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SURFACE WATER QUALITY CHANGES OF RIVER REACHES DUE TO URBANIZATION

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Abstract

It is commonly known that urbanization causes significant changes to water quality and quantity. Many catchments in our country are being rapidly modified as a result of the shift from agricultural to urban land use. These changes are even more noticeable in the Sitnica Catchment. The previous agricultural land is being progressively covered by new structures and roads, resulting in an increase of the imperviousness of that area as well as surface run off. In addition, considerable industrial development and surface mining activities are taking place in the area. These changes are in a relation to high population growth rates and rural to urban migration. All these factors are putting enormous stresses to surface waters in this catchment. Furthermore, those rivers are serving as a recipient of all untreated waste waters and end point for organic substances of domestic effluents. Since the water quality monitoring is the first step to establishing environmental protection policies, it is our aim to monitor those rivers and to document the changes in water quality of rivers selected in this research. The chosen rivers are flowing through the same catchment but are characterized with the different gradient of urbanization. The sampling was conducted in periurban and urban river reaches, under stable environmental conditions and the samples were sent to the laboratory of the Hydro Meteorological Institute of Kosovo for the needed analyses. The main physical- chemical water quality parameters are analyzed in this research, for all river reaches selected. The results gained by laboratory analyses, indicates that urban river reaches of rivers in this research experience an increase in almost all constituents, but mostly in oxygen demand, conductivity, turbidity, suspended solids and phosphorus. While in the peri urban river reaches the levels of analyzed constituents are relatively low they tend to have much higher values in the urban reaches of the same rivers. Therefore, this research shows that concentrations of nutrients and values of field parameters in urban river reaches are affected by the urbanization degree of this area. Therefore, the results indicate that the urbanization is adversely impacting the surface water quality of rivers in this catchment.

Keywords: *Urbanization, Imperviousness, Surface Runoff, Monitoring, River Reaches, Surface Water Quality.*

1 INTRODUCTION

Many catchments in our country are subject to rapid urban development, with the previous rural land transformed into urban areas and housing developments. Population growth and its migration to larger cities, associated with industrialization and economical growth, have resulted in land use changes. As a consequence, those catchments are suffering impaired water quality.

Therefore this research established the following research question:

- Is there a direct relation between the urbanization degree and the quality of surface waters in the same area? Or is there a difference in the quality of surface waters between a peri urban river reach and an urban river reach of the river?

To address this issue, the following objective is to evaluate and compare the surface water quality of the analyzed rivers based on the degree of their catchment's urbanization.

2 METHODS AND MATERIALS

2.1. Study Site Selection

Selection of study site is done carefully, after consideration of the suitability of the sites to conduct field investigations. Kosovo is experiencing higher population growth and it ranks amongst the first countries in Europe, based on the population density, about 220 inhabitants / km². The higher density is in Prishtina, where over 900 inhabitants are living in one square kilometer. Due to the lack of infrastructure and the distance from education and health centers, the rural to urban migration is very evident. This imposes higher stress to receiving surface waters..

The Sitnica Catchment was selected as the study site for this research, due to the rapid urbanization taking place in it. The population is concentrated in urban areas of the catchment and is associated with industrial and economic growth. As a result, the catchment experiences changes in land use and an increase of the impervious surface of the same. In order to see the differences in urban and non urban river reaches, the rivers for this research were chosen on the same catchment, but with a different gradient of urbanization. The river reaches selected for this project were rivers Prishtevka and Gracanka River.

The upstream of a river reach is considered as a periurban area, areas that are outside formal urban boundaries and urban jurisdictions, which are in a process of urbanization. On the other hand, river reaches that flow through urbanized part of the catchment are considered urban areas, and those streams are considered urban streams.

2.2. Sample collection and laboratory testing

Water samples were taken under stable environmental conditions, not following rainstorm or extremely high discharge event. Samples were collected manually in clean polyethylene bottles, volume 1000 ml, with the use of sampling rod. The water samples collected were labeled with the time, date and site and placed in the cooler. Samples were sent to the laboratory on the same day of sampling and tested within 24 hours.

The samples were tested for the following physico-chemical parameters: Electrical conductivity (EC), Dissolved oxygen (DO), Turbidity (TTU), Total Suspended Solids (TSS), Total Organic Carbon (TOC), Chemical oxygen demand (COD), Biological oxygen demand (BOD), Nitrite (NO₂), Nitrate (NO₃), Ammonium (NH₄), Total phosphorus.

3 RESULTS AND DISCUSSIONS

The results of main physico-chemical parameters, after water sampling in the upstream and downstream of a river reach, at 6 sampling locations, are given in the following table.

Table 5. Summary of main physical-chemical parameters in sampling locations

Physico-chemical parameters	Sym.	Unit	Sampling Location					
			I*P	II*U	III*U	IV*P	V*U	VI*U
Dissolved Oxygen	DO	mg/l	8.01	1.83	6.37	8.80	6.70	7.11
Electrical Conductivity	EC	mScm	808	820	798	587	1592	747
Chemical Oxygen Demand	COD	mg/l	8.8	39.5	365	2.7	113	27.2
Biological Oxygen Demand	BOD	mg/l	3.1	17.4	128	1.3	33.5	9.6
Total Suspended Solids	TSS	mg/l	16.6	127.0	196.0	8.8	81.0	18.2
Total Organic Carbon	TOC	mg/l	2.8	12.2	96	0.9	25.2	7.3
Turbidity	TTU	NTU	16.7	54.0	79.8	11.3	48.7	16.6
Ammonium	NH ₄	mg/l	3.25	1.74	0.96	0.47	1.82	0.72
Nitrate	NO ₃	mg/l	0.8	0.00	0.00	0.0	0.00	17.6
Nitrite	NO ₂	mg/l	0.39	0.29	0.13	0.09	0.20	0.32
Total Phosphorus	TP	mg/l	0.94	2.38	0.822	0.04	0.859	0.207

I*P - Peri urban reach of Prishtevka river, II*U- Urban reach of Prishtevka river, III*U- Urban reach of Prishtevka river, IV*P- Peri urban reach of Gracanka river, V*U- Urban reach of Gracanka river, VI*U- Urban reach of Sitnica River, after the outfall of Prishtevka and Gracanka.

4 CONCLUSIONS

The laboratory results helped us reach a conclusion into changes of water quality as a result of urbanization. The results indicates that urban reaches of Prishtevka and Gracanka experience an increase in almost all constituents, but mostly in oxygen demand, conductivity, turbidity, suspended solids and phosphorus. While in the peri urban river reaches the levels of analyzed constituents are relatively low, they tend to have much higher values on the urban part of the same river. Concentrations of nutrients and values of field parameters in urban river reaches selected for this research are affected by the amount of urbanization in this area. The results show that urbanization is adversely impacting the water quality of rivers included in this research.

Prishtevka River is the major recipient of all waste waters and end point for organic substances of domestic effluents. In the upper reach of Prishtevka River, the flow rate is relatively low, but water seems very clear and no odor is present. On the other hand, on the urban part of the river, flow rate is higher; the water has a dark color and bad odor, probably due to sewage effluent discharge. As for the Gracanka River, its quality in the peri urban reach differs a lot from an urban reach of the river, too.

To summarize, the main threats to the quality of those streams are untreated sewage system, industrial point sources, erosion, solid wastes, agricultural activities and changes in land use in their catchment. Therefore, the quality of surface waters of Prishtevka and Gracanka rivers is deteriorated step by step as those rivers are approaching and flowing through out urbanized areas.

The recommendations for further research to overcome current knowledge gaps is to couple those data with a Geographic Information System (GIS) database, which will be created in a conjunction with land use change model.

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