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Seasonal variation in the physico-chemical Parameters of Tirana river

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ABSTRACT: *Water quality has become a major concern due to ever increasing human developmental activities that over exploit and pollute the water resources. As the Economic and financial centre of Albania, Tirana has an extensive experienced urban expansion after 1990 with a very high cost in environmental degradation The aim of the present study is to examine the water quality of Tirana River Nile through several physico-chemical analyses. Results obtained from two seasons (June-September, during 2011-2013) . Water samples were taken at different locations and indicators were analyzed: temperature, pH, DO, TDS, NBO5, $NO3^-$, NO_2^-, NH_4^+, P_{total} and PO_4^{3-}. Based on the results of the analysis and the rates set by Albanian state standards catalogue (KSSH, 2012) has shown that the river was highly polluted due to urban and industrial effluent in the urban and the water of these river classified as class IV and V. High concentrations of NH3, total dissolved solids (TDS), biological oxygen demand (BOD), total alkalinity, turbidity and recognizable depletion in dissolved oxygen (DO) were recorded. Increasing pollution and negative impact of discharges in these river ecosystems is a disturbing problem and requires constant monitoring and a final solution by treatment of these waters before pouring them into the sea.*

Keywords: *Physico-chemical analyses, Pollution, Surface water quality, Tirana river.*

I. INTRODUCTION

Tirana is the city with the largest inflows demographic fact that has led to an increased number of productive activities in industry and agriculture. These processes have contributed significantly to increasing levels of pollution in surface waters. Tirana river passes through the capital city, and in this area are many urban discharges. During the last years of water pollution has reached very high levels by affecting the water quality and on the other hand affecting directly to the ecosystems of the area (Abazi et al., 2008). Tirana River is one of the branches of the Ishmi river, which flows into the Adriatic Sea near the Rodoni Bay. It has a length of 35 km and is the shortest river of this region compared with Erzeni and Terkuza.

This river stems in the Hurmëza village being supplied with water selita and several streams that flow into his bed. Passes through the Shali area, Zall Dajtit, Brar, Tufinë, Ferraj and traverses the field of Tirana, pervades Domje village and join with Terkuza river to forming Ishmi river, which continues the path to shed in the Adriatic Sea. In the upper of the river have Cretaceous carbonate sediments of Paleocene (Zone Dajtit Zall), thus disrupting the terrigenous carbonate deposits in the area Brarit. The average flow capacity per year is 3.1 m^3/sec (with a minimum value 0.94 m^3/sec at the maximum 5 m^3/sec). Surface of Tirana River watershed basin is about 71 km^2 (Kabo et al., 1991). Largest flow of water from precipitation: 80% -82% during the wet season and 18% -29% during the dry season. Tirana river from the Brari bridge to Kamza bridge, serves as a collector for the discharge of untreated wastewater portion of sewerage network to Tirana and many commercial activities and industrial. Numerous studies conducted since 1998 have demonstrated the highest pollution in Tirana River (Çullhaj A., Hasko A., Miho A., Scanz F., Brandl H., Bachoren R., 2005), (Bode A. 2012) not only for the physical-chemical parameters but also heavy metals in water and sendimente. Population growth permanently, the importance of Tirana river for the area ecosystem, its use of the many residents who live edge of the river are necessary indicators for ongoing evaluation of water quality of the Tirana river. Based on these important indicators for the life of residents in the area, the objective of the study was the assessment of water quality in Tirana river.

II. MATERIALS AND METHODS

Sampling for assessment of water quality of these river is done in such a way to present its changes in time and space. Determining of the number of sampling sites in rivers was relying on some size and, specifically in the surface of the them, their length and slope. Sampling points that are selected, considering the characteristic places in which have waited pollution from anthropogenic activities (industrial activities, traffic, sewage, agricultural land, etc.). During this study (2011-2013) were measured physico-chemical parameters in water which are important determinants in aquatic systems (A. Sargaonkar and V. Deshpande, 2003;, (Pavendan P.,; Anbuselvan S. and Rajasekaran C. Sebastian, 2011; Kamble Pramod N.,; Gaikwad Viswas B. and Kuchekar Shashikant R, 2011). The sampling was done at four (4) stations, T1 (Brari Bridge), T2 (Babrru Bridge), T3 (Kthesa Kamzës Bridge) and T4 (Laknas Bridge), were established on the river during June- September according to the methodology defined by the USEPA in 2011.

Water samples were collected in the morning with polythene bottles, (500 ml) and were transported to the laboratory by refrigeration at 4 grade before sending to the laboratory. At each station was measured water temperature, pH, dissolved oxygen, TDS, COD, BOD_5, is also made assessment of nitrates, nitrites, ammonium and phosphates. Some of this parameters are measured insitu used portable sensor multiparameter. The found results were compared with Norms set by Albanian State Standards Catalogue (KSSH, 2012) and assessment of water quality.

III. FIGURES AND TABLES

To assess the water quality was done based on Norms of the State Standards Catalogue (KSSH, 2012) and Water Framework Directive of the EU (Directive 76/160 / EEC, Table 1).

Table 1. Limit values of chemical parameters in rivers under the EU Framework Directive (Directive 76/160/EEC).

Parameters	Unit meas.	Limit values of chemical parameters				
		High Condition	Good condition	Moderate Condition	Poor condition	Poor state
DO		>7	>6	>5	>4	<3
BOD_5	mg/l	<2	<3.5	<7	<18	>18
pH (acid)			>6.5	>6		
pH (alkalin)			<8.5	<9		
NH_4	mg/l	<0.05	<0.3	<0.6	<1.5	>1.5
NO_2	mg/l	<0.01	<0.06	<0.12	<0.3	>0.3
NO_3	mg/l	<0.8	<2	<4	<10	>10
PO_4	mg/l	<0.05	<0.10	<0.2	0.5	>0.5
P-total	mg/l	<0.1	<0.20	<0.4	<1	>1

Table 2. Site and results of the physico-chemical parameters of Tirana River (During June-September 2011-2013)

Year	Parameters	Unit meas	T1			T2			T3			T4		
			June	Sept.	Mean	June	Sept.	Mean	June	Sept.	Mes.	June	Sept.	Mean
2011	Temp.	^{0}C	20.3	11.02	15.66	19.8	14.2	17	20.8	15.7	18.25	22.5	17.4	19.95
	pH	pH	7.80	8.26	8.03	7.65	7.96	7.805	7.75	7.90	7.825	8.15	8.67	8.41
	DO	mg/l	7.05	9.26	8.155	5.96	5.63	5.795	7.03	5.54	6.285	7.32	8.28	7.8
	TDS	mg/l	30.8	32.0	31.4	31.0	38.6	34.8	37.4	72.0	54.7	27.6	80.9	54.25
	NKO	mg/l	6	9	7.5	51	46	48.5	42	37	39.5	8	7	7.5

	NBO5	mg/l	4	3	3.5	30	20	25	25	15	20	40	28	34
	N-NO2	mg/l	0.007	0.001	0.004	0.02	0.04	0.032	0.016	0.003	0.0095	0.04	0.038	0.043
	N-NO3	mg/l	0.42	0.33	0.375	0.86	0.48	0.67	0.70	0.42	0.56	0.78	0.198	0.48
	N-NH4	mg/l	0.083	0.183	0.133	11.2	16.9	14.05	13.40	15.40	14.4	6.36	8.64	7.5
	P total	mg/l	0.012	0.11	0.061	0.63	2.07	1.35	0.66	1.35	1.005	1.28	1.35	1.315
	P-PO4	mg/l	0.009	0.007	0.008	0.59	2.03	1.31	0.61	1.33	0.97	1.27	1.32	1.295
2012	Temp.	^{0}C	12.3	15.4	13.85	15	15.7	15.35	17.2	16.6	16.9	17.8	17.2	17.5
	pH	pH	7.43	7.68	7.555	7.16	7.64	7.4	7.03	7.78	7.405	7.08	7.79	7.435
	DO	mg/l	8.49	8.48	8.485	7.68	7.87	7.775	7.06	7.94	7.5	7.61	8.32	7.965
	TDS	mg/l	12.5	9.3	10.9	27.4	28.5	27.95	34.1	15.3	24.7	35.3	17.6	26.45
	NKO	mg/l	9	4	6.5	27	62	44.5	23	80	51.5	27	84	55.5
	NBO5	mg/l	4	2	3	10	30	20	8	38	23	9	40	24.5
	N-NO2	mg/l	0.05	0.04	0.045	0.08	0.03	0.061	0.091	0.027	0.059	0.13	0.014	0.072
	N-NO3	mg/l	0.57	0.19	0.38	0.92	0.07	0.495	0.87	0.05	0.46	0.79	0.041	0.415
	N-NH4	mg/l	0.54	0.019	0.279	8.80	8.42	8.61	6.35	10.82	8.585	7.42	11.13	9.279
	P total	mg/l	0.015	0.023	0.019	0.34	0.66	0.5	0.36	0.89	0.625	0.34	1.08	0.71
	P-PO4	mg/l	0.014	0.017	0.015	0.35	0.64	0.499	0.34	0.86	0.6	0.28	1.06	0.67
2013	Temp.	^{0}C	18.4	15	16.7	21	16.5	18.75	21.7	17.2	19.45	27.5	18	20.55
	pH	pH	7.48	7.60	7.54	7.56	7.38	7.47	7.78	7.90	7.84	8.32	7.43	7.875
	DO	mg/l	6.81	6.20	6.505	6.03	5.97	6	5.68	5.87	5.775	5.60	5.82	5.71
	TDS	mg/l	16.4	33.6	25	142	16.7	79.35	178.4	69.0	123.7	221	109.2	165.4
	NKO	mg/l	43	6	24.5	52	18	35	58	27	42.5	63	54	58.5
	NBO5	mg/l	6	2	4	20	10	15	25	17	21	31	25	28
	N-NO2	mg/l	0.012	0.09	0.051	0.12	0.01	0.072	0.139	0.025	0.082	0.15	0.017	0.087
	N-NO3	mg/l	0.267	0.074	0.170	0.75	0.13	0.4455	0.943	0.156	0.5495	0.96	0.105	0.534
	N-NH4	mg/l	0.097	0.048	0.072	4.66	6.73	5.6995	5.98	13.08	9.53	6.17	15.09	10.63
	P total	mg/l	0.028	0.034	0.031	0.54	0.57	0.5555	0.638	0.672	0.655	0.73	0.758	0.747
	P-PO4	mg/l	0.026	0032	0.002	0.53	0.56	0.549	0.647	0.784	0.7155	0.73	0.843	0.790

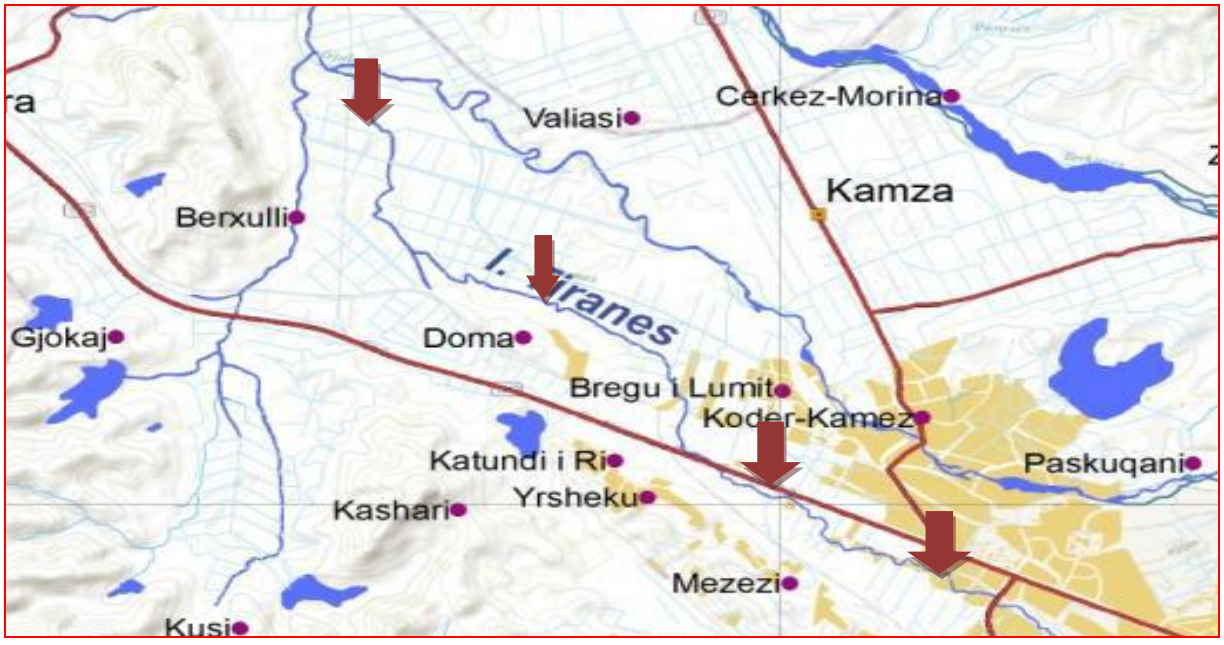

Figure 1. Sampling site in Tirana river

IV. RESULTS AND DISCUSSION

Results have demonstrated the value of water temperatures with different tendencies during three years of study. During the year 2011 is observed that temperatures have increased from the beginning to the end of monionitorimit. The reverse has happened in 2012 and 2013, as a result of climate change.

The pH ranging with different values for all samples in three year from 7.7 to 8.24. The pH values of 6.5 to 8.5 is normally acceptable under the guidelines suggested. Minimum value (7.12) is registered at the station T2 in 2012 and maximum values 8.67 is registred at theT4 in 2011, ranking in class IV. Different value comes as a result of accumulated urban discharge materials at all stages of the river.

Mean values of the Total Dissolved Solids in the analyzed samples contain about 15 times more than the ranging in class V, a fact that makes the necessary treatment of these waters. Minimume value measured in the water river si 9.3 mg/l at the station T1 in 2012 and maximume value is 221.6 mg/l at the T4 in 2012.

Throughout the study period 2011-2013, there has been a shortage of dissolved oxygen in the sample. The value of DO ranging from 5.54 mg/l minimume at st T3 in 2011and maximume 9.26 mg/l at st T1 in 2011. Low oxygen content in the water is usually associated with organic pollution. The value of thisparameters classify these waters in class III-IV.

Generally COD values resulted very high during the monitoring period.The influence of climatic factors, the increase of dilution has led to an increase of 15% of the COD values. Results have demonstrated a very high value of COD.The minimum value of COD is 4 mg/l at st T1 in 2012, while the maximum value result is 84.4 mg/l at st T4 observed in the same year. The COD values are very high compared with the legal norms belonging to class IV.

High variability has also resulted NBO_5 in the same year and between the years water monitoring. The minimum values of BOD_5 ranging from 2 mg/l at st T1 in 2012 and max. 40 mg/l at st T4 to the same year. Compared with the permissible values for BOD_5 wastewater spilling into the environment (20mg / l) and based on the values that have resulted over limits during all years of monitoring that go up to 30% of the samples analyzed, we believe it must treatment these waters. Compared with the norms value, the levels of nitrate exceeding the recommended amount.

Minimume value measured in the water river si 0.041 mg/l at the station T4 in 2012 and maximume value is 0.964 in 2013. High content of NO_3 in Tirana river is an indicator of pollution by urban and agricultural origin ending in groundwater from run off and erosion.

Minimume value measured in the water river si 0.001 mg/l at the station T1 in 2011 and maximume value is 0.158 in 2013. The content of NO_2 in water is an indicator of pollution by sewage discharges.

The values of the nitrogen content resulting from 0.019 in 2012-15.4 mg/l in 2011. Maximum values have resulted higher than allowable values of KSSH demonstrating a very high pollution due to the discharge of waste, wastewater and Slaughterhouses waste (rubbish). Generally increasing tendency of NH_{4+} from the first station at the last shows the negative effect of such discharges to surface waters.

The maximum value of P - PO4 resulted 1,32 mg/l at st. T4 in 2011 while other values found in the analyzed samples have been lower in 2012 and 2013. Tendency of P-PO4 ions from the first station monitoring in fourth station has resulted in an increase during the year 2011 and the same tendency observed for 2013. While in 2012 the values have been variability and is not observed the same tendency. The same trend has also led to the total phosphorus content, the content which has resulted higher in the first year of study in urbanized area that crosses the river length at T4.

The maximum value of the P total content is observed as the puntual value at the second station in the first year (2.07 mg / l). This high value found only in one case appears to be random due to discharges with high water content, waste and other effluents that contain high levels of phosphates.

V. CONCLUSION

Based on the finding conclude that the water quality of the river Tirana, comes down from the first station at the fourth as a result of the increased pollution. Results found classify waters of the river Tirana in class IV-V. The main cause of this contamination is the water used, the discharge of waste into surface waters, agricultural discharges, agricultural and industrial. Another cause is the erosion process, especially when favored by atmospheric factors. Use of these waters for irrigation of crops and for other uses washing, livestock and recreational purposes can have consequences for the human health. Regular monitoring and continual water quality of Tirana River is necessity as a result of continued pollution and protection of aquatic ecosystems and is a priority obligation of Albania at the regional level.

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