TECHNICAL BRIEF

August 2017
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.

Value chains and markets for aquatic ecosystems

A Water Research Commission (WRC) study has been completed on the value chains, markets and the actual economic value of ecosystem services.

Background

The understanding of the value chains, markets and the actual economic value of ecosystem services from aquatic ecosystems is still limited. Different studies have developed various approaches for determining the economic value of these benefits; and of the associated natural capital.

Most studies confirm that the value of aquatic ecosystems lies in the sustained net benefits derived from the many ecosystem services they supply; including various ecological functions, products for direct and indirect human consumption, energy, aesthetic and recreational benefits, and assimilative capacity of the residues of human activities. However, the geographic, cultural, and economic differences between countries or nations have resulted in different views which affect the market potential of ecosystem services from aquatic ecosystems.

This study focused on identifying key ecosystem services, their forward linkages, understanding how to improve market access to such services, and create or improve the value chains in the South African context. The research project was intended to help identify more broadly the opportunities for improvements that benefit society.

Specific aims of the study included:

- To investigate the forward linkages in the value chains of aquatic ecosystem services (AESs) and their markets in South Africa.
- To identify challenges and opportunities in the value chains of existing markets.
- To investigate the ripple effects of aquatic ecosystem services in South Africa.
- To recommend ways to improve the value chains of aquatic ecosystem services.

A **causal loop diagram (CLD)** formed the basis for presenting and analysing the value chains of AES and to graphically present the supply and user/consumer sides (including beneficiaries) of the value chain, along with the route the goods and/or services follow, in a graphical way. The work was done in two case studies.

The CLD enabled easier identification of the transactional route for each value chain which in turn enables the identification of potential inefficiencies in the chain. The consequent assessment of these inefficiencies informed the basis for recommending improvements to a market making process for AES's.

The final report presents relevant literature reviews, the methodological approach being followed to construct the CLD for AESs in a study area and the CLD itself. A scenario analysis presents the ripple effects of external shocks on the CLD and associated recommendations to improve (increase) the resilience of AESs in the study area. This information is used to argue the case for taking AESs to market, which is done by a market based approach explained in terms of a 'market making' process for a selected AES.

Study area

Causal loop diagrams (CLDs) – also referred to as influence diagrams or cognitive maps – are mostly considered to be the first stage of system dynamics modelling, the next stage would be to define the stocks and flows of the system and to quantify the interactions between elements and incorporate accompanying time delays in the system.

CLDs are a qualitative diagramming language aimed at graphically illustrating feedback-driven systems. Conceptualising a complex ecological system not only

requires a clear definition of the key elements of the system and the cause and effect relationships between these elements, but also an account of the relationship of the system with other systems. The model was used to unpack the complex natural and anthropogenic systems in the Baviaanskloof to illustrate the value chain based on land uses and impacts on ecosystems services, Figure 1.

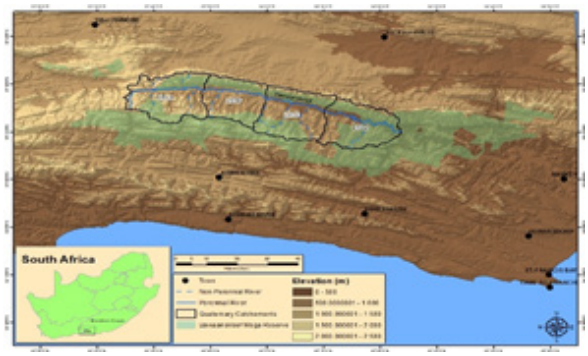

Figure 1. The Baviaanskloof Quaternary Catchments

Results

The catchment restoration CLD-scenario is a demonstration of some of the restoration activities that are currently being performed in the Baviaanskloof catchment. The Sub Tropical Restoration Programme and Working for Water are the primary proponents of these restoration initiatives. These activities include the building of weirs, river bank stabilisation with gabions and small balancing dams as well as the restoration of alluvial fans and the planting of ***Portulacaria afra ('spekboom')*** in degraded areas.

The ultimate purpose of these activities is to promote diffused flow of water throughout the catchment in order to retain as much water as possible for as long as possible.

Considering all of these restoration activities broadly, the scenario simulates the impact of increasing the surface roughness within the catchment and the associated impacts throughout the system.

With regard to water provision, the decrease in flow velocity will increase infiltration and thus increase groundwater flow while decreasing surface water flow, resulting in an ambiguous effect on water yield. Similarly, the system's ability to attenuate floods will be increased in the immediate term and an immediate decrease in sediment load is met by a medium-term decrease in dilution capacity which have opposite impacts in water quality; hence one cannot deduce the nature of the impact on water quality over a long period.

While the impacts on aquatic ecosystem health are once again ambiguous as it should improve in the short to medium-term due to decreased erosion and increase further in the long term due to increased water quality. Other scenarios, including fire, drought are detailed in the main report with clear and easy to follow cause and effect relationships, critical in land use and planning sustainable developments

Conclusions and recommendations

It is evident from the findings presented in this study that CLDs have the potential to facilitate an 'alternative' value chain analysis where traditional approaches to value chain analyses are unsuitable. Despite not being able to conduct a value chain analysis in the traditional manner, the outcomes of the scenario analyses allowed for an alternative value chain analysis to be completed that achieved the relevant goals of traditional value chain analyses.

The ecosystem service value chain analysis (ESVCA) framework as developed in this study enables the identification of forward linkages and ripple effects in individual value chains of final AESs and the identification and assessment of challenges and opportunities in the value chains of final AESs and associated markets. It also provides a framework through which progress towards understanding and integrating fully inclusive value chain analyses, which incorporate environmental processes and services, into policy and decision-making is a realistic outcome.

The model is predictive in nature and thus, allows for a proactive approach towards ecosystem management that is geared towards improving the provision of chosen AESs while increasing system understanding for relevant stakeholders and decision-makers. Private and public entities that rely on the provision of ESs have the potential to take advantage of this approach to recognise potential opportunities and threats within the value chains of these ESs.

Before the framework can be formally integrated into catchment scale management and decision-making, further research will need to be undertaken in an attempt to corroborate the findings of this study and address some of the fundamental limitations as far as possible.

Related project:
Assessing aquatic ecosystem services value chains and markets in selected catchments **(WRC Project No. K5/2341).**
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