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Groundwater pollution in Europe: an overview

An overview of groundwater contaminants in Europe is provided by a recent study, which calls for more integrated monitoring using a range of indicators. Groundwater contamination presents serious health and environmental concerns.

A number of Directives, including the Water Framework, Groundwater, Nitrates, Industrial Emissions and Landfill Directives, together aim to protect groundwater from pollution and deterioration. The study, supported by the EU's GENESIS project[1], focuses on four pollutants (radionuclides, salt, nutrients and trace elements) which have both natural and human-based sources and three synthetic contaminants (pesticides, crude oil compounds and wastewater contaminants).

The researchers also assess the usefulness of the Driver, Pressure, State, Impact, Response (DPSIR) framework for groundwater status asssessment. Drivers (e.g. agriculture) represent human activities that can affect the environment; pressures (e.g. pesticide contamination) are the direct effects of drivers which then influence the state, or condition, of the environment. Finally, impact is the environmental effect of a pressure and the response acts on drivers and pressures to improve/affect the state.

Radionuclides, molecules which remain radioactive for a long period of time, are widely and naturally present in the environment, including in some groundwaters, and can pose serious health risks, such as cancer. Human sources of radionuclides include nuclear fuel production, phosphate fertilisers and wastewater from mines. Salinisation occurs naturally in aquifers in coastal areas, but is exacerbated by excessive abstraction of water by humans. Other anthropogenic sources of salt include fertilisers and road de-icing. Fertiliser application, sewage leakage and animal manures can also contaminate groundwater with nutrients and high concentrations of nitrate in drinking water have been linked to health problems in babies.

Finally, natural trace elements, such as copper and lead, are generally found at low levels in the environment, but can become toxic when more concentrated, either because of the local geology or as a result of human activity. Sources of trace elements include the mining industry, urban waste disposal and agriculture. Specific examples include phosphorus fertilisers, which are a source of cadmium contamination, and fungicide sprays which contain copper compounds.

Synthetic contaminants include pesticides, crude oil compounds, and pharmaceuticals and personal care products. Agriculture is the main source of pesticides, while sources of crude oil compounds include dry-cleaning waste, solvent use and leakage from sewage systems. Pharmaceuticals and chemicals found in personal care products reach groundwater from leaking sewage systems and sewage sludge application in agriculture, and because most are not removed by the conventional treatment of wastewater from households and hospitals, which are the dominant source.

The study's authors call for integrated monitoring of groundwater quality where a range of physical, chemical and biological indicators (e.g. acidity, levels of different minerals, biodiversity indicators etc) are combined to allow measurement of pressures, states and impacts. Such integration is needed to make the best use of existing monitoring networks and to account for different aspects of the environment, such as soil and water.

A shift towards integrated monitoring would also help improve the use of the DPSIR framework, in which indicators are a key aspect. However, the researchers identify other drawbacks to DPSIR, such as the fact that it does not fully account for land use or climate change and currently only includes anthropogenic effects. It is also not possible to use it for new pollutants, because of the relative lack of information on sources and effects.

Environment

1. Groundwater and Dependent Ecosystems: New Scientific and Technological Basis for Assessing Climate Change and Land-use Impacts on Groundwater (GENESIS) is supported by the European Commission under the Seventh Framework Programme. See: www.bioforsk.no/ikbViewer/page/prosjekt/hovedtema?p_dimension_id=16858&p_menu_id=16904&p_sub_id=16859&p_dim2=16860