# Biomonitoring of Freshwater Ecosystems: Research and Citizen Participation in the Upper Valley of Río Negro and Neuquén (Patagonia, Argentina)

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Increases in population, along with related economic activities, have increased pressure on freshwater ecosystems in the Upper Valley region (Río Negro and Neuquén, Patagonia) in Argentina. Pesticides, fertilizers, hydrocarbons, plastics, and other pollutants drain into freshwater streams, rivers, wetlands, and ultimately the ocean, causing changes in the water quality, the biota, and ultimately affecting all ecological processes. To make sound decisions for the management of Argentinian fresh water, including planning and active regulation, it is essential to study and understand the relative risks of anthropogenic activities on the aquatic ecosystems. It is necessary to identify the sources and causes of the degradation of natural water habitats, assess their current state and analyze long-term trends in the health of the ecosystem so that Argentinian water bodies are sustainable and continue to provide fresh drinking water for local populations and irrigation water to sustain intensive agricultural production.


*App developed to enable involvement of the local population in the protection of water bodies in Argentina.*

The Chromatography Laboratory of the Comahue Research Center for Environmental Toxicology and Agrobiotechnology (CITAAC) (National University of Comahue) of Argentina participated in a 5-year FAO/IAEA coordinated research project on integrated analytical approaches to assess the impact of pesticide management practices at a catchment scale (CRP D52035). During the project, CITAAC prepared and validated the physical, chemical and biological methods to test for the integrity of the freshwater system, including the aquatic ecosystems, and was a contributor to the book 'Integrated Analytical Approaches for Pesticide Management' (ISBN: 9780128161555, Eds. B. Maestroni and A. Cannavan) which was compiled by FEPL. The Argentinian laboratory is specialized in the detection of pesticides, hydrocarbons, heavy metals and emerging contaminants using chromatographic and spectrophotometric methods in different matrices, including water, soil and air. For several years the laboratory has also been incorporating biomonitoring activities, based on the analysis of aquatic macroinvertebrates as bioindicators of the effects of agricultural inputs on the ecosystem, to promote an integrated approach to monitoring of freshwater quality and safety. The chromatography laboratory has been a member of the RALACA network of laboratories since 2012 and has headed the RALACA-Biomonitoring Cittee (http://www.red-ralaca.net/activities-committee) since 2014.

In recent years in Argentina, biological criteria based on analyses of aquatic macroinvertebrates have been added to the traditional nuclear and isotopic, physical and chemical monitoring methods to assess the quality of water in the region's aquatic ecosystems.

Between 2014 and 2018 CITAAC conducted field studies in rivers and wetlands in the Negro River basin (Upper Valley), and applied chromatographic techniques for pesticide analysis and biomonitoring to assess the effect of pollutants on the ecosystem. The studies were conducted within the framework of IAEA technical cooperation project RLA7019, 'Developing Indicators to Determine the Effect of Pesticides, Heavy Metals and Emerging Contaminants on Continental Aquatic Ecosystems Important to Agriculture and Agroindustry' (ARCAL CXXXIX) and were supported by the Food and Environmental Protection Laboratory (FEPL) of the Joint FAO-IAEA Division with specific training on analytical methods for pesticide residues testing and nuclear and related techniques to assess sorption coefficients in soil/sediments. Some of the main research results from CITAAC have clearly demonstrated the effects of pesticide contamination (mainly chlorpyrifos) on the richness, diversity, and abundance of macroinvertebrates in freshwater ecosystems. The most notable changes are the decrease in sensitive taxa abundance and the increase in some tolerant taxa associated with maximum concentrations of pesticides.

CITAAC also conducted a comparison between an environmental risk assessment (ERA) and the results from biomonitoring activities. It was shown that both approaches can be complementary for the assessment and prediction of the effects of pesticide contamination, demonstrating the causal relationship between stressors and the responses of macroinvertebrate communities. This line of research is currently being expanded to analysis of the effects of emerging pollutants on macroinvertebrate communities.

The growing concern about the deterioration of aquatic ecosystems in the Upper Valley has led to a requirement for routine monitoring and the development of rapid testing that can be used by local governmental water management agencies. It is also important that citizens are empowered towards sharing a sustainable environment and that all community stakeholders take up the challenge of conserving and managing water quality. With this in mind, CITAAC collaborated with the Institute of Paleobiology and Geology (IIPG) of the National University of Río Negro, Argentina in the development of an application for mobile cell phones, called Biomonitoreo RN. This app allows collective citizen participation in the monitoring of the biological quality of the water of streams and rivers of the Negro river basin, enhancing ownership and emphasizing citizen responsibilities in the sustainable management of the rivers of the Argentinian region. The app enables the user to identify the types of macroinvertebrates present up to the family taxonomic level and calculate the value of a biotic index, which assesses the quality of the water in the monitored section. More information about the app and the participative project can be found (in Spanish) at www.biomonitoreo.com.ar

After six months of implementation of the participative biomonitoring activity, the results indicate that there has been outstanding community participation in biomonitoring, which has allowed the preparation of an environmental map

of water quality, identifying the sections of rivers and streams along the water basin that are most affected by the agricultural inputs.

*Using the biomonitoring app to provide data on water quality.*

The results of the initial period are encouraging and suggest that citizens could play a more active role in environmental monitoring, become more responsible with respect to the preservation of fresh water supplies and help ensure the sustainability of natural resources.