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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.

Greening the catchments secures water quantity and quality for society and economy

A recently completed Water Research Commission (WRC) project focused on providing researched evidence on the value and role of the healthy natural ecosystem (ecological infrastructure) in enhancing water security. The project focused on the uMngeni River Basin, supporting the third-largest regional economy.

Executive summary

Over the past two decades, many authors have highlighted the fundamental role of the natural environment in underpinning societal well-being. Associated with this recognition, Green Economy initiatives are highlighted as one of the National Presidential Outcomes in South Africa. The WRC has therefore developed The Green Village and Economy Lighthouse as one of its flagship initiatives.

Through this initiative, the WRC funds research intended to support development that results in improved human well-being, social equity and access to resources, while significantly reducing environmental risks. Lessons from this project also highlight that state-citizen partnerships facilitate this approach, allowing for the acknowledgement and adoption of local community practices and knowledge for **meaningful collaboration** of the state, private sector and citizens in decision making.

Natural resources which deliver ecosystem services, such as water supply, water purification, flood attenuation, recreational services, etc, are known as Ecological Infrastructure (EI), as opposed to built infrastructure (BI, such as dams, pipelines, etc). Thus, EI is defined as “**functioning ecosystems that produce and deliver valuable services to people**” and has, until now, been understood as an alternative or complementary intervention that provides similar benefits to conventional BI (SANBI, 2013). There are some similarities with the established “ecosystem goods

and services” concept and the broader concepts of Natural Capital, Nature Based Solutions, etc. In South Africa, there is now an increasing understanding and acceptance of the term, EI, and its significance and value in a country where a pro-growth economic development agenda threatens to compromise sustainability of natural resources. This project demonstrated that investment in EI forms part of a continuum of interventions in catchment investment opportunities. In some countries, EI is already part of legislation in water resources management.

Background



The Umgeni River as it flows through Durban.

The uMngeni River Basin supports over six million people, providing water to South Africa's third largest regional economy, contributing approximately 11%, or about R460 billion, to national GDP. It is therefore a significant catchment that contributes to human wellbeing locally, regionally and nationally. It supports South Africa's third largest city, Durban, as well as an important secondary city and political and administrative centre of KwaZulu Natal, Pietermaritzburg. It covers an area of 4 440 km² and has an average annual rainfall of a little under 1000 mm.

The catchment is dominated by agricultural activities in the upper reaches, including dairy, beef, poultry, timber and sugar cane. The middle and lower reaches are dominated by urban development, industry and mixed rural-urban land uses. The area under commercial plantation forestry in the basin is roughly 740 000 ha of eucalyptus/pine trees. These plantations are estimated to reduce streamflow by approximately 64 million cubic metres per annum.

Alien invasive vegetation in the catchment is estimated to consume 7.2 million cubic metres of water over and above what would have been consumed by natural vegetation. Despite a series of dams (Nagle, Midmar, Albert Falls, and Inanda) within the uMngeni Catchment, it remains a water stressed catchment, which is only just meeting the water demands of its inhabitants.

The Spring Grove Dam on the Mooi River has recently been completed and the Smithfield Dam on the uMkhomazi River is in the planning phases. These dams are planned to meet water demands now and into the future. However, the catchment is considered to be a closed one, unless more water can be transferred into it from other adjacent catchments.

The water resources in the catchment are seriously threatened by point (WWTW) and diffuse sources of pollution, which causes eutrophication, very high microbial occurrence, health impacts on both people and ecosystems, reduction in water clarity and unpleasant odours.

This poses a serious threat to a wide range of water users in the catchment, with a particular impact on recreation and tourism. Indications are that the Duzi canoe marathon numbers are declining, which impacts on revenue and employment in the catchment. Diffuse pollution varies across the catchment and, unlike point source pollution, it is a function of the topography, land use, land management, soil type, hydrology and climate.

The anticipated urban and industrial development in the

uMngeni system will increase the demand for water, which exceeds the presently available water resources. However, even with these challenges the uMngeni River and its catchment continues to provide the resources required to sustain the economy of this growing region, supporting human wellbeing, economic development, social needs and ecosystem services.

The critical question facing the catchment is how to sustain and enhance water security in the catchment. **The overall aim of this project was to identify where and how investment into the protection and/or restoration of EI can be made to produce long-term and sustainable returns in terms of water security assurance.** In short, the project aimed to guide catchment managers when deciding "what to do" in the catchment to secure a more sustainable water supply, and where it should be done.

Approaches and main results

Degradation of the catchment is an anthropogenic activity, i.e. caused mainly by people, therefore can be solved by people. This is a very complex socio-ecological systems approach or action research by a collective.

No restoration can be successful and sustainable without citizen's support. This project partnered with other research initiatives in the catchment, including projects funded through the Green Fund of the DEA/DBSA. The uMngeni catchment became a focus area and pilot study site through various initiatives, with research and social learning being consolidated through the uMngeni Ecological Infrastructure Partnership (UEIP).

Through this initiative, more than 24 government departments, academic institutions, private companies and NGOs have signed an MoU which documents their commitment to investing in restoring, maintaining and managing EI for water security. In an attempt to ensure uptake of the research products, the project was aligned with UEIP restoration initiatives, including Mphophomeni (upper catchment), the Baynespruit in Pietermaritzburg (middle catchment), the Palmiet River Catchment and Mzinyathi in eThekweni Municipality (lower catchment).

Over five years, the project explored the conceptual and philosophical basis for investing in EI. This report demonstrated how EI can be utilised to secure water for the benefit of society through research focused on selected case studies in the uMngeni Catchment. This addresses a critical gap in moving from the many vague and broad conceptual ideas of how EI could form part of a catchment

management strategy (of the CMA), to demonstrating how this can be an integral component of future water resource management plans in cities and urban areas.

The study highlighted that there is an interdependent and co-constitutive relationship between EI, society, and water security. In particular, by working in spaces where EI investment is taking place, it is evident that socio-economic, environmental and political relations in the catchment play a critical role in making EI investment possible, or not possible. In contrast to many projects which have identified this complexity, here, this study moved beyond identification and actively explored and explained these interactions and provide lessons based on these experiences and analyses.

The study inherently addresses aspects of water quantity and quality, economics, societal interactions, and the governance of natural resources. It highlights that ensuring the availability and sustainable management of water resources requires both transdisciplinary and detailed biophysical, economic, social and development studies of both formal and informal socio-ecological systems, and that investing in human resources capacity to support these studies, is critical.

To this end, an Opportunities and Risks Framework for Investing in Ecological Infrastructure was developed to guide future development plans. Furthermore, the study produced 10 Lessons for investment in EI that are critical in the uMngeni Catchment.

These lessons are also applicable wherever investments in EI are being considered. Finally, the study identified opportunities in the uMngeni Catchment where investment into the maintenance and/or rehabilitation of EI can produce long-term and sustainable returns for the delivery of water-related ecosystem services, showing these spatially in an annotated map form.

An estimated R201million is currently required to rehabilitate the core degraded areas if water security in this strategic water resource area is to be realised. The study also estimated a saving that is in billions way beyond the investment required, in fact the current plans of inter-basin water transfers can be postponed by simply integrating EI and BI in uMngeni.

The water resources supply to the residents of the uMngeni Catchment are under pressure with an estimated shortfall of approximately 50 million m³ per annum. Although EI alone cannot provide the additional 200 million m³ per annum forecast to be needed by 2030, the analysis shows that

clearing IAPs in the catchment headwaters (including the uMsundusi) would provide 56 million m³ of water at a 90% assurance of supply.

Based on 2017 rates and the extent of invasive alien plants (IAPs) in the catchment, it can be argued that clearing the upper uMngeni of IAPs could save uMngeni Water approximately R15 million per year. A cost-benefit analysis of the rehabilitation of a portion of the wetland system demonstrates that the benefits of rehabilitating the wetland - based on the costs of replacing the water quality enhancement service of the wetland with a standard 1 ML waste water treatment plant - exceed the costs of rehabilitating and maintaining the wetland (benefit-to-cost ratio of 1.25 under an 8% discount rate and 20 year timeframe).

The benefits (importance) of catchment maintenance compared to rehabilitation: Based on the Unit Reference Value (URV) approach, analysis demonstrated that the cost per unit volume of water supplied (m³) by maintaining grasslands is considerably lower (R0.31/m³) than for restoring degraded areas (R2.44/m³).

So who must fund EI? The approach in this project has been to consider the opportunity to invest in EI through identifying opportunities to do so from existing tariffs and where BI needs have been identified, to include aspects of EI in the financing plan. Our approach shows that this is practical and financially feasible, instead of looking at EPWP only.

Finally, the project offered an opportunity to a huge number of students who are now well equipped and an expansion of EI expertise. In total, 3 Postdocs, 9 PhDs, 15 MSc, and 7 Hons students were affiliated with the project.

Conclusions and recommendations

These lessons have emerged from and inform the development of the ORF4EI framework which can be applied to determine where, how, and by whom, EI interventions in the uMngeni Catchment, can be made.

Through this project, the potential water quality and quantity benefits on investing in EI have been quantified and the costs and benefits analysed. The conclusion is that there are great opportunities to enhance water security in the uMngeni catchment through investments in EI.

However, in order for these to be sustainable, any investment in the catchment's Natural Capital requires a concomitant

investment in its Human and Social Capital. Maintenance/conservation of EI is 'cheaper' than restoration. Responding to this reality requires a shift to a perspective of investing in EI as proactive/preventative measure, rather than as an impact mitigation response (receiving system).

However, who is to bear the cost of maintenance and restoration? Finding ways to draw the private sector into innovative and participatory governance platforms, which this research has identified as being critical for water security, and to understand the way the private sector values and hence is willing to invest in EI interventions, requires urgent research as this remains a major gap in water governance and EI investment currently.

Policy recommendations

Ongoing engagement across the water sector in support of the National Water and Sanitation Master Plan is a great initiative as it refers to EI and its possible role. The re-thinking of the actual price of water and possible source of funding EI/BI is critical to avoid relying on EPWP only. Restoration is expensive, but any delays will cost the country more.

Related project:

Evidence of the value and role of the healthy natural ecosystem (ecological infrastructure) in enhancing water securing (WRC Project No. K5/2354). For more information, contact WRC Research Manager, Mr Bonani Madikizela, at

Email: bonanim@wrc.org.za