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Impact of the wastewater as an indicator for quality of water resources in Republic of Macedonia

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Abstract

The increased water consumption in Republic of Macedonia is responsible for generating significant amounts of wastewater, which are an essential source of contamination for all types of water throughout the country. The largest amount of wastewater is generated from industry and households. Significant source of pollution of natural waters is also the agriculture, which is a major sector of the economy.
This work is the analysis of the impact of the wastewater on the quality of water resources in R. Macedonia. The monitored indicators for this burden were: wastewaters generated from economic activities, discharged untreated wastewater from the economic activities by type of receiving water, production of pesticides and fertilizers, the nitrogen balance.

1.Wastewater from industry and mining

Wastewaters from the industry and mining are generated after their use in engineering and manufacturing processes, cooling systems, from sanitary facilities, or other sources. Primary, the wastewater in 2008 was generated in manufacturing processes (77,5% of the wastewater), 13.1% of effluent is a result of cooling and approximately 6.3% from the sanitary wastewater. It is also important to note that the water used for cooling is discharged into receiving waters without being cooled with causing thermal pollution. Only three wastewater treatment plants are made in the country: in the cities of Ohrid, Prespa and Dojran, but they are not fully completed and untreated sewage is discharged directly into rivers. Discharged untreated wastewater can be found in many river sections: River Dragor (after the town of Bitola), Kumanovo River, Black River - after Skochivar to Bitola, river Kiselichka in Probishtip, Kichevo River, river Vardar - after Tetovo, Skopje and Veles and Bregalnitsa river after the cities of Kocani and Stip. The quality and quantity of contaminated wastewater in the river basins are presented in Table 1. The analysis shows that the Vardar River has the greatest contamination, with 90% of discharged untreated wastewater daily.

Table 1. Pollution of rivers

River	quantity of contaminated wastewater (m^3/day)	Dissolved substances (kg/day)	BOD_5 (g/day)	Total nitrogen (g/day)	Total phosphours (kg/day)
Vardar	265,557	193,974	55,130	13,064	2,347
Strumica	10,616	9,168	2,606	618	111
Crni Drim	17,221	15,167	4,312	1,022	184
Total	293,394	218,309	62,048	14,702	2,642

The total amount of discharged waste water into receiving waters from industry and mining in 2007 is estimated as 3,306,127 $\times 10^3$ m^3. For the period from 2000 to 2007, the trend is towards an increase in the amount of wastewater. The largest amounts of wastewater was generated in 2003, 2004 and 2007. This period coincides with the period when the rivers acumulated the largest quantities of fresh water from the country and in the same time the industry increased substantially in its development.
Of the total wastewater discharged into receiving waters in 2007 only 11% are under varying degrees of purification. Compared with 2000, the ratio between untreated and treated water is 99% to 1% (Fig.1).

Figure 1.

The remaining amount of 2,956,200$\times 10^3$ m^3 of untreated wastewater in 2007 was discharged into different receiving waters: in ground water, public sewers, rivers, natural lakes and reservoirs.
The largest burden is on the river flows with 60.2% of discharged untreated wastewater and second, dams are loaded with 30.4% of the untreated wastewater. Only a small proportion of this water is discharged into public sewers. In comparison

with 2000, in 2007 has increased the pressure on all receiving waters, except the lakes, where in 2007 were no discharged untreated water (Fig.2)

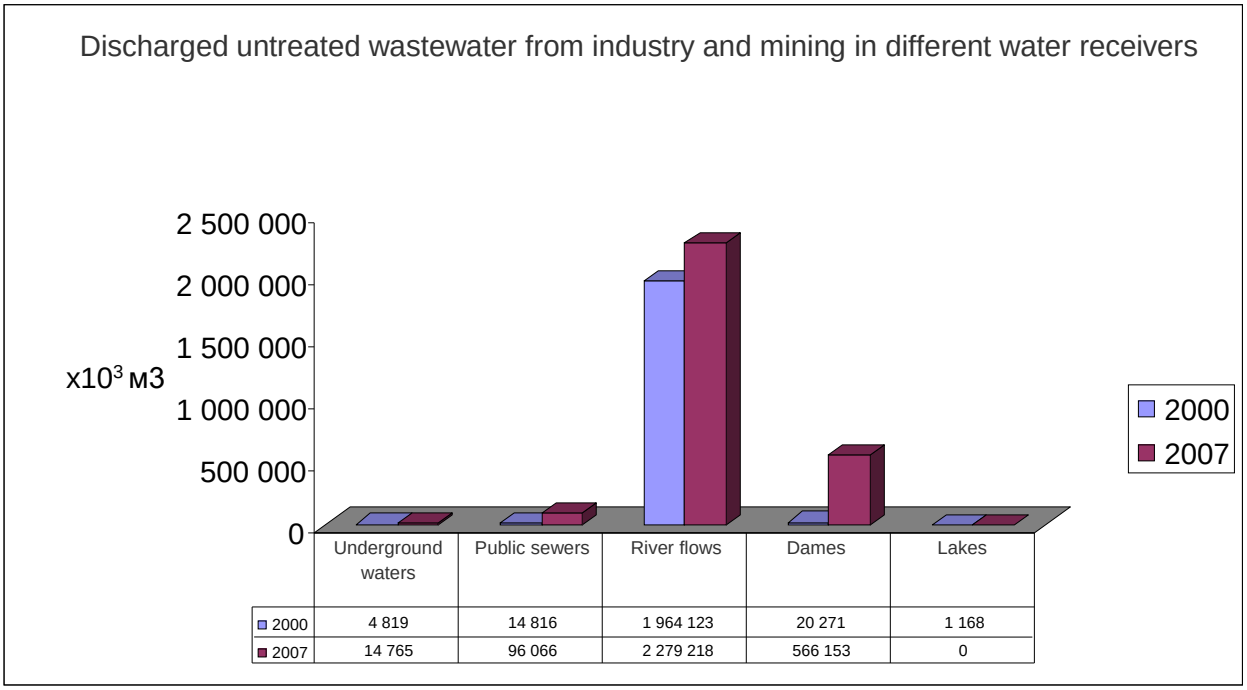

Figure. 2.

Large quantities of industrial and hazardous industrial waste is generated by mining, metallurgy, chemical industry, as well as heating. Industrial waste especially metallurgy and chemical industries pose a serious threat to the natural waters in the country. Wastewater in the flotation of minerals are a potential threat to nearby groundwater aquifers and river flows. Mines in Zletovo, Sasa, Toranica and Buchim already polluted rivers, mainly with heavy metals. The effluents from metallurgy is often not treated. Sites for disposal of toxic waste from the plant for lead and zinc in Veles and chromium in Yegunovtse near Tetovo also pose serious potential problems for groundwater flows.
There is a need for proper management for the production of waste from the plant for ferronickel "Fenimak", which generates about 430 000 t of slag per year and TPP Bitola dispose its waste production on area of 1,000 ha. Smaller productions of waste are often disposed outside of the production sites in areas that are not appropriate for the environment. As a result of leakage of the slag from the landfilleds, the waters of many rivers are contaminated (Zletovska river, Bregalnica and Vardar) and their surroundings. This pressure on surface and groundwater foregrounds the need for proper management of hazardous waste production, which will prevent the negative impact on human health and the environment in Macedonia.

2.Manufacture of pesticides and fertilizers

Diffuse agricultural sources of pollution and their impact on quality of water resources are not thoroughly examined. Some indirect indicators for assessing the impact of agriculture on water quality in the country are following: "Quantity of used fertilizers in agriculture", "Quantity of manufactured pesticides" and "Nitrogen balance".

The total amounts of pesticides (insecticides, herbicides and fungicides) in 2008 was 56 tons. The largest share of production are insecticides (63% of the total production of pesticides), followed by fungicides, rodenticides and other derivatives. The amount of herbicides production is insignificant (Fig. 3).

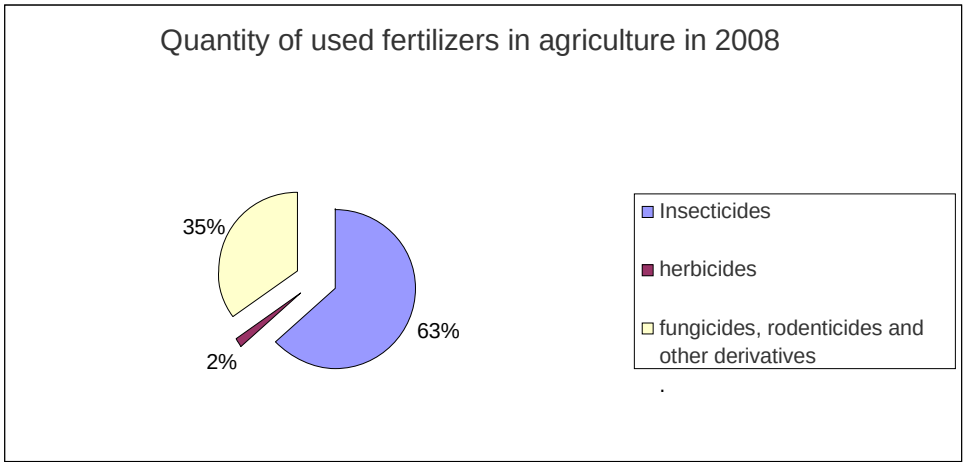

Figure. 3.

The consumption of pesticides has decreased dramatically in recent years, from 2706 tons in 1983 to 659 tons in 1993 and 56 tons in 2008. Use of herbicides was also reduced.
During the period 2004 - 2008 the production of pesticides (insecticides, herbicides and fungicides) in conjunction with reduced consumption tends to decrease. An exception in this regard in 2006, when total manufacturing of pesticides increased to 169 tons, accounted for the largest share of production of insecticides (Fig.4).

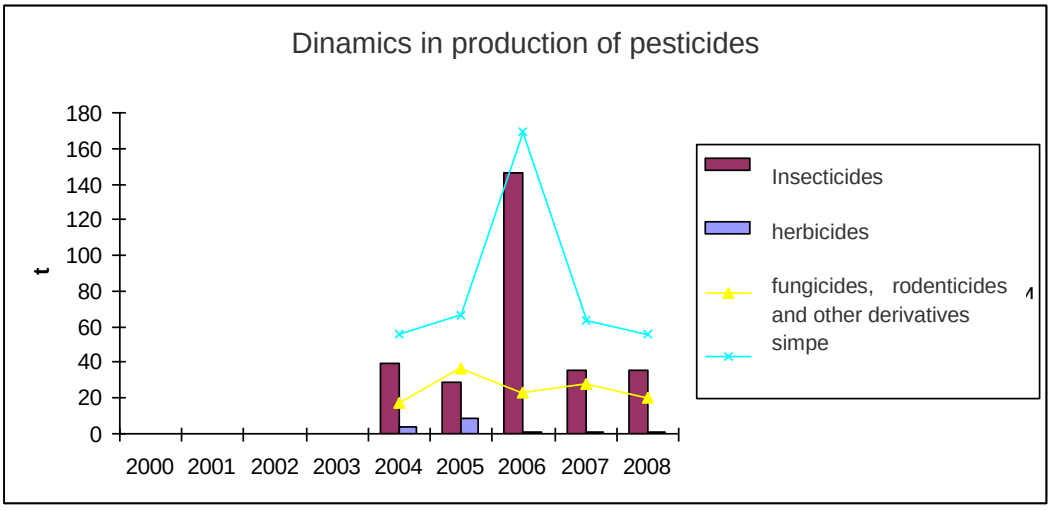

Figure. 4.

It can be concluded that the problems in Macedonia in terms of retention of pesticide residues in plant products are not great, partly because pesticide use is much lower than in Western Europe, partly because standards in their use are complied. The data show that the use of fertilizers decreased in recent years, the most rapidly declining is the use of fertilizers in the period of 1990-1993 due to the gradual

reduction of subsidies, import restrictions and the financial difficulties faced by farmers. However, fertilizer use remains very high. From 1983 -1993 it was an average of 338 kg/dca, and in the cultivable ground is higher than 402 kg/dca (compared to average consumption of fertilizers in Romania in 1980 was 150 kg/dca, while in France was 312 kg/dca and in Switzerland 405 kg/dca). The use of fertilizers in agricultural cooperatives is higher than in the private sector because financial incentives and subsidies granted to cooperatives are higher. Consumption of mineral fertilizers has been reduced from 43,000 t to 24,000 t in the period from 1982-1992, but consumption of nitrate increased from 35,000 t to 48,000 t. Organic fertilizers are estimated about 3 million tons, of which about 40% of the sheep, 40% of cattle and pigs and 20% of poultry. Organic fertilizers meet about 30% of the total demand for fertilizers. There is no detailed analysis of the impact of fertilizer use on soil and water. From analysis of the production and use of pesticides and fertilizers used in agriculture can be concluded that this will reduce the load on ground and surface water from polluting substances.
On the other hand, waste products from livestock also contribute to pollution, especially in the north-east of the country where there are more farms, slaughterhouses and processing of milk, meat and canned food. Effluent from livestock farms is discharged without treatment into several rivers, including Bregalnitsa, Pchinja River, Mavrovitsa, Zletovska and Berovska.

3.Nitrogen gross balance

With the indicator of *nitrogen gross balance* is monitored the nitrogen balance in agriculture. The input of nitrogen include nitrogen applied through mineral and artificial fertilizers, nitrogen from the air and other minor sources. Gross balance of nitrogen is expressed in kgN / year for ha.
In the period from 2000 to 2001 there has been a significant increase in the gross balance of nitrogen, followed by maintaining the balance, and after 2002 there was significant reduction. (Fig.5).

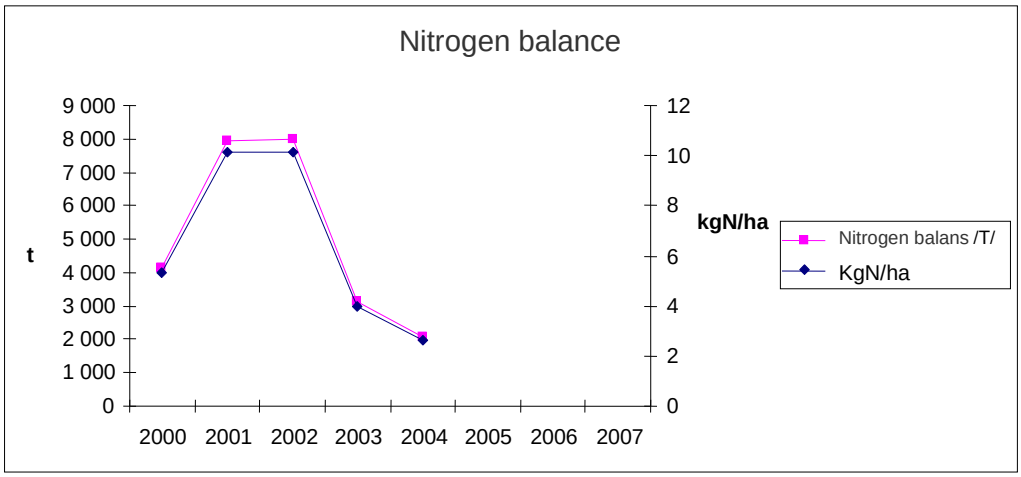

Figure. 5

The constant excess of nitrogen is a prerequisite for potential environmental problems and the shortage of nitrogen balance shows potential for reducing nutrients in the soil.

Conclusion

Overall, it can be concluded that the impact of agriculture on the quality of surface and groundwater for the period 2000 - 2007 decreased. Major share in this process is the plant production, where the financial and organizational reasons are reducing the consumption of pesticides and fertilizers, which are an essential source of pollution of natural waters with a number of organic and inorganic substances. Potential degredation of water quality continues to be livestock farming where the waste products and water from its activities is discharged without any treatment, mostly in the surface waters.

References

1.European Environment Agency. Technical report No 25 Environmental indicators: Typology and overview. EEA, Copenhagen;

2.European Environment Agency (1999). Technical report No 18 Towards a Transport and Environment;

3.Reporting Mechanism (TERM) for the EU, part 1. EEA, Copenhagen;

4.Lisa Segnestam, 2002. Indicators of Environment and Sustainable Development Theories and Practical Experience. THE WORLD BANK ENVIRONMENT DEPARTMENT;

5.OECD,1994 OECD (Organisation for Economic Co-operation and Development). 1994. Environmental Indicators. OECD Core Set. OECD: Paris, France.

6.OECD,2003.OECD Environmental Indicators. Development, measurement and Use. Reference paper.

7.Trajce Mitev, Dissertation 2011, University St. Kliment Ohridski Sofia, Bulgaria