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Andrzej Zuber
Jarosław Kania
Ewa Kmieciak



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title: **Bacterial contamination in groundwater due to latrine pits in urban areas — case study in Sri Lanka**

author(s): **Ranjana U. K. Piyadasa**
University of Colombo, Department of Geography, Sri Lanka,
ranjana@geo.cmb.ac.lk

K.D.N. Weerasinghe
University of Ruhuna, Sri Lanka

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Urban areas of the Sri Lanka mostly groundwater pollution patterns arising from core existing pit latrines and wells. In rural areas the population continues to grow and the land available for homestead use decreases in proportion. In populated areas latrines are sited within the homestead due to small land plots. Land reform programs tend to increase homestead densities in zoned residential areas and reduce distances between pit latrine and family wells thereby increasing the possibility of groundwater effluent pollution. It is therefore possible that effluent from latrines may pollute adjacent groundwater wells within the homestead. Present research study was conducted in out skirt of tsunami affected area in southern Sri Lanka to determine groundwater pollution due to poor sanitary facilities. Continues monitoring was conducted with respect to bacterial contamination parameters (Coli form and E Coli), groundwater level, pH and Electrical conductivity (EC). The results significantly revealed that the E coli and Coli form (bacterial) contaminations depend on the well constructions, well water collection method, latrine pit depth (latrine pits are constructed above and below the groundwater level) and distance of dug well and latrine pit. In dug wells constructed below the groundwater table, bacterial contamination is higher than the wells constructed within the unsaturated zone. Bacterial contamination is higher in well water collection using the bucket than electrical water pump installed wells. Soil sampling were conducted to identify saturated (aquifer) and unsaturated zone characteristics within the study area. Soil samples were taken from surface layer and followed by each 50 cm depth until reach water table and also water samples were taken from auger holes. Soil samples were studied with respect to physical and chemical parameters. The Soil analysis results show that pit latrines aquifer permeability contribute significant affect to contamination of bacterial pollution.

The necessity for groundwater protection is considered in the European Union in the context of its influence on the state of surface water and connected directly with terrestrial and water ecosystems as well in the context of its significance for the drinking water supply of the population. An estimation of ground and surface water quality includes among others the recognition of its biological elements of quality: plankton, macrophytes, phytobenthos and benthic invertebrates (Directive No 2000/60/EC, 2000).

The authors have carried out an investigative project on this topic. Investigations have carried out on the carbonate massif of the Cracow-Czestochowa Upland (the CCU). This is an area of upland karst not fully developed and differentiated in its inner structure. The Upper Jurassic aquifer, which is the Major Ground Water Basin (MGWB No 326), is located in this area. In the southern part of the CCU it is a typical unconfined aquifer, which is closely connected with surface water. The Upper Jurassic aquifer is also closely connected with the surface water including living biocoenoses and other biocoenoses which depend on the state of water. With the aim of protecting the natural environment and groundwater resources, most of the area in the CCU is protected by law (Ojców National Park, Landscape Parks, Nature 2000 area). Therefore, this region with its unique karstic features, that is environment extensively managed and protected by law, is an excellent area for hydrogeological studies (Rózkowski, 2006).

The presented project refers to hydrogeoeological studies. They include interdisciplinary studies of ecosystems of damp areas under the influence of ground and surface water as well marshes. Investigations have dealt with the water environment regime and also with the presence of subterranean microorganisms and invertebrates in it (Humphreys, 2009).

These habitats connected directly with groundwater outflow are treated in the so-called Habitat Directive of the European Union as very valuable and they have the rank of European cultural heritage. In the area of the CCU there are several hundred springs. They are not only the local groundwater drainage points but they also set composite hydrologic biotic ecosystems (Springer, Stevens, 2009). The durability and stability of habitat conditions in springs results in the occurrence of a specific fauna (crenobionts) and some relic species, e.g. in the area of the CCU — *Crenobia alpina* and *Bythinella austriaca*. The composition of fauna living in springs is influenced by hydrogeological conditions, their surroundings, zonal differences eucrenal-hypocrenal and also by disturbances, especially in the form of anthropopression (Dumnicka et al, 2007). Existing faunistic and ecological studies on the springs located in the CCU indicate that they are highly diverse although the number of taxa found in individual springs was not substantial. However, there are no complex studies on fauna which take into account the presence and conditions of populations of crenobiotic and oligo-stenotermic species in individual springs.

Within the framework of this project in chosen study polygons the unconfined aquifer is investigated. The study is performed in spring drainage areas in zones of unconfined flow systems as well as in caves and outflows from caves, and in water-logged quarries. Such an approach to the natural environment will allow water and terrestrial ecosystems connected with the water of the unconfined aquifer to be recognized. An assembly of benthic invertebrates, higher plants, bryophytes will be determined as the biomarkers of the environmental state and then they could be compared (on basis of literature) with porous environmental analogs. The study, done together with the recognition of regional management and pollution sources, will allow the influence of natural and antropogenic factors on water environment and its biotic elements within the karstic area of the CCU to be estimated. They will also show the current trends of this environment is development. In addition to the study aspect the project also has practical and methodological aims. For the purpose of providing the effective protection of karst water and its ecological environment in the area of the CCU, the further development of research procedures typical for the karstic areas is necessary.

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