

“VULNERABILITY TO POLLUTION BY NITRATES –CONCEPT-CASE STUDY IN ROMANIAN COUNTY CLOSE TO THE DANUBE RIVER”

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Abstract: The 91/676/EEC Directive, whose main objectives consist in reducing the pollution produced or induced by the nitrates coming from agricultural sources and the prevention of the water pollution with this type of compounds, was transposed by adopting Romanian Government Decision No. 964/2000. This document refers to the approval of the Action Plan for the water protection against pollution by nitrates from agricultural sources. As a consequence, the Ministry of Agriculture, Forests, Waters and Environment financed and coordinated the elaboration of the studies regarding the methodology of identifying and assessing the vulnerable areas.

The case study performed in Carasi county was carried out in cooperation with Development Alternatives Inc. -USA in the framework of APRA Project (Agricultural Pollution Reduction Activity in Romania) promoted with financial support from USAID. In Calarasi county, all vulnerability designated areas correspond to the alluvia deposits due to the permeability of the Danube, Dambovitza and Arges river meadows, credited with categories of “bad quality”. Based on studies concerning hydrography, hydrological characteristics, geological characterization, hydrogeological characterization, groundwater dynamics, groundwater chemistry, N compounds utilization in irrigation, soil and groundwater pollution danger, two vulnerable areas, Sohatu and Frumusani have been established. They have an area of 7,035 ha and 6,454 ha respectively.

The Master Plan will include measures to reduce the impact of nutrient compounds in the vulnerable areas.

Keywords: pollution, nitrates, agriculture, water, vulnerable, area, permeability, quality.

Zusammenfassung: Verwundbarkeit zu flußverunreinigung über nitraten –konzeptfallstudium in einen rumänischen bezirk in der nahe der donau

Die 91/676 EEC Richtlinie, welcher Hauptziele bestehen im Reduzierung der Flußverunreinigung produziert oder induziert durch die Nitrat folgen aus landwirtschaftliche Quelle und Flußverunreinigung Vorbeugung mit diese Typverbindung, war umgesetzt nach Rumänischen Regierungsdeziehung Nr 964/2000. Diese Urkunde bezieht auf Aktionplan Billigung für Flußverunreinigungschutz gegen Nitrat aus landwirtschaftliche Quelle. Konsequent, das Landwirtschaft Wald, Wasser und Umwelt Ministerium hat finanziert und beordnet Verarbeitung der Studium betreffend die Methodologie zu identifizieren und abschätzen verletzbare Zonen.

Das Fallsstudium geleistet im Calarasi Bezirk war ausgeführt mit Beihilfe von Development Alternatives Inc.-USA übereinstimmt mit APRA Projekt (Landwirtschaftliche Verunreinigung Tätigkeit Reduzierung in Rumänien) befördert durch finanziell Stütze aus USAID. Im Bezirk Calarasi, alle verletzbare bestimmte Zonen entsprechen einer Hochwasserablagerung dank zu Donau, Dambovitza und Arges Flüsse Bettdurchlässigkeit, eingestuft mit Kategorien auf schlechte Qualität.

Gründen auf Studium betreffend Gewässerbeschreibung-, Hydrologie-, Geologie-, Wasserkunde-, Bodenkunde-, Grundgewässerkundenlinien, Untergrundwasser Dynamik und Chemismus, N-Verbindungen Nutzung im Bewässerung, Boden und Untergrundwasser Verunreinigunggefahr, zwei verletzbare Zonen, Sohatu und Frumusani abgemarkt. Sie haben eine Fläche von 7.035 ha und 6.454 ha beziehungsweise. Der Hauptplan wird einschließen Regelungsmaßnahme zu reduzieren der Aufprall des N und P Verbindungen aus den verletzbare Zonen.

Schlüsselwörter: Flußverunreinigung, Nitraten, Landwirtschaft, Wasser, verletzbar, Fläche, Durchlässigkeit, Qualität.

One of the most negative phenomenon at this moment is the pollution of waters, soil and air. Long time people believed that main pollution sources belong to human settlements and industry. According to the latest data, it is obvious that numerous dangerous chemicals generated in the agriculture can be sometime found in the food chain.

The agriculture became, gradually, of the environment, especially for water factor.

The pollution appeared in the agriculture due to the necessity of increasing the agricultural production. Many chemicals (fertilizers, pesticides) are utilized according to the intensive style of agriculture.

The European Directive 91/676 from December 12, 1991, aims to reduce the Nitrogen pollution due to agricultural activity. Romania, being a country on its way to join EU, adopted the Government Decision in 964/2000, approving the Action Plan for the water protection against the nitrates generated in the agricultural activity.

The main targets of the Action Plan were:

- a) The reduction of water pollution due to the nitrates from agricultural sources;
- b) The prevention of nitrates pollution;
 - c) The optimization of chemical and organic fertilizers utilization in order to diminish the Nitrogen contribution;

2. The Case Study –Calarasi county close to the Danube river

A project called “Agricultural Pollution Reduction Activity in Romania”-APRA- was initiated in 2003, with financial support coming from USAID which provided assistance to Romania. At county level, in order to assess water quality, is necessary to identify appropriate practices to reduce water pollution associated with nutrients resulted from agricultural activities and develop an Action Program.

In this way, the projects outputs designed to help Romania deal with nitrates problem, developing a code of good agricultural practices and preparing a national action program.

The key activities are:

1. Provide a general characterization of Calarasi county including administrative territorial structure, land register, demography, topography, climate, flora and fauna, natural resources, hydrographic data and main water works;

2. Provide an analytical synthesis of the general state of surface water resources in Calarasi county;

3. Identify and provide analysis of the agricultural and non-agricultural sources of N and P pollution, including the known and potential impacts of contamination upon drinking water and water utilized for other purposes.

4. Develop a data profile on the geological and hydrological situation in Calarasii county,

5. Provide detailed description of surface and subsurface geophysical systems (as inputs to the pollutant transport analysis). This data profile should cover aquifer formations, including data from the observation well network.

6. Provide inputs to Calarasi Action Plan, particularly related to selection of actions (and their costs) to reduce agricultural and non-agricultural sources of N and P pollution. In the last part of the study, the concept of “areas vulnerable to pollution by nitrates”, hence, the action plan has been focused on the two vulnerable areas identified in the West part of Calarasi county:

The evaluation of the potential risk of affecting the soils and water with nutrients from agricultural sources, allowed identification of the vulnerability areas onto three categories:

A-potentially vulnerable areas because of the nitrates moved by the surface waters bodies flowing over slopes;

B-potentially vulnerable areas due to nitrates lixiviation beneath the soil layer towards the vacant level aquifers (average risks);

C- high vulnerability risk areas when nitrates lixiviation occurs beneath the soil layer up to the vacant level aquifers;

In Calarasi County, all vulnerable designated areas range within “B”category;

3. Characterization of the Area Related to Calarasi County :

3.1. Natural Background

Calarasi County lies in the S-E of Romania, being intersected in the central part by 27^ş eastern longitudinal meridian and of 42 ^ş 20' northern latitude parallel. With a 5088 km² surface and limited on its south-eastern boundary by the lower reach of Danube River, this county covers 2.13% of the whole national territory.

3.1.1. Units of Relief

The respective area belongs exclusively to the Romanian Plain, alongside meadows and ponds are to be distinguished.

The Danube meadow is the lowest relief unit extended exclusively on the left hand side of the river.

3.1.2. Hydrographic Network

The hydrographic network of the county is entirely tributary to the Danube river that flows at the Southern and Southeastern limit of the territory.

3.1.3. Climate Conditions

The Calarasi County is included, on the whole, to the continental climate sector, characterized by great contrasts between seasons.

The mean annual rainfall quantity sums up to 484-540 mm.

3.2. Natural Resources

3.2.1. Land fund: Agricultural lands that cover over 84% of the overall surface, with high soil fertility characteristics represent the main natural wealth. Applying the Land Fund Law No. 18/1991, about 80% of the agricultural surface county was transferred into private property.

3.2.2. Soil: Most of the county territory ranges within the chernozem. soil type area of zonal nature and to a lesser extent soil that have a zonal and intrazonal nature.

3.2.3. Water resources: From the view point of water resources used for water purposes for drinking purposes, these may be considered as moderate, taking into consideration the inappropriate quality of some surface waters and especially the uneven distribution of the existing resources on the territory.

The Danube River maximum run-off is recorded during spring-summer time, May-June.

The main groundwater resources are stored in Mezozoic limestones (between 180 and 650m), the potential being 9m³/s.

3.2. Pressures on the Environment

3.2.1. Urban and Rural Communities

The county has 2 municipalities (Calarasi and Oltenita-harbours to the Danube River) 3 towns, 48 communes and 160 component villages.

The county population on 1-st of July 2001 was 330.553 inhabitants.

Communal husbandry activities. From the town endowment point of view, Calarasi county has a precarious situation. Except the 2 municipalities that are supplied from Danube River and have water treatment plants, the rest of localities use groundwater as source. Out of the total population, only 42 % is connected to a centralized drinking water supply system.

For collecting wastewater, only 6 localities have public sewerage systems; 24.3% out of the total population is connected to sewers, whose simple length is about 140km. Only 3 localities have wastewater treatment plants, summing up 837 l/s. In the rural area, the sewage is stored in so-called septic tanks (about 68.000).

Concerning the solid waste deposits, with the exception of municipalities, in 48 communes there is no permanent activity of waste management. In the urban centers deposit platforms are being operated without approval from the local authorities.

3.2.2. Economic activities

The agricultural represents the dominant component inside this territory. The vegetal sector, in the last years was of 67.3% and the animal sector of 32.7% out of the total value of agricultural production.

The quantities of chemical fertilizers used in 2001 were:

13,273 tons out of which Nitrous-10.141, Phosphates 2.763 and Potassic 369. In 2002, the fertilizers decreased to 11.609 tons, out of which Nitrous-8.941, Phosphates 2.552 and Potassic 116. The above mentioned quantities have been applied on a surface of 280.021 ha, representing 47 kg fertilizers/ha in 2001, respectively 41.5 kg fertilizers /ha in 2002.

The Calarasi County has very good conditions for developing animal breeding activities. In the present situation, the animal effective that were raised before 1990 were more numerous, the resulted change contributing with high quantities of N and P compounds at the soil and water pollution phenomena. The animal number decreased during the transition period: cattle with 70%, hogs with 77%, sheep with 49%. The birds, after 4 years of decreasing trend, begin to recover due to the private sector, reaching nowadays about 2,240,000 heads.

3.2.3. Water Resources Stress

Danube River is very important in this space, being the water supply source for drinking purposes (3 municipalities). Besides, the water supplied for industry, the Danube waters are intensively used for wide surface irrigations.

On the Calarasi County can be found 396 drilled wells for drinking water centralized supply for the urban and rural localities, for about 120 commercial and agricultural societies. According to the recorded data, in the last years, the global volumes taken have increased (mainly for irrigation) from 64 million m³ to about 98 million m³. Besides these, the majority of the rural population uses for drinking water supply and domestic purposes, the local sources, usually represented by phreatic aquifer captured by mean of individual fountains.

Existing Water Management Facilities

In order to harmonize the variable regime of the river flow rates with the water demands, in the county there were realized a succession of water management works, which plays, in the meantime a part in protection against floods effects.

The most important are :

Storage reservoirs, the existing 5 reservoirs having a total volume of 224 mill.m³;

87 ponds with fish farming potential;

diversion and headrace pipes and canals;

works meant to prevent water destruction effects;

Irrigation Facilities: Calarasi County has important irrigation works, due to the accentuate lack of humidity during vegetation periods, the existence in the area of some water resources; the suitability of the soils toward the irrigation regime, etc. The existing surface developed for irrigation systems are of 361,0758 ha, mainly supplied from Danube River with installed flow of 344 m³/s.

B. Report upon General Conditions of Surface Water Resources from Calarasi County

The water quality in Romania is controlled according to the methodology of the National System of Monitoring for Water Quality, which consists of 5 subsystems, two of them being: surface run-off and groundwater.

The running water in Calarasi County are:

Danube River, including Borcea arm;

Dambovită and Argeș Rivers on the West side and Mostiștea River in the central part, all of them flowing to the Danube.

The lakes are natural (one) and storage reservoirs (5). The most important river is Danube which has a multiannual discharge of about 6,000 m³/s.

Romania has legislation in the water field, which gradually is under approximation process with European legislation. The Acquis communautaire in the field of Environment comprise about 200 regulations covering a large range of problems, including water management. As for the surface water quality assessment, we are in the transition process from STAS 4706-88 (3 quality categories) to the Norms 1146/10.12.2002.

In the table B3 the Danube water quality is presented, according to the two regulations taking into account the following group of parameters: OR (oxygen regime) MD (mineralization degree) Nut (nutrients) and Gen (general assessment).

Table B3

River	Control Section	Physico-chemical characterization							
		STAS 4706-88				N1146/2002			
		OR	MD	Nut	Gen	OR	MD	Nut	Gen
Danube	Downstream Confluence with Arges river	D	I	II	III	III	I-II	III	III
	Dorobantu	II	II	II	II	II-III	II	II-III	II
	Chiciu-Silistra	D	I	II	II	III	I-II	II-III	II

For the small river is to be mentioned Dambovită River which is conveying the wastewater of Bucharest, without being treated. Dambovită river is discharged into Arges river which has a serious impact on the Danube (see the Table B3). From biological point of view, the storage reservoirs on Mostiștea Valley are classified either “mesothropic” category or within “eutrophic” category.

C. Non-Agricultural Sources of Nitrogen and Phosphorous Pollution and the Impact of known and Potential Sources of Contamination on Drinking Water and Water used for other Purposes

Long time before physico-chemical and bacteriological indicators have been related to STAS 1342-91 “Drinking Water Quality Indicator Conditions” which in 2002 has been replaced by the Law 458, having in view the approximation with European legislation.

In Calarasi county, the water supply is made from two main categories of sources:

Groundwater which is the most used one for individual household in the rural area. There are situations when the phreatic water is affected by animal manure. The water pollution with nitrites is the cause of reports by authorized bodies with sanitary control, for up to one year old babies that fall sick of “methemoglobinemia”

Surface Waters also constitute an important water supply source for the communities, animal breeding farms, irrigation and industry. The Regulations provide that water supply to be used for drinking purposes and food industry, will be only from the 1-st category surface waters.

The existence of river stretches classified within the 2-nd and 3-rd category raise questions as to meet the legislation requirements concerning the quality of drinking water resulting from the raw water withdrawn from such polluted rivers. The identification of the pollution sources exceeding the values of NTPA 001/2002, (which indicates what maximum pollutant concentration may have the effluents discharged into the water resources) represents a first stage in identifying the environmental impact sources.

The non-agricultural pollution sources with Nitrogen and Phosphorus are represented mainly by the wastewater pollution sources. In Calarasi county, there are factories for cellulose, cities, animal breeding industrial facilities (hogs and birds) etc

Pollution Sources due to Solid Wastes:In Calarasi county the uncontrolled waste deposits creates serious environmental problem. None of the existing 184 platforms had authorization for environmental protection. Concerning the urban solid waste, the approved area for waste depositing was of 201.000m² A special problem is the waste depositing on the water banks. After year 2000, control actions and measures were taken, by decommissioning or restricting the waste deposits situated at less than 150m from the water course.

The industrial solid waste consists into finishing waste, unprocessed slag use refractory coverings and materials, metallic scrap, used tires, inorganic wastes, waste from construction materials and demolitions. During year 2000, about 80,000 t of industrial wastes have been produced. Out of them about 12% have been recycled.

In Calarasi county area, there are 20.883 of dangerous waste (pesticides) which need an important cost for their neutralization.

Environment Factors Quality

Air quality- The air pollution in the urban settlement of the county is due, mainly to the industrial activities, road traffic, heating system, etc

Water Quality- It was mentioned, previously, that Danube water quality, the exceeding indicators being P and COD-Cr.

Arges and Dambovitza River enter the Calarasi county with the degraded category, until the confluence of Arges with Danube, due to the untreated wastewaters from Bucharest.

Soil Quality: Due to soil pollution, in 2001 were proposed for improvement through forestation 265 ha.

The Impact on the Environment due to External Factors

In this category of issues mention will be made only on the surface waters and especially Danube River, which is an international river. Till it reaches Romania (considered downstream country) , Danube crosses Germany, Austria, Slovenia, Hungary, Serbia and Bulgaria. One can add Croatia and Slovenia, which contribute to the Danube river pollution through its tributaries, Drava and Sava. Taking into account that the Danube collects wastewaters, more or less treated, from four Capitals, it can be stated that a great deal of polluting water into the Danube come from upstream area, where it enters Romanian territory and, consequently, from the upstream area from Calarasi county.

D. Designated Areas as being Vulnerable to Pollution by Nitrates from Agricultural Sources in Calarasi County

The 91/676/Directive, whose main objectives consist in reducing pollution produced or induced by nitrates coming from agricultural sources and the prevention of the water pollution with this type of compounds, was transposed by adopting the Romanian Government Decision 964/2001, which includes all the mentioned requests. This document refers to the approval of the Action Plan for the water protection against pollution by nitrates from agricultural sources and the set up of the commission and a Support Group for applying the Action Plan. As a consequence, the Ministry of Environment and Water Management, financed and continued the elaboration of the studies regarding the methodology of identifying and assessing the vulnerable areas, such as other necessary studies for the reminded purpose, which were ratified and approved by the Commission for applying the action Plan. Based upon all these , the respective areas are foreseen to be reanalyzed and completed, especially after the institutional forecasted in 2004 of the National Integrated Support for Monitoring, Control and Decision making-made up of the two interactive subsystems for water and soil-which will collect, store, process, assess and report quality data concerning the respective resources. Thus, will permit the update of the land register and the vulnerability maps.

The evaluation of the potential risk of affecting the soil and water with nutrients from agricultural sources, based on the use of a methodology elaborated for the current stage, permitted the identification of the vulnerability areas into three categories:

–potentially vulnerable areas as a consequence of the nitrates moved by the surface waters bodies flowing over slopes;

–potentially vulnerable areas due to the nitrates lixiviation under the soil layer towards the vacant level aquifer;

-high vulnerability risk areas when nitrates lixiviation occurs under the soil layers towards the vacant level aquifers;

The vulnerable zones estimated in the present stage represents about 8.64% of the country area, respectively 13.93% of the total agricultural area of Romania.

In Calarasi county, the vulnerability-designated areas are included in B category. Generally, the respective areas corresponds to the alluvia deposits with a vulnerability potential (due to the permeability) of Dambovita , Arges and Danube river meadows, qualified with categories of degraded and damaged quality. As a consequence of the balance between the imports due to the stabling manure according to the animals number and the export in the vegetal cultures, superior to the limit values of 20 kilos/ha towards the surface and groundwater bodies, two vulnerable areas (with an average vulnerability risk), Frumusani (6454 ha) and Sohatu (7035ha) were identified.

The assessment of the Land by Pollution with Nitrogen compounds, in vulnerable Zones (V.Z.N) in the Calarasi County

The calculus of the contribution of different factor to V.Z.N. pollution with N compounds , has taken into account:

the localities (number of inhabitants);

the animals existing in the population households)

the animals existing in the large, industrial-type complexes (swine breeding, aviculture, sheep breeding, cattle breeding). The most numerous swine breeding farms have 26,000 to 44,000 capita and the aviculture farms have 139,000-662,1000 heads.

Finally, a global loading with total Nitrogen in Sohatu resulted 1007 tons/year (meaning 143 kilos/ha/year) and in Frumusani V.Z.N. 662 tones/year (meaning 102.5 kilos/year).

Conclusion

The reduction of N and P leakage from the agriculture to the natural collectors has been designated as a priority measure in the National Action Programme for environment Protection through the strategic plans to protect water quality of the Danube and Black Sea.

The conclusion of APRA Project will be disseminated throughout the country in order to contribute to the national programme of improvement the quality of water and soil.