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Chemical and Statistical Analyses of Elements in River Water of Morava e Binces

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ABSTRACT

The objective of this research was assessment of environmental toxic elements downstream the river of Morava e Binces (Kosovo) and this study is a continuation of earlier studies of surface waters in our country. The sampling and analysis are conducted in accordance with EU and WHO standards. This study uses both quantitative and qualitative analysis to assess the water quality in several points along river. The concentration of major and minor elements was determined by Inductively Coupled Plasma Mass Spectroscopy (ICP-MS). The concentration of toxic elements which we received from surface waters are compared with the results received for the source where anthropogenic effects aren't present (the part of river in the source). The study firstly shows that Morava e Binces River is considerably polluted. Results obtained by the box plot method showed the regions with determined anomalous element concentration values in water River of Morava e Binces. This study strongly recommends the immediate correction of these issues to protect the health of population from water borne diseases.

Keywords: Chemical and Statistical Analyses, Morava e Binces, River Water, Anomalies, Pollution Assessment, ICP/MS

1. INTRODUCTION

Multidisciplinary collaborative research is essential for understanding the pollution processes. Determination of total quantitative and qualitative metals and distribution of all physical and chemical forms in traces (speciation) in natural water equilibrium resources today is to be considering as the main challenge for most of the scientists. Overexploitation of nature and uncontrolled use of natural resources, including inadequate processing of industrial wastes have caused large contamination of world ecosystems by toxic metals such as; Hg, Pb, Cd, Cu, Zn, Ni, Mn, Sb.

The World Health Organization (WHO) estimated that in developing countries about 80% of water pollution is a result of domestic waste. Moreover, the inadequate management of water systems can cause serious problems in the availability and quality of water (Krishnan *et al*., 2007). Drinking water is an essential environmental constituent and the quality of drinking water is an issue of primary interest for the residents of the European Union (Chirila *et al*., 2010).

Decomposition of organic matter and pollution due to anthropogenic activity are the main sources of pollution of water. Water flows freely in the active layer of water or acrotelm. Water storage is critical to the balance of water in peat swamps and at surrounding areas. Logging activity, agriculture, peat extraction and destruction of peat swamp drainage activity also give a negative effect and bad implication on the hydrology (Hamilton, 2008).

Based on the results of such studies, it will be possible in the future to propose protection and detoxification

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measures of affected river waters and general protection and remediation of ecosystems. This study is a continuation of earlier studies of surface waters in our country (Gashi *et al*., 2009; 2011; 2012a; 2012b).

The sampling sites in river of Morava e Binçës are geographically positioned using Geographic Information System (GIS). The results were interpreted using modern statistical methods that can be used to locate pollution sources. Selected locations, where certain toxic elements should be monitored and remediation possibly performed, were highlighted.

2. MATERIALS AND METHODS

2.1. Study Area

The aim of this study was the quantitative determination of some environmental toxic elements in the water of Morave Binçës River, as surface water resource. Morava e Binçës River, length of 49 km, is located in south-east side of Kosova, its flow near of Gjilan city to the union of the South Morava River in Serbia. Determination of elements in water samples was performed using ICP-MS technique.

Fig. 1. Study area with sampling stations

Table 1. Sampling stations with detailed locality description

Sample	Locality	Coordinates	Height above sea level (m)	Possible pollution sources
M_1	Binçë	N 42°28'32"5 E 21°,36'00"4	561	Low probability;
M_2	Dalja e Binçës	N 42°30'67"5 E 21°36'20"9	506	Settlement; waste water; road; agriculture.
M_3	Gjylekar	N 42°37'10"4 E 21°40'05"9	485	Road; agriculture; waste water from Vitia city; road.
M_4	Partesh	N 42°40'06"3 E 21°46'77"9	463	Settlement; agriculture; road.
M_5	Uglar	N 42°42'45"8 E 21°53'20"6	452	Settlement; road; waste water from Uglar village.
M_6	Pogragjë	N 42°43'15"0 E 21°57'90"2	448	Settlement; waste water from Pogragje village.
M_7	Ranillug	N 42°49'46"1 E 21°59'39"6	436	Agriculture; waste water from Gjilan city.
M_8	Dheu i bardhë	N 42°50'49"0 E 21°63'35"4	420	Agriculture; road

Our sampling strategy were concentrate in the eight monitoring points from the source in the mountain, downstream to the end of river within our territory near the border of Serbia. Surface water sampling of champions and their elaboration in the depth ≥ 0.20 m were done with non-contaminating bottles Pyrex according to standards methods for surface water. Some of the natural water samples are filtered with Whatman paper of 0.45 μm made from cellulose nitrate in the bottle of Teflon under pressure of nitrogen (purity 99.99%).

In natural rivers most of trace elements occur primarily as "dissolved' including colloidal species less the 0.45 or 0.4 μm in these analyses filtration is avoided, to minimize contamination or losses due to adsorption. The chemical analysis of suspended particle matter itself is not done in this kind of determinations.

2.2. Sampling and Sample Preparation

Samples were taken from along the banks of the sampling station on 20.01.2012. Sampling tools were washed and dried with water before the next sample was collected. Water samples were collected from surface waters below 10 cm (Gupta, 2009). The collected samples were stored in polythene plastic containers. Weather was cloudy and rainy, with middle water levels, which was very suitable for sampling. Extraction of champions and elaboration of samples were done according to standards methods for surface water (Alper *et al*., 2003; APHA, 2005). The study area with the sampling locations is shown in **Fig. 1** and the details about all sampling sites are presented in **Table 1**.

Geographical positions were determined by GPS, using model "geko 201, 12 channel". The numbers of sampling spots is 9 and in every sampling spot were taken samples in order to determine the chemical parameters. Each sampling spot of water in the river of Morava e Binçës, have been marked by codes M_1, M_2, M_3, M_4, M_5, M_6, M_7 and M_8.

2.3. Chemical Characterization

Determination of elements in water samples was performed in commercial laboratory ACTLABS, Ontario, Canada, using a "Perkin Elmer SCIEX ELAN 6100" ICP-MS instrument, with the program "Code 6 Hydrogeochemistry".

2.4. Statistical Methods

Program Statistica 6.0 (Statsoft, 2001) has been used for all statistical calculations in this work, such as: determination of basic statistical parameters and determination of anomalies (extremes and outliers) for solution data. Outlier values are between 1.5 and 3 and extreme values above 3 standard deviations.

3. RESULTS

3.1. ICP-MS Analyses of Major and Trace Elements

Table 2 presents concentrations of major and trace elements (μg L^{-1}) in water of river Morava e Binçës. The results for Pearson's Correlation Coefficient are displayed on **Table 5**.

Determination of basic statistical parameters and anomalous values of concentrations for elements: The database (**Table 2**) will be used in statistical calculation and in physico-chemical assessment of water quality. **Table 3** presents basic statistical parameters for 58 elements in 8 water samples of Morava e Binçës River. For each element, the values are given as arithmetic mean, geometric mean, median, minimal and maximal concentration, variance, standard deviation, skewness and curtosis. Using experimental data (**Table 2**, obtained by ICP-MS method) and box plot approach of Tukey (1997), anomalous values (extremes and outliers) in water were determined for the whole region. Frequency Distributions of eight measured ions and Two Dimensional Scater with Plots diagrams are presented in **Fig. 2 and 3**. **Table 4** presents anomalous values (extremes and outliers) of concentrations for particular elements (μg L^{-1}).

Table 5 show classification of the polluting segments of river, based on Norwegian standards.

4. DISCUSSION

Chemical data presented in the **Table 2**, Frequency Histograms of some measured ions (**Fig. 2**) and Two Dimensional Scatter and Plots diagrams (**Fig. 3**), can be used for the assessment of water contamination by toxic elements according with WHO standards and EU directives. Chromium, zinc, manganese, nickel, cadmium, iron, arsenic and uranium generally appeared to be significantly concentrated in the River water.

The concentrations of Mn above 50 μgL^{-1} (according EU Directives), causing significant toxic effects were found at stations M_2-M_8. The highest concentration was found at station M_8 (501 μg L^{-1}).

At all locations the concentrations Cr in water, are below the value causing toxic effects (50 μg L^{-1}).

At all other locations the concentrations of Zn in water are below the value causing the lowest toxic effects (3000 μgL^{-1}). The highest concentration was found at station M_8 (109 μgL^{-1}).

The concentrations of Ni below 20 μgL^{-1}, which causes the lowest toxic effects, were found at all locations (M_1- M_8) and the highest concentration of Ni was found at station M_8 (4.7 μgL^{-1}), as a result of anthropogenic pollution.

Table 2. Concentrations (μg L^{-1}) of 58 elements in water of the River Morava e Binçës

	Sample point							
Element/μg/L	M_1	M_2	M_3	M_4	M_5	M_6	M_7	M_8
Na	3840.000	5540.000	>35000.000	>35000.000	>35000.000	>35000.000	>35000.000	>35000.000
Li	2.000	2.000	37.000	43.000	31.000	36.000	35.000	26.000
Be	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100
Mg	11100.000	8570.000	16600.000	19700.000	>20000.000	>20000.000	>20000.000	>20000.000
Al	10.000	6.000	10.000	19.000	12.000	14.000	13.000	20.000
Si	5600.000	4600.000	7700.000	8500.000	8700.000	9200.000	9200.000	9400.000
K	1330.000	2120.000	9380.000	9640.000	10400.000	11100.000	11500.000	10200.000
Ca	>20000.000	>20000.000	>20000.000	>20000.000	>20000.000	>20000.000	>20000.000	>20000.000
Sc	1.000	<1.000	1.000	2.000	2.000	2.000	2.000	2.000
Ti	0,8.000	0,7.000	1,4.000	1,6.000	2,6.000	3.000	3,2.000	2,6.000
V	0,2.000	0,3.000	0,9.000	0,9.000	1,1.000	1,2.000	1,4.000	1,2.0000
Cr	1,8.000	1,7.000	1,2.000	1,5.000	1,3.000	1,6.000	1.000	2,7.000
Mn	3,3.000	22,3.000	123.000	189.000	258.000	241.000	293.000	501.000
Fe	60.000	60.000	250.000	300.000	330.000	310.000	330.000	330.000
Co	0,074.000	0,084.000	0,226.000	0,297.000	0,445.000	0,495.000	0,512.000	0,734.000
Ni	0,9.000	0,7.000	1,5.000	1,3.000	2,6.000	3,4.000	2,6.000	4,7.000
Cu	3,4.000	1,4.000	2,7.000	2,2.000	3,1.000	2,4.000	2,2.000	4,2.000
Zn	10,3.000	2,5.000	6,8.000	5,3.000	8,8.000	6,8.000	5,7.000	109.000
Ga	<0.010	0,01.000	0,01.000	0,01.000	0,01.000	0,01.000	0,02.000	0,02.000
Ge	<0.010	0,01.000	0,34.000	0,29.000	0,15.000	0,19.000	0,14.000	0,1.000
As	1,17.000	0,85.000	1,7.000	1,76.000	2,49.000	2,65.000	4,06.000	3,32.000
Se	<0,2.000	<0,2.000	0,6.000	0,7.000	0,6.000	0,9.000	1.000	0,6.000
Rb	0,343.000	0,566.000	14,1.000	14,1.000	10,5.000	11,4.000	10,8.000	7,33.000
Sr	137.000	>200.000	>200.000	>200.000	>200.000	>200.000	>200.000	>200.000
Y	0,025.000	0,024.000	0,042.000	0,049.000	0,04.000	0,048.000	0,073.000	0,081.000
Zr	0,02.000	0,01.000	0,09.000	0,08.000	0,05.000	0,05.000	0,06.000	0,06.000
Nb	<0.005	<0.005	<0.005	<0.005	0,007.000	0,006.000	0,007.000	0,006.000
Mo	0,3.000	0,3.000	0,4.000	0,4.000	0,5.000	0,7.000	2,4.000	0,8.000
Ag	1,3.000	0,6.000	0,3.000	<0,2.000	<0,2.000	<0,2.000	<0,2.000	0,4.000
Cd	0,03.000	0,04.000	0,01.000	<0,01.000	0,46.000	0,66.000	0,46.000	0,34.000
In	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Sn	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100
Sb	0,26.000	0,2.000	0,18.000	0,16.000	0,24.000	0,27.000	0,26.000	0,46.000
Te	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100
Cs	0,002.000	<0,001.000	1,65.000	1,19.000	0,601.000	0,656.000	0,754.000	0,393.000
Ba	24,9.000	32,4.000	58,5.000	60,4.000	53,6.000	53.000	59,5.000	61,8.000
La	0,062.000	0,019.000	0,032.000	0,036.000	0,025.000	0,037.000	0,043.000	0,064.000
Ce	0,071.000	0,033.000	0,057.000	0,064.000	0,046.000	0,071.000	0,082.000	0,137.000
Pr	0,006.000	0,004.000	0,007.000	0,008.000	0,006.000	0,009.000	0,009.000	0,015.000
Nd	0,017.000	0,017.000	0,028.000	0,028.000	0,026.000	0,029.000	0,029.000	0,051.000
Sm	0,005.000	0,004.000	0,009.000	0,006.000	0,005.000	0,007.000	0,01.000	0,013.000
Eu	0,002.000	0,003.000	0,006.000	0,007.000	0,005.000	0,006.000	0,006.000	0,007.000
Gd	0,005.000	0,002.000	0,007.000	0,009.000	0,011.000	0,017.000	0,013.000	0,014.000
Tb	<0.001	<0.001	0,001.000	<0.001	0,001.000	0,001.000	0,001.000	0,002.000
Dy	0,003.000	0,003.000	0,06.000	0,006.000	0,006.000	0,007.000	0,009.000	0,011.000
Ho	<0,001.000	<0,001.000	0,001.000	0,001.000	0,001.000	0,002.000	0,002.000	0,002.000
Er	0,002.000	0,002.000	0,003.000	0,003.000	0,004.000	0,004.000	0,005.000	0,006.000
Tm	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Yb	0,001.0001	<0.001	0,004.000	0,002.000	0,003.000	0,003.000	0,006.000	0,007.000
Lu	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0,001.000	0,001.000
Hf	<0.001	0,002.000	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Ta	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
W	<0.020	<0.020	<0.02	<0.020	<0.020	<0.020	0,02.000	<0.02
Tl	<0.001	<0.001	0,005.000	0,003.000	0,004.000	0,005.000	0,006.000	0,006.000
Pb	5,08.000	5,43.000	2,09.000	2,9.000	2,17.000	3,27.000	0,7.000	4,22.000
Bi	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300	<0.300
Th	<0.001	<0.001	<0.001	<0.001	<0.001	0,001.000	0,003.000	0,003.000
U	0,334.000	0,338.000	1,72.000	1,82.000	1,86.000	2,01.00	2,16.000	2,22.000

Table 3. Basic statistical parameters for 32 elements (μg L^{-1}) in 8 water samples

Element /μg L^{-1}	Basic statistical parameters Valid N	Mean	Geometric	Median	Minimum	Maximum	Variance	Std. Dev.	Skewness	Kurtosis
Li	8	26.500	16.839	33.000	2.000	43.00	252	15.884	-1.05525	-0.47935
Al	8	13.000	12.222	12.500	6.000	20.00	22	4.690	0.29903	-0.46411
Si	8	7862.500	7645.128	8600.000	4600.000	9400.00	3262679	1806.289	-1.19732	0.00021
K	8	8208.750	6565.461	9920.000	1330.000	11500.00	16538384	4066.741	-1.32663	-0.07978
Ti	8	1.988	1.733	2.100	0.700	3.20	1	0.986	-0.15679	-1.86614
V	8	0.900	0.757	1.000	0.200	1.40	0	0.434	-0.86531	-0.56116
Cr	8	1.600	1.536	1.550	1.000	2.70	0	0.518	1.41231	2.84405
Mn	8	203.825	105.728	215.000	3.300	501.00	25785	160.578	0.57909	0.57557
Fe	8	246.250	204.072	305.000	60.000	330.00	13912	117.951	-1.24721	-0.33150
Co	8	0.358	0.277	0.371	0.074	0.73	0	0.229	0.21497	-0.76374
Ni	8	2.213	1.842	2.050	0.700	4.70	2	1.376	0.75640	-0.16495
Cu	8	2.700	2.577	2.550	1.400	4.20	1	0.860	0.39138	0.30760
Zn	8	19.400	8.755	6.800	2.500	109.00	1316	36.279	2.80513	7.90161
As	8	2.250	2.008	2.125	0.850	4.06	1	1.089	0.43385	-0.65868
Se	8	0.600	0.521	0.600	0.200	1.00	0	0.288	-0.28751	-0.65505
Rb	8	8.642	4.959	10.650	0.343	14.10	30	5.492	-0.84895	-0.80337
Y	8	0.048	0.044	0.045	0.024	0.08	0	0.020	0.60455	-0.52532
Zr	8	0.052	0.044	0.055	0.010	0.09	0	0.027	-0.35078	-0.50780
Mo	8	0.725	0.560	0.450	0.300	2.40	0	0.701	2.47480	6.43603
Sb	8	0.254	0.242	0.250	0.160	0.46	0	0.093	1.76683	4.02679
Ba	8	50.513	48.332	56.050	24.900	61.80	196	13.987	-1.32655	0.24563
La	8	0.040	0.037	0.036	0.019	0.06	0	0.016	0.57208	-0.71865
Ce	8	0.070	0.065	0.068	0.033	0.14	0	0.031	1.47109	3.23477
Pr	8	0.008	0.007	0.007	0.004	0.01	0	0.003	1.40563	2.92992
Nd	8	0.028	0.027	0.028	0.017	0.05	0	0.011	1.50007	3.57507
Sm	8	0.007	0.007	0.007	0.004	0.01	0	0.003	0.87402	-0.05085
Eu	8	0.005	0.005	0.006	0.002	0.01	0	0.002	-1.04510	-0.12675
Gd	8	0.010	0.008	0.010	0.002	0.02	0	0.005	-0.15398	-0.78283
Dy	8	0.006	0.006	0.006	0.003	0.01	0	0.003	0.37973	-0.12571
Er	8	0.004	0.003	0.004	0.002	0.01	0	0.001	0.47992	-0.56450
Pb	8	3.233	2.774	3.085	0.700	5.43	3	1.611	-0.04958	-0.83004
U	8	1.558	1.260	1.840	0.334	2.22	1	0.773	-1.23779	-0.24507

Table 4. Water samples with anomalous values (extremes and outliers) of concentrations for particular elements (μg L^{-1}) determined in water

Sample	Extremes of elements (¤) (μg dm^{-3})	Outliers of elements (o) (μg dm^{-3})
M_1	-	-
M_2	-	-
M_3	-	-
M_4	-	Ni (19.5)
M_5	-	-
M_6	Pb (11.2)	-
M_7	-	-
M_8	Zn (109.0)	-

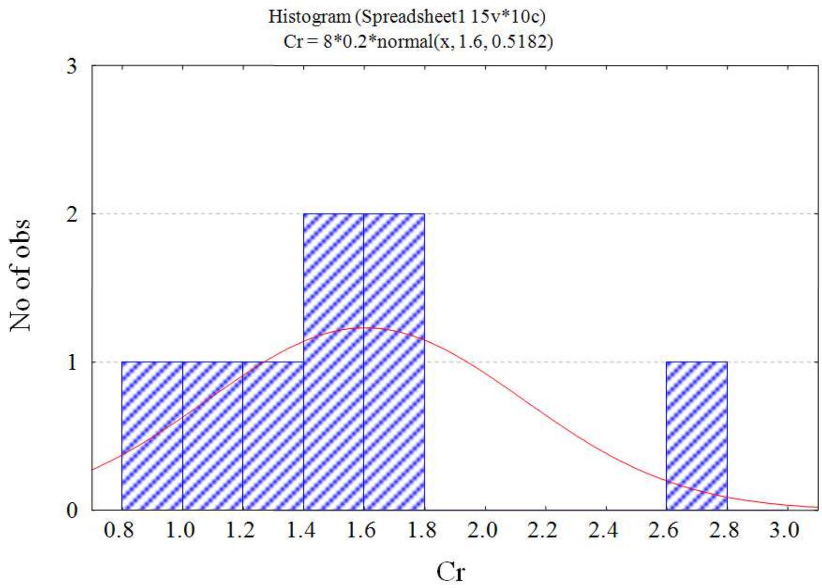
Table 5. Correlation factors for 15 elements (μg L^{-1}) in 8 water samples

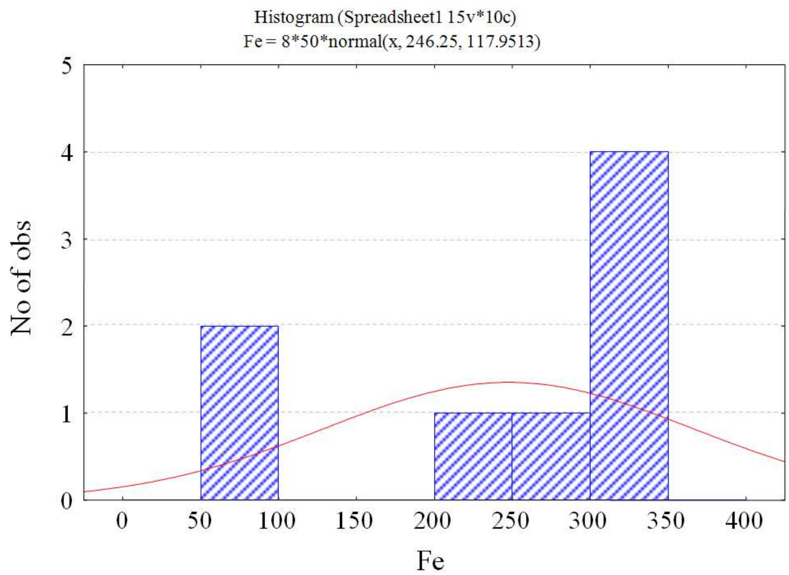
Correlations Marked correlations are significant at $p<0.05000$ N=8 (Case wise deletion of missing data)

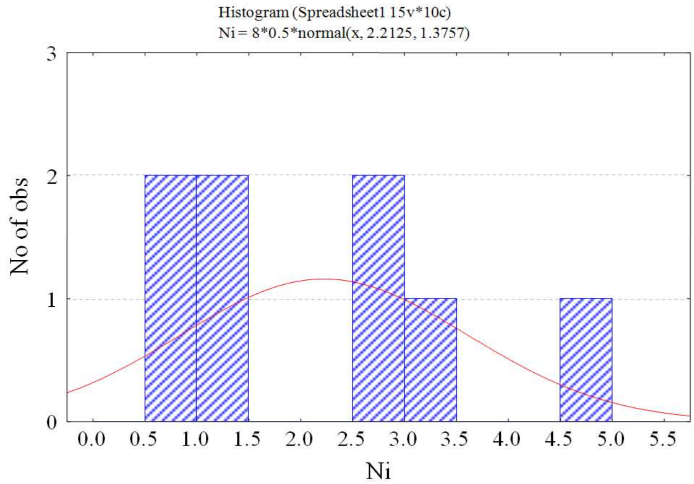
Variable	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	As	Mo	Sb	Ba	Pb	U
Ti	1.00														
V	0.94	1.00													
Cr	-0.09	-0.15	1.00												
Mn	0.80	0.83	0.40	1.00											
Fe	0.87	0.96	-0.11	0.82	1.00										
Co	0.88	0.88	0.32	0.98	0.85	1.00									
Ni	0.81	0.77	0.47	0.94	0.72	0.96	1.00								
Cu	0.22	0.18	0.61	0.53	0.26	0.48	0.58	1.00							
Zn	0.26	0.28	0.86	0.75	0.29	0.66	0.74	0.75	1.00						
As	0.93	0.90	-0.02	0.84	0.80	0.89	0.79	0.30	0.40	1.00					
Mo	0.68	0.64	-0.32	0.45	0.46	0.50	0.36	-0.09	0.03	0.83	1.00				
Sb	0.44	0.34	0.78	0.74	0.28	0.73	0.83	0.75	0.91	0.55	0.23	1.00			
Ba	0.70	0.89	-0.10	0.77	0.94	0.75	0.61	0.16	0.32	0.69	0.41	0.19	1.00		
Pb	-0.66	-0.77	0.68	-0.36	-0.75	-0.41	-0.23	0.09	0.24	-0.65	-0.65	0.20	-0.72	1.00	
U	0.86	0.97	-0.06	0.84	0.99	0.87	0.76	0.27	0.35	0.83	0.50	0.33	0.96	-0.73	1.00

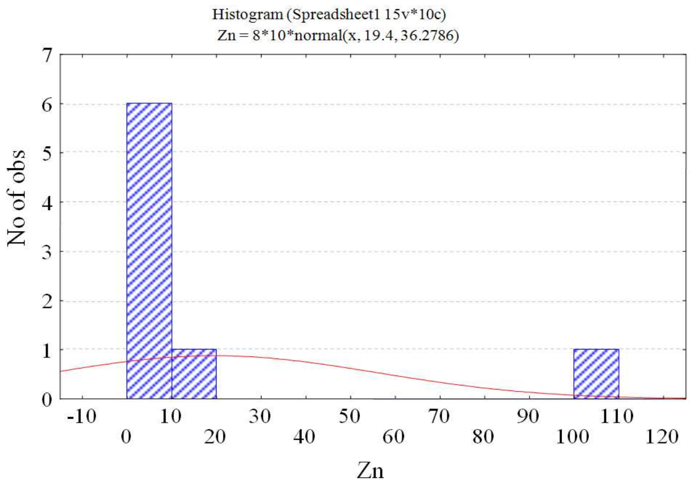
Table 6. Classification waters segments of River, based on Norwegian standards

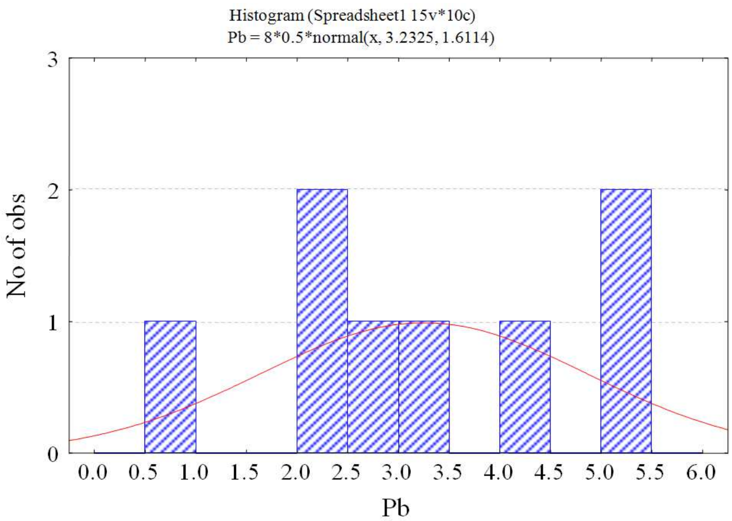
Element	Water class I	Water class II	Water class III	Water class IV
Zn (μgL^{-1})	< 30	30 - 60	60 - 300	>300
	M_1 - M_7	-	M_8	-
Cd (μgL^{-1})	<0.2	0.2 - 0.5	0.5 - 1	>1
	M_3 M_4	M_1 M_2 M_5 M_7 M_8	M_6	
Pb (μgL^{-1})	<1	1 - 5	5 - 15	15 - 40
	-	M_3-M_8	M_1 M_2	-
Cu (μgL^{-1})	<3	3 - 15	15 - 60	>60
	M_2 -M_4 M_6 M_7	M_1 M_5 M_8	-	-

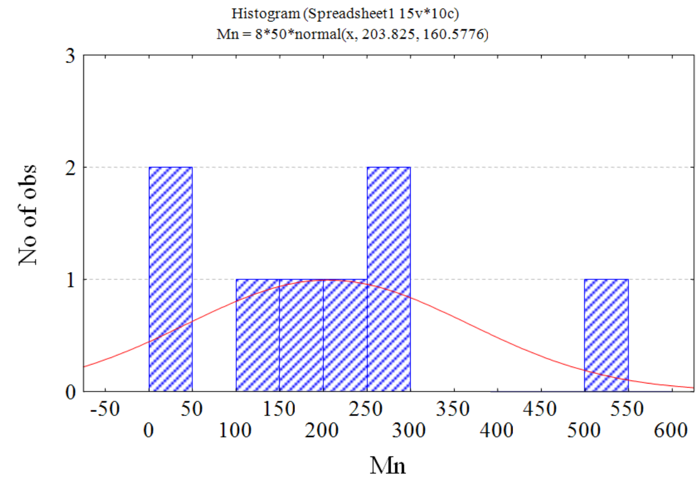


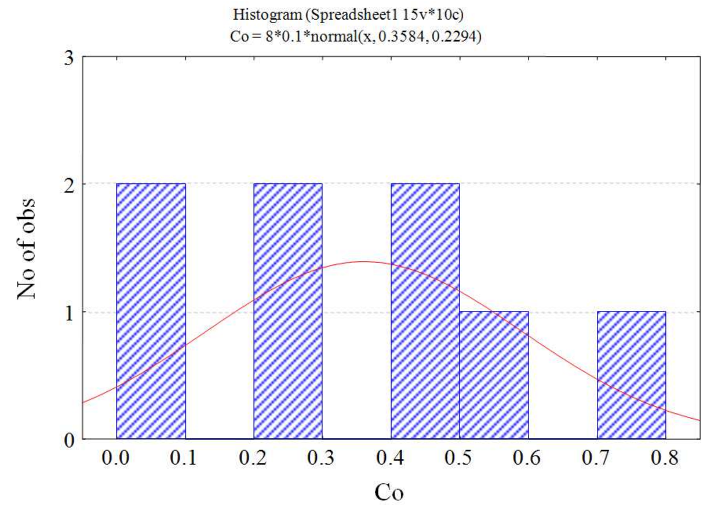


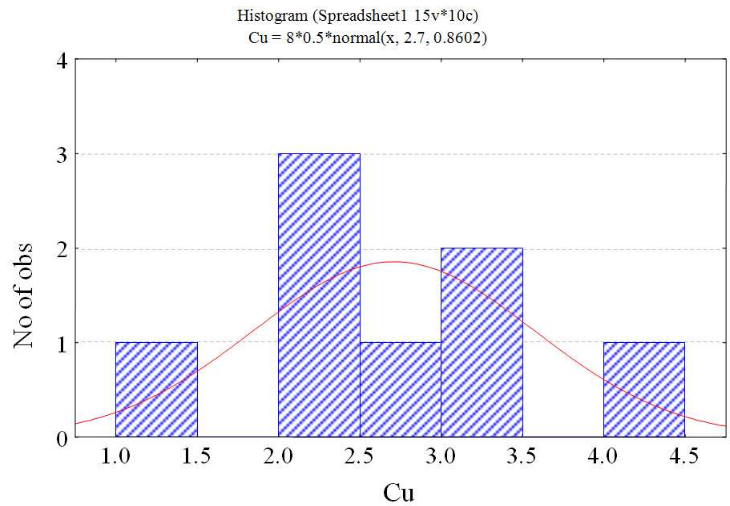

Histogram (Spreadsheet1 15v*10c)
Ni = 8*0.5*normal(x, 2.2125, 1.3757)
No of obs
0 1 2 3
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5
Ni

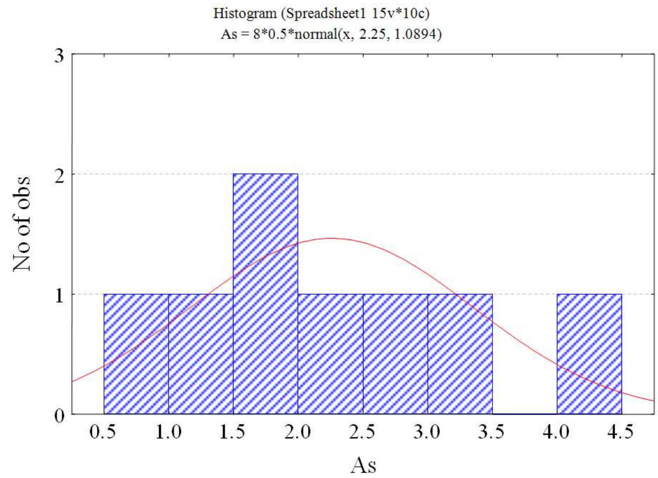

Histogram (Spreadsheet1 15v*10c)
Zn = 8*10*normal(x, 19.4, 36.2786)
No of obs
0 1 2 3 4 5 6 7
-10 10 30 50 70 90 110
0 20 40 60 80 100 120
Zn


Histogram (Spreadsheet1 15v*10c)
Pb = 8*0.5*normal(x, 3.2325, 1.6114)
No of obs
0 1 2 3
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0
Pb


Histogram (Spreadsheet1 15v*10c)
Mn = 8*50*normal(x, 203.825, 160.5776)
No of obs
Mn


Histogram (Spreadsheet1 15v*10c)
Co = 8*0.1*normal(x, 0.3584, 0.2294)
No of obs
Co


Histogram (Spreadsheet1 15v*10c)
Cu = 8*0.5*normal(x, 2.7, 0.8602)
No of obs
Cu



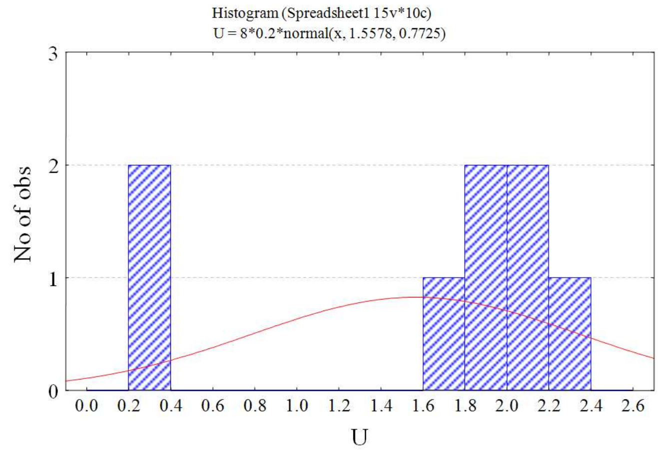
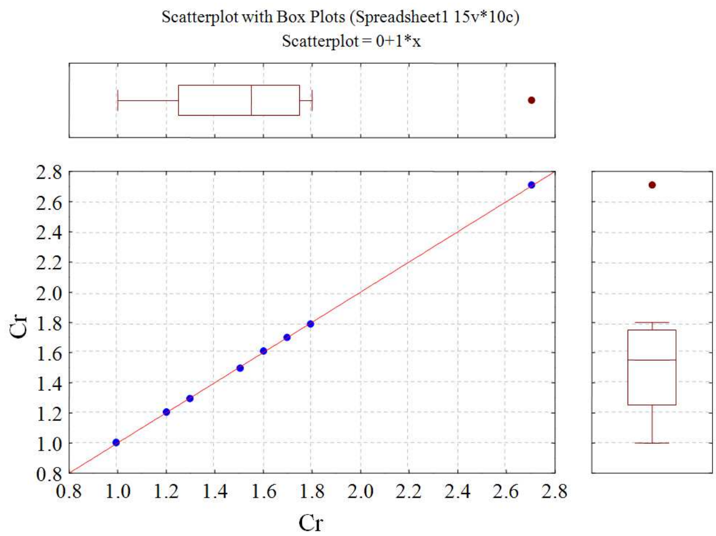
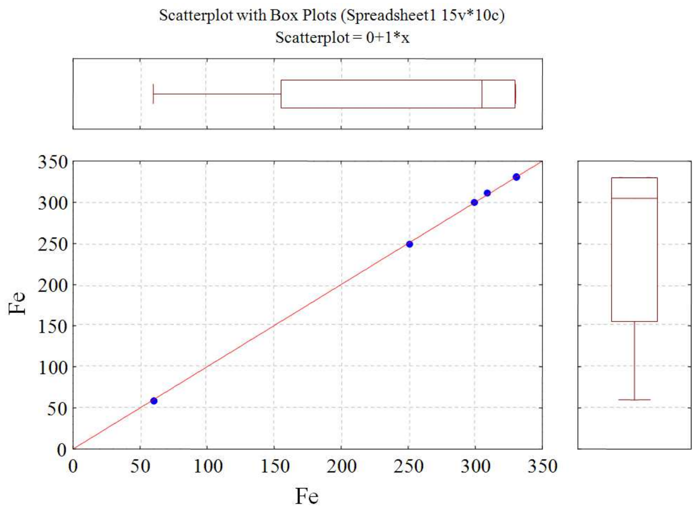
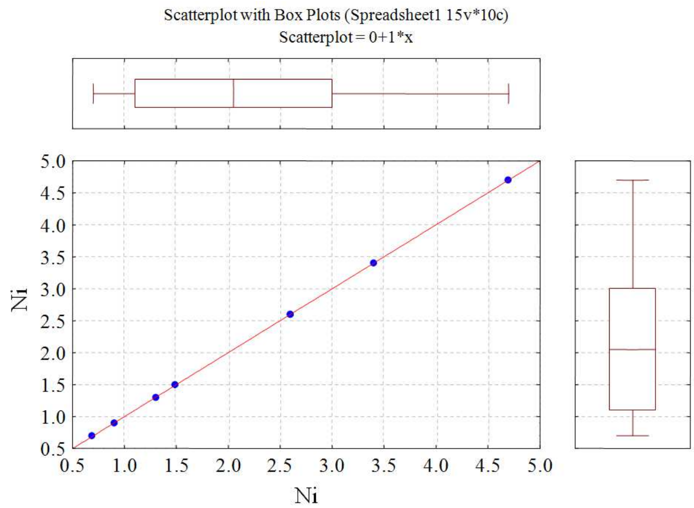
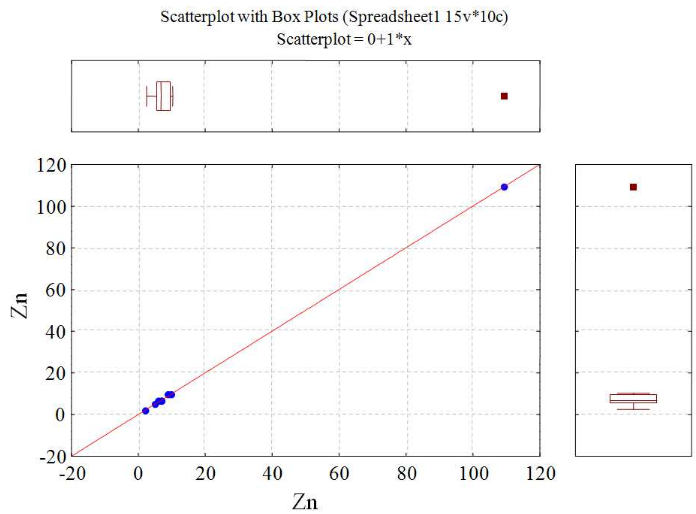


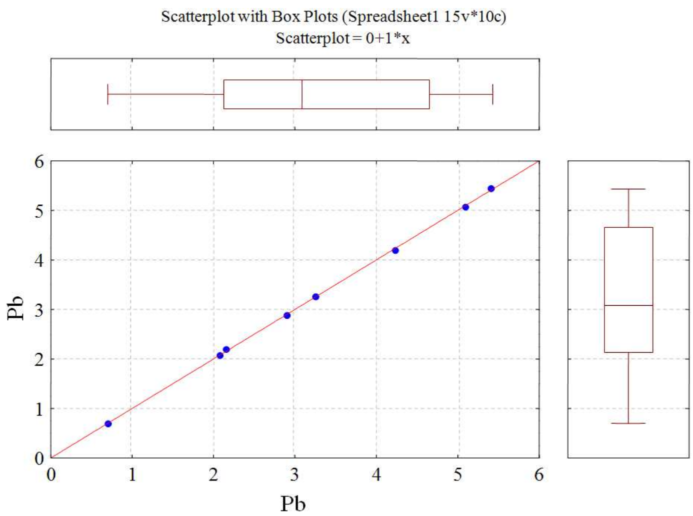
Fig. 2. Frequency histograms of some measured ions

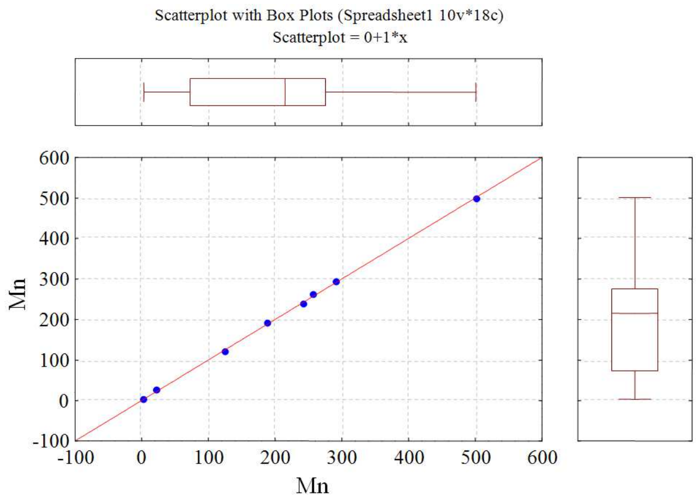


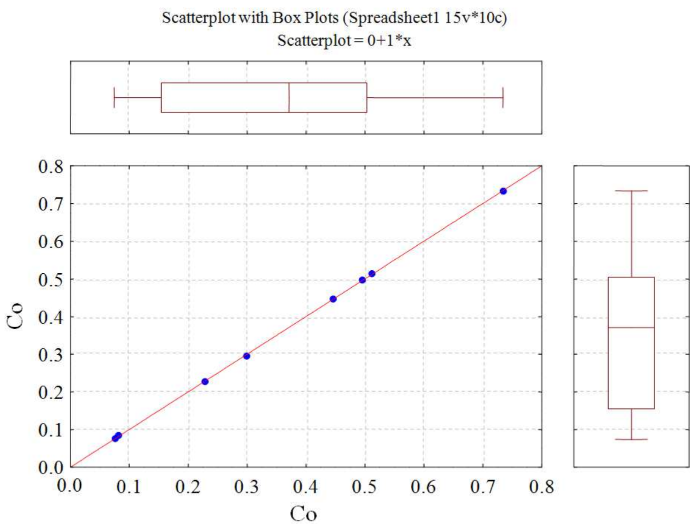

Scatterplot with Box Plots (Spreadsheet1 15v*10c)
Scatterplot = 0+1*x
Fe
Fe
0
50
100
150
200
250
300
350


Scatterplot with Box Plots (Spreadsheet1 15v*10c)
Scatterplot = 0+1*x
Ni
Ni
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0


Scatterplot with Box Plots (Spreadsheet1 15v*10c)
Scatterplot = 0+1*x
Zn
Zn
-20
0
20
40
60
80
100
120


Scatterplot with Box Plots (Spreadsheet1 15v*10c)
Scatterplot = 0+1*x
Pb
Pb


Scatterplot with Box Plots (Spreadsheet1 10v*18c)
Scatterplot = 0+1*x
Mn
Mn


Scatterplot with Box Plots (Spreadsheet1 15v*10c)
Scatterplot = 0+1*x
Co
Co

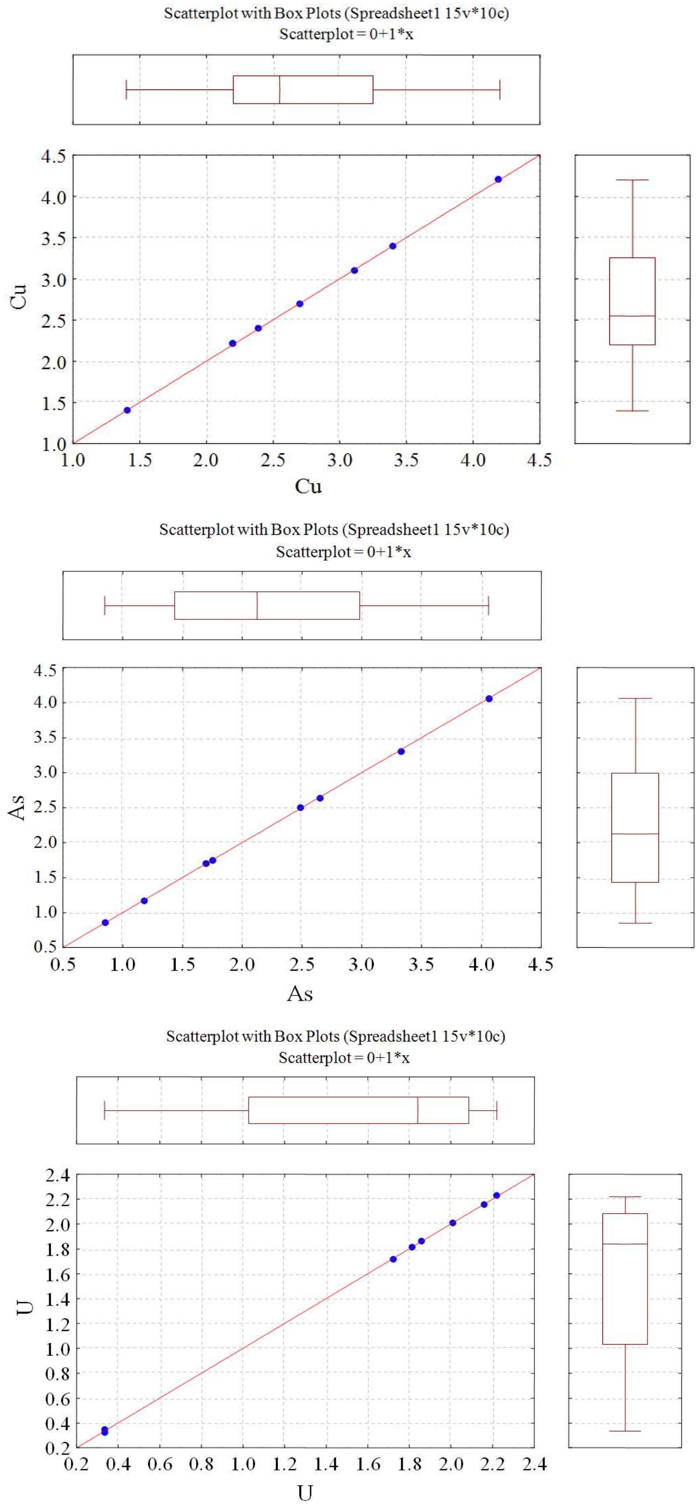


Fig. 3. Two dimensional scatter with plots diagrams of some measured ions

The concentrations of Cd, which causes the lowest toxic effects, were found at all locations M_1- M_8. The significant concentration of Cd was found at stations M_5-M_8, as a result of anthropogenic pollution.

The concentrations of as below 10 µg dm^{-3} which causes the lowest toxic effects, were found at all locations. The highest concentration of as was found at station M_7 (4.06 µgL^{-1}).

The concentrations of Pb below 10 µgL^{-1} which causes the lowest toxic effects, were found at all locations. The highest concentration of Pb was found at station M_2 (5.43 µgL^{-1}).

The concentration of Fe above 300 µgL^{-1}, which causes the significant toxic effects, was found at stations M_4-M_8 and M_8 (330 µgL^{-1}). The highest concentration of Fe in water was found at station M_5, M_7 and M_8 (330 µgL^{-1}).

The concentrations of U below 10 µg$L^{\square 1}$ which causes the lowest toxic effects, were found at all locations. The highest concentration of U was found at station M_8 (2.22 µgL^{-1}).

The results for Pearson's Correlation Coefficient displayed on Table, showed that Cr was an excellent and very high positive relationship with Zn, Sb and Pb. No correlation was found with Fe, As, Mo, Ba and U. Mn was an excellent and very high positive relationship with Fe, Co, Ni, Zn, As, Sb and U. No correlation was found with Pb. Fe was an excellent and very high positive relationship with Co, Ni, As, Ba and U. No correlation was found with Pb. Co was an excellent and very high positive relationship with Ni, Ass, Sb, Ba and U. No correlation was found with Pb. Ni was an excellent and very high positive relationship with Zn, As, Sb and U. No correlation was found with Pb. Cu was an excellent and very high positive relationship with Zn and Sb. No correlation was found with Sb. Zn was an excellent and very high positive relationship with Sb. As was an excellent and very high positive relationship with Mo and U. No correlation was found with Pb. Ba was an excellent and very high positive relationship with U. No correlation was found with Pb. BP was a very high negative relationship with U.

The River Morava e Binçës is significantly polluted with Cr, Zn, Mn, As, Fe and U as a result of natural pollution. The low levels of anthropogenic pollutions with Ni and Cd (segment M_5-M_8), are coming from waste waters of "Ni-Cd Accu" factory in Gjilan city.

Based on Norwegian standards of the water quality (**Table 6**) according the mass concentration of Zn(II) in the monitoring point M_8, is classified in class III. Also from mass concentration of Cd(II) we see that monitorng point M_6 is classified in water class III. Similiarly the amount of mass concentration of Pb(II) in the monitoring points M_1 and M_2 are classified in water class III. Based in the amount of mass concentration of Cu(II) in the monitoring points M_1, M_5 and M_8 are classified in water class II.

5. CONCLUSION

According to the performed chemical analyses, we have noticed that water of River Morava e Binçës is significantly polluted with Cr, Zn, Mn, As, Fe, Pb and U, as a result of natural pollution and the low levels of pollutions of Ni and Cd as a result of anthropogenic pollution. Based on Statistical methods and norwegian standards according **Table 6**, for most metal indicators segments waters are classified mainly from I to III category.

6. ACKNOWLEDGEMENT

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7. REFERENCES

Alper, B., K. Abidin and K.B. Yuksel, 2003. The effect of Yatagan thermal power plant (Mugla, Turkey) on the quality of surface and ground waters. Water Air Soil Pollut., 149: 93-111. DOI: 10.1023/A:1025660629875

APHA, 2005. Standard Methods for the Examination of Water and Wastewater. 21st Ed, American Public Health Association, Washington, DC., ISBN-10: 0875530478, pp: 1200.

Chirila, E., T. Bari and L. Barbes, 2010. Drinking water quality assessment in constanta town. Ovidius Univ. Ann. Chem., 21: 87-90.

Gashi, F, F. Faiku, A. Haziri, R. Hoti, F. Jusufi, F. Laha, B. Shala, F. Feka and A. Dreshaj, 2012b. Study of anthropogenic impact in water quality of drini i bardhë river (kosova). J. Int. Environ. Appli. Sci., 7: 530-537.

Gashi, F., F. Faiku, A. Haziri, R. Hoti and F. Laha *et al*., 2012a. Study of physical and chemical parameters in river water of lumbardh (Kosova). J. Int. Environ. Appli. Sci., 7: 373-380.

Gashi, F., S. Franciskovic-Bilinski and H. Bilinski, 2009. Analysis of sediments of the four main rivers (drini i bardhë, Morava e Binces, lepenc and sitnica) in kosovo. Fresenius Environ. Bull., 18: 1462-1471.

Gashi, F., S. Franciskovic-Bilinski, H. Bilinski, N. Troni and M. Bacaj, 2011. Establishing of monitoring network on Kosovo Rivers: preliminary measurements on the four main rivers (Drini i Bardhë, Morava e Binqës, Lepenc and Sitnica). Environ. Monit. Assess., 175: 279-289. PMID: 20512619

Gupta, P.K., 2009. Methods in Environmental Analysis Water, Soil and Air. 1st Edn., Agrobios, India, ISBN-10: 8177540556, pp: 443.

Hamilton, L.S., 2008. Forests and Water: A Thematic Study Prepared in the Framework of the Global Forest Resources Assessment. 1st Edn., Food and Agriculture Organization of the United Nation, Rome, ISBN-10: 9251060908, pp: 78.

Krishnan, R.R., K. Dharmaraj and B.D.R. Kumari, 2007. A comparative study on the physicochemical and bacterial analysis of drinking, borewell and sewage water in the three different places of Sivakasi. J. En. Biol., 28: 105-108. PMID: 17717994

Statsoft, 2001. Statistica (data analysis software system), version 6.

Tukey, J.W., 1977. Exploratory data analysis. 17th Edn., Addison-Wesley, Reading, Mass., ISBN-10: 0201076160, pp: 688.