

## **Content of Some Heavy Metals in Soils of Kakheti Region**

**Liana N.Intskirveli, Nugzar S. Buachidze, Lali U. Shavliashvili**

*Institute of Hydrometeorology of Georgian Technical University, e-mail: intskirvebi2@yahoo.com*

### **Abstract**

*Content of some heavy metals (Cu, Zn, Pb, Cd) in soils and surface waters of Kakheti region is considered in the work. Physical and chemical parameters (pH, electric conductivity, salt content, temperature, amount of water-dissolved oxygen) of river water were determined in field conditions. In particular cases in soil samples were identified high contents of lead and zinc, which several times exceed their appropriate maximum allowable concentrations (MAC).*

*Key words:* soil pollution, natural water, heavy metals, ecosystems, maximum allowable concentration (MAC)

### **Introduction**

Kakheti is the eastern border region of Georgia. It adjoins in the north with Russian Federation, while in the east and south with Azerbaijan republic. Area of Kakheti region is 11,310 thou. sq. km, that is 17,5% of Georgian territory. According to January 1<sup>st</sup>, 2013 data of GEOSTAT (National Statistics Bureau of Georgia) there are 405 thousand people in Kakheti that equals to 9% of whole population of country. According to this parameter, Kakheti is on the fourth place, after Imereti, Kvemo (Lower) Kartli and Samegrelo – Zemo (Upper) Svaneti. There are 9 cities and 276 villages in the region, and Telavi is the administrative center of Kakheti. Location of Kakheti, in particular, vicinity to Tbilisi and common border with Azerbaijan republic causes the role of this region as of transport corridor and creates good basis for economic cooperation between countries in case of increase of tourist flow.

11-12% of forest area of Georgia falls on Kakheti region. 30% of Kakheti territory is covered by forests and in this regard it is on third place in Georgia compared with other regions. 98% of regional forests belongs to category of mountain forests, which are of great ecological and economic importance.

Kakheti is main agricultural region, and mineral fertilizers and toxic chemicals are intensely used here. Lots of toxic agents are added to soil along with fertilizers. For instance, due to high rates of systematic use of phosphorous fertilizers takes place soil pollution by heavy metals – lead, cadmium, copper, chrome, zinc that created great threat to the health of humans and animals. Most of potassium fertilizers causes environment pollution by chlorine and sodium. Also should be mentioned the fact that there are a lot of uncontrolled dumps in Kakheti region, which usually are located near settlements in village gorges (where rivers flow frequently) or near pasture lands. All this also creates the threat to health of population resident in the region.

Proceeding from abovementioned is obvious that there are a lot of sources of ecosystem pollution (including soil contamination) in the selected region. That's why we decided that assessment of soil contamination degree by heavy metals is one of the priority problems of Kakheti region. Based on this circumstance the goal of carried out research works was a determination of carcinogenic metals content in soils of some districts of Kakheti, such as Cu, Zn, Pb, Cd, as well as determination of physical and chemical parameters of some surface waters.

### **Study area, method and data description**

Physical-chemical and hydrochemical analyses in Kakheti region were conducted in Sagarejo, Gurjaani and Telavi (Ikalto village) districts, on soil and water analysis samples taken from previously selected observation points.

For correct assessment of pollution degree on territories under study we selected object of study, which played the role of background (Gombori, 1800 meters above sea level) that was conditioned by the fact that this observation point is at a distance from all types of pollution sources. In some cases obtained results were compared with maximum allowable concentrations (MAC) of determined components; sometimes, for comparison we turned to such parameters as tentative (estimated) allowable concentrations (TAC) of heavy metals in soils. Physical-chemical parameters (pH, electric conductivity, salt content, temperature, amount of water-dissolved oxygen) of river water were measured in situ (in field conditions), by means of portable equipment.

Following methods and equipment were used in studies for determination of researched components:

1. Ion-selective chromatography (ICS-100) *ISO100304-1:2007*
2. Spectrophotometry SPECORD 205 *ISO7150-1:2010*
3. Membrane filtration *ISO9308-1, ISO 7899-2*
4. Plasma-emission spectrometry ICP-MS
5. Field portable device.

Heavy metals in soil and water samples were determined by atomic-absorption method that implies transition of metal being in excited state into the solution. Also flame spectrometers are used, where metals' atomization occurs at high temperature, which is created in the device by flame. Thanks to modern equipment (ICP-MS) metals' atomization occurs by means of laser beam that sufficiently increases method sensitivity. We offer exactly this equipment – plasma-emission spectrometer ICP-MS, which is characterized by high determination sensitivity. Given equipment and used methods [1-5] in all cases (soil, water, and air) give us an opportunity to simultaneously test several dozens of samples using the device and respectively to simultaneously determine several dozens of components by its means.

### **Results and discussion**

Results of chemical analysis of all taken water and soil analysis samples are given in Tables 1-3 and Diagrams 1-2.

As we can see, total content of some heavy metals (Pb, Zn) in soil samples is quite high. In particular, lead concentration in soil samples from territory adjacent to Sagarejo is 9-times

higher than MAC and 2-times exceeds estimated allowable concentration. Also zinc content in the same sample is 1,6-times higher than its estimated allowable concentration. It should be noted that soil analysis sample section, which was selected at Sagarejo territory is placed near uncontrolled dump, which exists for many years as local residents testify. In our opinion exactly the dump existing at the given territory is the reason of the fact that increased contents of lead and zinc were discovered in analysis samples, since only this type of pollution sources is located at the given territory.

Table 1

The heavy metal (Cu, Zn, Pb, Cd) concentration in the soil samples collected from the adjacent areas of uncontrolled landfill sites in Kakheti Region

Sampling location	Sampling time	Coordinates	Altitude (m.a.s.l.)	Cu, ppm	Zn, ppm	Pb, ppm	Cd, ppm
Sagarejo, Tskarostavi village	01.11.2013	524120 4620201	813	65	<b>350</b>	<b>295</b>	<2.5
Gurjaani, irrigation Channel (3 km from the city)	21.11.2013	568940 4623145	303	70	170	15	<2.5
Telavi, Ikalto village (200 m from the settlement)	06.12.2013	532596 4644794	589	20	75	20	<2.5
Gombori, 1200 m.a.s.l (background)	06.12.2013	513908 4634711	1200	50	200	15	<2.5
Maximum Allowable Concentration (MAC)						32	
Estimated Allowable Concentration (EAC)				132	220	130	2.0

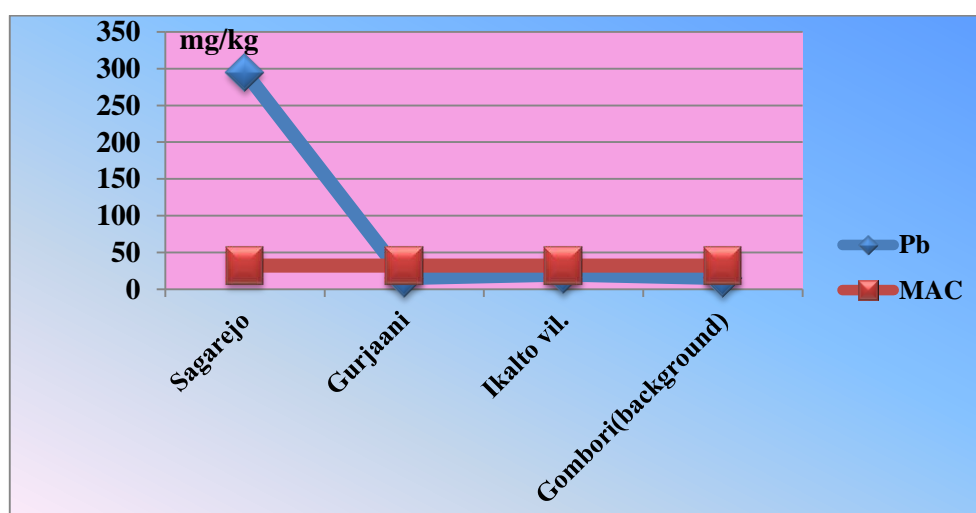


Diagram 1. The lead concentration in soil samples collected in Kakheti Region.

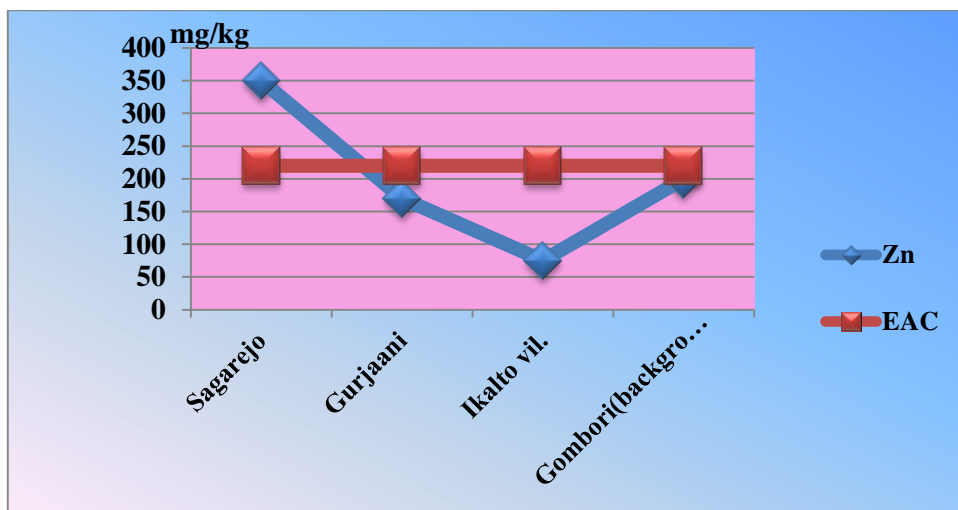


Diagram 2. The zinc concentration in soil samples collected in Kakheti Region.

Water samples from irrigation channel (uncontrolled dump is located nearby) situated near Gurjaani, and water from Ikalto village were taken for analysis in Kakheti region. Physical-chemical parameters and heavy metals contents (Tables 2, 3) were determined in them. Obtained results are given in Tables 2-3.

Table 2  
Physical-chemical parameters of Gurjaani irrigation channel and Ikalto water (2014).

Sampling location	Sampling time	Coordinates	pH	Conductivity $\mu\text{S}/\text{cm}$	Salinity	Do	T, °C
The river flowing into Ikalto gully	29.04.2014	532596 4644794	8.2	368	0.04	3.97	21.0
Irrigation channel (3 km from Gurjaani center)	21.11.2013	568940 4623145	8.08	297	0.01	5.31	9.9

Table 3  
The heavy metal (Cu, Zn, Pb, Cd) concentration in water samples of Gurjaani irrigation channel and Ikalto water (2014).

Sampling location	Sampling time	Coordinates	pH	Cu, ppm	Zn, ppm	Pb, ppm	Cd, ppm
Irrigation channel (3 km from Gurjaani center)	21.11.2013	568940 4623145	8.08	0.02	0.03	0.003	0.0012
The river flowing into Ikalto gully	29.04.2014	532596 4644794	8.2	0.02	0.02	0.003	0.0012

As we can see, according to physical-chemical parameters both surface waters (Ikalto water and Gurjaani irrigation channel) don't experience any kind of heavy anthropogenic impact, as to heavy metals, their concentrations in water phase are considerably lower than MACs that is caused by high pH index of water (Table 3), at this time major part of heavy metals experiences sedimentation in bottom settings in the form of hydroxides.

## Conclusions

Researches and obtained results obviously showed that high contents of some toxic elements (Pb, Zn) were found in soils samples of Kakheti region, particularly at territories adjacent to Sagarejo district. Their concentrations several times exceeded not only MAC values, but even their content in background samples. In our opinion it is caused by the presence of agricultural and domestic waste that are located in large quantities in settlements of Kakheti region. As to surface waters, no signs of anthropogenic load are observed in them.

## References

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## კახეთის რეგიონის ნიადაგებში ზოგიერთი მძიმე ლითონის შემცველობა

ლ. ინჭკირველი, ნ. ბუაჩიძე, ლ. შავლიაშვილი

### რეზიუმე

შესწავლილია კახეთის რეგიონის რამოდენიმე რაიონის (საგარეჯო, გურჯაანი, თელავი, გომბორი) ნიადაგებისა და ზედაპირული წყლის დაბინძურების ხარისხი ზოგიერთი მძიმე ლითონით (Cu, Zn, Pb, Cd) და გამოვლენილია დაბინძურების წყარო. ადგილზე, სავსე პირობებში, განსაზღვრულია ზედაპირული წყლების ფიზიკურ-ქიმიური მაჩვენებლები (pH, ელექტროგამტარობა, მარილიანობა, ტემპერატურა, წყალში გახსნილი ჟანგბადის რაოდენობა).

## Содержание некоторых тяжелых металлов в почвах региона Кახети

Л.Н. Инцкирвели, Н.С. Буачидзе, Л.У. Шавлиашвили

### Резюме

Изучена степень загрязнения почв и поверхностных вод некоторых районов региона Кахети, Грузия (Телави, Гурджаани, Сагареджо, Гомбори) тяжёлыми металлами (Cu, Zn, Pb, Cd). Выявлен источник загрязнения. В полевых условиях, с помощью портативного аппарата, определены физико-химические параметры поверхностных вод (pH, электропроводность, температура, солёность, растворенный в воде кислород).