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THE GLOBAL GOALS

# Water quality monitoring in the Red River Delta (Vietnam): how to improve water resource management in the region

Professor Suzanne McGowan


## Executive Summary

Policy makers should use collected datasets to inform policy making that supports improved water resources management.

The Red River Delta has a long history of collecting water quality data. These datasets can help policy makers understand how population growth and urban development has impacted water quality in the region. This brief suggests new methodologies and approaches to guide collection, analysis and interpretation of water quality monitoring datasets for improved water resources management.


## Recommendations

- Stable isotopes of oxygen and hydrogen in waters should be added to the list of routinely monitored parameters to provide cost-effective, rapid and wide scale hydrological assessments
- Upgrading and maintenance of the water drainage and storage structures in the Day River should be a priority
- Monthly water quality monitoring should be maintained across the river system
- Decisions on flow regulation from the Red River to the Nhue River should be taken using a combination of water flows and water quality measurements
- The Nhue River should be a priority for monitoring and water quality improvement efforts

## Why is water quality monitoring important?

The Red River Delta has the most complete and longest water quality monitoring dataset across all of Southeast Asia. As well as being a valuable resource for scientific researchers, monitoring data can be used to calibrate and develop models to explore management scenarios. There are particular challenges in interpreting and modelling water quality in complex and modified tropical river systems, and we need baseline monitoring data to help develop new approaches. Because the Red River has been monitored for almost 20 years, we can assess how population growth and rapid development have influenced water quality. It is rare to have such a long-term perspective in tropical regions.

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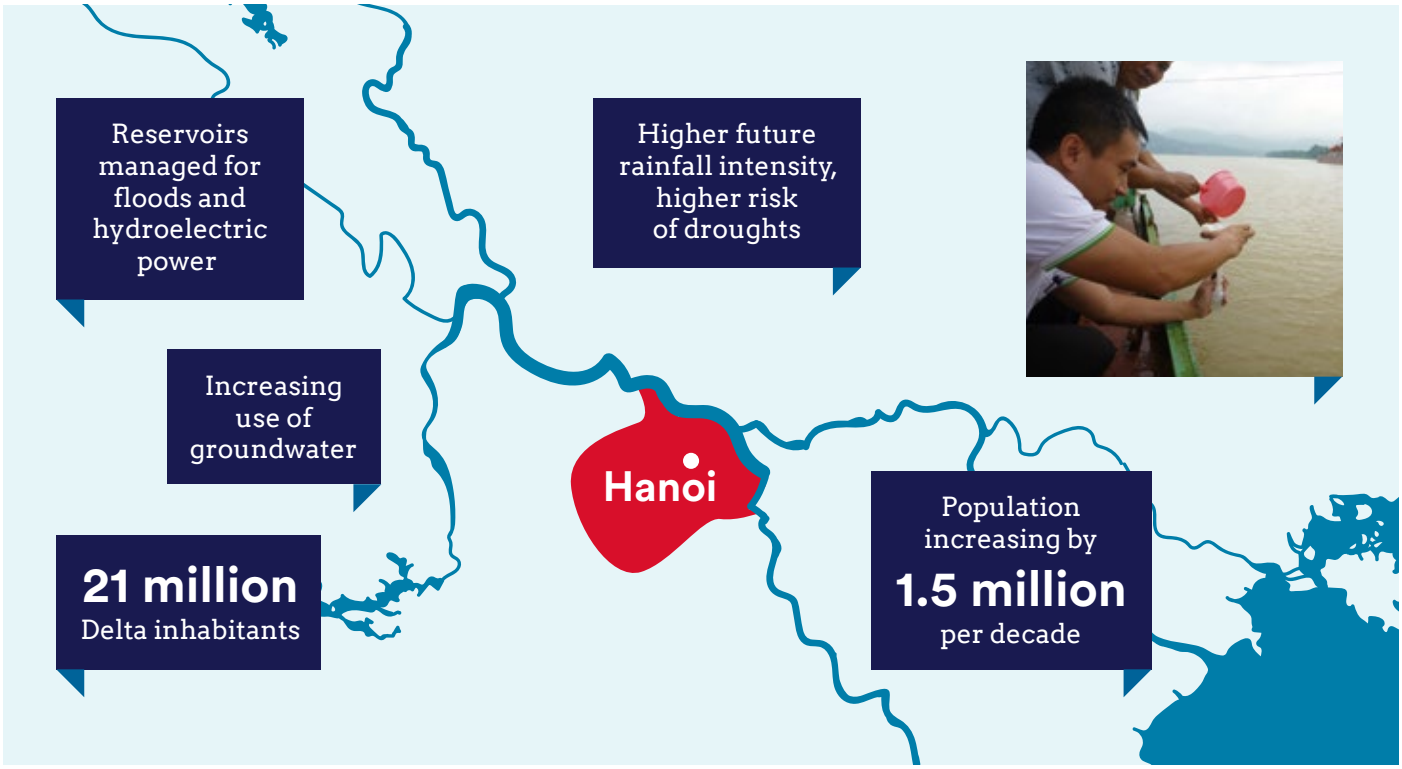



## 1. Stable isotopes provide insights into the Red River water cycle

The oxygen stable isotope signature of rainwater falling on the Red River Delta varies seasonally. We compared this distinctive seasonal pattern, with the isotope signature of river water samples collected each month to calculate the proportion of the Day River waters that is composed of 'young' rainwater (defined here as less than three months old) (Kirchner 2019).

Our stable isotope calculations suggest that around 66% of the water in the Day River system derives from 'young' rainfall. This proportion is much higher than the global average of 33% (Jasechko et al 2016).

The implications are:

- Water drainage from the Day catchment is accelerated by artificial flow paths such as rice paddy, dykes, and hard urban surfaces
- River flows will be highly affected by severe tropical storms and droughts, which are both predicted to increase in the future.

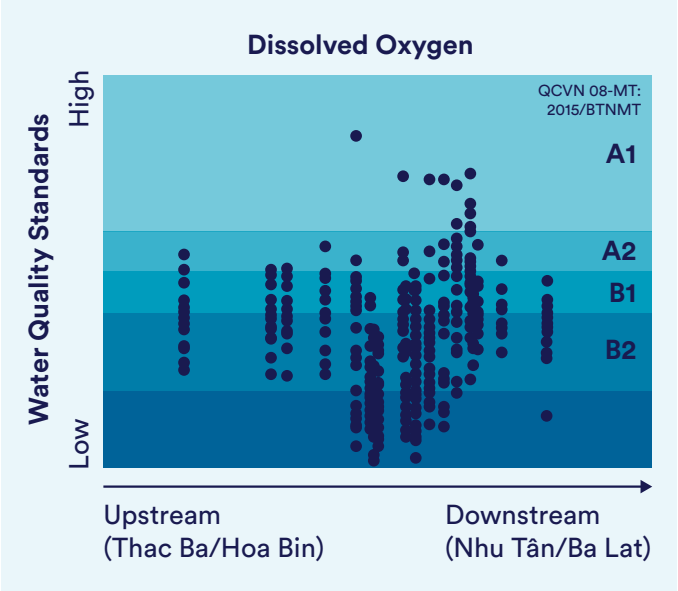
## Recommendation

The Day River drainage system should be upgraded to allow more responsive water management during storms and infrastructure for water storage put in place.

## Stable Isotopes Oxygen ($^{18}O$)

Water consists of one oxygen and two hydrogen atoms. 0.2% of the oxygen atoms on earth are heavier ($^{18}O$). $^{18}O$ is called a stable isotope because it does not decay and so can be used as an environmental tracer. In water, we use the proportional abundance of the heavier isotopes to trace where water has come from and to determine its residence time in water bodies.

## 2. Regular monthly water quality monitoring is necessary




Our project monitored water quality at 21 sites along the Hong and Day Rivers from the reservoirs in the uplands to the coast each month between 2018 and 2019. We used the Vietnam water quality standards (QCVN08MT-2015/BTNMT) to assess the state of the river.

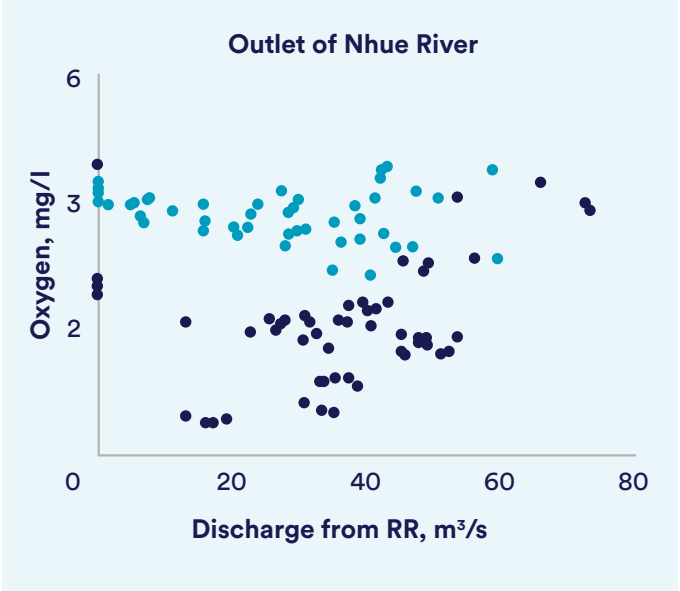
Using dissolved oxygen as a key measure of river health (left), we can see that the mid-stream sites had much lower water quality and they coincide with the urban areas in and around Hanoi including the Nhue River.

There was a lot of seasonal variability in water quality and the timing of sampling has a major impact on how the water is classified using the Vietnam water quality standards. Water quality tends to be classified as better during the wet than the dry season. Therefore, it is crucial to understand and measure the annual cycle.

### Recommendation

Water quality should be monitored at least monthly over the annual water cycle.

## 3. Active water management at the Nhue River will improve water quality




We used the Seneque model to study how diverting flows of Red River waters into the Nhue-Day River can be used to improve water quality. We identified that discharge inputs of Red River waters above 60m³/sec into this river could significantly improve water quality as measured by oxygen levels. These flows can be controlled by gated structures at the confluence.

### Recommendation

Where possible, flows over 60m³/sec from the Red River to the Nhue River should be maintained to improve water quality. The Nhue River should be a strong focus for future monitoring efforts.

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## Resources


Trinh et al (in prep), Using stable isotopes to estimate young water fractions in a well-regulated, tropical lowland basin

Luu et al (in prep), Water quality in an urbanized river basin impacted by multi-pollution sources: from comprehensive surveys to modelling

Vietnam General Statistics Office (CEICdata.com)

Kirchner (2019), Hydrol Earth Syst Sci 23, 303-349

Garnier et al (2002) Estuarine, Coastal and Shelf Science, 54, 285-308. Jasechko, S., Kirchner, J. W., Welker, J. M. & McDonnell, J., 2106. Substantial proportion of global streamflow less than three months old. Nature Geoscience, 9(2), pp. 126-129.


## Contact


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## Methodology


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