Establishing of monitoring network on Kosovo Rivers: preliminary measurements on the four main rivers (Drini i Bardhë, Morava e Binçës, Lepenc and Sitnica)

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Abstract The main goal of this work was to suggest to authorities concerned a monitoring network on main rivers of Kosovo. We aim to suggest application of WFD (Water Framework Directive) in Kosovo as soon as possible. Our present chemical research could be the first step towards it, giving an opportunity to plan the monitoring network in which pollution locations will be highlighted. In addition to chemical, future ecological studies could be performed. Waters of the rivers Drini i Bardhë, Morava e Binçës, Lepenc and Sitnica, which are of supra-regional interest, are investigated systematically along the river course. Sediments of these rivers were also investigated at the same monitoring points and results have recently been published by us. In this paper we present results of mass concentrations of eco-toxic metals: Cu(II), Pb(II), Cd(II), Zn(II) and Mn(II) in waters of four main rivers of Kosovo, using Anodic Stripping Voltammetry (ASV), Atomic Absorption Spectrophotometry (AAS) and Ultraviolet-Visible (UV-VIS) Spectrometry. Also some physico-chemical parameters are determined: water temperature, electrical conductivity, pH, alkalinity, total hardness and temporary hardness. Results of concentrations of eco-toxic metals in water are compared with concentrations found in sediments at the same locations. Statistical methods are applied to determine anomalous regions. Classification of waters at each sampling station of our work was tentatively performed based on metal indicators, using Croatian standards. Our results are showing that concentrations of Zn in all waters are low and pose no risk for living organisms. Exception is water at S5 station, where concentration is above permanent toxic level. Concentrations of Pb and Mn are high at D5 station on Drini i Bardhë River (14 km from boarder to Albania) and at all stations along Sitnica River. Cadmium in high concentrations which is above permanent toxic level is measured in water only at two stations, one (M1) on Morava e Binçës River and the other (S5) on Sitnica River (56 km from boarder to Serbia). Comparison with available results from the past shows that water pollution with respect to toxic elements decreased since 1989, what is explained with closing of heavy industry since then. Continuation of water and sediment monitoring using more than one experimental technique is highly recommended.
particularly at locations S2 and S5 with anomalous concentrations of toxic elements, as well as establishing of permanent network of monitoring stations by Kosovo authorities. Remediation of sediments at polluted locations in Sitnica River would be desirable.

**Keywords** Monitoring network · Water Framework Directive · Rivers of Kosovo · Eco-toxic metals · Pollution of Sitnica · Needs for remediation

**Introduction**

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 (Hg, Pb, Cd, Cu, Zn, Ni, Mn). Decomposition of organic matter and pollution due to anthropogenic activity are the main sources of pollution of water and stream sediments (Montgomery 1996).

It is known that nature has developed best “auto purification” mechanisms, but it is extremely important to have knowledge about precipitation, dissolution, adsorption and redox processes, which regulate water-sediment system.

Traces of metals in natural waters allocate between dissolved species and species bound to particular (colloid) particles. Interaction of dissolved traces of metals, as sediment and biota, depend on physico-chemical characteristics of their chemical species. For better understanding of processes which control cycling of trace metals between certain components in water it is necessary to know their distribution and concentration of their particular species.

We could claim that the most polluted areas in the world are those with the densest population. It should therefore be the foremost goal of environmentalists to prevent such pollution, and to educate the population towards proper management of ecosystems (Šajn et al. 1998).

As reported by Brils (2008), adequate water quality in Europe is one of the most eminent concerns for the future. There exists recent EU policy Water Framework Directive (WFD), according to which water management should be performed on the whole river basin district. All water bodies should be restored by 2015. It can be mentioned that Kosovo belongs to the Balkan countries not yet integrated to EU and the WFD is not an obligatory mechanism. Looking in the future possible EU integration, the first work on stream sediments in Kosovo was performed (Gashi et al. 2009). In river waters only a few studies of toxic elements have been performed before the present work. From the main rivers of Kosovo, Sitnica was studied above and below the inflow to Ibar River, with respect to Pb (Bacaj and Branica 1983). Rugova et al. (1989) and Berisha et al. (2008) have reported extremely high concentrations of Pb, Cd, Cu, Zn in all four rivers, far above permanent toxic level. They have used one experimental technique (ASV).

Contaminant sources characteristic to the investigated area of the Sitnica River flowing to Serbia were described in details by Berisha et al. (2008). Historically the water of Sitnica was used like water supply, for irrigation, fishing and recreation. Nowadays Sitnica is a recipient of wastewaters from a power plant in Obiliq and from urban sewage.

**The aim** of the current work is to perform, a systematic research on waters of the rivers Drini i Bardhë, Morava e Binçës, Lepenc and Sitnica. These rivers, which belong to different watersheds, have drainage basins that cover a large area of Kosovo, being as well of supra-regional interest. Based on adequate sampling strategy, preliminary classification is performed using the system applied in Croatia. Selected locations, where certain toxic elements should be monitored and remediation possibly performed, were highlighted. We aim to suggest a permanent network of monitoring stations situated at the whole course of the river, where authorities concerned will continue the regular water and sediment monitoring, applying chemical and ecological study (WFD) in Kosovo.