

POSSIBILITIES OF REDUCING ENVIRONMENTAL POLLUTION WITH NITROGEN AND PHOSPHORUS AS PART OF AN AGRI-ENVIRONMENTAL PROGRAMME

Wojciech Gotkiewicz¹, Bartosz Mickiewicz²,
Andrzej Klasa³

¹Chair of Agribusiness and Environmental Economics
University of Warmia and Mazury in Olsztyn

²Chair of Rural Development and Food Economy
Agricultural Academy in Szczecin

³Chair of Agricultural Chemistry and Environmental Protection
University of Warmia and Mazury in Olsztyn

Abstract

Data from the Central Statistical Office and from the literature of the subject have been used to present the hazards for the natural environment, created by nitrogen and phosphorus compounds. The issue concerns inland waters and the Baltic Sea. The existing hazards are controlled by rational fertilisation, the appropriate structure of cultivation and biochemical barriers. Following Poland's accession to the European Union, an effective instrument has been obtained in the form of an agri-environmental programme, especially the packages: „water and soil protection” and „establishing buffer zones”, which can result in reducing the infiltration of biogenes to the environment. The data from the Agency of Agriculture Restructuring and Modernisation and the research conducted by the authors in the Warmia and Mazury and the West Pomerania Provinces have confirmed the large interest of farmers in the „water and soil protection” package. The clearly observed lack of interest in the „buffer zones” package necessitates corrections, mainly by increasing financial subsidies for farmers.

Key words: nitrogen, phosphorus, infiltration to the environment, agri-environmental programme, „soil and water protection” and „buffer zone creation” packages.

MOŻLIWOŚCI OGRANICZENIA ZANIECZYSZCZEŃ ŚRODOWISKA AZOTEM I FOSFOREM W RAMACH PROGRAMU ROLNOŚRODOWISKOWEGO

Abstract

Na podstawie literatury oraz danych Głównego Urzędu Statystycznego przedstawiono zagrożenie środowiska przyrodniczego związkami azotu i fosforu. Dotyczy to zarówno wód śródlądowych, jak i Morza Bałtyckiego. Ograniczaniu występujących zagrożeń sprzyja racjonalna gospodarka nawozowa, właściwa struktura upraw oraz bariery biogeochemiczne. Po wstąpieniu Polski do Unii Europejskiej uzyskano skuteczny instrument w postaci programu rolnośrodowiskowego, a zwłaszcza pakietów „ochrona gleb i wód” oraz „tworzenie stref buforowych”, mogący zredukować przenikanie biogenów do środowiska. Materiały Agencji Restrukturyzacji i Modernizacji Rolnictwa oraz badania własne przeprowadzone w województwach warmińsko-mazurskim i zachodniopomorskim, potwierdziły duże zainteresowanie rolników pakietem „ochrona gleb i wód”. Wyraźny brak zainteresowania pakietem „strefy buforowe” wymaga korekty, polegającej zwłaszcza na zwiększeniu dotacji finansowych przeznaczonych dla rolników.

Słowa kluczowe: azot, fosfor, przenikanie do środowiska, program rolnośrodowiskowy, pakiety „ochrona gleb i wód” i „tworzenie stref buforowych”.

INTRODUCTION

Intensive agriculture adversely affects the natural environment, especially the quality of surface and underground waters. The biogenic elements, unused in the course of agricultural production, especially nitrogen and phosphorus, cause the degradation of aquatic ecosystems. A significant factor in the north of Poland is the pollution of the Baltic Sea by biogenes carried by rivers from agricultural areas.

An important system solution to reduce water pollution, mainly with nitrogen and phosphorus, may be provided by the agri-environmental programme, which is one of the forms of subsidising farmers by the European Union. The program consists in voluntary actions taken by farmers, aimed at promoting such systems of agricultural production which comply with the requirements of environment production (*Plan Rozwoju ... 2003*).

This study analyses the manner of operation of the agri-environmental programme in Poland, in particular the packages which comprise it – soil and water protection as well as buffer zones creation in terms of possibilities of restriction of water pollution with nitrogen and phosphorus.

MATERIALS AND METHODS

Data from the Central Statistical Office and from the literature of the subject have been used to present the hazards to the natural environment created by nitrogen and phosphorus compounds, which concerns the Baltic Sea.

Then, based on an analysis of documents of the Agency of Agriculture Restructuring and Modernisation, The Ministry of Agriculture and Rural Development and studies conducted in two provinces in the northern part of Poland – the Province of Warmia and Mazury and the Province of West Pomerania – the current and potential use of specific packages (soil and water protection as well as the creation of buffer zones) of the agri-environmental programme in order to restrict the adverse effect of biogens on the natural environment has been shown. Field studies conducted in the years 2005–2007 on a group of 750 beneficiaries have provided data on the execution of the programme by farmers.

RESULTS AND DISCUSSION

Agriculture is one of the most important sources of environment pollution. This regards both area pollution (agriculturally utilised land) and point pollution (farms with their immediate surroundings) (KOC 1994, SAPEK 2006).

According to SMOROŃ (1998), it is extremely difficult to determine the exact load of nitrogen and phosphorus which infiltrate into waters as a result of agricultural activity, as it depends on a number of factors. These include: the structure of land use, amount of fertilisers and the manner of their use, intensity and manner of farm animals breeding, etc. Hence, the load of nitrogen and phosphorus which infiltrate into water, and then to the Baltic Sea, can be a good measure of the amount of pollution of the environment by both elements.

The data shown in Fig. 1 show that despite a clear decrease in the load of nitrogen carried to the Baltic Sea, the hazard is still present. Utilisation of nitrogen used in agricultural production is better in plant production – it ranges from 40% to 90% – than in animal production, where it is lower than 20%. Poor utilisation of nitrogen in animal production is caused mainly by an improper method of animal nutrition, and the main source of nitrogen losses is an improper method of storing dung (SAPEK, SAPEK 2001).

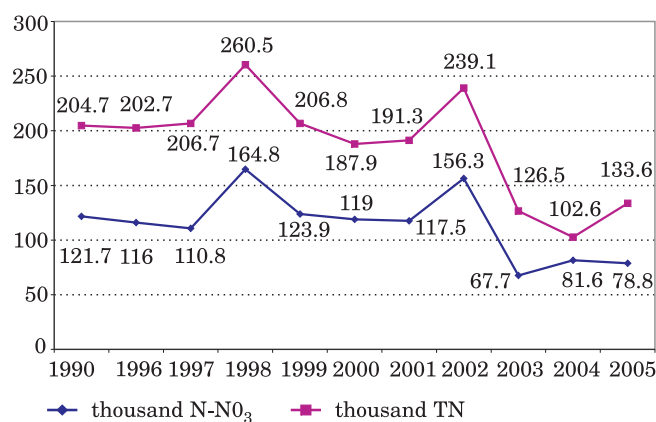


Fig. 1. The load of nitrogen carried to the Baltic Sea from the area of Poland
Source: Environment protection. Statistical information and analyses 2006. GUS Warszawa

The case of phosphorus is similar (Fig. 2). It is widely believed not to be harmful to humans or animals; however, when accumulating in the environment, it increases its fertility, i.e. it causes its eutrophication. As SAPEK (2002) reports, only one-tenth of the phosphorus introduced to the food chain with fertilisers, ends up in consumed food; the remaining part is accumulated or dispersed in the environment

There are several methods of restricting the outflow of nitrogen and phosphorus to the environment. Among them there are rational fertilisation and correct storage of fertilisers, especially organic ones. Of great importance is also the creation of natural barriers which prevent infiltration of N and P compounds into surface and underground waters. This paper focuses on the latter.

According to ROMAN (1995), the major ways of restricting the process of washing biogens out to waters include, as long as possible, the period when soil remains under plant cover. This was confirmed by SAPEK (1997), who claims that it is necessary to create conditions to encourage farmers to introduce catch crops or intercrops in the area endangered with pollution of underground waters with nitrates. The plants used as catch crops and intercrops take up a lot of nitrogen and phosphorus. For example, 1 tonne of rye cultivated as green crop takes up about 4.9 kg of N and 0.7 kg of P, and 1 tonne of oats cultivated as green crop – ca 3.7 kg of N and 0.5 kg of P.

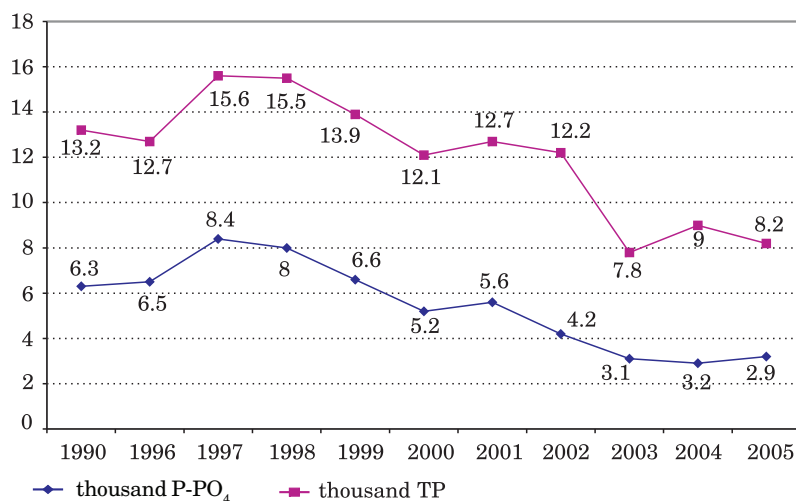


Fig. 2. The load of phosphorus carried to the Baltic Sea from Poland

Source: Environment protection. Statistical information and analyses 2001 and 2006.
GUS Warszawa

An important factor in restricting the amount of nitrogen and phosphorus which infiltrate into water is the creation of biogeochemical barriers which help control migration of chemical substances from fields to waters [ZAJĄCZKOWSKI 2000, DRUPKA 2003, GOLINOWSKA 2004]. An example of this was shown in the study by KOC AND SOLARSKI (2006), which indicates that the concentration of N-NO₃ in drainage ditches is significantly reduced owing to biological absorption of nitrogen, mainly by vegetation growing in the ditches.

KOC (1999) studied the process of biogen accumulation in zones surrounding small water reservoirs and found that one hectare of waterside vegetation can accumulate material which inflows from 40 ha of the drainage area and protects 1 ha of the reservoir from eutrophication. Biogen accumulation depends on the type of vegetation and the zone width. The study found that a 20-metre wide zone of turf surrounding a water reservoir accumulates 250 kg nitrogen and 40 kg of phosphorus per hectare. Thickets absorb 79 kg⁻¹ ha of N and 12 kg⁻¹ ha of P, whereas rushes – 37 kg⁻¹ ha and 6 kg⁻¹ ha, respectively.

In practical terms, developing and conducting such protective actions encounter numerous obstacles. Therefore, the agri-environmental programme can be a helpful instrument in executing such actions (LATA CZ-LOHAMANN, HODGE, 2003, GLEBE 2006). In Poland it concerns two packages which comprise it: „water and soil protection” and „buffer zones creation”.

The first agri-environmental programme in Poland was developed as part of the Plan of Rural Area Development for the years 2004–2006 at the Ministry of Agriculture and Rural Development. Farmers who conduct agricultural production on an area of at least 1 hectare can participate in the national agri-environmental programme. An additional obligation is to apply the principles contained in the Code of Good Agricultural Practice, especially in the part concerning the restriction of nitrogen and phosphorus outflow. Implementation of the programme in Poland is planned in two phases (years 2004–2006 and 2007–2013).

The „soil and water protection” consists of the following variants: supplementary crops, winter catch crops and stubble intercrop (*Krajowy program rolnośrodowiskowy...2004*).

For „buffer zones”, the environmental plan provides for creating sodded strips, whose main purpose is to reduce the contamination of water in water courses. 2- or 5-metre wide buffer zones will be established along water courses and small water reservoirs on soil of low intensity use. 5-metre wide zones will be established on arable land and meadows of high intensity use – along the water courses running through them and small water reservoirs or valuable habitats situated within them, e.g. peat bogs (*Krajowy program rolnośrodowiskowy...2004*).

An analysis of data provided by the Agency of Agriculture Restructuring and Modernisation has shown that the „soil and water protection” package, which is of great importance in terms of environment protection, attracted the greatest interest. In the years 2004–2006 farmers filed 54,504 applications, 51 185 of which have been positively verified. However, it is a cause of certain concern that so few potential beneficiaries of the agri-environmental programme are interested in the „buffer zones” package. In the years 2004–2006 only 122 applications were filed around the country, 80 of which were positively verified.

According to the data provided by the Agency of Agriculture Restructuring and Modernisation, soil and water protection attracted the greatest interest in the Provinces of Pomerania and Lublin. Surprisingly, actions related to the package were the least frequent (excluding the Province of Silesia) in the Province of Warmia and Mazury and in the Province of Subcarpathia. These are the provinces where so-called „Naturally Sensitive Areas” were established and the agri-environmental programme appeared as a pilot programme before Poland’s accession to the European Union (*Programy rolnośrodowiskowe w Europie Środkowo-Wschodniej...2000*).

Studies concerning the interest of farmers in the agri-environmental programme have been conducted in the Province of West Pomerania and the Province of Warmia and Mazury. The provinces were ranked 11th and 14th, respectively, in terms of the number of applications for the „soil and water protection” package. Actions related to the soil and water protection

were taken by the relatively greatest number of farmers – 49.2% (47.2% in West Pomerania and 51.2% in Warmia and Mazury). No interest was recorded in creating buffer zones.

It was found in the study that the choice of the „soil and water protection package was usually caused by good financial conditions and by the fact that most farmers had grown catch crops and intercrops earlier.

In the „buffer zones” package, which requires excluding considerable areas from agricultural use and in which additional work has to be done, the financial resources which accompany the programme have proved insufficient. Given the threat caused by the outflow of nitrogen and phosphorus compounds from fields to waters, a correction of the package is necessary.

CONCLUSIONS

1. As the data provided here show, agricultural production in Poland is a cause of deterioration of the natural environment. This concerns in particular water pollution by nitrogen and phosphorus compounds. Contamination of water by such substances poses a threat to the quality of the Baltic Sea waters.

2. An analysis of the available materials has shown the need to reduce the threat discussed above. The most important actions include the rational use of fertilisers, maintaining the appropriate structure of cultivations as well as creating and maintaining geochemical barriers. However, such actions encounter numerous obstacles.

3. Following Poland’s accession to the European Union, the agri-environmental programme, especially the packages: „water and soil protection” and „establishing buffer zones”, is an effective instrument which can help control infiltration of biogens to the environment.

4. An analysis of documentation provided by the Agency of Agriculture Restructuring and Modernisation and the studies conducted in the Province of Warmia and Mazury and the Province of West Pomerania have confirmed the national tendency which indicates a high interest in the „soil and water protection” package”. However, the other package, „buffer zone creation”, which is also important for the discussed issue, did not attract much interest on the national level or in either of the two provinces. Therefore, a correction of the package is necessary, mainly by increasing the amount of financial subsidies for farmers.

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