POLICY BRIEF

December 2018
The WRC operates in terms of the Water Research Act (Act 34 of 1971) and its mandate is to support water research and development as well as the building of a sustainable water research capacity in South Africa.

The Mzimvubu Water Project: Baseline indicators for long-term impact monitoring

The Mzimvubu Water Project, set to kick off in 2019, is expected to be an important economic stimulus to this impoverished area of the Eastern Cape. However, despite the recognised benefits of dams, dam development raises important questions of social and environmental sustainability. Since these impacts are unique to every area, it is considered crucial to establish a baseline of conditions prior to development in order to measure the impact of such development on the environment, economy and sociological dynamics. A completed Water Research Commission (WRC) study established a baseline of environmental, agricultural and socio-economic data that would aid the long-term impact monitoring of the Ntabelanga Dam.

Background

The Mzimvubu River is the largest undeveloped river in South Africa, despite having high potential for development. In recognition of this, the South African government has announced plans to build two multipurpose storage dams in Tsitsa River, one of the largest tributaries of the Mzimvubu.

The Mzimvubu Water Project comprises the Ntabelanga Dam, which will largely be used for irrigation (2 686 ha) and potable water as well as the smaller Laleni Dam, to be located 20 km downstream from Ntabelanga. The latter dam will predominantly be used for the generation of electricity.

The objective of the project is to stimulate economic development and promote job creation through rejuvenation of the agricultural sector, hydropower, water transfer and tourism.

The success of a dam project does not only depend on technical feasibility but also sociological feasibility. Since these impacts are

unique to every area, it is considered crucial to establish a baseline of conditions prior to development in order to measure the impact of such development on the environment, economy and sociological dynamics.

In recognition of this, the WRC funded a short-term project aimed at conceptualising long-term monitoring to capture environmental, agricultural and socio-economic impacts of the Mzimvubu Water Project in the Ttsitsa River. In this project several aspects which should be monitored in the long term were identified.

This gave rise to another interdisciplinary project, which is the focus of this briefing note. This project aimed to construct a baseline of environmental, agricultural and socio-economic intersections associated with the Mzimvubu Water Project.

Throughout the project the research team engaged with the Department of Water and Sanitation and its consultants. The outcome of this project also informed the environmental impact assessment of the Mzimvubu Water Project

Methodology and main results

Quantifying water quality at selected locations

The water quality in the Tsitsa River is likely to change once the dam wall is closed. Water quality was assessed over four seasons at twenty fixed sites in the main stem of the river, its tributaries and from the taps/groundwater from villages most likely to be affected by the dam development.

Turbidity levels in the Tsitsa River and its tributaries were above recommended average levels of 4.88 and 4.64 for the Tsitsa River and its tributaries respectively. Other water quality indicators such as pH, total dissolved solids, alkalinity, chlorine and phosphates were, however, present at acceptable levels at all the sites.

Determining potential pollution from dry-sanitation systems
As in many developing areas, water for domestic use in the Ntabelanga area is derived from groundwater and streamwater. At the same time, 56% of households in the area rely on pit latrines. Several of these sanitation systems are located around the Ntabelanga Dam footprint.

There is a concern that, with the rise in the groundwater level associated with impoundment, water sources can become contaminated through these sanitation systems.

Four sites located close to the inundation footprint and near a tributary to the Tsitsa River were identified. A hydropedological transect study was conducted at each site to conceptualise the hydrological behaviour, followed by measurements of key hydraulic properties of the soils.

Samples were collected of representative horizons to determine the total coliform, total bacteria and ***E.coli*** contents of the soils as well as that of the tributary. Results show high levels of various microbial indicators with spatial variation (vertical and horizontal) which support the hydropedological interpretations.

Characterising stream geomorphology at selected locations
Fluvial systems are dynamic systems in which variables in a catchment and river channels affect the morphology of river reaches. South African rivers are increasingly being exposed to stresses from a combination of factors, one of the most prevalent being the impacts of dams which result from a combination of factors, one of the most prevalent being the impacts of dams which result in varying sediment yields and flow regimes.

The sediment load combined with flow characteristics for respective river channels provides the physical habitat for aquatic ecosystems. The damming of the Tsitsa River, through the construction of the Ntabelanga Dam, will change the overall downstream geomorphology.

A baseline survey was thus completed to monitor the current condition of the Tsitsa River. Five sites were established in variable reaches of the river proximal to the proposed Ntabelanga Dam. In each of these sites features such as the nature of the substrate, distribution of clasts, turbidity, suspended sediment concentration and slope of flow were measured at various temporal intervals.

This baseline study provides a set of data about the current geomorphic condition of selected sites in the Tsitsa River as well as seasonal variations in flow hydraulics against which post-impoundment impacts can be assessed.

Describing aquatic biodiversity at selected locations
Impoundments can augment the amount of sediment entering fluvial systems resulting in a marked change in both aquatic habitats and associated biota. The physical habitat was described at selected locations in the Tsitsa River under current conditions.

From this a physical habitat score was created based on, among others, temperature, pH, dissolved oxygen, phosphate concentrations, and occurrence of macroinvertebrates. In addition, macroinvertebrates were classified into orders and related to their sensitivity to habitat change.

Documental seasonal changes in the Tsitsa River is expected to aid a better understanding of the current processes at work between sediment characteristics and river habitats. Post-dam impacts can be monitored at all the sites to quantify the impact of the development.

Characterising natural vegetation
Plant diversity, composition and utilisation within the Tsitsa River catchment were examined in relation to how the planned development will impact the livelihood needs of the local people.

Nine different uses of plants were recorded in the area, namely beverage (one species each), cereal and crafts, ornamental, live fence or hedge (three species each), and herbal medicines (28 species). Useful plant species were mentioned by at least 50% of the 21 participants interviewed.

Quantifying soil quality of representative soils
The proposed dam will result in alteration of land uses (e.g. conversion of dryland crop production to irrigated fields). These changes will invariably result in changes to the soil quality.

The Soil Management Assessment Framework (SMAF) tool was used to conduct soil quality assessments at 19 different sites. Indicators included organic carbon, microbial biomass carbon, phosphorous and exchangeable potassium, among others. The SMAF scores serve as valuable baseline data for

future comparisons of soil quality, not only to determine the impacts of land-use change but also on the effectiveness of rehabilitation practices.

Characterising carbon stocks and wetland water regimes
The soils under the dam footprint will change from a carbon sink to a carbon source once inundated. Since decomposition of carbon will occur under anaerobic conditions, large quantities of greenhouse gases, and especially methane can be released following dam construction. Closing of the Tsitsa River will also impact flow regimes and consequently wetlands downstream of the proposed dam.

Carbon stocks were calculated following a digital soil mapping approach. A soil association ma of the dam footprint was created. Five soil associations were identified, and the soil organic carbon (SOC) contents of these soil associations were then determined.

The SOC contents is relatively low when compared to other similar environments due to chemical and physical degradation in the area.

Wetlands below the proposed Ntabelanga Dam were identified using desktop analysis. The study determined that the wetlands below the dam are not gaining water from the river but are, in fact, feeding river. The impact of the dam on wetland water regimes will therefore be restricted to streambed incisioning directly below the dam wall.

Describing dominant agricultural practices
One of the anticipated benefits of the Mzimvubu Water Project is the rejuvenation of agriculture. With this in mind it was important to describe existing agricultural practices and quantify yields/productiveness of dominant practices.

A socio-physical approach was used and interviews were conducted with more than 300 respondents in five villages to be impacted by the dam. An additional 21 interviews were held with farmers who were actively involved in agriculture.

The study found that even the highest maize yields were 49% below potential based on soil and climatic conditions. The interviewed farmers attributed the poor yields to unreliable rainfall, lack of labour and lack of external outputs. Timely access to good quality seeds, fertilisers and extension services as well as in-field rainwater harvesting might be a more cost-effective approach to improve agricultural production in the area, rather than large-scale irrigation.

Capturing social-economic perceptions, hopes and fears dynamics
This study is a sequel to several qualitative studies by the research team in selected Ntabelanga Dam communities. The sociological aspects of those studies revealed, among other things, narratives of hope, fear and even disdain with regard to the proposed dam – especially disdain about the modes of public participation and community engagement so far adopted by the state (or consultants acting on its behalf).

For the latest baseline survey five communities were selected. The survey highlighted that there are social, cultural and ecological impacts that the dam will impact, and because of the sensitivities embedded in these dynamics, such impact must be carefully monitored.

Conclusion

The South African government's pronouncements concerning the Ntabelanga Dam is unequivocal about the dam's potential to bring about rural renewal in, at the very least, the surrounding communities – through hydropower, irrigated, modernised and commercial agriculture, ecotourism and multifarious job-creation opportunities that these bring. Indeed, if there is one idiom that underpins the state's investment in this project, it is an economic one.

What has emerged from qualitative data obtained in the five selected communities and a quantitative survey of community members – is that a dam is a multivalent investment, but, in the case of the Ntabelanga Dam, one which the state appears to view in an overwhelmingly beneficial way.

From the findings of this study, it is of utmost importance to adopt a holistic view of the dam communities and, thus, to view the dam's impacts as being potentially more than just economic and more than simply beneficial.

The present study was designed principally to establish a baseline of environmental, agricultural and socio-economic data that would aid the long-term impact monitoring of the Ntabelanga Dam.

Further reading:

To order the report, *The Mzimvubu Water Project: Baseline indicators for long-term impact monitoring* (**Report No. 2433/1/18**) contact Publications at Tel: (012) 761 9300, Email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy.