

# IMPLEMENTATION OF WFD WITHIN TRANSBOUNDARY BASIN OF THE VISTULA LAGOON – EXTENSION OF THE EU MANTRA-EAST PROJECT.

MALGORZATA BIELECKA \*, PIOTR MARGONSKI \*\*, ANDRZEJ LEWANDOWSKI \*\*\*

\* Institute of Hydroengineering of the Polish Academy of Sciences, Gdansk, Poland  
(E-mail: [gosia\\_bk@ibwpan.gda.pl](mailto:gosia_bk@ibwpan.gda.pl))

\*\* Sea Fisheries Institute, Gdynia, Poland  
(E-mail: [pmargon@mir.gdynia.pl](mailto:pmargon@mir.gdynia.pl))

\*\*\* GEOMOR - Geoscience and Marine Research & Consulting Co. Ltd, Gdansk, Poland  
(E-mail: [alewand@sprintnet.pl](mailto:alewand@sprintnet.pl))

Address: Koscierska 7, 80-953, Gdansk, Poland  
Tel.: +48 – 58 – 552 20 11  
Fax: +48 – 58 – 552 42 11  
Email: [gosia\\_bk@ibwpan.gda.pl](mailto:gosia_bk@ibwpan.gda.pl)

## ABSTRACT

The EC Water Framework Directive (WFD) takes into account not only rivers and lakes but also estuarine and coastal waters therefore the MANTRA-East project has been extended by additional estuarine drainage basin – the Vistula Lagoon – shared by Poland and Russia. The main objective of the project is implementation of the common water management system that will allow achieving goals of WFD. The project focuses on analysis of existing monitoring systems, long-term changes in water quality and biota, and uses modelling tools for assessment of ecological status and forecasts in the WFD context. The participation of end-users from both countries assures implementation of common data-base and the operational usage of the applied modelling tools in order to meet WFD requirements. Two sets of scenarios are proposed to be carried out within the project. One set of scenarios concerns “Business As Usual” situation in both countries. Second set of scenarios addresses impact of implementation of “Target Development Plans” on water quality in the Lagoon. The proposed scenarios serve as a tool indicating most efficient directions in development of water management system that will assure proper water quality of Vistula Lagoon according to WFD.

**KEYWORDS:** water quality, estuary, transboundary water management, WFD, modelling, scenarios

## INTRODUCTION

Originally the MANTRA-East project concerns environmental management of transboundary lakes and river basins. Since the EC Water Framework Directive (WFD) takes into account not only rivers and lakes but also estuarine and coastal waters, the MANTRA-East project has been extended by additional estuarine drainage basin located also at Eastern European fringe but connected with the Baltic Sea – the Vistula Lagoon (Fig. 1).

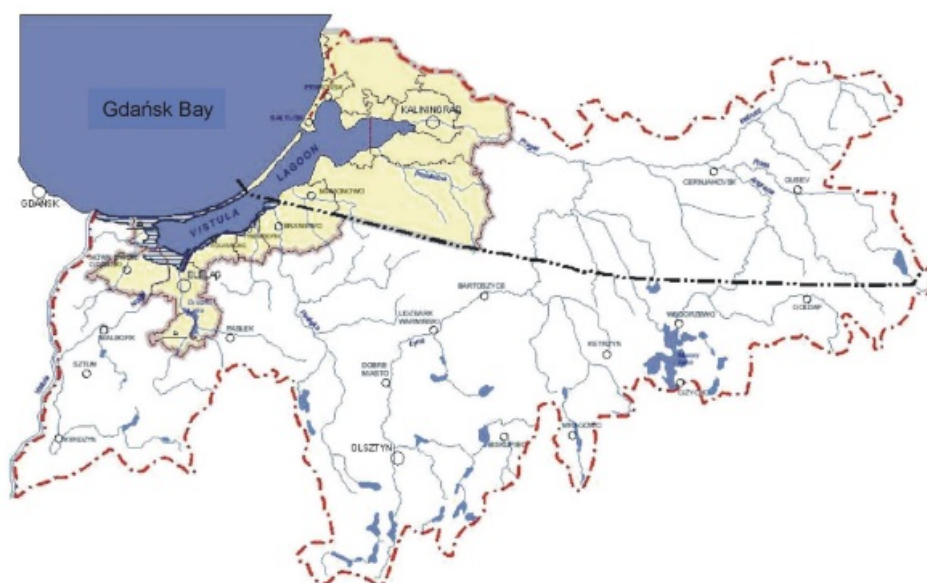


Fig. 1. Vistula Lagoon and its drainage basin

The Vistula Lagoon is one of the largest transboundary lagoons in the Southern Baltic Sea shared by Russia and Poland. In the near future it will become the EU border region. The direct connection with the Baltic Sea through Baltiysk Strait causes significant interactions between the sea and lagoon. Moreover the Lagoon itself is subjected to point and non-point sources of nutrient loads so only integrated management would provide successful solutions. The extended part of the project focuses on analysis of existing monitoring systems, long-term changes in water quality and biota, and uses modelling tools for assessment of ecological status and forecasts in the WFD context. The participation of end-users from both countries assures implementation of common data-base and the operational usage of the applied modelling tools in order to meet WFD requirements. Although the WFD is not obligatory for Kaliningrad Region, but in practise it will be followed there as well.

### **OBJECTIVES OF THE PROJECT**

The main objective of the project is implementation of the common water management system that will allow achieving goals of WFD. The water management system is also necessary to prioritise the necessary changes within the Vistula Lagoon basin with respect to point and non-point loads, in order to obtain the good status of water quality (WFD) in the Vistula Lagoon. To achieve this goal it is necessary to develop a common database as a basis for an effective water management system. In the next step the same modelling tools will be installed in both countries at the authorities responsible for water management. In the future those tools will be applied for water quality and environmental impact assessment in the Vistula Lagoon basin. As a natural consequence of this fact a need for the common monitoring system at the Lagoon will evolve.

## **PROJECT TASKS**

Following tasks are realized within the project.

### **Evaluation of criteria for assessment of ecological status in a Water Framework**

#### **Directive context**

- Collection of all available time series of water quality and biota parameters of the Vistula Lagoon and riverine loads necessary for ecological status assessment, trend analyses, and modelling.
- Collection of all available publications on water quality and biota of the Vistula Lagoon including Polish, Russian and old German publications and “grey” literature.
- Comparison of monitoring parameters evaluated for freshwater and brackish water bodies, used in ecological status assessments.
- Evaluation of criteria for assessment of ecological status of Vistula Lagoon in a WFD context.

#### **Analysis of trends in water quality and biota in Vistula Lagoon**

- Quality assurance of the Vistula Lagoon data collection methods (from 1950s to present time).
- Evaluation of long-term changes in chemical variables, nutrients and biotic parameters. The degree of changes of different parameters will be qualified and used as a measure of human impact.

#### **Estimation of nutrients load to the Vistula Lagoon on the basis of the Pasleka River as a pilot basin**

- A computer modelling system MIKE BASIN (DHI - Water & Environment, 2002), have been applied at Pasleka River (DANCEE and National Fund for Environmental Protection and Water Management, 2003).

In general terms MIKE BASIN is a mathematical representation of the river basin encompassing the configuration of the main rivers and their tributaries, the hydrology of the basin in space and time, and existing as well as potential major schemes and their various demands of water.

Basic input to the model consists of time series data of catchment run-off. Additional input files define reservoir characteristics and operation rules of each reservoir, meteorological time series and data pertinent to each water supply or irrigation scheme such as diversion requirements and other information describing return flows.

MIKE BASIN can simulate transport and degradation of seven water quality related species. Biological oxygen demand, ammonia, nitrate, and oxygen are treated as one system, since the processes involved for these species are highly interrelated. Chemical oxygen demand, total phosphorus, and total nitrogen are treated individually.

#### **The consequences of river basin inputs to Lagoon water quality and fish - a modelling approach**

- The 3D and 2D water quality models for Vistula Lagoon have been set up using the same data sets. For 3D modelling the Delft3D-FLOW (Delft Hydraulics 1999a) and 3D-WAQ (Delft Hydraulics 1999b) have been used and for 2D modelling –Mike21 (DHI - Water & Environment, 2001) software has been applied. Calibrated models will be used to assess influence of the climatic conditions versus anthropogenic impact on the selected water quality indicators. To do so different scenarios are proposed. It is also intended to determine where and when it is enough to use 2D model and where and when 3D model is necessary (Fig.2).

## Modelling approach

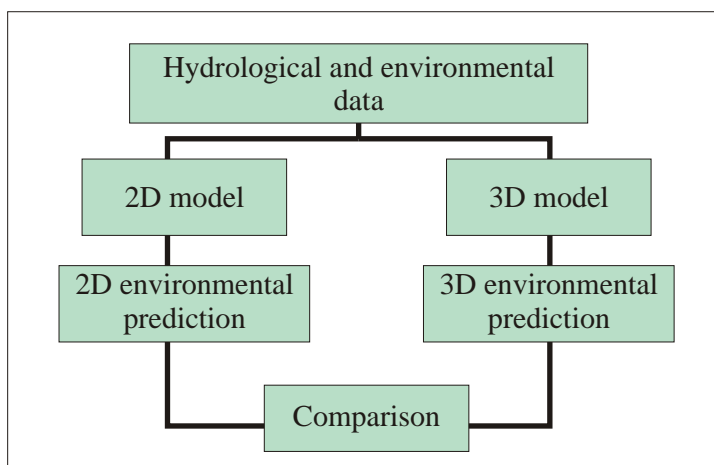


Fig.2. Modelling approach

- Trophic interactions between phytoplankton, zooplankton and fish larvae will be assessed with use of bioenergetic budget calculations and 0-dimensional, dynamic model.
- The influence of the water quality and productivity on the fish stocks will be analysed by means of multiple regression analysis.

### PROPOSED SCENARIOS

The proposed scenarios will serve as a tool indicating most efficient directions in development of a water management system that will assure a good water status of Vistula Lagoon according to WFD. They will enable to determine the necessary investments and the acceptable level of the agricultural development in future.

The good water status is expected in year 2015 according to the WFD requirements. It is assumed that the base year for scenarios is 2000 and the predictions are run for year 2015. Two sets of scenarios are proposed to be carried out within the project. In both scenarios impact of agricultural development on water quality of the Vistula Lagoon will be evaluated on the base of the Pasleka river basin studies.

First scenario concerns “Business As Usual” situation, meaning that economical situation is not changed and environmental investments and agricultural practices in both countries stay at the same level as at present.

#### *Scenario 1 – Business As Usual (BAU)*

The impact of present nutrient load due to the recently finalised and under-construction investments in the Polish as well as Kaliningrad point sources will be evaluated. Agricultural production and fertiliser levels will be as it is today.

## ***Scenario 2 – Target Development Scenario According to Strategic Plans in the Region***

### ***2.1 Improved Wastewater Treatment Technology***

The environmental effect of improved wastewater treatment will be studied. It is assumed that in all cities, where the population exceeds 10 000, mechanical-biological-chemical treatment will be applied, while in the smaller towns - only mechanical-biological treatment.

### ***2.2 Impact of Expected Agricultural Development***

The environmental impact of the expected agricultural development, increased fertilizing as well as changes in land use, animal production, manure and slurry handling on the eutrophication processes in the Vistula Lagoon will be evaluated. As in BAU (Scenario 1) it is assumed that the wastewater treatment technologies will be improved taking into account under-construction investments.

### ***2.3 Joint Environmental Effect***

The joint environmental effect of improved wastewater treatment technologies, reduced deposition of nitrogen compounds from the atmosphere, increased use of fertilizers and action aiming at reducing the non-point runoff of nutrients to the surface waters, will be evaluated.

## **CONCLUDING REMARKS**

Several steps, needed for the successful implementation of the EU WFD, were identified:

- Development of a common data base structure and data collection.
- Application of a MIKE BASIN model within Vistula Lagoon basin.
- Assessment of applicability regions for 2D and 3D models.
- Calibration and transfer of 2D modelling tools to end-users for their operational usage.
- Development of a water management system assuring a good water status of Vistula Lagoon according to WFD.

The transboundary cooperation, data exchange and implementation of the same models for operational usage on both sides of the border are crucial for development of integrated strategies for the management of the Vistula Lagoon.

The proposed scenarios serve as a tool indicating most efficient directions in development of a water management system that will assure a good water status of Vistula Lagoon according to WFD. As a consequence, an assessment of the necessary investments and introduction of good agricultural practices can be identified.

## **ACKNOWLEDGEMENTS**

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