Implementation of a National Framework for Water

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Abstract. Since the 1970s water quality monitoring in Brazil has been developed by the State and Federal governments, with different strategies regarding sampling point location, sampling frequency and assessed parameters. In 2010 the National Water Agency introduced the National Water Quality Evaluation Program that aims to provide the country with an integrated monitoring system based on standardized collection and analysis procedures. Since then, various activities were developed, including the creation of the National Water Quality Monitoring Network, the release of the National Field Guide for Water, Sediment, and Biological Sampling, and the publication of the report Surface Freshwater Quality in Brazil. In a country of continental dimensions, the implementation of the National Water Quality Evaluation Program is a great challenge and can only be achieved through the integration of the various entities that monitor and disseminate water quality information.

Keywords: Water quality, monitoring framework, Brazil

1. INTRODUCTION

Surface water quality monitoring in Brazil began in the 1970s when the first state networks were established. Since then, the Brazilian states have implemented different strategies in their monitoring networks, with specific criteria regarding point location, sample frequency and assessed parameters. Currently, 17 of the 26 states monitor their surface water quality, totaling 2,167 monitoring points. The number of parameters monitored varies from 8 to 50, along with the frequency of sampling, from monthly to quarterly.

In addition to the points monitored by the states, the National Water Agency of Brazil (ANA) monitors water quality in 1,340 points within the National Hydrometeorological Network. Sampling frequency at these points is quarterly, and the parameters monitored are pH, electrical conductivity, temperature, dissolved oxygen and discharge.

The distribution of these state and federal monitoring points over the Brazilian territory is very uneven and concentrated in the most populated states along the Atlantic Coast. There are huge information gaps to be filled in relation to the spatial distribution of points and the need for standardization of water quality monitoring.

States usually have an administrative segmentation, with different institutions responsible for water monitoring in terms of quality and quantity. This separation needs to be eliminated, and coordination between institutions is necessary to prevent the overlapping of functions.

Faced with the need to expand and integrate water quality monitoring, in 2010 the National Water Agency introduced the National Water Quality Evaluation Program. The program has the following objectives:

i. Eliminate geographic gaps in water quality monitoring in Brazil

ii. Increase the reliability of information on water quality

iii. Standardize and ensure that data and information on water quality are comparable between states

iv. Evaluate, disseminate and make water quality information available to society

The program aims to provide the country with an integrated monitoring system based on standardized collection and analysis procedures applicable to all states, which allows the systematic monitoring of the evolution of water quality throughout the national territory.

2. OBJECTIVE

The objective of this work is to describe the main achievements and challenges in the implementation of the National Water Quality Evaluation Program in Brazil.

3. RESULTS AND DISCUSSION

The National Water Quality Evaluation Program seeks to comply with the provisions of the National Law on Access to Environmental Information, which states that all government environmental information is public and that competent environmental agencies shall publish annual water quality reports.

One of the main actions of the National Water Quality Evaluation Program is the standardization of sampling procedures. The National Field Guide to Water, Sediment, and Biological Sampling, was prepared by the São Paulo State Environmental Agency (CETESB) and was submitted to national consultation led by the National Water Agency with state environmental and water resources management agencies.

On World Water Day 2012, the National Water Agency, with the support of the Inter-American Development Bank (IDB) published the National Guide and a video showing the main water sampling methods. A resolution of the National Water Agency established the National Field Guide as the technical reference document for surface water sampling throughout the Brazilian territory.

The National Water Quality Monitoring Network was created in 2013 and is a major component of the National Water Quality Evaluation Program. It is composed of the state and federal networks, and its development involved a series of previous studies to identify representative water sampling points and the establishment of monitoring logistics. It includes regionalized goals to states relating to the minimum density of sampling points, minimum sampling frequency, and a minimum set of water quality parameters.

With regard to the parameters to be analyzed, the target is to analyze, as a minimum, water discharge and the water quality parameters established by consensus of the Brazilian states under the National Environmental Program (Table 1). Supplemental indicators (eg. metals, pesticides) will be analyzed according to specific needs.

Table 1. Parameters of the National Water Quality Monitoring Network.

Category	Parameter
Physical-chemical	Dissolved Oxygen
	Electrical Conductivity
	pH
	Total Alkalinity
	Total Chloride (brackish and saline water)
	Turbidity
	Water and Air Temperature
	Water Transparency (Secchi-disc)
Demand	Biochemical Oxygen Demand – BOD
	Chemical Oxygen Demand – COD
	Total Organic Carbon – TOC (brackish and saline water)
Solids	Suspended Solids
	Total Dissolved Solids
Microbiological	Thermotolerant Coliforms
Biological	Chlorophyll a
	Phytoplankton (Qualitative and Quantitative)
Nutrients	Nitrogen (Nitrate, Ammonia, Total Nitrogen)
	Phosphorous (Total Phosphorous, Soluble Reactive Phosphorous)

Water pollution in Brazil is more concentrated in the eastern states where 75% of the country domestic organic load is concentrated. In contrast, the northern states in the Amazon basin have 4 % of the country domestic organic load. Considering these regional differences, the Brazilian territory was divided into three regions according to the minimum criteria of sampling point density.

Sampling point densities ranges from 0.1 point / 1,000 km² in the Amazon basin to 1 point / 1,000 km² in the most populated eastern states (Figure 1). Sampling points were divided in three groups: Reference, Impact and Strategic. Reference sampling points are located in pristine or least impact sites and represent 10% of the national network. Impact sampling points are located downstream of pollution sources and strategic sampling points are located in the borders between states and neighbor countries. For the micro location of sampling points a methodology that considers pollution sources, self-depuration and access to sampling point (roads, bridges) was developed.

Figure 1. Sampling point density for Brazilian states participating in the National Water Quality Monitoring Network.

As for monitoring frequency, the aim of the network is to collect at least quarterly samples in the whole country.

An initial proposal for the arrangement of the National Water Quality Network was drafted, based on technical criteria for the location of monitoring points and considering the regionalized monitoring point density targets. This initial draft was then discussed with representatives of environmental and water resources management state agencies.

A comprehensive diagnosis was carried out in each state agency involved in water quality monitoring with respect to the current situation of their networks (monitoring points, parameters assessed, sampling frequency, itineraries, costs, and information systems). The laboratories were evaluated for their analytical capacity, and the needs for infrastructure improvements were assessed. The National Water Agency then signed a Memorandum of Understanding with all states in order to implement the national network and launched the Water Quality Data Dissemination Program in which monitoring goals are established to states, according to the project of the National Water Quality Monitoring Network.

At the start of the program states receive field and laboratory equipments, vehicles and boats. So far around US$ 6 million were spent in the implementation of the network. According to the goals of the program, every year the states have to send their water quality data to the National Water Agency and then receive financial resources to continue the implementation of monitoring network in the following year. The goal of the Program is to have the National Water Quality Monitoring Network implemented in all Brazilian states in 2020 with a total of 4,500 sampling points. When the network is fully implement an operational cost of US$ 4,8 million per year is expected.The main challenge for the implementation of the national network is the Amazon Basin, where most states do no have a monitoring network and the long distances make the monitoring logistics more difficult.

Capacity building is vital to the National Water Quality Evaluation Program in order to acquire high-quality data and to increase states technical capacity for water quality monitoring and reporting.

Some courses on water quality sampling and assessment were developed and an intercalibration

study of the laboratories participating in the National Water Quality Monitoring Network is planned for the second semester of 2015.

Regarding the assessment and reporting of water quality, since 2009 a national water quality assessment is produced every year as part of the Report Water Resources Conjuncture in Brazil. Most states in Brazil use the Water Quality Index developed by the United States National Sanitation Foundation (WQI-NSF) and these first national water quality assessments used the average values of this index in order to provide a national overview of water quality.

In 2012 during the Rio+20 United Nations Conference on Sustainable Development, the National Water Agency with the support of the Inter-American Development Bank launched the publication "Surface Freshwater Quality in Brazil – Outlook 2012" [1]. This report adopted the Pressure-State-Response framework and analyzed 1,988 sampling points using the WQI-NSF and the Trophic State Index (TSI). The WQI-NSF calculated for urban sites revealed that 47% of sampling points had a bad or very bad condiction. The Canadian Council of Ministers of Environment Water Quality Index (CCME-WQI) was also calculated using the following parameters: pH, Dissolved Oxygen, Biochemical Oxygen Demand, Total Phosphorous, Turbidity and Thermotolerants Coliforms.

This report also presented a trend analysis of the WQI-NSF and TSI for the period 2001-2010 in 658 sampling points. This trend analysis showed that investments in sanitation where responsible for the improvement of water quality in some river basins. On the other hand, a reduction of water quality was observed in river basins with population growth that was not accompanied by investments in sanitation and the control of industrial and agricultural sources. This type of analysis was very important to relate water quality monitoring results to water resources management.

4. CONCLUSIONS

The implementation of the National Water Quality Evaluation Program is a work in progress, and some important aspects of this process can be highlighted. The National Law on Access to Environmental Information Access and ANA's resolution establishing the national field guide as the national reference for water sampling were important steps to provide legal support. The discussion with states agencies about the national monitoring framework was also an important approach for the creation of the National Water Quality Monitoring Network. Providing capacity building and financial resources to states are also important aspects to guarantee the long term viability of the water quality networks.

The elaboration of national water quality reports, even with information gaps, was also important to show to states and the public that a national assessment was possible. Wide dissemination of information on water quality to the population should be a priority in the following years, using means and forms of communication that enable social participation in the water quality management.

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