A Scorecard system to track pollution and improve water quality in the River Ganga

The River Ganga is used by millions of people every day, but the quality of its water is under threat from a range of domestic and industrial pollutants. This project undertook to develop a water quality assessment framework that could be applied at key locations along the river and incorporated into an easy-to-understand scorecard. This scorecard will provide accurate, up-to-date information to help regulators, industry and domestic users of the river to appropriately manage water quality in the Ganga Basin.

What's in our water?

Wastewater from a range of domestic and industrial sources is discharged into open drains which flow through urban environments into the river, with untreated sewage comprising more than two-thirds of the wastewater generated. Contaminants in wastewater entering the drain can include faecal material, common household chemicals, as well as a wide range of organic and inorganic chemicals from a variety of industries operating within the Ganga Basin. Industrial chemicals can include heavy metals, pesticides, herbicides, plasticisers, pharmaceuticals, and surfactants (Figure 1).

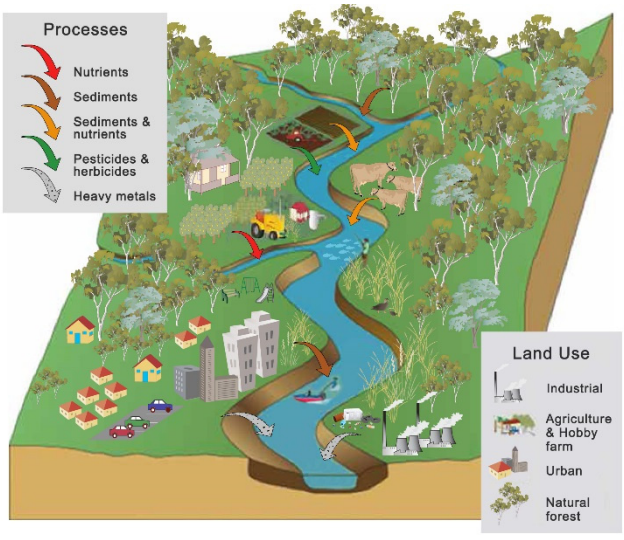

Figure 1. Conceptual River

The use of contaminated river water for human activities such as drinking, bathing, and irrigation poses a serious threat to the health of local residents as well as aquatic and terrestrial ecosystems. To encourage better management of effluents and drains, it is imperative that an objective indication of water quality in the River Ganga is available to regulatory bodies, industries and users of the river at all levels of society.

A composite water quality index for the River Ganga

Through discussions with the National Mission for Clean Ganga (NMCG), this project was designed to obtain an understanding of the contributions of common contaminants present in drains flowing through urban areas to the degradation of overall river water quality in the River Ganga, and to facilitate the rapid visualisation of water quality status through the development of a composite water quality index (WQI). The development of a WQI provides non-experts with an assessment of the overall quality of inland surface water resources as it relates to both human and aquatic ecosystem health. The WQI will also form the basis of a scorecard framework that can be used to visualise water quality at various locations in the river in an easy-to-understand yet information-rich interface.

Designing a water quality scorecard framework

The scorecard framework was developed using four water quality variables as indicators to assess and compare the general status of surface water quality in relation to environmental concerns.

- Dissolved oxygen (DO)
- Biological oxygen demand (BOD)
- pH
- Faecal coliforms (FC)

These indicators were chosen after a systematic review of historical water quality data. The thresholds implemented in the derivation of water quality scores for each parameter (DO, BOD, pH, FC) were based on WHO drinking water guidelines and ANZECC/ARMCANZ 2000 guidelines. Five categories were defined and designated scores from 1 to 5 representing low to high water quality.

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By implementing the WQI in a simple color-coded scoring system (Table 1), overall water quality can be reported on a 5-level rating scale ranging from 'Excellent' to 'Very Poor'. To validate the scorecard framework, water quality data from a trial period for which data were available for the four key parameters (2010–11) were simplified into this 'traffic light' summary to convey the condition of selected sites based on the WQI.

Table 1. Water quality indicators, guidelines and thresholds used for the scorecard framework

Status	DO	BOD	pH		FC
Excellent (5)	>10	<2	6.6 - 7.5		≤10
Good (4)	8.5-10	2 - 3	6.2 - 6.6	7.5 - 7.9	>10 - 100
Fair (3)	7 - 8.5	3 - 7	5 - 6.2	7.9 - 9	>100 - 1000
Poor (2)	4 - 7	7 - 9	3 - 5	9 - 11	>1000 - 10000
Very poor (1)	<4	>9	<3 and >11		>10000

DO, Dissolved Oxygen (mg/L); BOD, Biochemical Oxygen Demand (mg/L); FC, Faecal Coliform count, (MPN/100 mL)

A web-based water quality visualisation tool

A website was developed in consultation with HydroNumerics to demonstrate the mapping of colour-coded WQI rankings along the Ganga River. The visualisation tool displays information on how WQI changes over time. This reveals which WQ indicators are responsible for poor water quality. It visualises the points of threshold exceedance, thus providing early alerts to operators and regulators. The map-based scorecard format allows users to quickly and easily track water quality within and across catchments over time (Figure 2).

While the current version of the tool visualises only the data collected during the project, it has been designed to interface to a real-time water quality monitoring system.

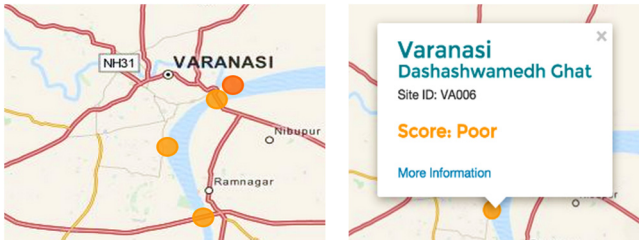

Figure 2. Screenshot of the Report Card for Varanasi

By regularly monitoring the physical and chemical makeup of water quality, it is possible to detect changes (both good and bad) and implement response measures to mitigate detrimental change before a situation worsens. Monitoring data are essential to identify areas of concern that require immediate attention; having access to real-time monitoring data enables attention to be focused where and when it is needed the most. The tool demonstrates the benefits of being able to track, interpret and report changes in water quality over time, and at many locations.

Next steps

There is a need to implement appropriate treatment systems to improve the quality of the water prior to discharge into Indian rivers. Before suitable wastewater treatment systems can be designed and installed, it is important to have an adequate knowledge of the composition and quality of the collected wastewater from different sources. By using the same principles applied in the development of the river water quality scorecard, the scope of the existing scorecard can be expanded to allow the monitoring of water quality in drains and effluents.

This project has contributed to current efforts towards the restoration and maintenance of the chemical, physical and biological integrity of the Ganga River. By helping to strengthen integrated water resources management in India and across the region more broadly, CSIRO is supporting the vision for Ganga rejuvenation in terms of ensuring safe water for human health and well-being, ecosystem health, and environmentally sustainable development.

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