly into surface waters (omitting urban drainage),
- sewage disposal from villages where waterworks were built before sewer system and sewage treatment plant (legal and illegal disposal).

### 2. Large-scale pollution:

- flows from agricultural lands where fertilisers, plant protection agents and manure (cow dung, liquid manure) are used,
- flows from urban areas by sewage disposal from combined sewerage system (organic compounds, biogens, suspension, heavy metals),
- flows from traffic areas (intersections of roads and watercourses).

### 3. Secondary pollution:

- progressing eutrophication of Jeziorsko reservoir causing secondary water pollution (toxic blue-green algae blooms which limit recreational prospects and depreciate tourist values of the region).

### 4. Limitation of possibilities of water autopurification caused by acceleration of water circulation in the environment, elimination of wet grounds, ecotonic zones and regulations of rivers.

Further in this chapter, certain factors that deteriorate the ecological status of water in the Jeziorsko reservoir are discussed in detail

#### a) water supply and sewage disposal

Inhabitants of the area are supplied with water from 19 district tapping water intakes. The length of the water supply system is 400 km. All fixed settlement units have access to the water supply system. There is no access to it in part of the recreational land on the right (east) side of the reservoir (Wylazłów, Popów, Siedlątków area).

In 2004 the intake from tapping water intakes was 1 076 536 cu m (2 949.4 cu m/d on average). Exploited intakes fulfil the need for water. Only 3 wells out of 19 exploit the Quaternary water-bearing stage, others upper-Cretaceous water stage.

Apart from these tapping water intakes several drilled wells taking both water-bearing stages were built in the documented area. The wells were made mainly for private users and for Jeziorsko pumping station. Most of the wells are closed or open only periodically so their intake is small. There are 93 wells altogether in the documented area. The number of wells may be larger because these mentioned above are registered (have geological documentation).



Fig. 5: The water-pipe and sewage network system on the Jeziorsko reservoir area.

In the documented area there is no organised system of sanitary sewage disposal and neutralisation. There are four purification plants in Warta, Jeziorsko, Pęczniew and Skęczniew. They have very limited scope and do not have much impact on sewage disposal in the region. The length of the sewerage network is 13.1 km.

The wastewater treatment plant in the Warta is being modernised (in fact it is being built anew). The purification plant in Pęczniew requires general modernisation (or reconstruction anew).

In approximately 98% of the documented area there is no municipal sewerage network so the inhabitants use local and individual sewerage networks, based mainly on cesspits. The relation of the length of the water supply system to the length of the sewerage network is 30:1, which means backwardness in this respect (see Fig. 6). The collected sewage is periodically disposed at discharge points situated at purification plants in Warta, Jeziorsko and Pęczniew. Total sewage disposal in 2004 was 195 038 cu m, which is 534.4 cu m/24h. It is estimated that only 38% of sewage in Warta district, approximately 7.3% in Pęczniew district and about 11% in Dobra district is treated. Table II presents the data concerning water from water mains supplied to households in villages located near the Jeziorsko reservoir against the level of sewage system in these villages.

District	Water-pipes	Sewage system
Goszczanów	> 90%	0 %
Warta	60% – 90%	20% – 70%
Pęczniew	60% – 90%	0%
Uniejów	60% – 90%	20% – 70%

Tab. II: Jeziorsko reservoir - population with access to water-pipe and sewage system (%)

On the basis of the data it should be supposed that many of the existing cesspits in individual farms are leaking and their contents infiltrate to the ground and most of sewage is discharged onto wastelands and ditches. This means that the sewerage network on that area should be urgently built.

**b) waste disposal**

In the documented area there is one working waste disposal site. It is located in Kraczynki, in Pęczniew district. Another waste dumping site (now closed) was situated within borders of the town of Warta in its western part. In the documented area there is also closed graveyard in Księża Wólka, in Pęczniew district.

Warta district is served by waste dumping site in the village of Bartochów, situated outside the borders of this report. Its closure and reclamation is planned. Waste will be disposed at Waste Treatment and Disposal Plant in Prażuchy Nowe, Ceków Kolonia district (Kalisz region, Wielkopolska voivodeship). Building and putting it into use is the aim of Municipal Districts Union "Clean Town, Clean District". The union was established in 1995 and gathers 19 local governments from Wielkopolska and Łódź voivodeships with the town and the district of Warta, Goszczanów district and the town and the district of Dobra.

Current waste collection from the documented area occurs by its disposal by litter authorities and by individual transport. The collection comprises mixed wastes, with no selection, which leads to a rise in deposited wastes.

**c) structure of land use**

The documented area is of agricultural character, due to good climate and rich soil. The main business activity is connected with agriculture and fishing. Agricultural production consists mainly of cereal crops, potatoes and vegetables growing and cattle and pigs breeding. There are mainly small farms of the area up to 5 ha. Services for the agricultural base are provided by the town of Warta and district villages. The structure of land use is shown in Fig. 6.

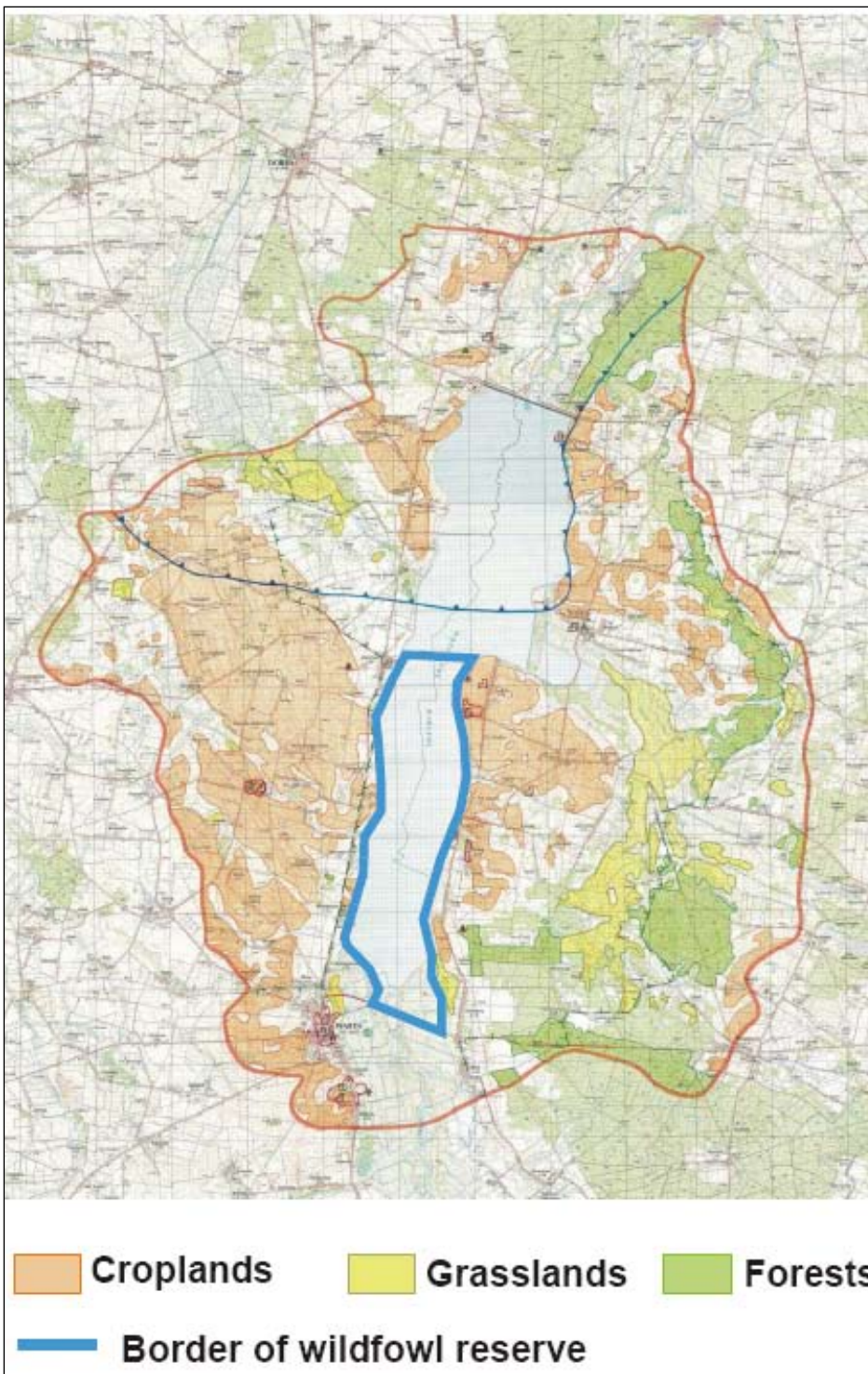


Fig. 6: The structure of land use on the Jeziorsko reservoir area.

A new developing form of land development are garden plots located mainly north of the border of the bird sanctuary along Jeziorsko coastline, on its both sides and in a dispersed form on forest lands (Księżę Młyny, Pierzchnia Góra).

Unfavourable location of arable land near the Jeziorsko reservoir and lack of a protective forest belt around its banks, cause that surface flow from fields supplies the reservoir with biogenic substances. This increases the risk of algal blooms, and the concentration of chlorophyll "a" exceeds the admissible level in spring and summer season.

**d) bird habitat**

The construction of a dam in the valley as well as cyclic filling and emptying of the reservoir (which empties more than half of its surface) from 21 June to 31 January, created brand-new natural conditions. The area of Jeziorsko has been inhabited by numerous bird species that found good conditions to breed and rest here while migrating. This situation affects directly the way of the reservoir's exploitation where changes of water lifting are forbidden from 16 April to 30 June due to bird hatching. Regulations on water lifting in the reservoir are stated in "Water Law Statement" and "Instruction to water husbandry on Jeziorsko reservoir".

The reservoir is one the most important objects of hatching and migrating avifauna in Poland. There were plans to add more prestige to the reserve by including it in the European Protection System NATURA 2000 but due to financial restrictions the area was not taken into consideration. During spring and autumn migration of about 230 bird species (150 hatching ones) can be observed over Jeziorsko.

Jeziorsko natural reserve was established in 1998. It covers the land from a bridge on the Warta in the south to Jeziorsko-Brodnia line in the north. The most precious part of the reserve is now in its southern part. It is worth noting that now wildfowl habitat is a significant diffuse source of phosphorous compounds, emitted directly into Jeziorsko reservoir water.

The Warta river and Jeziorsko reservoir is a habitat of numerous fish species as well. One of the main tasks during the project and construction stage was rational fish farming. The structure of ichthyofauna is characteristic of eutrophicated reservoirs where breams, roaches, pikeperches and pikes dominate. At the time of the construction of Jeziorsko

reservoir, a fishing pond complex was created. It is made of eight ponds with a total surface of 171 ha. For the reserve's opponents birds are competition with anglers and hinder fish farming.

**2.3 Analysis of impacts and pressures**

Hazards resulting from the character of land management are connected with forms of its use. Construction of Jeziorsko reservoir has changed natural environmental conditions on the local and regional levels. Below, in Table III the assessment of environmental transformation connected with construction of the reservoir is presented.

Favourable effects	Unfavourable effects
<ul style="list-style-type: none"> <li>▪ Construction of the reservoir reduced potential flood damages in the Warta valley, provided water supply for Konin-Turek coal-energy region</li> <li>▪ Water conditions were regulated by building irrigation channels, thus agricultural productivity was improved</li> <li>▪ Construction of the water power station enabled acquisition of cheap renewable energy</li> <li>▪ Construction of the reservoir made the area more attractive and provided conditions for recreational development</li> <li>▪ Construction of the reservoir contributed to biodiversity of the environment</li> <li>▪ The reservoir created good conditions for bird hatching and contributed to the rise in size of the populations of many bird species (some under special protection). Many species especially of water and marsh-water birds found good conditions here to settle. An essential advantage is establishing a bird sanctuary of European significance.</li> <li>▪ Construction of the reservoir improved people's living conditions (repurchase of flooded lands, building waterworks, possibility of selling land for recreational purposes, jobs in tourism and technical operation of the dam and its objects).</li> </ul>	<ul style="list-style-type: none"> <li>▪ Many concomitant objects (side dams, technical base, blocks of flats) had to be built. They are not always in harmony with the landscape</li> <li>▪ Construction of side dams cut off the natural outflow of the underground waters towards the Warta. Washlands of the Pichna, the Teleszyna, Glinna, Proboszczowice appeared where flooding and concentration of nitrates pollution of agriculture and of domestic origin was raised as a result of the raising of water table.</li> <li>▪ As a result of water damming in the reservoir and the change of flow direction of underground waters, the quality of these waters deteriorated near the east abutment of the frontal dam. Below the dam significant deterioration of the quality of the Warta waters is observed (eutrophication).</li> <li>▪ Cutting down tree stands and single trees limited hatching possibilities for hole birds and many other singing birds in favour of water and marsh-water birds. A rise in size of water and marsh-water birds leads to a rise in phosphates content in chemical composition of the water in the reservoir, which is easily observed in seasonal bird migration periods.</li> <li>▪ Construction of the reservoir without a fish-pass disturbed the balance of species (in favour of carp group species) and caused degradation of part of the population.</li> <li>▪ Development of holiday houses building in the area of the reservoir caused a rise in intensity of land and environment use (increased water intake and sewage disposal, increased waste amount, etc.)</li> <li>▪ In areas intended for flooding the investment required resettling people living in traditional rural houses to newly-built blocks of flats which involved a change of their lifestyle.</li> </ul>

Tab. III: Assessment of environmental transformation caused by construction of Jeziorsko reservoir

In the documented area agricultural land exploitation (arable lands, meadows, pastures) and homestead buildings dominate. Due to the important role of agriculture in land exploitation and underdevelopment of the technical and municipal infrastructure, individual farms are treated in the study as economic objects which are real and potential pollution sources (domestic sewage, process wastes e.g. plant protection chemical packaging). Homestead buildings are situated mainly on the banks of the reservoir, i.e. in the border zone of the Warta valley. Other economic objects in the documented area are: a poultry slaughterhouse in Włyń, meat processing plants in Pęczniew and Poniatów, mechanical mills in Warta and Pęczniew, bakeries in Warta, Pęczniew and Jeziorsko, agricultural engineering centres, fuel and plant protection chemical shops and fuel stations.

Liquid fuel stations may be potential sources of underground water pollution. These stations do not have the required protection (single-mantle basins, no monitoring of fuel leakage). Other objects dangerous to the environment include municipal landfill sites for Pęczniew district in Kraczynki, a graveyard in Księża Wólka and a closed dumping site in the town of Warta. Tests on the ground around the graveyard proved its influence on the environment (organophosphorous pesticides pollution).

Closed bore-holes of deep wells and closed dug wells may also be the source of pollution. According to hydrological assessments, Jeziorsko reservoir itself, whose polluted waters spread to Cretaceous sediments, is a source of pollution of underground waters. The degree of hazard of underground waters is connected with the existence of potential pollution sources and is influenced by geological structure – occurrence or lack of isolation of water-bearing level from the ground surface. Thickness of isolating sediments characterises the pollution resistance degree.

Within the useable level waters in Quaternary sediments emergency areas were sectioned off:

- The Warta valley before the reservoir (the town of Warta, the villages of Dzierżazna, Włyń, Kolonia Glinna, Proboszczowice)
- The Teleszyna valley (Jeziorsko, Ostrów Warcki)
- The Pichna and Jadwiczna valleys with their tributaries
- the villages of Celinówek and Józefów with their surroundings (north-west of Rossoszyca)
- The Warta valley below the front dam (Siedlątków, Łyszkowice, Skęczniew, Księża Młyny, Łęk Piekarski, Księża Wólka).

These areas were sectioned off on the basis of low lying of the water-bearing level, which means lack of isolation from the ground surface, hydraulic connection between the water-bearing level in Quaternary and upper Cretaceous sediments, huge water-bearing capacity of sandy Quaternary sediments, potential pollution sources in the form of homestead, family housing and holiday buildings deprived of sewerage network.

Forest complexes were considered to be less threatened because they are less exposed to anthropogenic effects despite their location of huge liability to pollution conditioned by geological structure.

Water quality hazards in Jeziorsko reservoir are:

- inflow of polluted waters from the Warta and the Pichna
- surface water flow from fields and roads (direct and by drainage ditches)
- domestic sewage infiltration from leaking septic reservoirs
- sewage disposal from the purification plant, illegal sewage disposal from villages near the reservoir
- biogenic substances inflow connected with numerous bird settlements in the area of the reservoir.

Natural landscape hazards are also dispersed holiday houses and buildings not connected with the tradition and culture of the region.

The most serious threat to the environment is the lack of organised sewage disposal (lack of sewerage system) and lack of organised waste disposal. Fig. 7 shows the matrix of pressures and impacts of Jeziorsko reservoir.

	Jeziorsko Reservoir	Physicochemical quality elements								Biological quality elements					Hydro-morphological quality elements					
		Transparency	Temperature	Oxygen conditions	Conductivity	pH	Nutrients	Acidification	Pesticides	Otoliths	Macrophytes	Phytoplankton	Plankton biomass	Benthic invertebrates	Eutrophication	Color index	Hydrogeomorphology	Morphology	River continuity	Turbidity
Diffuse sources	Urban drainage																			
	Agriculture																			
	Forestry																			
	Other bird habitats																			
Point sources	Wastewater industry																			
	Mining																			
	Construction sites																			
	Agriculture																			
	Waste management																			
	Aquaculture																			
	Manufacture																			
	Other																			
Abstract	Power supply																			
	Agriculture																			
	Industry																			
	Fishing																			
	Hydroenergy																			
	Other																			
Morphological pressures	Flow regulation																			
	River management																			
	Coastal management																			
	Other																			
Other anthropogenic pressures	Recreation																			
	Fishing																			
	Climate changes																			
	Land drainage																			
	Exploitation of natural resources																			
	Introduced species																			
	Introduced diseases																			

- Not present
- No effect
- Low impact
- Moderate impact
- High impact

Fig. 7. Jeziorsko reservoir impact and pressures matrix.

## 2.4 Protected areas

### 2.4.1 Objects and areas of the natural environment

The area has regional and national natural and landscape amenities. The area of national natural significance is Jeziorsko bird sanctuary established by the government order on 23 Dec. 1998. It covers the area of 2350.6 ha and lies entirely in the cap of Jeziorsko reservoir. The reserve protects among the others water-marsh birds sanctuary rarely found in Poland. The sanctuary plays an important role as a preying and resting place for migrating birds. It also fulfils scientific, didactic and landscaping purposes. On the basis of many years of ornithological observation 250 bird species were identified.

At the moment the sanctuary does not have a protection plan.

The main problem connected with the sanctuary is its co-existence with fish farming. Damages caused by birds are not that significant. Therefore it seems that the necessity of full conservation of the sanctuary is not accepted because of lack of knowledge. The sanctuary is of European significance and can be an attraction for tourists from Poland and abroad and a factor of the region's development.

The areas of regional significance are the Nadwarciański Area of Protected Landscape and the Uniejowski Area of Protected Landscape.

The Nadwarciański Area of Protected Landscape covers 27 432 ha and was established by Sieradz provincial governor's order of 31 July 1998. Jeziorsko bird sanctuary lies within its borders. It protects the Warta valley lying between Landscape Park of the Warta and Widawka Interfluvium and the Uniejowski Area of Protected Landscape.

The Uniejowski Area of Protected Landscape covers 180 square kilometres and was established in January 1986. It comprises parts of the Warta valley with Uniejowska scarp and the Teleszyna river.

The report covers also an ecological land that includes the stream "Mazur" with a surface of 3 ha. The land is east of the town of Warta. Książę Młyny range (Pęczniew district) is planned to be included in the ecological land.

A research station is the scarp in Pęczniew district on the east bank of Jeziorsko reservoir between Siedlątków and Popów. This scarp undergoes natural erosion processes and is protected by the Sieradz provincial governor's order of 4 May 1994. The protected area covers approximately 200 ha.

The Warta valley with the lower Pichna lies within the nodal area of international significance in the ecological network structure ECONET. It is marked with 19M symbol – Middle Warta Area. Inside the area of the Middle Warta Valley there is a natural sanctuary of European significance (no. 497) named Jeziorsko reservoir, registered on the map of habitats CORINE-biotopes. NATURA and ECONET area in the Warta basins are presented in Fig. 9.

### 2.4.2 Objects and areas of the cultural environment

Cultural heritage objects (churches, palaces, houses, homesteads, etc.) are the evidence of the region's history and arise people's interest in the region. They are also important for educational and didactic purposes for the younger and the older generation of Poles.

Most such objects are situated in Warta, the oldest town located on the south banks of the reservoir, which was granted a town charter in 1255. There are three precious churches from 14<sup>th</sup> and 15<sup>th</sup> century, a town hall from 1842

and the Museum of the Town and the River of Warta with a display of archaeological excavations.

The urban layout of the town of Warta is under conservation. In some other towns and villages near the reservoir there are other important historic and artistic objects. They are important for tourism but need to be promoted. These objects (churches, manor houses, wind mills) are situated in Mikołajewice, Ustków, Jeziorsko, Skęczniew, Siedlątków, Pęczniew, Brodnia, Brzeg and Małkowo.

Within borders of the report there are also numerous national memorials connected with the Second World War and the Uprising in 1863.

Due to early settlement, in the Warta valley many archaeological sites (over 170) are found.



■ Natura 2000 network



■ M ECONET areas within european rank    ■ K ECONET areas within domestic r.

Fig. 9: NATURA 2000 and ECONET areas in Warta river basin

### 3 WFD implementation

#### 3.1 Conflicting directives and national legislation

The major objectives of water management in Poland include both the improvement of the quality of surface waters and groundwater and the provision of population and national economy with the necessary quantities of water with adequate quality.

The basic legal instruments in Poland for the implementation of environmental policy in the scope of water management include:

- the Water Act of 18 July 2001,
- the Environmental Protection Act of 27 April 2001,
- the Geological and Mining Act of 4 February 1994,
- the Inland Navigation Act of 21 December 2000, as well as executive orders to these Acts.

In order to ensure the more specific transposition of the provisions of the Water Framework Directive into the Polish legal system, e.g. the following amendments were made to the Water Act of:

- the general principles to be followed in the management of waters were complemented and regulations were adopted to enable better co-ordination of Poland's co-operation with other countries in the management of waters in international River Basin Management Districts,
- amendments were made to enable the correct establishment of necessary environmental objectives (in relation to the quantity and quality of water resources),
- the objectives of water protection were specified, the measures to achieve them were indicated and an amendment was proposed to meet the requirement to adopt in the Act, as required by the Water Framework Directive, the deadline for the achievement by the Member States of the European Union of good status or good potential of water resources (by uniform bodies of water) and the derogations from these requirements as allowed by the Water Framework Directive,
- a system for the collection of opinions and consultations in the process of drawing up River Basin Management Plans as an important element of the planning work allowing the public to take an active part in decision-making processes.

At the present moment, Poland finds itself in a situation where the legal system for the management of waters has been substantially restructured and the implementation of this system is directly related to the implementation of EU legislation.

Irrespective of changes which adjust the Polish legal system to WFD requirements, other actions are undertaken to accomplish requirements contained in this directive. The most important tasks in this area are as follows:

- development of River Basin Management Plans and the related programmes of measures,
- support for the measures taken in the process of public participation and in the development of River Basin Management Plans and programmes of measures,
- development of the system of reporting to the European Commission on the implementation of WFD, based on the results of the work of the Working Group on Reporting,
- the provision of assistance in the introduction of the principle of the recovery of costs for services

in the range of water management (including the environmental and resource-related costs) into the water pricing system,

- training courses for the public administration competent in the matters of the management of waters in river basins.

#### 3.2 Spatial planning dimension

There are some trends in the development of spatial management plans covering the problems concerning the Warta River Basin and Jeziorsko reservoir tributary. The following are the documents defining the area as for spatial management plans:

- Spatial management plan of Łódź voivodeship
- Study of conditions and trends in district spatial management of the districts of Warta, Pęczniew, Dobra, Goszczanów and Zadzim
- As far as environmental protection is concerned (including water and sewage disposal and waste disposal) the documented area is regulated by the following:
  - Regional Project WARTA
  - Environmental Protection Programmes and Waste Disposal Plans for Łódź and Wielkopolska voivodeships, regions of Sieradz, Poddębice, Turek and districts of Warta, Pęczniew, Dobra and Goszczanów.

Spatial management plan of Łódź voivodeship fulfils the function of a coordinator between national and local planning. It is not a local law act and does not contravene district entitlements as far as the spatial management is concerned. Decisions and methods within the Plan should be transferred into spatial management of local governments.

Spatial management and water husbandry operations included in Spatial Management Plan of Łódź voivodeship focus on:

- Reduction of building development in the areas of high natural qualities
- Excluding the valleys from exploitation
- Minimisation of surface of technical development and reduction of excessive dispersion of building development
- Realisation of Regional Project WARTA
- Protection of existing water reservoirs – preventing eutrophication of Jeziorsko reservoir by reduction of inflowing pollution
- Construction of sewage disposal and treatment installation
- protection of river valleys from investments
- increasing the woodiness

There are five spatial management zones in the plan. The documented area belongs to three sub-zones. Arrangements concerning individual zones are the following:

- Green growth sub-zone comprises the Warta valley. It is a protection zone of unique natural areas. Wildlife protection dominates here. Different forms of recreation, tourism, holiday buildings development and ecological farming may develop here. Conflicts resulting in unprofitable natural transformations may arise when recreational functions will develop beyond control and will not be adapted to environmental capacity.

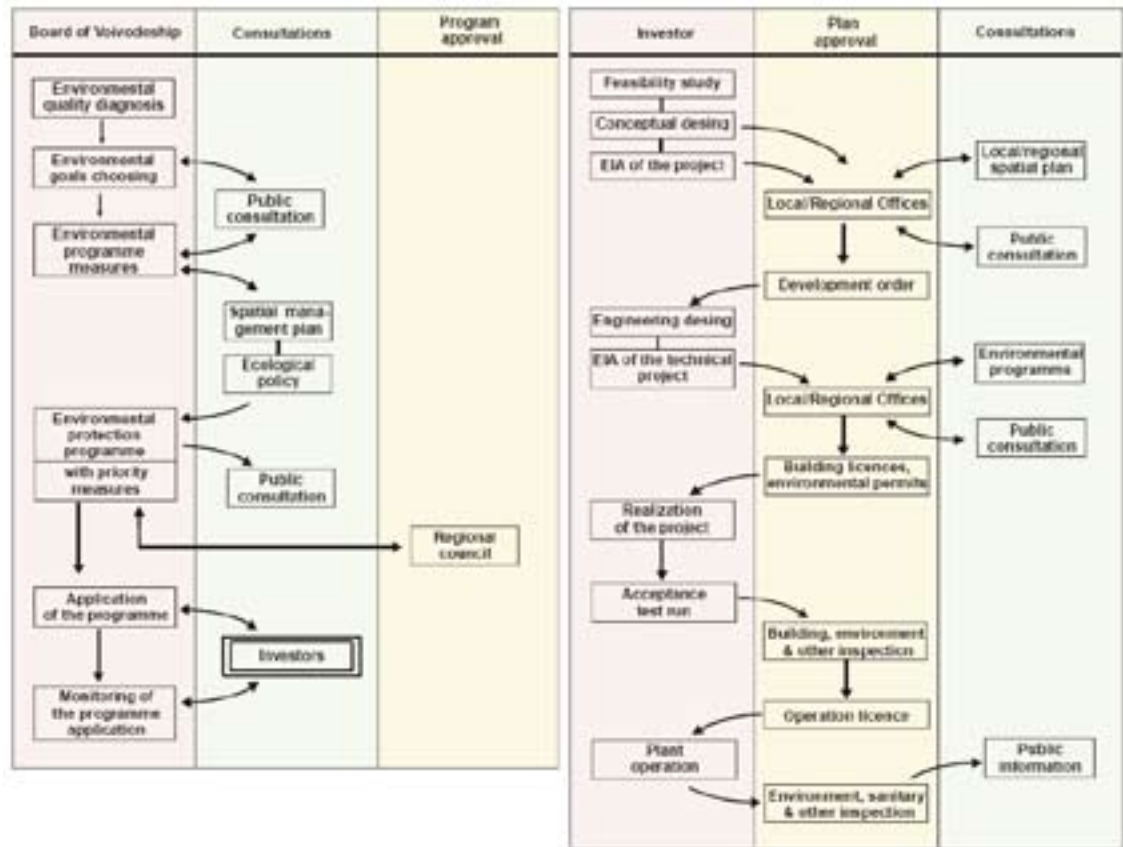


Fig. 8: The schemes of a) environmental planning process at regional level, b) application of programme measures

- Agriculture-forest sub-zone (eastern part of the report) comprises forest complexes and areas of medium and low agriculture potential. Development offering new jobs outside agriculture or based on environment-friendly agro-forestry is preferable. The zone borders unique natural-landscape areas. Consequently, spontaneous development of different forms of recreation may occur. That in turn may cause degradation of landscape amenities.
- Agriculture sub-zone (western part of the report). These areas offer good conditions for agriculture development, which is predominant. Efforts to restructure the country and agriculture are being made. Excessive chemicalisation and mechanisation and further country building development dispersion will have a negative effect on the environment.

In the Spatial Management Plan of Łódź voivodeship there are proposals of projects for realisation of regional public objectives. For the documented area, there are the following projects: Warta's ring road, modernisation of a section of the road Lutomiersk-Szadek-Warta, 110 kV line from Jeziorsko power plant to Leśnik, gas pipeline Błaszki-Warta-Goszczanów with branches to Pęczniew and Jeziorsko, verification of the borders of the Nadwarciański Area of Protected Landscape, protection of historic layout in the town of Warta.

### 3.3 Public involvement

In Poland the contribution of citizens and social organisations to form and implement environmental protection programmes and spatial management plans is regulated by the following legal acts and regulations:

- Environmental Protection Act
- Spatial Planning Act
- Building Act
- executing regulations: relevant enactment of the Council of Ministers.

A general pattern of formulating spatial management plans and plans of investment accomplishment is shown in Fig. 8. From data shown in this figure it follows that formally there are many possibilities for citizens and social organisations to participate in decision-making processes in planning and investment. All spatial management plans and investment projects in Poland according to the law must be consulted with society. Social opinions submitted on this stage should be considered in planning, however, it should be stressed that these opinions are not obligatory and cannot intrude competencies of local governments or state administration offices that are authorised to pass decisions. Opinions formulated on the stage of social consultation should, however, be taken into account by the authorised organs as far as legal and economic possibilities permit.

It should be stressed, however, that there are formal and legal bases for society to take part in planning decision making, which create conditions for social organisations and ordinary citizens to formulate and accomplish spatial management plans. In practice, the actual participation of society in taking these planning decisions is now very small. This is a result of the lack of interest and general low social activity of citizens. It seems that one of the most urgent tasks in this area will be to stimulate active approach of citizens by relevant well organised informing actions and educational programmes.

#### 4 Implemented solutions – programme measures

Art. 11 of Water Frame Directive specified the following main objectives, which should be met until 2012:

- a 30% reduction of pollutant load discharged to the reservoir from surface flows and municipal sewage
- total stopping of discharge of hazardous substances (elimination of burial grounds),
- stopping of discharge of untreated municipal sewage,
- reduction (by 75% till 2015) of the biogenic elements in municipal sewage and decrease of nitrogen compounds from agricultural sources,
- improvement of water quality to achieve WFD standards.

The existing programmes for the Warta River Basin, described above in paragraph 4.2. have a chance to meet some of the WFD objectives, if corresponding economic, legislative and social conditions are fulfilled. One of these programmes is the *WARTA REGIONAL PROJECT*.

The Warta valley and the region of Jeziorsko reservoir are encompassed by The Warta Regional Project. Its decisions were included in the spatial management plan of Łódź voivodeship. The aim of this project is "a complete monograph of water supply and sewage disposal in the Warta's reservoir and its realisation".

Detailed aims are:

- Creating conditions which enable water quality improvement in the Jeziorsko reservoir,
- Protection of the Warta and its valley; reduction of pollutant loads inflow through the Warta to the Odra and the Baltic Sea.

Water supply and sewage disposal projects which are to be realised in The Warta Project are: construction of a treatment plant in Pęczniew (expansion), Brzeg-Zagórki, Dzierżazna and Jeziorsko (expansion).

The Warta Project also concerns investment needs as for land melioration and modernisation of rivers' embankments.

At this moment districts do not have valid local plans of spatial management covering their whole areas. The previous plans were valid until 31.12.2003. Thus, the districts should apply to the decisions included in the study of conditions and trends in district spatial management. These decisions are binding for the district's authorities while making local plans. The study is not a local law act and defines general rules and trends of spatial management. The monograph should include previous land functions and management and confinements resulting from the environmental state and statutory requirements of its protection (legal restraints of environmental use). It should also include realisation of regional public objectives contained in voivodeship and region plans and regional programmes.

Main rules of spatial management on the documented area defined in Studies of conditions... are the following:

- Aspirations to improve the spatial order by gradual implementation of the local spatial management plan,
- Protection and optimal usage of the existing natural and cultural amenities,
- Protection and modernisation of agricultural production space and realisation of afforestation programmes,

- Preserving open grounds excluded from cubage building development,
- Development of weekend and holiday recreation and development of holiday buildings on attractive grounds.

As far as water supply and sewage disposal are concerned, the Studies predicted construction of rural treatment plants with release points, construction of household biological treatment plants and construction of sewerage system for the reservoir.

Grounds for individual and group holiday buildings development with service buildings for recreational purposes are located along the reservoir, in a zone with a width of approximately 2 km from the reservoir. Small grounds for recreational purposes are outlined in the zone of unnamed streams in the area of Przywidz-Krowica-Osowiec on the eastern border of the region and in the forest zone near Księżę Młyny and Chorażki. Because of that, a partial change of the agriculture lands into building, recreational and holiday garden plots is predicted.

When analysing data contained in the Warta programme and in other documents and experts' opinions on the Jeziorsko reservoir, it can be stated that the programme of activities which will result in the improvement of its ecological status should encompass the following:

- Development of sewer system and application of other sewage collecting systems,
- Construction of new wastewater treatment plants,
- Improvement of the existing wastewater treatment plants by adding biogenic elements removal stages,
- Implementation of the programme for increasing forest area in the Warta river basin,
- Improvement of waste management system,
- Change of the functions of croplands and reduction of fertiliser loads,
- Development of small-scale water retention (reservoirs < 5 ha.).

## 5 Experience gained to sustainable river basin management

For several years, in Poland an improvement of sewage and water supply management and water management systems has been observed. A measurable effect of these processes is, for instance, a significant growth of the amount of municipal sewage that is subjects to treatment. In 1980, 42% of municipal sewage was discharged directly to surface water. Now the percentage of such sewage discharged to rivers and lakes without treatment decreased to 9%, which is the evidence of a significant advancement in water protection. However, this 9% from the total amount of 2.3 milliard of untreated sewage m<sup>3</sup>/year, is still an enormous stream of sewage that has serious environmental impact. On this occasion we should mention that efficiency of pollutant removal in the Polish sewage treatment plants is unsatisfactory. Only 47% of sewage is treated with efficiency higher than 90%, and in the case of nearly 20% the efficiency of COD removal is lower than 75%.

A significant progress was also observed in adjustment of the Polish legal system to the WFD requirements. However, implementation of WFD regulations to practice encounters many barriers in Poland, among them:

- Limited implementation of local spatial management plans,
- Incoherence in the legal system referring to spatial planning,
- Insufficient execution of legal regulations, including the ones referring to environmental protection and spatial planning,
- Limited funds,
- Poor ecological awareness of society,
- Insufficient cooperation of local authorities with society,
- Unsatisfactory integration of development programmes with spatial planning.

## 6 Conclusions

Jeziorsko reservoir was built mainly as a retention basin for industry in Turek-Konin energy region and for agriculture in Wielkopolska region, which is deficient in water and serves as a flood control reservoir. The planned retention function is now limited as far as agriculture is concerned. A new function is creating good settling conditions for water-marsh birds.

The reservoir is an example of proper combination of water husbandry with environmental protection. Filling and emptying the reservoir in an annual cycle was adjusted to the needs of the bird sanctuary created on the reservoir. It contributed to development of town and villages in the area in terms of recreation and tourism.

The recreational-tourist investments are limited to development of recreational areas with individual housing mainly. The natural pressure of individual investors is on acquiring lands very close to the reservoir. This caused a tendency towards building around the reservoir. It is thought that the areas for potential housing are too extensive, disperse and not adequate to existing natural conditions. All investments should be connected with the improvement of technical infrastructure (building of water supply system, sewerage network, gas pipeline and road network).

The problems of water supply and sewage disposal as well as sewerage network are not solved. Due to the lack of finances the problem will not be solved in the next few years.

Underground waters are generally unpolluted. Due to a considerable risk of pollution (lack of isolation layer in the geological structure and high abundance), the waters should be under constant monitoring in accordance with European regulations.

In contrast to underground waters, the surface waters of Jeziorsko reservoir and its tributaries are polluted. The level of pollution results from water supply and sewage disposal in the districts where the reservoir is situated and in the areas outside the report. The problem of surface water pollution is beyond the documented area and the competence of local authorities. It is advisable to provide the whole Jeziorsko reservoir basin with the integrated database GIS. This system would identify pollution sources and assess effectiveness of actions undertaken.

In order to solve the problems and conflicts of economic use of the environment and its protection effectively, it is essential to carry on thorough ecological education, which will create new role models full of environmental concern.

## 7. References

### **Biuro Planowania Przestrzennego Województwa Łódzkiego, 2001.**

Concept of Tourist and Recreation Management of Jeziorsko Reservoir Basin (*Koncepcja zagospodarowania turystycznego obrzeży zbiornika Jeziorsko*), BPP, Lodz, Poland.

### **Biuro Planowania Przestrzennego Województwa Łódzkiego, 2001.**

Spatial Management Plan of Lodz Voivodship (*Plan zagospodarowania przestrzennego województwa łódzkiego*), BPP, Lodz, Poland.

### **INTEREKO – Przedsiębiorstwo Inżynieryjne, EKOLOG Holding, MCE PAN, Katedra Ekologii Stosowanej UŁ, 2001.**

Regional Spatial Management Plan WARTA (*Program Regionalny Warta*), (opracowanie zbiorowe), Lodz, Poland

### **Janiszewski T., Wojciechowski Z., Markowski J., 2002.**

The Main Bird Habitats In Lodz Region (*Najważniejsze ostoje ptaków na Ziemi Łódzkiej*), *Acta Universitatis Lodzensis, Folia Biologica et Oecologica*, UŁ, Lodz, p. 227-251.

### **Kaczmarek Z., 2005.**

Water Resource Management in Poland on the Edge of XXI Century (*Gospodarka wodna w Polsce u progu XXI wieku*), Monographies of Komitet Inżynierii Środowiska Polskiej Akademii Nauk, vol.32, Lublin, str. 27-40

### **Przedwojski B. (red.), 1999.**

Exploitation and Impact of Big Plain Water Reservoirs on the Case of Jeziorsko Reservoir (*Eksploatacja i oddziaływanie dużych zbiorników nizinnych na przykładzie zbiornika wodnego Jeziorsko*), Wydawnictwo Akademii Rolniczej w Poznaniu, Poznań, Poland.

### **Skrzypski J. i zespół, 2003.**

Environmental Protection Plan for Lodz Voivodship (*Program ochrony środowiska dla województwa łódzkiego*). Opracowanie dla Zarządu Województwa Łódzkiego, Lodz, Poland.

### **Skrzypski J., 2002.**

Hydrosphere – Sources and Types of Contaminants; Ways of Waterbody Protection" (*Hydrosfera – źródła i rodzaje zanieczyszczeń, sposoby jej ochrony*) in Kurnatowska, A. (ed.) *Ekologia - jej związki z różnymi dziedzinami wiedzy*, PWN, Warszawa - Lodz, p. 31-51.

### **Wielgościński G. i zespół, 2003.**

Waste Management Plan of Lodz Voivodship (*Plan gospodarki odpadami dla województwa łódzkiego*), Zarząd Województwa Łódzkiego UWŁ, Lodz, Poland.

### **WIOŚ, 1994-2005.**

Environmental Quality Report in Lodz Voivodship (*Raporty o stanie środowiska w województwie łódzkim*), WIOŚ, Lodz, Poland.

### **Zalewski M (ed.), 1994.**

Integrated strategy of conservation and management of freshwater ecosystems (*Zintegrowana strategia ochrony i zagospodarowania ekosystemów wodnych*), Biblioteka Monitoringu Środowiska, Lodz, Poland.

