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HYDROCHEMISTRY AND POLLUTION OF RIVERS IN THE UPPER AND MIDDLE HYDROGRAPHYCAL BASIN OF THE MURES RIVER

PHD THESIS SUMMERY

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CONTENTS

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1.Territorial unit and subordinate elements of regional

1.1. Geographic location and boundaries

Mureş system is the largest expansion in the central part of the country, hilly basin of Transylvania and the southern Basin Giurgeu place until the Pannonian Plain.

This study includes the upper sector of Mureş, on the mountain, between the source and Toplita-Deda Defile (110 km) and medium sector, the sub-Carpathian plateau, between the junction with Aries and Deda (282 km from source), integrated central area of the Transylvanian Depression.

Surface water area upstream of the confluence with Aries takes 6733 km^2 corresponding to 24,11 % of Mures and 2,82 % of the country.

Geographical and mathematics position gives a geomorphological and geological diversity, and also climate change and hydrological elements uneven in different areas.

Divide separating the basin west of the study of Aries, Somes basin north, east basin of the Siret and the south of Târnavei Small.

1.2. Elements of regional subordination in the geographic area of the upper and middle Mureş.

Relief units overlapping area of the upper and middle Mureş to confluence with Aries, are represented by a mountain district formed a depression area surrounded by massive mountains and a narrow upper basin corresponds Follows a sub-Carpathian area in contact with the west façade of volcanic mountains, consists of hills and mountain areas depressions, that of a more extensive, low-depression to social middle hills basin (Fig. 1).

Local peculiarities of the river basin, imposed by geological structure, expressed by the appearance and degree of development of the landscape, land usage and the degree of individualization allowed more popular sub-mountainous and hilly pf a lower rank (Sorocovschi V. , 1996).

Overlay area mountain sector includes major areas: Mountains Giurgeu, Călimani, Gurghiu, the Defile of Mures and Depression Giurgeu.

The area includes sub-Carpathian hills of Bistriţa and Reghin, and the north and north-west of Niraj and Olt Hills. The region includes depressions and hills formed by: south-eastern section of the Hills Bistrita, Reghin Hills and the northwestern part of the Hills of Niraj and mountain areas depressions and related interhill region.

Follow hilly sector of the basin studied, grafted on the central-southern Plains and the northern part of Transylvania Târnavei Hills Small.Basin contains a "relative geographical discontinuity area" (V Mihaiescu, 1966)

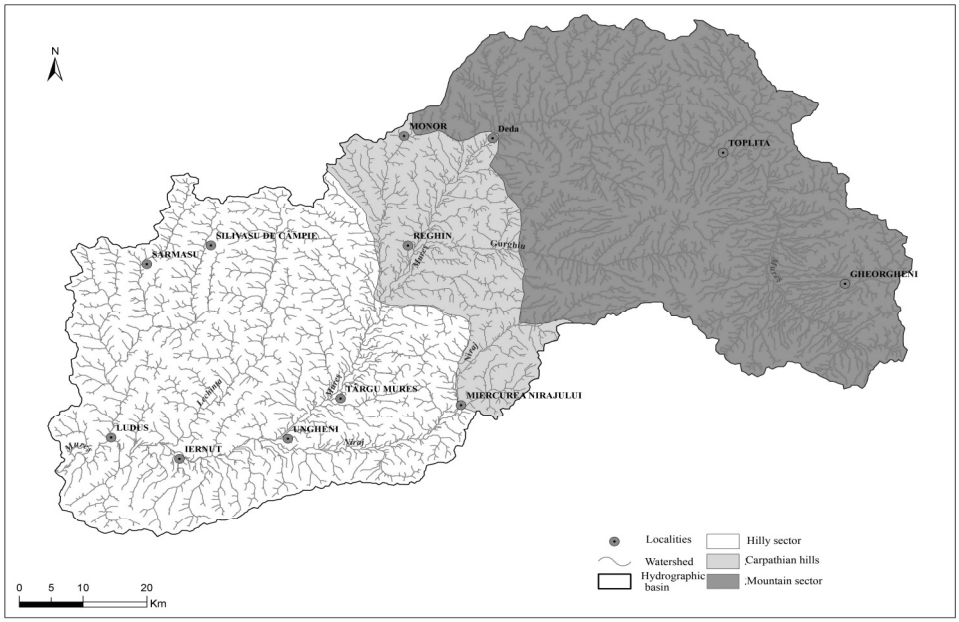

Fig.1. Map of major section areas

between the Transylvanian Plain and Plateau Târnavelor the corridor of Mureş.

Position these units in the studied area relief is from east to west towards the Mureş river flow.

2. Geographical factors and human system, which determines the chemistry of the river Mures basin

2.1. Geological substrate

In Mures covered a wide variety of geological formations, as a consequence of the variety lithological, structural and tectonic land cover in the region. Their effects are evident in the composition of the subsoil, the morphology of the relief and chemical characteristics of water.

In the Hydrographical basin studied, the substrate is composed of sedimentary rocks 64 %.Largest share, 66 % are in the plateau, 21 % and 13 % sub Carpathian region in mountainous areas. Sedimentary formations are the most widespread marl, sand, gravel, tuffs of Neogene-Miocene (wire), clay shale and tar sands of Neogene-Pliocene and Quaternary sands and gravels of upper-Holocene.

Igneous rocks make up 32 % of the substrate pool, which is found in almost all geological substrate of the mountains, only 1 % in the sub-Carpathian.

The mountainous area geological substrate is composed largely of volcano and volcano-sedimentary formations. For these configurations the highest percentage of 31 % they have char-a-banc pyroclastic, crowded micro char-a-banc pyroclastic, micro crowded alternating with conglomerates and tuffs, micro conglomerates, sandstones and sands of andesites nature. Of Neogene and Quaternary magmatic a share of 18,6 % were in composition andezites amphibole rocks.

Metamorphic rocks are found only in the mountain.

The rocks form the mountain region, crystalline formations 4,4 % fall in the proportion represented by green shale facies: sericito-chlorite shale. It notes the existence at a rate of 3,7 % of the facies-granito metasomatites Dior, nepheline syenites, nepheline syenite pegmatoides.

Rocks from Earth's crust are subjected to destructive processes, such as oxidation, hydration and dissolution. These processes are highly dependent on physical-chemical composition of rocks. Water acting on rocks through direct contact by dissolving the constituent minerals. River water chemistry is determined by the nature of minerals arrived in various forms in river water.

2.2. Relief

The landscape and elements such as morphometric. height, depth and drainage density, etc. slopes and slopes exposure. indirectly affect water chemistry in determining sources of supply, the river flow, thermal power conditions. Meteorization nuances and alteration processes, plays a decisive role in perception, accumulation and transport of material displaced by river.

Mureş basin relief from upper and middle is made up of several categories of shapes.

In the mountain: the dam basin tectonics and volcanic plains, river terraces, cones of dejection, relief sculpture and river-lake form of shoulders, plateaus, slope, volcanic and crystalline fragmented.

In the sub-Carpathian depressions such as tectonic-erosion carved valleys with terraces, piedmont area with low hills and mountain areas depressions and interhill.

In the plateau landscape dominated by hills, steep structural fronts Cuesta, cornices landslides, river terraces and flood plains. Local bulging, buttoning and semicircular cuestas have developed the structure of domes. Subsequent valleys of the tributaries are accompanied by Cuestas.

In relief carving competed around glacial processes, river erosion, the landslides, processes, the subsidence.

2.2.Climate

Variety climate of the area studied, the dynamics on climate contributes to defining the chemical composition of water and changes occurring over time.

The basin floor have mountains of climate, weather and climate of high hills low hills. Climate elements temperature, air humidity, precipitation etc. have importance in the chemical composition of water changes.

2.3. Hydrological regime

Hydrological conditions of surface waters, have great influence on the change in water composition.

Mureş in the upper and lower network of tributaries is well d dentritic developed. In the mountain d density of river network average is between 0,9 and 1,1 km/km^2 tributaries are short with large slopes (40-60 m/km).

The sub-Carpathian sector after leaving the gorge, receives tributaries from Căliman hills Mureş and western slopes of Gurghiu.

Plateau in the domes and crosses a region of small slope trough around 0,5-2,5 m / km, forming along the lake fireplaces courses. This sector receives major tributaries: the left and right Nirajul, plain and Lechinţa Creek.

All water supplied from depression are relatively weak Giurgeu water because of the scarcity of precipitation falling in this region.

River power sector is the type rainfall-snowfall plateau and moderate underground. Changes in specific environments spill over Mureş River, is strongly influenced by topography drained sector. In the mountain, the river flows through a trough, with average specific leakage than the 5 l/s km^2 In the Gorge, increased to 8,7 l/s km^2. Downstream, the average specific discharge, gradually decreases to 5,6 l/s km^2 and miles from the confluence with the River.

In the fluid regime, higher sector of the Mureş belong Transylvanian Carpathian type and sector of the plateau, type Transylvanian Carpathian hills.

Feeding rivers, the water flow and silt, freezing and thawing phenomena are basic processes that affect water quality.

2.4. Soils

Soils are complex ion deposits, which are dissolved and transported in rivers and thus have great influence on the chemical composition.

In basin have a variety of soils. Soils in the mountains, especially on slopes, because the substrate are andesitic in a proportion of 67,4 % andosoil.

Districambisoil occupy large areas as education sector and in the middle of the basin.

In the Carpathian basin soils most common, a proportion of 55 % are associated with districambisolurile eutricambisolurile and Luvisols.

Districambisoils and Eutricambisoils are present in a proportion of 26,6 % in the plateau area and have adequate properties for many of the crops.

Albic preluvisoil and Luvisoils are typical and widespread, reaching 30 % in the plateau. Wash soil found only in a proportion of 9,3 %.

Chernozems sector is the heart of the basin. Chernozems are widespread in the lowland south-west of the driest area in a proportion of 18,9 %.

The basin of the Mureş, land use is defined by the high percentage of natural areas: grasslands, forests, agricultural land used as hayfield, wetlands, areas with sparse vegetation.

2.4. Vegetation

In Depression Giurgeu forest floor is the main element being extended spruce, and fir and beech. South Giurgeu Depression is represented by galleries brush-up of deposit, forming dwarf răchitişuri eutrophic fens.

In pass-Deda -Topliţa because thermal inversion phenomenon occurs an inversion of forest vegetation, meaning that appear on top of the mountain beech and spruce stands to their base.

In the Carpathian a in the vicinity of frame interference occurs evergreen beech and conifers. With deforestation of Sessile cover large areas of grassland and mezoxerofile, xerofile.

Small vegetation Târnavei Hills region has a transitional character. Woody vegetation currently occupies only Dalur highest peaks, the slopes in May shade. Predominates oaks plus hornbeam, elm,. Shrub layer is made of blackthorn, wild rose, itchy wood, horn, etc.. On sunny slopes meet xerofile grass associations. In the western sector of steppe vegetation predominates.

In addition Transylvania Plain soil conditions, add and climate warmer and dry plateau, which caused the installation of steppe vegetation. It is noted here a high percentage of exotic species occupied land areas of agricultural land.

Meadow vegetation consists of woody and herbaceous species.

2.5. Land use

The area sector presented coniferous forests occupied occupy 31 % of the total, followed by mixed forests with a share of 25 %.

Secondary grassland is a lower share of 19.23 %, resulting from deforestation.

Agricultural lands are widespread in the middle of the Mureş has a 10 % share.

2.6. The human factors

The upper and lower sector of the Mureş human factor influencing the composition of water through activities such as extraction of underground resources (minerals, salt, mineral water, etc..) Processes resulting from wastewater, wastewater discharges from households, crop chemistry, livestock farms, etc.. The most significant changes to water quality in Mureş are chemical products, wood processing industry, food industry, construction materials industry, the urban, village and agriculture.

3. River basin water hydrographical chemistry of upper and middle Mureş

The formation of the chemical composition of river water, compete a number of environmental factors, some directly others indirectly. Existing salt concentration depends on how food sources and water flow.

Wastewater discharges resulting in a change of chemical composition and degree of mineralization.

Network of rivers in the region under study collected west of the central group of the Eastern Carpathians (Giurgeu, Călimani, Gurghiu and depression), Carpathians (Reghin hills and enrolled) and Transylvanian Plateau (Mureş and North Hills Plain Târnava Small).

Mineralization and chemical composition of rivers in upper and middle basin of the Mureş has been addressed in several works and general studies, which concern the entire country (V. Anghel, 1958, V. Anghel, I. Ujvari, 1957, I. Ujvari, 1959 and 1972, Rivers of Romania, 1971) and those relating to some river basins (Mureş River) basin and surrounding regions in the study (V. Sorocovschi, 1996 and 2005).

Analysis of temporal and spatial features of the degree of mineralization of river water from the sector of the upper and middle Mureş to confluence with Aries was based on processing data from systematic observations conducted between 1984-2003 in six sections I control located the main course, and those from five control sections of the order II, located on tributaries (Gurghiu Niraj, Lechinta and the Lowland Creek). Two control sections of the order II period measurements was lower: the stream of 1989-2003 and 2000-2003 on field Avrămeşti Lechinta upstream of confluence.

Variations in space and time content of total dissolved salts in control sections studied were determined using the daily, monthly and annual data analysis linking the water flows when sampling data.

Salts are transported in the form of solutions (anions and cations), colloidal suspensions and dispersed. Ions present in water are expressed in milliequivalents/l, milliequivalents %, mg/l and mg %.

Major ion composition of the mineralizations are: -anions: HCO_3^-, Cl^-, NO_3^-, NO_2^-, PO_4^{3-}, SO_4^{2-}

-cations: Ca^{2+}, Mg^{2+}, Na^+, NH^+_4, Fe^{2+}

Changes in chemical composition can be expressed by linking content absolutely (me/l) and relative (% me) of each major ions to the total amount of ions. These correlations are determined for each section and submit ion concentration changes depending on the mineralization. Based on these changes can build graphs that can determine areas of variation of different ion concentrations.

3.2. Mineralization regime rivers

Changes in water mineralization is closely related to changes in water flow, such as water supply, by wastewater discharges, but the weather elements such as precipitation and temperature.

3.2.1. Annual variation of mineralization

Average annual values of mineral water in the studied Mures increase from spring to Cheţan Mureş, with a decrease of the section to those of spring Stânceni Mures.

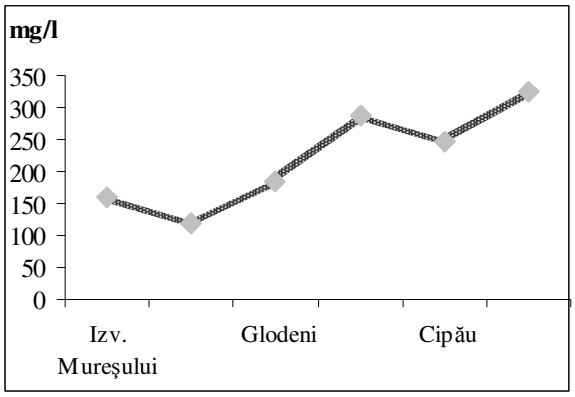

Fig.2. Changes in average annual mineralization along the river Mureş

Average annual increase of mineralization values in general, from source to mouth.Thus, in the space for the mountain, low mineralized waters Mureş, easily exceeding 100 mg/l.

With the penetration in the Mures region plateau mineralization values gradually increased from 183,7 mg/l to 323 Glodeni 5 mg / l Cheţan, paying near Aries.

Multi-annual average water mineralization Mures arrived from space mountain tributaries, presents the lowest values (below 100 mg/l) and those that cross and sub-Carpathian area values increased to 150 mg/l (145, 3 mg/l on Gurghiu to Solovăstru).

And tributaries that cross the plateau region of annual mean mineralization values increase to 400 mg/l (366,9 mg/l on the sing-Ungheni Niraj).These higher values are due to the low level of afforestation and brittle substrate Carpathian region and plateau. Elevated mineralization on section Ungheni Mureş (287,5 mg/l) to Section Glodeni (183,7 mg/l) is explained by the influence it carries discharges from Tg.Mureş.

Significant contribution of salts in solution which brings Nirajul Cipău kicks in at, where we have a multi-annual average of 246,5 mg/l. There is a slight decrease from Ungheni mineralization due to Self-purification processes.

Mineralization of water arriving from Transylvania Plain tributaries is high, exceeding 1.500 mg/l (1694,4 mg/l on the Lechinţa and 1774,4 mg/l on the field Avrămeşti Creek), which increases to 77 mg/l Mureş mineral water on average only 74 km away from Cipău and Cheţan. Cheţan control section increases considerably the amount of mineralization containing 323,52 mg/l (Fig. 2).

Spatial distribution of river water mineralization is not uniform, remarking the contrast between mountain and plateau area. Thus, suitable mountain area Gurghiu and Harghita volcanic mountains, annual average river water mineralization is low below 115 mg/l average Carpathians (200-350 mg/l) and high in the Transylvanian Plain (1500 to 2000 mg/l).

Compared to the average situation can vary from year to year climate particularities imposed specific time interval in the study.

In dry years the degree of mineralization was high and low in rainy years. In control sections not sight mountainous area in synchronization with the mineralization distribution of high and low years.

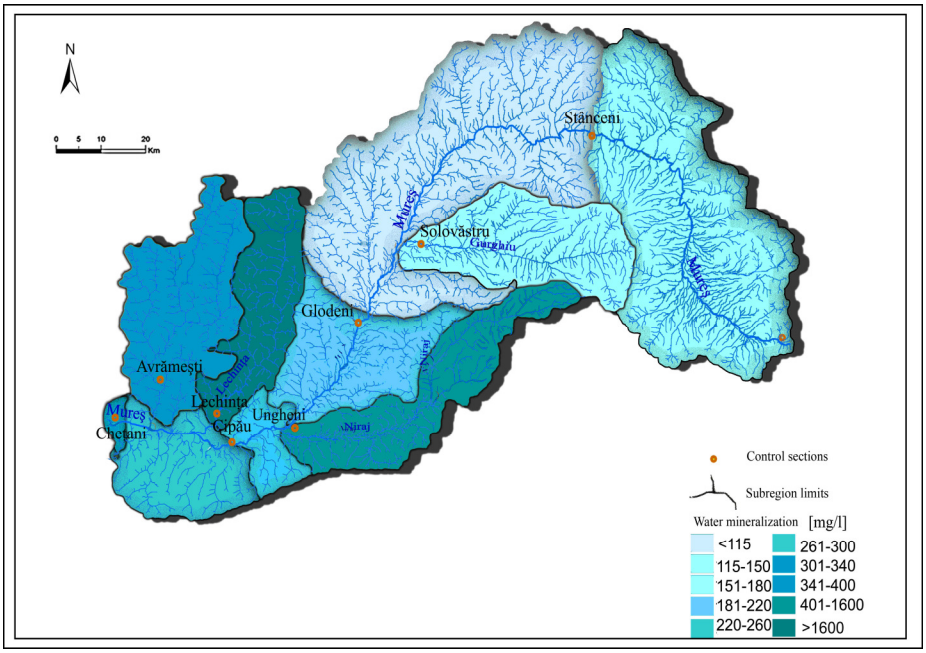

Fig.3. Water mineralization in control sections Mureş

Mineralization values were calculated based on measured liquid flow rates on days when samples were taken for analysis. Ionic weights so calculated values give increased accuracy.

It should be noted that from 1983 to 1993 was not considered that the concentration of bicarbonate ions artificially increasing the values we mineralization in 1993.

In all control sections have high mineralization in dry years: in 1985, 1991, 1994, 1995, 1996, 2000, 2003 and low in rainy years: in 1983, 1988, 1997, 1998, 1999, 2001 (fig.4) .

3.2.2. Monthly Variation mineralization

During the degree of mineralization is low during periods when surface water intake increased (high waters of spring and summer floods) and high during winter low water, winter and summer.

In control sections of mountain area is noted differences in the monthly regime of mineral water Mureş.Thus, the spring section Mureş mineralization is reported monthly average winter in February, in late spring, in April, and autumn in October and

November. Instead, the main peak appears Stânceni section in February and the second in September (Fig. 5).

Minimum main sections from both control was reported in April, when liquid

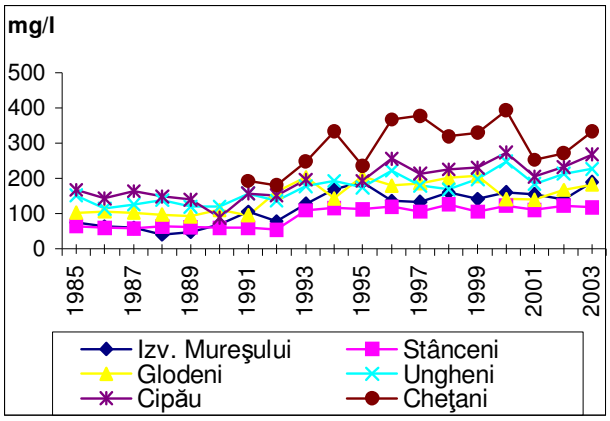

Fig.4.Change in mean annual mineralization in the main control section

flow values are high.

In control sections of the plateau region to highlight the main maximum in winter, in January and February, when the groundwater supply is rich and contribute to greater mineralization of surface water. Secondary minimum fall was reported in September and October, when rainfall begins to increase quantity, having provided a significant amount of material that can be disaggregated easily dissolved.

Minimum occurs mainly in spring, in April and May, when dilution is high due to solutes important contribution of water from melting snow in mountain area and large liquid precipitation and evaporate - transpiration still low. Secondary minimal underline in August, when low levels of mineralization are subject to diminishing food intake groundwater sources and small amounts of liquid precipitation.

In all control sections is an increase of mineralization in winter, when water flows are low and a decrease during spring floods.

Over a year and varies monthly values Mureş tributaries, smaller and higher in spring autumn and winter.

3.3. Hydrochemistry types

By comparing the results expressed as% equivalents of various ions, the average mineralization of the main components of the control section, determine the types of water hydrochemistry Mureş and its tributaries studied (fig. 6).

Classification of river water is the criteria established by a Alekin (1953) and N. Florea (1971).

Mures water belongs to the chemical composition class after bicarbonate and calcium group, except section Ungheni waters, which belongs to a group of mixed

hydrochemistry.After I set contents relative ion hydrochemical type and subtype of water to control different sections.

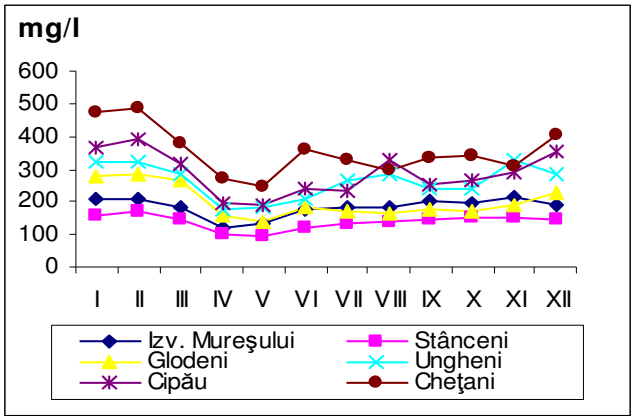

Fig.5. Variation of monthly average values of mineral water in the main sections of control Mureş (1985-2003).

In tributaries Mures, bicarbonate and water mixed group in class because large proportions of calcium and sodium in composition.

3.4. Chemical composition of rivers

Changes in water chemistry highlighted by linking content in mg/l, me/l it shows the changes that have occurred along the river, monthly or annual limits to held and expressed the state of a river hydrochemistry basin.

3.4.1. Ionic balance of river water

Is an increase of annual average concentrations of major ions along Mures from source to confluence with River. Changes in water chemistry Mures is caused by intake of water of tributaries with different salt concentrations in river receiver.

In each section control calcium ions and bicarbonate prevailing characteristic of rivers that pass through areas with humid climate and rich vegetation.

Of anions with large weight are sulphates in concentrations extreme right tributaries, largely due to sediment substrate. Add the input tributaries and wastewater discharges, which after Ungheni also increase concentration of sulphates.

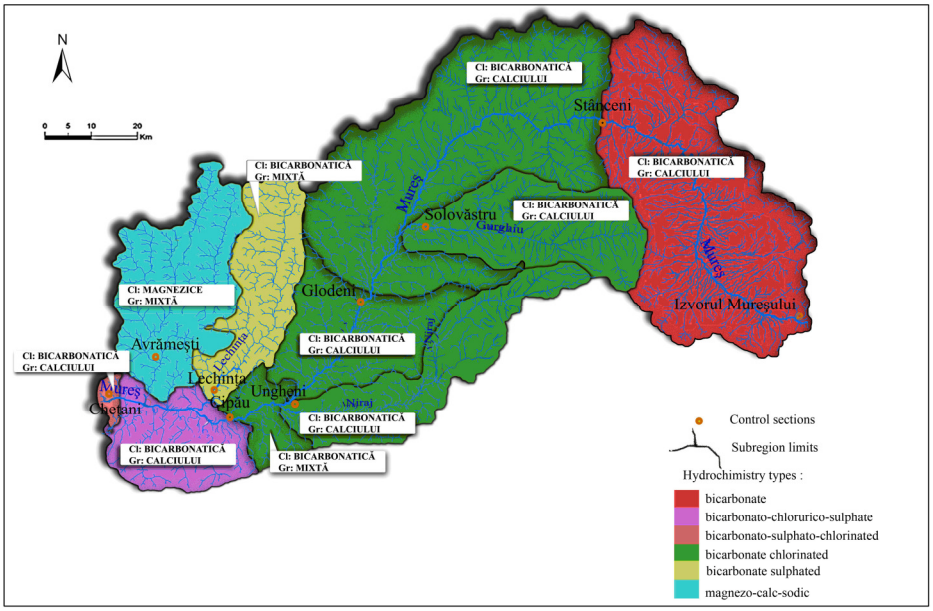

Fig.6.Changes in hydrochemistry types along Mures

Saline washing deposits and other sedimentary rocks containing chlorine in water Mureş these ions are found in significant quantities. A significant increase has Ungheni control section, which comes due to pay the tributaries of the left, who brook Gurghiu of multi-annual average concentration of chlorine is greater than that of brook Niraj.

Ammonium ions and nitrates have high concentrations in control sections Ungheni, Cipău and Cheţan, due to discharges of industrial and domestic wastewater and diffuse pollution from agriculture.

Cations with high proportion of stands apart from calcium, magnesium and sodium ions.

Transylvania Plain streams, one wash sedimentary area with slightly soluble salts, therefore the composition find a large amount of magnesium ions, calcium ions together with water gives a high hardness.

Sodium ions from the washing area naturally Gurghiu diapire the creek, but also of wastewater discharged into the river collector.

3.5. Chemical leak

Leakage of solutes can be expressed in the form of ion flow (Kg/s, t/ year) along a river, or reporting the unit area as a specific ion flow.

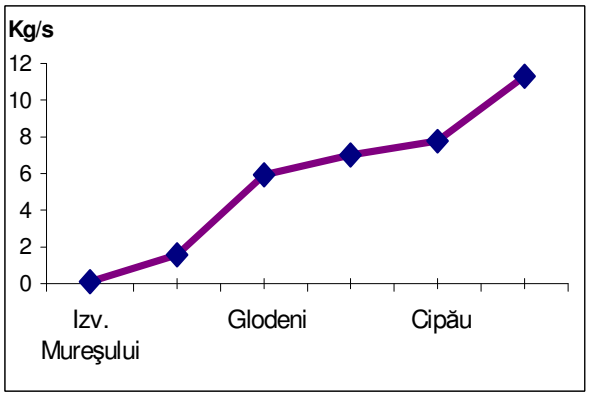

Fig.7. Changes in average annual values of the flow of dissolved substances is along Mures

Increased multi-specific average leakage values over the Mureş.

Mures spring section to Cheţan. We are seeing a big increase from the spring section to Cheţan Mures (fig.7).

Monthly average leakage values of specific salts that flow oscillations have the same solutes and faithfully pursues water flow fluctuations (Fig. 8).

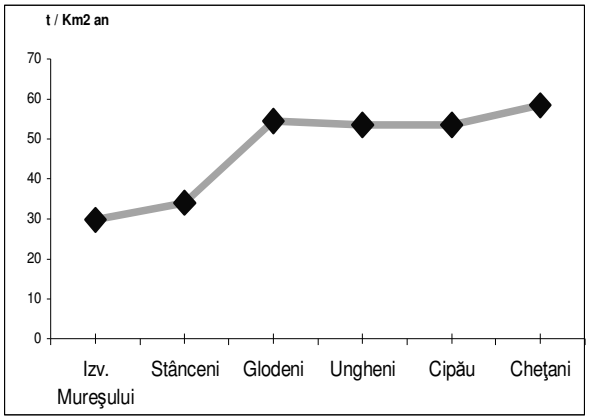

Fig.8.Changes in specific multi-media outlet dissolved salts along Mureş

4. Indicators of water contamination in the upper and middle Mureş

4.1. Indicators of contamination

Changes in water quality study is based on analysis of group-specific qualitative and quantitative indicators, which change depending on environmental conditions in the

area. Presentation of space-time evolution of indicators of doping concentration is made using average annual values, annual and monthly expressed in mg/l, me/l.

Characterization of water quality is achieved through physical indicators, which can be determined through physical processes: material in suspension, temperature, or chemical indicators of contamination: indicators of pH, oxygen regime indicators, indicators of salinity (fixed residue, water hardness, iron ions, manganese ions), biogenic indicators, specific indicators of organic impurities (byproducts phenol, detergents), specific indicators of inorganic impurities (ions of zinc, copper, chromium), biological indicators, indicators of bacteriological .

Is studying water quality control in the main section of the upper sector of the river Mureş. Analysis of contamination indicators enables the assessment of water cleanliness.

4. 1.1. Physical indicators of contamination

Physical indicators studied are suspended and river water temperature. In all control sections in terms of suspension, water quality was good, I was included in suspension in water intake than the control section Cheţan comes from tributaries of the right of rich alluvial Mureş. Monthly peaks are sometimes very high, especially during floods. All tributaries show an increase from March to July the average monthly values due to suspension of water flow.

Average annual temperature values over the Mureş are constant. It's been a slight increase in values Cheţan control section, due Iernut power plant.

4.1.2 .Chemical indicators of contamination

Wastewaters contain numerous chemicals, some are in concentrations enough to be indicators of pollution. The variation in concentration by growth or their deficit may indicate the presence of various harmful substances in water.

Of chemical indicators to analyze the evolution of *pH,* which is low in spring. Here, name of the manufacturer region rich carbonated mineral water river is loaded with free carbon dioxide, which is reflected in low pH water from the other sections.

Low pH values in Section Stânceni may have natural causes, such as brown podzolic soil drainage - preluvisoils and Luvisoils - the river tributaries, but human causes, such as paying wastewater with high content of mineral acids from plant Gălăuţaş Colemn or domestic wastewater treatment plant in Toplita.

Section Cheţan pH increase due to river tributaries that drain right in the Transylvanian Plain rich sediments with high carbon content.

For *determining the oxygen* of water were analyzed spatial and temporal features of the system of oxygen indicators: dissolved oxygen, biochemical oxygen demand and chemical oxygen demand.

Lowest *dissolved oxygen* values over the Mureş were determined Cipău section, due to collection of waste leakage from the payment of Tg-Mureş and stream content Niraj than waste. Self-purification due process, downstream Cipău oxygen was restored in May, but not to recover the contents measured Glodeni (Fig.9).

Control section Ungheni river pollution due to municipal and industrial wastewater, increased concentration of organic material and nutrients, leading to excessive consumption of oxygen.

Along water courses is a natural downward trend of monthly average values of dissolved oxygen with increasing water temperature.

River water quality in the sections studied in terms of dissolved oxygen concentration is good.

Water quality in terms of *biochemical oxygen demand* is variable. Between control sections and Glodeni quality multi-Mures spring fall into the category I. At Ungeni quality was tier-II and the Class II-III Chetan. From 1993 to 2003 water quality was significantly improved.

Of *biogenic indicators* were studied: ammonium ions, phosphate ions, nitrates ions and phosphorus ions. At the concentration *of ammonium ions* in water Stânceni Mureş control section included in the quality category. Glodeni section include water quality category, except 1988, when water quality was II.

Here are feeling the effect of municipal sewage discharged into the water but also wastewater from pig farms in Gorneşti, serving until 2004. Tributary Gurghiu Get with water quality, water helps to dilute the concentration of ammonium ions.

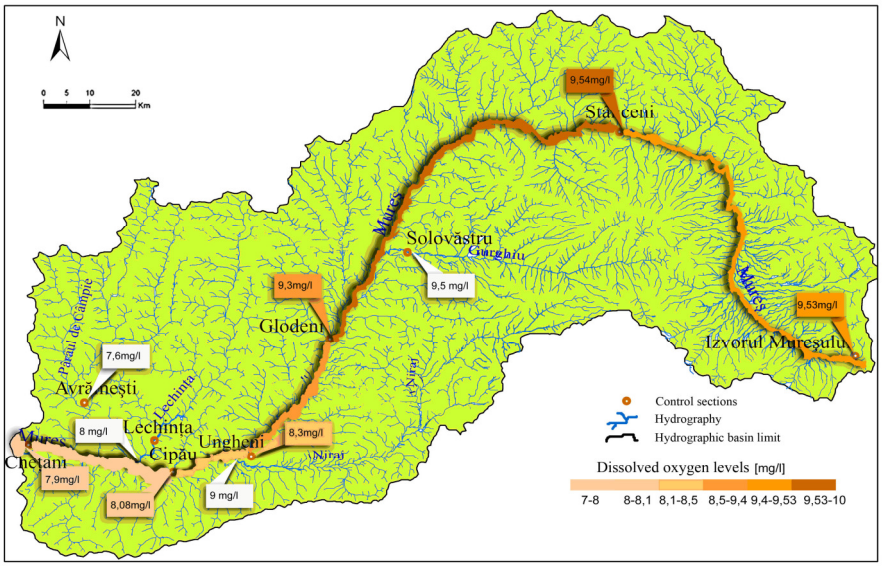

Fig.9.Evolution in space and time dissolved oxygen levels along Mureş

Concentration of ammonium ions, greatly increases Ungheni section, therefore water quality greatly decreases (Fig.11). In 1983-1992's waters are included in category III and between 1992, 2003 as the Class II quality. Water quality was also improved lately, due to lower production capacity Chemical Azomureş, but because of more stringent control of water discharged into the river towns listed plant (Fig.10)

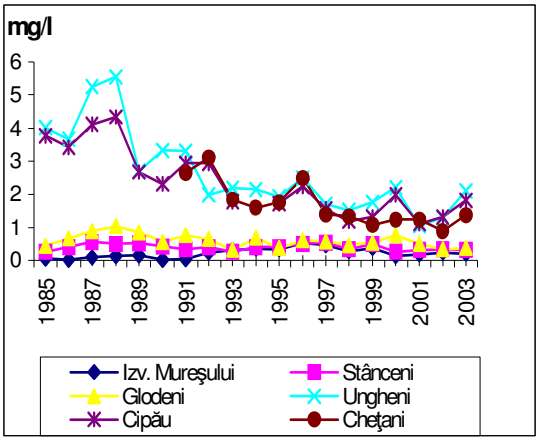

Fig.10.Changes in annual average content of ammonium ions in the main control section

Section Cipău water quality still remains poor. Ammonium ions are found in high concentrations. Waters in this section, between 1983, 1992 were classified in category III, between 1992, 2003 in Class II quality. It felt the effect of stream water to Niraj, who with few exceptions, from 1987 to 1997 falls in category II quality.

Water pollution was produced by wastewater discharge from livestock farms and faeces sewer water - of household waste. Because practicing a long period of intensive agriculture, have used large amounts of fertilizers, which were washed in water and studying the precipitation.

Cheţan section, included in Class II water quality. No right tributaries fail to dilueeze through their water intake, especially that of Lowland Creek brings an ammonium ion injection, the stream waters are included in category II quality.

In terms of river Mureş *nitrites ions* are included in quality category. Decrease is observed with some exceptions, the ion concentration of nitrogen in 1985-2003.

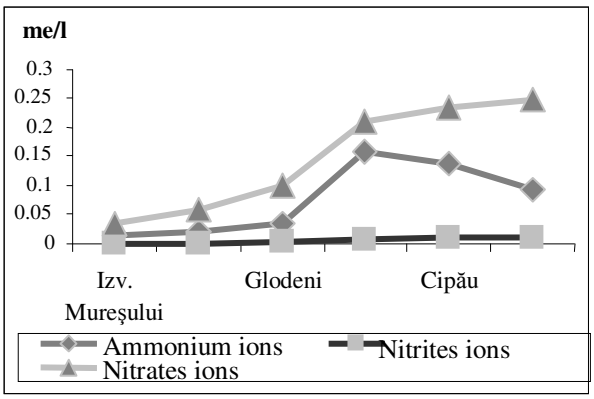

Fig.11.Variation many years average content of nitrogen ions in the main sections of control (1985-2003)

Concentration *of nitrate ions* in water increases the flavor by Cheţan section. There is a slow growth from spring until Glodeni Mureş and suddenly here until Ungheni (fig.11).

From spring until Glodeni Mureş waters included in class I make exception 1985.1986 years, when waters were classified as II.

Section Ungheni extreme values were determined by nitrogen concentration, river waters are included in category II quality, except 1991, 1998, 2001, 2002, when water quality was I..

Mureş tributaries are polluted by waste water from livestock units or torrent on fields fertilized with nitrogen substances, which oxidizes and contributes to increasing the concentration of nitrate ions. In general, the waters are included in category II quality.

Salinity indicators show: *fixed residue, water hardness, iron ions and manganese ions.* Mean annual total increase in water hardness from Mureş to Cheţan Stânceni control section (Fig.12). In spring Mures hardness was higher than Stânceni because high groundwater. In Transylvania Plain streams are very high hardness values.

In terms of water salinity indicators are included until 2003 Mureş Get quality category sections studied.

Sprint *iron content* is increased due to supply river water from rainfall, which washes the surface soil humic substances. Winter in all sections of the values are lower because the groundwater supply.

Organic contamination present *specific indicators* are: *phenolic byproducts, washing powder.*

Mureş river basin and produced medium containing phenol at concentrations above the limit allowed.

Analysing the average annual values of phenol concentration along the river Mures is found a small oscillation of values. Determine the highest values Ungheni section.

Spring Mures control section was not produced determinations of phenol in river only after 1999. From this perspective, Mureş waters in this area have been included in category II quality. Mean annual maximum concentration of phenols in this sector was 0, 004 mg / l in 1999.

In the mountain sector of the river, located in Gheorgheni Depression, the predominant soil type is humic-gleyic and peat, with broad spread of oligotrophic and eutrophic swamps filled with organic matter content of phenols. However, the largest amount of phenol reaches the river through wastewater from human activities such as woodworking.

Stânceni control section monitoring indicator phenol was from 1985 to 1990 and from 1993 to 2003. Mureş waters were included in the 16 years examined once in quality class III, six times as category II, and the rest of the class I.

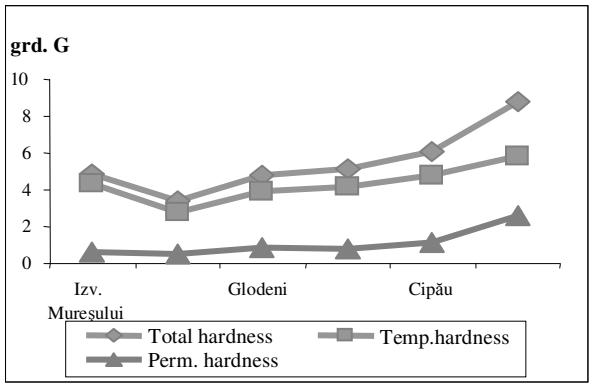

Fig.12.Variation of hardness many years average content in the main sections of control (1993-2003)

Control section Glodeni maximum annual average concentration of phenol was measured 0.01 mg/l in 1999. Phenol pollution sources are discharged by municipal sewage treatment plant Reghin the fall and sewage from the bushes of charcoal and wood processing factories.

Section Ungheni main sources of contamination of river water are discharged into waters of WWTP Tg- Mures.

Control section of the river Cipău phenol concentration was not monitored between 1985-1990 and 1990-1995.

Mureş water control in all sections are included in category II as this parameter.

In this setting Mures tributaries water is not monitored.

Toxic metal ions with data received by the water from industrial activities.

By monitoring *the contamination* of the main and *specific inorganic indicators* between 1983, 2003, the metal ions were determined by varying concentrations of zinc ions. Mureş *zinc ions* in water are mostly natural origin, but may be the result of diffuse pollution in mining areas and agricultural areas. Heavy metal concentration depends on rainfall and water pH. Rainfall and high acidity favors the increase in concentration.

Average annual values of zinc concentrations are relatively high Stânceni section of 0.03 mg/l and Izvorul Mures of 0,027 mg/l. This is due to volcanic rocks rich in heavy metals, which comprises the upper substrate Mureş.

Regarding water quality in terms of concentration of zinc ions, and it has Stânceni section Glodeni included in Class II waters quality and Ungheni and Cheţan as in category III.To keep Mureş influent waters included with degraded quality.

Perform a case study on monitoring indicators of toxic specialists since 2004 in the sector studied. After adoption of the Law 310/2004 on amending and supplementing the water, and micro pollution heavy metal ions such as phenols, detergents, etc.. are more rigorously defined. Test values are in micrograms per liter, giving a more accurate analysis. It examines the values obtained at concentrations of zinc ions, chromium and copper.

Chromium ions, reaching the waters of tanneries Mureş, in metal processing, general industrial waste water sources. It may also result from natural geochemical processes, especially on a background of high soil acidity and high rainfall areas.

In tributaries Mureş witnessing the same situation, increasing concentrations of chromium ions in summer and autumn months amid low water flows.

As the concentration of chromium ions have not been large overshoot of the limit values are included in water quality category.

In terms of concentration of *copper ions in* water control sections main Mureş included in category II quality.

Niraj brook copper ion concentration exceeds that of chromium.

Gurghiu stream waters are included in category II quality, while the stream of Plain Lechinţa and quality in Category III.

4.1.3. Biological indicators

Saprobiological indicators were analyzed in control sections of the Mureş river from its source to its confluence with Aries, the left tributaries, stream and brook Gurghiu Niraj, the right tributary, creek and stream Lechinta plain, between the years 1986-2003 .

Over the course of a river can distinguish several areas with different degrees of contamination. Thus, evacuation of wastewater containing organic can observe a low degree of cleanliness, which change over time due to natural processes of water purification. After laden organic and physico-chemical characteristics are established several saprobic zones.

Highest average annual cleaning is determined in spring Mureş control section, with a variation between 79 % şi100 %.

In the first section studied bioindicators oligo and β eta are in the highest percentage (40% -50%).

In the section control is felt Stânceni effect of water pollutants discharged with high organic matter content of milk powder factory Remetea, Colemn Gălăuţaş faeces and waste water treatment plant in Toplita. We determined the saprobic β.

At Glodeni witnessing a continuous degradation of water quality in natural and anthropogenic causes. In this area Mureş wash east side of Plain Transilvania where alluvial soils have accumulated, in some salty clay, easily degradable which were grafted farmland. Tributaries enter such areas large quantities of organic matter in river waters. Anthropogenic causes of decreased water quality are faeces discharging waste water treatment plant in Reghin and pig farm in Gorneşti (works until 2004).

Control section Ungheni water quality is determined by the presence of chemicals in the city of Târgu Mures in water discharged. We are witnessing a sharp increase of organic matter in water discharged faeces from households and local food. Saprobic zone is determined β - α.

Section Cipău we all a poor quality water with high content of organic matter and nutrients. Niraj creek without a significant organic load from livestock farms and agricultural lands. Cleanliness is between 48% and 82%.We are seeing an increase in oligo bioindicators after 2000 and a decrease of alpha and poly largely due to the closure of livestock farms, but also measures against water pollution from household waste. Saprobic zone is β - α.

Cheţan section, is found in water quality analysis, the influence of right tributaries, which drain Win mpia Transylvania and loaded with organic matter.However due to the process of Self-purification and dilution by tributaries have water quality improvement

from the previous section. Cleanliness of the water has extreme values of 55% and 80%.Saprobic zone β is determined.

Making comparison between saprobe indicators and indicators of stream water Gurghiu Mures Glodeni control section, it was found that the latter shows a pronounced pollution.

Lechinţa streams and stream the Plains have a high content of organic matter. Transylvania Plain drains, is loaded with organic matter in waste that are discharged from households, small streams with flows, water pollution becomes more pronounced.

4. 1.4.Bacteriological indicators

Analyzing these indicators, there is a large increase in the number of total germ control section spring Mureş. This is due to the large amount of wastewater which drain large areas of lowland Gheorgheni with livestock activities developed and low river flow in this section.

From Section Stânceni bacteriological parameters indicate a state of low quality water because water discharge faeces from domestic wastewater treatment plants Topliţa Reghin sewage from livestock farms, sewage plants in Târgu-Mures, Iernut and Luduş.

4.2. Water quality

For a more accurate characterization of water quality is considered a section considering the cumulative effect of all indicators of a group characteristic, namely: *oxygen regime,* represented by dissolved oxygen, BOD_5, COD and COD-Cr-Mn; *scheme mineralization,* which includes fixed residue, chlorides, sulphates, calcium, magnesium, sodium, carbonates, *nutrient regime,* including: biogenic elements such as ammonia, nitrites, nitrates, *phosphorus, and toxic and special groups* such as zinc, phenol, with , Cr, etc. .

It is well established, the frequency of occurrence of the categories of quality indicators group differences in absolute and percentage control sections.

Qualities shall be determined on sections of rivers. On the river Mureş, within sections were established between control sections and lengths were found on four categories of quality and for five groups of indicators.

4.2.1. Categories of water quality control sections of rivers in

Mureş is analyzed in terms of quality in terms of values recorded in the five sections I control over the 1985-2003 period in the four main tributaries of Mureş.

As to the oxygen system, the indicator values fall in Class I river quality monitoring sections to Glodeni Mureş spring. From Glodeni by Cheţan, water quality decreases significantly, with Class II-III, over 35 % of the cases studied.

In terms of nutrient regime control sections spring waters Mureş, Stânceni, fall in quality category.

In speaking of the nutrient regime of Section Ungheni water quality is deteriorating. Between 1983,1992, water quality is included in category III and degraded, and between 1992-2003 in Class II quality. In terms of indicators of water salinity Mureş from 1985 to 2003 includes the class I taught in sections.

Toxic and special indicators throughout the length of Mures, exceedance of values relating to zinc ions, iron and phenol. In terms of this indicator, a frame determined values in Class II-III water quality and degraded in all sections.

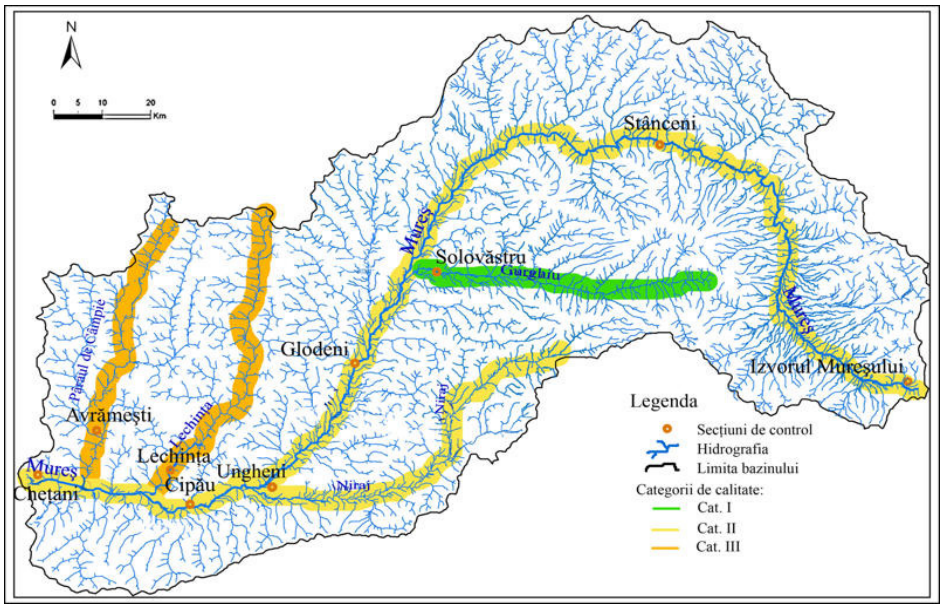

Fig.13.Map of Mures river water quality in different grades

Gurghiu waters where values fall into the category I indicators of quality.

Niraj brook water, with few exceptions, fall into Class II-III quality.

Tributaries of Mureş, plain and stream waters Lechinţa are mostly Class II, III and degraded, except in special toxic regime indicators falling quality category.

4.2.2. Categories of river water quality in sections

On the river Mureş, sections limits are established between control sections and lengths are considered as the four categories and five groups of indicators.

Over the five sectors are designated Mureş between source and mouth. In tributaries Mures, be bounded in all four sectors between the source and upstream of the mouth.

Considering the cumulative effect of indicators, from section to Chetan Mures spring a distance of 262 km falls in Mureş water quality class II (Fig.13). Gurghiu water over a length of 44 km are quality category. ☒

Niraj water over a distance of 80 km, falling within category II storm wastewater quality. Right to water tributaries, and stream of Plain Lechinţa recorded a sensitive situation because of the high mineralization, thus falling within category III as a distance of 65 km and 50 km.

5. Sources of pollution of surface water from the sector of the Mureş

5.1. General

The sector area studied appear organized and unorganized sources of pollution, accidental pollution and diffuse.

It examines the main characteristics of wastewater drain you expressed in mg/l, tons/year between 1995, 2002. It exceeded the limits of the main characteristics of wastewater discharged into mg/l and %. It is the evolution of concentrations of major pollutants in wastewater discharged. Determine the types of pollutants are highest weight in different wastewater and the flow and volume of wastewater discharged.

5.2. Organized sources of pollution

Organized sources of pollution are industrial units whose activities from industrial wastewater arising from industrial technological process, is most often treated separately in their respective industries, sewage plants. Pollution sources are livestock farms. The Pele waste from livestock farms are generally characteristics of urban waste water, primary pollutants are organic substances and suspended materials.

The catchment area studied most important point sources are the organized *industrial wastewater* from the factory in the middle basin of chemical fertilizers, followed by waste water from wood processing facilities in the upper basin, the food industry with the uneven farmaceutica pelvis. In these types of sources are included and sewage from urban and livestock farms.

Major sources of pollution-potential (economic), are: *SC Go.SA* Gheorgheni and *SC Ediltop SA* Toplita (wastewater treatment *plants), Milk Powder Factory* Remetea *SC Colemn SA* Gălăuţaş (industrial wastewater treatment plants), *RAGCLTOP Reghin SC Romsuintest Peris SA*. the area Gornesti SC *Azomures SA* Targu-Mures., *AR AQVASERV* Tg Mures Targu Mures *sugar factory, SCC zoo. Transylvania SA (Nutrimur)* Field *", RAGCL* Ludus, SCSECOM Ludus (Fig.14).

The most important sources of industrial pollution combined chemical industry, food industry, metallurgy industry, from power plants, wood processing industry, leather processing industry, livestock farms, etc.

In the mountain sector of the basin, as economic activity, woodworking risk regarding water pollution Sewage discharged from SC Colemn SA Gălăuţaş contain pollutants such as particulates, organic matter, tannins, ammonium ions, phenols, detergents. In this area these sources are the main source of phenols in water.

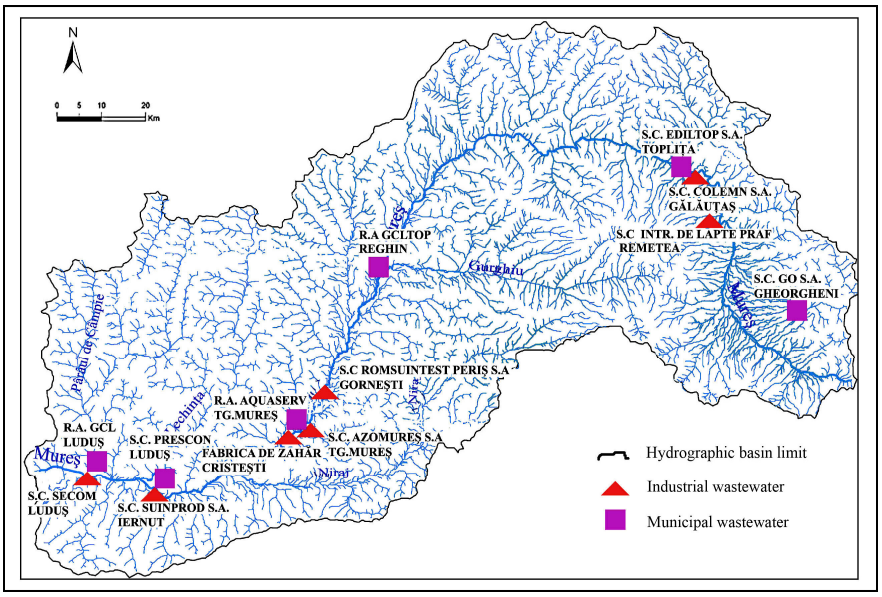

Fig.14. Map the spatial distribution of the main sources of pollution in the catchment area of Mures

In the plateau, livestock farms are important sources of pollution. *SC Romsuintest Peris SA* Gorneşti area, between 1995-2004, discharging large amounts of organic substances and ammonium ions.

Middle sector Mureş, Tg-Mureş Chemical, SC Azomureş the main source of pollution. Increase the concentration of pollutants in the river Mureş average of about 1,5 to 1,7 mg/l ammonium, 9,99 mg/l nitrate, 1,14 mg/l urea. Wastewater resulting from the technological is characterized by high contents of contaminated particulates, organic matter, chlorides, sulfates, phosphates, fluorides, sodium, calcium, magnesium, ammonium, nitrites, nitrates, urea (Fig.15).

Domestic wastewater is a mixture of water from households and small and medium production units of local agglomerations. They can meet under a wide range of pollutants.

The main sources of such pollution are the units of municipal services, urban settlements related to the pelvis.

These companies provide services such as acquisition and sewage treatment and collection, purification and distribution of drinking water for the city. Studied are representative basin management units which are city utilities.

Units with major impact on water quality are: *S.C.G.O. SA Gheorgheni, URBAN EDILTOP Topliţa R.A.G.C.L.T.U.P.Reghin, Tg. Mures, S.C.AQUASERV SA PRESCOM Iernut SA + SC Sugar RAGCL Luduş*. These companies discharging wastewater loaded with different concentrations of pollutants such as particulates, organic matter, chlorides, sulfates, ammonia, nitrites, nitrates, phenols, detergents, extract (fig.16).

Often, the concentration of pollutants exceeds the limit values allowed. Sewage is often under treated.

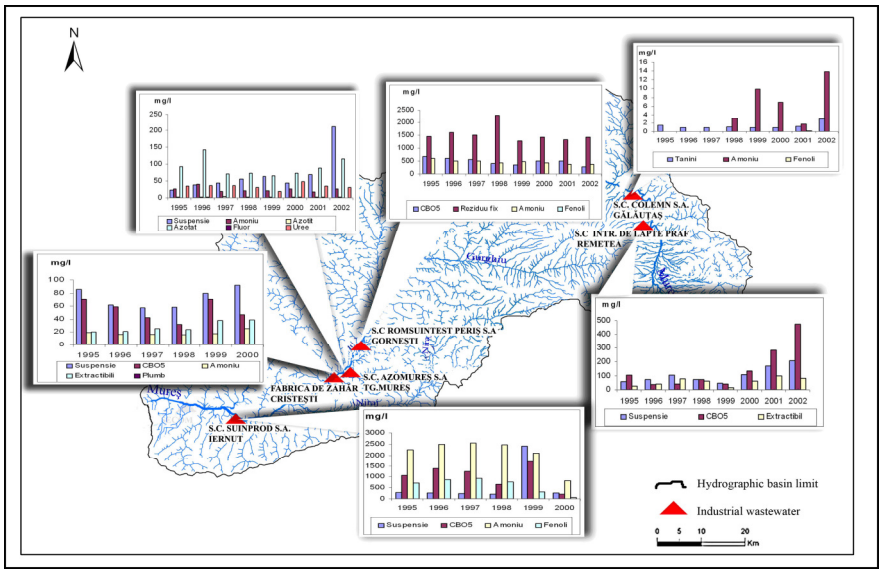

Fig.15. Evolution of concentration of major pollutants from industrial wastewater sources

5.3. Unorganized sources of pollution

Unorganized sources of pollution of surface waters include wood processing facilities, stockpiles left over from Geological densely in the upper basin of the Mures and also industrial waste landfills in the vicinity of urban areas or adjacent industrial units (Fig. 17).

Jolotca Belcina, of Mures tributaries and are polluted with heavy metals and radioactive materials through heaps left by the decline of the Geological Jolotca respectively by washing and / or crumbling heaps remaining after Belcina exploration area, upstream of the city Gheorgheni.

5.4. Diffuse sources of pollution

Diffuse source pollution refers to pollutants originating inputs difficult to identify and control. Include pollution from agriculture, sewage from storm (Fig.18).

The area studied are represented by agricultural activities, nitrate and solid sediment accumulated in the last 20 years of intensive agriculture, raw material consumption and waste resulting in the industry.

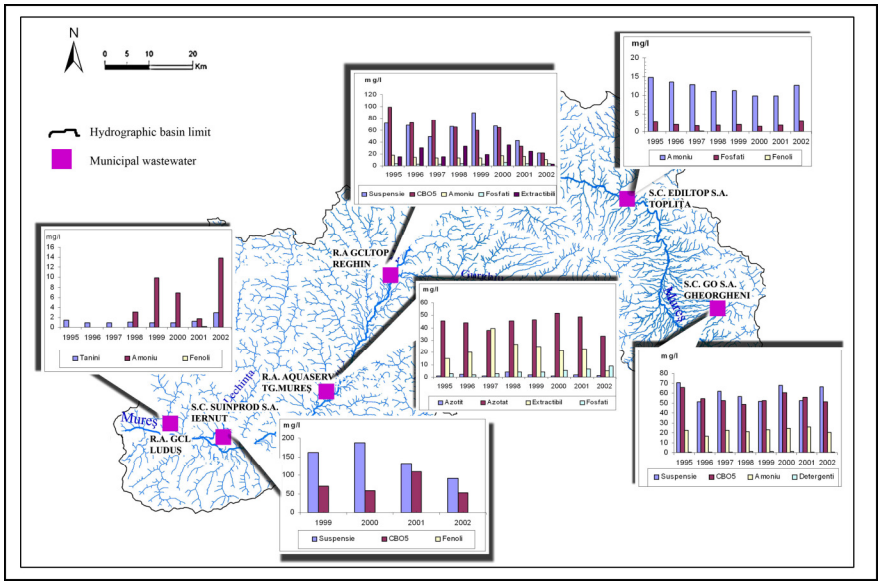

Fig.16.Evolution of concentration of major pollutants from domestic wastewater sources

Nutrient-sensitive areas are represented throughout the basin analysis, given the provisions of the European Union.

Areas vulnerable to nitrates from agricultural sources have been designated perimeters of 13 localities in basin analysis, that localities: royally, Cristeşti, Gorneşti, Sâncraiu of Mures, Sântimbru, etc. Urmeniş (Report on the environmental conditions in Romania - Sources: Regional and local agencies of environmental protection).

In agriculture as diffuse pollution sources are represented in particular: chemical fertilizers used for fertilizer, pesticides, herbicides used to control pests and diseases.

Discharges of sewage and animal manure into waterways, agricultural lands and other areas, livestock units that are not equipped with stations or sewage treatment facilities.

We remember and diffuse pollution due to geological substrate, eg the stream of field-high concentrations of salinity in the area due to soil conditions.

In rural areas the most important pollution sources are diffuse within the perimeters of settlements.

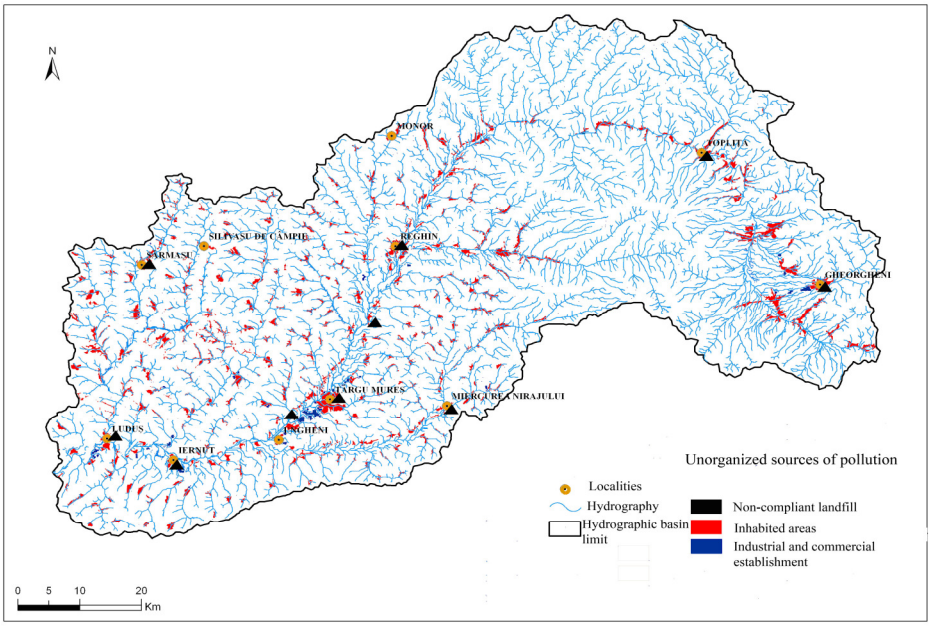

Fig.17. Map the spatial distribution of the main sources of pollution in the catchment of the Mureş unorganized

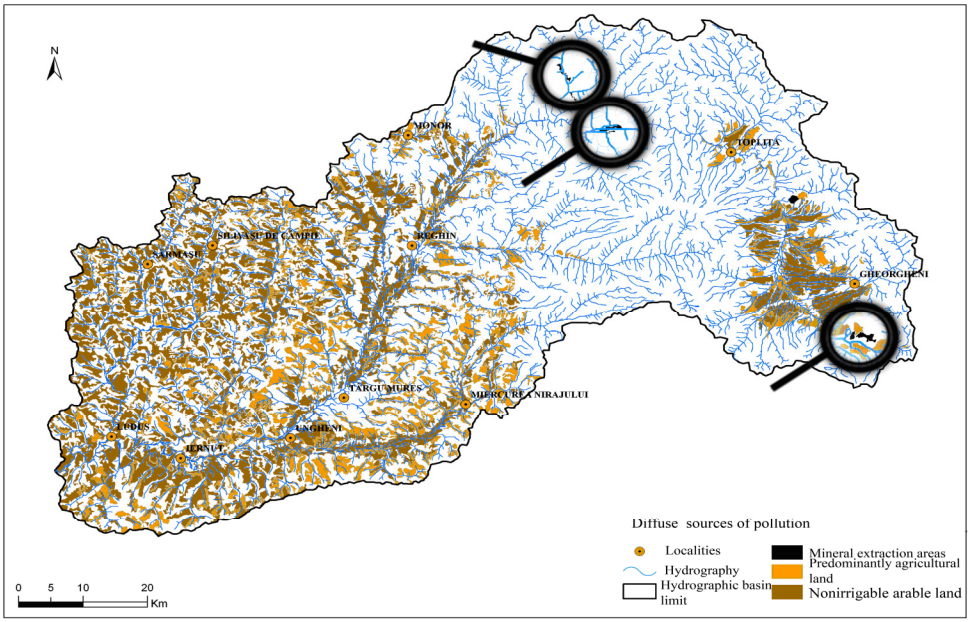

Fig.18. Map the spatial distribution of the main sources of diffuse pollution from the catchment of the Mureş

Human clusters of rural and urban areas, given the small percentage of the population connecting to the sewerage network (by 1,73 % and 71,98 %) are potential

sources of pollution.

Anthropogenic activities affect the quality of surface water and groundwater decisively. One such activity is the mining of mineral aggregates: the terrace gravel, the gravel bed and sorting stations. A major risk is the storm sewage that before reaching the ground, washes of atmospheric pollutants come into contact with land or premises furnished mining areas, or populated centers, the process flow, lead to both types diferte sewage and waste.

5.6. Accidental pollution

Accidental pollution sources, but they are mostly related to problems of industrial risk.

Accidental pollution occurs, for example, due to disturbance by industry, when large quantities (abnormal) of harmful substances reach sewage system or due to failure of station targets treatment.

Chemical Azomureş major risk is where runoff pollution incidents binds toxic substances that poison the river ponds. Sludge residue present at risk for environmental factors in the area.

5.7. Balance pollution sources and pollutants from the sector of the Mureş

Analyzing detailed sources of pollution in the catchment area of upper and middle Mureş we can draw conclusions as regards the amount of pollution sources, the nature of wastewater discharged into the hydrographic network and their importance in the pelvis (Tabelul1).

Analyzing the obtained and their sum for each year that the largest quantities of pollutants were discharged in 1995, 1998 and 2002 (14 % of full value).A graphic representation of this distribution is shown in Figure No. 19 Ste.

6. Conclusion

Many environmental factors have undergone changes due to human activities. Any modification of various factors and human influences geoecology overall characteristics of geosystems. Elements that lead to environmental degradation is a deep connection.

Aquatic environment is a structured, organized and Hydrochemistry, any pressure on it has an impact on the whole. Impact of human activities on surface water and groundwater have a spatial and temporal component.

Crt. Nr.	Types of wastewater discharged from point sources	Source Pollution
1	Industrial wastewater from chemical industry	S. C. Azomureş S. A.
2	Ind. wastewater from wood processing industry	S. C. Colemn S. A. Gălăuţaş
3	Industrial wastewater from food industry	S.C. Intr. de Lapte Praf Remetea Fabr. de zahăr Cristeşti S. C. SECOM Luduş
4	Industrial wastewater from industrial complex animal growth	S.C. Romsuintest Peris S.A. Gorneşti S.C. SUINPROD S.A. Iernut
5	Municipal wastewater	S. C. GO. S.A.Gheorgheni S.C. EDILTOP. Topliţa RAGCL TOP Reghin R. A. AQUASERV Tg-Mureş S.C. PRESCOM Iernut RAGCL Luduş

Table 1.Type of wastewater discharge and pollution sources

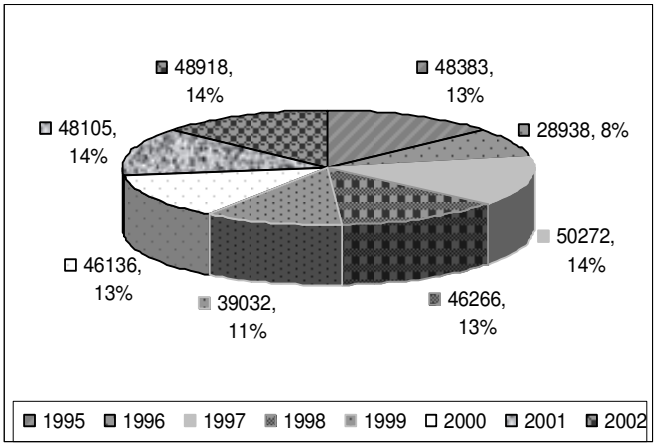

Fig.19.The total quantities of pollutants discharged through wastewater (t / year,%) during 1995-2002

In a period of time a given region can seize the change, which affects mostly aquatic biocenosis.

By studying the evolution of hydrochemistry and microbiological parameters of water over a period of twenty years, considers the state of water quality in the river Mureş studied. Observe how the river responds to elements disrupters, regains balance as a Self-purification process.

Hydrochemistry of water is strongly influenced by the existence of pollutants from various sources. Mureş this issue is very complex and very varied sources of pollution. The upper and middle basin of the Mureş most representative sources of pollution are

units of chemical, food, wood processing industry, livestock farms, domestic and agricultural sources.

By analyzing the chemical composition of water and study its evolution in space and time, appreciate the interaction and collaboration of environmental factors in its definition.

The temporal analysis of quality indicators, I noticed an improvement especially after 2000.This is partly due to careful monitoring of parameters especially after 1989.

Reducing production or closure of industrial units with large environmental impacts have contributed to increased quality.

Changes in agriculture through the rational use of fertilizers moving from traditional to intensive production has beneficial effect on quality.

The spatial analysis made along the Mures, there is a change in water quality.

Leaving Depression Giurgeu strong human water quality is improving dramatically, that reached in the plateau to worsen.

From Cheţan, Glodeni to assist in a reduction of dissolved oxygen to increase mineralization and nutrient content and toxic substances because of intense human Intense. On the right tributaries, due to the geochemistry and human stands and degradation of water quality. Some tributaries of the left, the creek water quality is good Gurghiu unlike stream water, believe that due to diffuse pollution from agriculture and domestic water quality is poor.

In the interpretation of data determined in control sections representative can take protective measures on waters discharged by consumers.

Knowing the evolution of environmental quality and the water we can estimate current and future.

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