Vulnerability of water quality exemplified on the river Seine
By Michel Meybeck

The Seine catchment (France) is a medium sized, highly vulnerable river basin and is one of the most impacted fluvial systems of the world. The high vulnerability of the catchment results from the low sediment discharge and moderate dilution power (for example of pollutants) of the river. The most important pressures are human pressures, climate change pressures are of minor importance. Important human impacts on the integrity of the river basin result from acidification, industrial waste, channelization and the creation of reservoirs.

In the course of history, different issues concerning water quality have been identified. Already in the Middle Ages, when there was no sewage collector yet, the river Seine downstream of Paris was eutrophied. In 1830, there was a severe cholera outbreak which caused microbial pollution. As a consequence a sewage collector was built. In the 60's, organic pollution became more important, followed by eutrophication in the 70's. In the 80's, metal pollution, pollution by POPs and the concentration of nitrates increased. In 2000, pollution by endocrine disruptors was recognized as a problem as well. The risk of thermal pollution became more relevant during the heat wave in the summer of 2003. Salinization, acidification and radionuclides don't pose severe threats to the river Seine. Each of the mentioned issues has its own specific trajectory of driver (D), pressure (P), state (S), impact (I) and response (R).

Recently, the Seine river is one of the most impacted fluvial systems in the world. Intensive agriculture is widespread and the megacity Paris is the most important point source of pollution. Between 1950 to 2000, the nitrogen load in the river has increased, and is the river Seine now has the second worst nitrogen load on world level. Besides, most of the drained network is regulated and only few forest patches are still present.

"Piren Seine" is a multidisciplinary project that makes use of long term records on water quality, pressures, material reconstruction flow analysis and sediment archives to assess different issues. It reconstructs changes of the past and investigates scenarios for the future water quality of the river Seine.

Four water quality issues have proven to be of particular importance in the river Seine (in the period between 1850 and 2000), namely: nitrates, organic pollution, metals and atrazine (use of pesticides).

The nitrogen, phosphorus and zinc budget over the last 50 years was studied in relation to land cover change, increasing agricultural drainage and decreasing riparian denitrification. Some of the scenarios dealt with the changes in nitrate concentration as a result of temperature and precipitation changes, the impact of phosphorus input on chlorophyll levels and summer oxygen and ammonia profiles. An example of a somehow different approach to the changes in nitrogen concentration, was the reconstruction of the impact of human activities on the nitrogen cycle, making use of archives of the Burgundy Abbey.

Some important lessons that were learnt, are as follows: managers need tools as scenarios exploration based on models. Models need a lot of process understanding, socio-economic data and field data for validation. Issue perception depends on society consensus (the role of phosphor as a key factor in the eutrophication process, for example, was still very controversial in the '70s), scientific knowledge... and each issue has its own DPSIR trajectory and its own spatial development.

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