IMPLICATIONS OF FERTILIZER USE WITHIN EUROPEAN WATER FRAME DIRECTIVE

Ana Maria DODOCIOIU, A. TUDOSIE, M. SUSINSKI

University of Craiova, A.I. Cuza Street, 200585, Craiova, Romania
E-mail: ana_m3310@yahoo.com

Abstract: *Water Frame Directive (WFD) 2000/60/CE assumes the improvement of the quality of the aquatic environment during the next 15 years. Its main objective is to establish a frame for protection of surface waters, transition waters, coastal waters and underground waters. One of the main polluting agents of the aquatic environment is the using of fertilizers and manure. The fertilizer quantities within Europe and worldwide within 1975 – 1996 have increased up to 1985, reaching 110 – 270 kg/ha and to 145 million tones a year in the world. After 1985 there was recorded a tendency of decreasing fertilizer quantities both in Europe and worldwide. The eutrophication of surface waters and the contamination of underground waters as a result of massive fertilizer application have a grave impact on ecosystems from several countries from Europe. The effect of nutrients on the eutrophication of waters is done by reducing the biodiversity of ecosystems of the surface waters and exaggerated growing of algae (some toxic). Many times, the toxic substances released by algae have determined the death of fish species and fauna as well as human diseases. There results that nitrogen and phosphorus from waters is the elements that determine the ecological status of inland waters. Beginning with 1990, the nitrate concentration of European rivers has stayed relatively constant and the phosphorus one has decreased due to improving of the management of waste waters and the reduction of phosphorus quantities from detergents. In order to reduce nutrient losses from these waters, at European scale there unfolded within 2007-2011 period the COST Program, Action 869 which I joined. This program has established 80 mitigation options of nutrients losses that can be grouped as follows: nutrient management, crop management, husbandries management, soil management, water management, land use changing management, landscape management, and surface waters management.*

Key words**:** *nutrient loss, water quality, Water Frame Directive*

INTRODUCTION

The quality of waters in Europe are under a constant threat taking account the permanent increase of water demand, water of good quality and in sufficient quantity for all kind of use.

In order to maintain and improve the aquatic environment of human communities, respectively, the water quality there have been elaborated the Directive 2000/60/CE of European Parliament and of European Council from 23.10.2010 named Water Frame Directive (WFD).

The objective of this directive is to establish a frame for water protection; this includes inland waters, surface waters, transition waters, coastal waters and underground waters. It is focused on:

- future deterioration prevention, the conservation and improving the status of aquatic ecosystems;
- promoting sustainable water use;
- ensuring the protection and improving of aquatic environment, reducing the emissions and losses of prioritary and dangerous substances;
- flood effects minimization;
- significant reduction of pollution of underground waters;

- the protection of surface waters, marine and inland waters by national regulations.

In order to achieve these objectives the measures envisage, mainly, the environmental aspects of the surface and underground waters with the goal of obtain a good status of them within the next 15 years.

The WFD is considered a progressive and innovative law that will determine the improving of the quality of surface waters in Europe. It requires evaluations on ecological basis of a series of indicators of environmental issues and ecological stress related to the degree of changing the reference values.

One of the most important factors that contribute to the decreasing of water quality is the using of fertilizers that reach into the surface or underground waters through runoff or leaching (CHARDON, 2007).

MATERIAL AND METHODS

In order to asses the effect of fertilizers on the quality of underground waters at European scale there was implemented the Research Program COST (European Cooperation in the Field of Scientific and Technical Research), Action 869 during 2007-2011 period, named „Mitigation options of nutrient leaching into surface waters and underground waters ".

The main objective of COST Action 869 has been the evaluation of suitability and the cost of different mitigation options of nutrient losses within underground waters and surface waters at the scale of river basins and their boundaries; it accomplished the following issues:

- the study of temporary dynamics and the nutrient losses, the localization of the critical source areas of nutrient losses and their transport routes into surface waters and underground waters;
- the identification of the areas where the mitigation actions could have the highest ecological, social and economical impact;
- the study of the influence of nutrients on ecological processes from surface waters of river basins under different conditions and the influence of the ecological factor on choosing the mitigation of nutrients losses;
- the study of zones from Europe where the reduction options can be tested and their results can be monitored;
- the evaluation of the finalized or ongoing projects on the reduction of nutrient losses with the respect of what worked well, what did not worked, what can be done to improve (COST Action 869 – Final Report);

RESULTS AND DISCUSSIONS

The fertilizer quantities within Europe and worldwide within 1975 – 1996 have increased up to 1985, reaching 110 – 270 kg/ha and to 145 million tones a year in the world. After 1985 there was recorded a tendency of decreasing fertilizer quantities both in Europe and worldwide (fig. 1.).

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The eutrophication of surface waters and the contamination of underground waters as a result of massive fertilizer application have a grave impact on ecosystems from several countries from Europe. WFD 2000/60/CE implies an improvement of surface water and underground quality. This thing will determine a dramatic decrease of nutrient losses from agricultural sources which will have long term implications on the durability of agricultural ecosystems. Moreover, the situation of the coastal waters of Baltic Sea and North Sea represent a constant concern of many European countries. The eutrophication status of these waters has determined the elaboration of Action Plan that will be implemented in all European countries (JONSON, 2002).

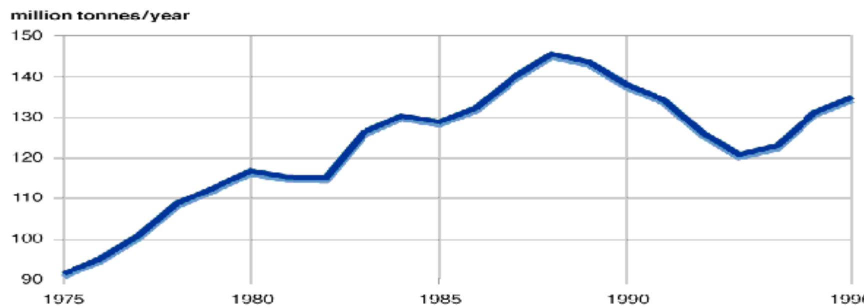

Figure 1. Fertilizer quantities applied in the world from 1975 to 1996

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There results that nitrogen and phosphorus from waters are the elements that determine the ecological status of inland waters (DOWSON, 2006).

Beginning with 1990, the nitrate concentration of European rivers has stayed relatively constant and the phosphorus one has decreased due to improving of the management of waste waters and the reduction of phosphorus quantities from detergents. The natural limits are 0-10 µg P/l are still quantifiable on northern European countries as Finland and Sweden.

The nitrate concentration from underground waters has increased in the first half of 90 decade and it stayed almost constant. The average concentration from European rivers has decreased by 10% since 1998 when it was 2.8 reaching 2.5 mgN/l and reflecting the effect of reduction measures of nitrate losses from agricultural sources. The level of the nitrate concentration in lakes is, generally, lower than in rivers by 15%. Nitrate concentrations under 0.5 mgN/l are considered normal for in European rivers though in some rivers it reaches 1.0 mgN/l. Concentrations over 7.5 mgN/l means water of poor quality, over passing the admitted concentration of 5.6 mgN/l regulated by surface drinkable water directive 74/440/EEC (fig. 2).

Within large rivers the quality of waters will be improved by long term nutrients management by reducing the losses from agricultural sources. The main factors that determine the nutrient load in a river basin are: the industry, sewage of urban areas, atmospheric sediments, agriculture and the natural system.

Nitrogen is the main form of pollution in agriculture. Nitrogen losses in high intensive agriculture zones are 5-10 time higher than in other places. Phosphorus losses are related with husbandries and industry. Nevertheless, in many countries sewage waters, water from industry and the restriction to use phosphorus detergents have reduced phosphorus losses by 50% since 1980 yet the phosphorus losses from agriculture have increased (CHARDON, 2007).

There can be appreciated that in northern countries of Europe the nutrient losses are of 28 kg N/ha and 2.7 kg P/ha.

An image of the origin of nutrients (N and P) in soil and their losses is given in figures 3 and 4.

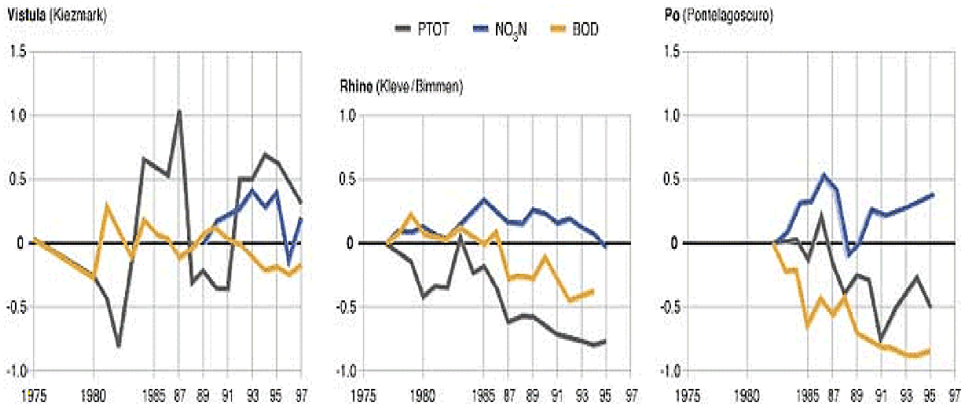

Figure 2. Nitrate, phpsphorus and organic matter contents in three major rivers in Europe.

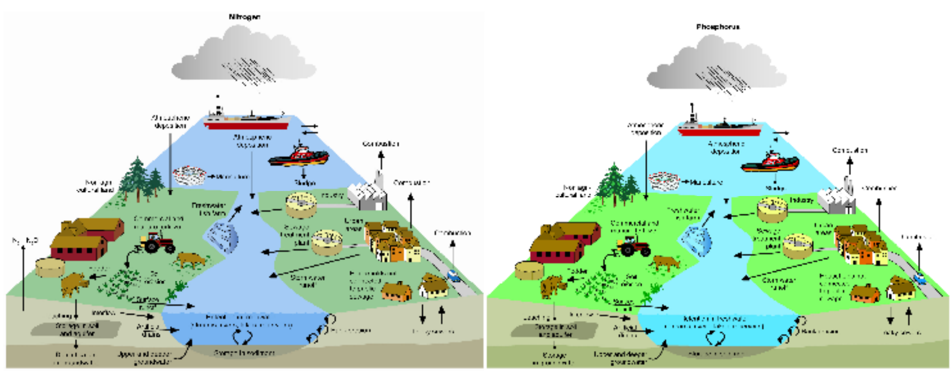

Figure 3. Nitrogen and Phosphorus paths

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There was established in a conceptual frame that soil losses are produced within one of the following systems:

- cropping system: by cropping surface, the type of production, the number of animals, the nutrient balance at farm scale;
- soil-crop system: technology used, farm management, fertilizer and manure quantities;
- hydrology – landscape system: rainfall, land slope, distance to surface waters;
- ecology system: the specificity of the system (COST Action 869, Final Report).

The main options of reducing nutrient losses from agricultural sources elaborated by COST Program, Action 869 have been 101 that were later structured to 80. These 80 mitigation options have been grouped in 8 categories as follows:

- nutrient management: the balance, the way and the type of application, high risk areas to nutrient losses;
- crops management: soil coverage by vegetation all year round, specific technologies for every crop, the improvement of plant nutrition by soil nutrients;

- livestock management: the reduction of N and P content of animal feed, protecting creeks of direct animal access, pasture restriction, a better depositation of solid and liquid wastes;
- soil management by direct drilling, minimum tillage, spring plow, soil reclamation by amendaments;
- water management: controlling runoffs from crops and animal farms, finding the paths of nutrient loss to surface waters, buffer zones (protection zones) changing the drainage system;
- the management of changing the land using: the agricultural land has to represent 50% of total landscape, crop rotation, keeping the soil covered by vegetation, reforestation;
- landscape management by creating buffer zones with grass or bushes, woody trees or mixed;
- the management of surface waters: the rehabilitation of water courses, restoring former marshes, lakes, manmade wetlands (Mocanu, 2010).

CONCLUSIONS

One of the factors that must be taken into account in implementing WFD is the using of fertilizers in agriculture. The ways they reach surface waters and underground waters are leaching and runoffs.

At European level there was initiated the COST Program, Action 869 by which this phenomenon was monitored and there were established the mitigation options of nutrient losses from soil to water. This program has set up 80 mitigation options which were grouped in 8 categories of management, as follows:

- nutrient management;
- crop management;
- husbandries management;
- soil management;
- water management;
- land use changing management;
- landscape management;
- surface waters management.

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