Applied Research Partnerships with Developing and Transition Countries
Swiss Universities of Applied Sciences and Universities of Teacher Education

Project title

Groundwater vulnerability assessment in La Habana city area, Cuba

Foto: Daniel Pittet

Thematic focus
Groundwater vulnerability, GIS, drinking water

Year
2009

Project location
La Habana City, Cuba

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Description

The assessment of groundwater vulnerability is crucial for sustainable management of water resources. Aquifers in general and karst aquifers specially, could be extremely vulnerable to pollution. Once polluted quality restoration is difficult, often impossible, and may have negative social and/ or economic consequences. As water from karst aquifers are an important sources of drinking water in Cuba (80% of grounwater comes from karst aquifers) the assessment of their vulnerability to pollution is a necessary step in order to setting up land-use restrictions for maintaining its quality.

By using the EPIK, multimparameter method developed by Federal Agency for the Environment, Forest and Landscape (SAEFL), groundwater vulnerability maps were developed for aquifers providing drinking water to La Habana city and nearby areas. The produced maps constitutes a management tool for local policy makers.

Development relevance

The project is directly linked goal 7 " to ensure environmental sustainability". Produced maps help to sustainable management of groundwater resources as both: a natural asset and foodstuff. Providing also the scientific bases for long-term water quality protection. Goals 4, 5 and 6 concerning population health and child mortality are also related since facilitating access to safe water reduces the incidence of water related deceases. Implementation of the project paid particular attention to gender and cultural issues in order to ensure an equilibrated partecipation from all involved partners.

Emergency drinking water distribution in La Habana

Effluent disposal in Ariguanabo river

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Swiss Agency for Development and Cooperation SDC

Main features of the project

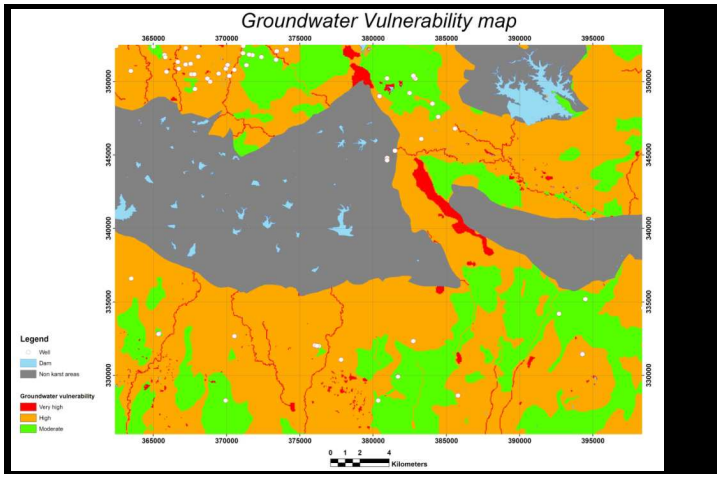
During the last decades the principle of sustainable management applied to water resources has been widely promoted at different levels. However its effective application is difficult and needs important investments in order to acquire the necessary information. A key aspect to sustainability concerning water resources, regards their vulnerability and its assessment. Vulnerability, is an intrinsic aquifers' property which depends from its sensitivity to natural and human impacts. It can't be measured directly but is determined by using geological and hydrogeological data, and express the sensitivity of an aquifer to point and diffuse anthropogenic pollution. Knowing the vulnerability of groundwater resources help their quality protection through the enforcement of land use restrictions to pontentially hazardous activities. The more vulnerable is an aquifer, the more restrictions to land-use will be necessary to protect it.

Karst aquifers are characterized by particular geomorphological and hydrological phenomena. Morphological features include springs, swollow holes, absence of surface drainage networks. Hydrological features include spring hydrographs that have peaky discharge, fast recession and low base flow rates with variable chemistry as a function of discharge rates. These aquifers contain a variety of flow regimes, ranging from rapid turbulent flow in freely draining conduits to slow laminar flow through bedrock-fracture networks, cave and fracture sediments, or regolith. The relative importance of different flow types varies with depth, horizontal location, short-term changes in hydrologic conditions, and long-term geologic evolution of the aquifer. The spatial and temporal distribution of different flow regimes largely defines the overall hydraulic character of a karst aquifer, and therefore its vulnerability to pollution.

Karst aquifers in Cuba are mostly fretatic, morphologically expressed as very gentle coastal flatlands passing without transition to mountain relief. Although Cuba has considerable amount of water resources, during last years water shortage due to drough and pollution episodes have occurred. Major identified pollution sources in Cuba are: agriculture and husbandry, domestic wastes, industry and mining, and sea water intrusion. The project consist in the assessment of groundwater vulnerability in areas providing drinking water to La Habana City and the development of vulnerability maps, by using as base the multiparameter EPIK method, integrated with auxiliary techiques like geophysics and tracer tests. The method's parameters are: Epikarst (E) meaning the presence/absence of karstic landforms (i. e. dolines, karren fields, caves) and high permeability zones due to the presence of fractures; Protective cover (P) which includes the soil cover and other overlying geological formations with possible protective effects; Infiltration conditions (I) that identifies the areas where infiltration concentrates and assessment of diffuse infiltration areas; Karstic network (K) evaluates the existence and development of a karst conduit network. Each parameter was assessed in the study area by mapping them directly and/or by using the mentioned auxiliary techniques. Maps showing graphically several degrees of grounwater vulnerability were produced.

The method and results were also discussed with local water authorities raising great interest, since is a relativelly cheap, clear and scientifically tested one. Although link between polluted wells/areas and suspected sources needs to be proved by detailed studies, produced vulnerability maps constitute a base to relocate hazardous activities and/or ask for protection measures in order to ensure long-term water quality protection.

Soil cover, study area relief



Groundwater vulnerability map