



NEPAD Networks of Centre of Excellence in Water Sciences PHASE II

A C E W A T E R 2 P r o j e c t

2 0 1 6 - 2 0 1 9

WATER and COOPERATION within the ZAMBEZI River Basin

(WACOZA)

**WATER GOVERNANCE, COOPERATION
AND INFORMATION SYSTEMS**

Project Manual

“A Catalyst for Practical Governance”

September 2019

**NEPAD Networks of Centre of Excellence in Water Sciences
PHASE II
ACE WATER 2 Project 2016-2019**

**Water and COoperation within the ZAmbezi River Basin
(WACOZA)**

**WATER GOVERNANCE, COOPERATION AND INFORMATION
SYSTEMS
Project Manual**

Report Prepared for:

European Commission
(Joint Research Centre)
and
Stellenbosch University
International
(NEPAD SANWATCE)
Private Bag X1, Matieland
Stellenbosch 7602
South Africa

Prepared by:

Council for Scientific and Industrial
Research (CSIR)
Division: Natural Resources, Enabling
Infrastructure, Public and Professional
Services
Smart Places Cluster, Water Centre
PO Box 395
Pretoria 0001
South Africa

Contact Person:

Ashwin Seetal
Tel: +27 012 841 3477
Fax: +27 012 842 7017
Email: aseetal@csir.co.za

CSIR Document Reference Number:

CSIR/ECWA01_02/2019

Date:

September 2019

TABLE OF CONTENTS

| | |
|---|----|
| INTRODUCTION | 1 |
| PART I: BACKGROUND AND CONTEXT | 4 |
| 1.1. The Manual Perspectives..... | 4 |
| 1.1.1. Why a Manual? | 4 |
| 1.1.2. Linkages with other Project Work-Packages..... | 5 |
| 1.1.3. Contextualising Cooperation and Conflict | 6 |
| 1.1.4. Relevance of the WEFE Nexus..... | 7 |
| 1.1.5. An African Perspective | 9 |
| 1.1.6. A Living Document | 11 |
| 1.2. Literature Review | 11 |
| 1.2.1. Other Basin Information of Relevance..... | 13 |
| 1.3. Situational Assessment..... | 13 |
| 1.4. Scientific Assessments and Analyses..... | 13 |
| PART II: APPROACH AND METHODOLOGY | 15 |
| 2.1. Project Approach | 15 |
| 2.2. Science and Policy for Cooperation and Governance | 16 |
| 2.3. Selected Frameworks, Methodologies and Approaches..... | 17 |
| 2.3.1. Policy, Institutions and Governance | 18 |
| 2.3.2. Complexity and Uncertainty..... | 18 |
| 2.3.2. Adaptive Management..... | 20 |
| PART III: WEFE NEXUS IMPLEMENTATION | 22 |
| 3.1. Critical Success Factors and Fatal Flaws | 22 |
| 3.2. Governance Implementation Cycle: 5-Point Checklist..... | 23 |
| 3.2.1. Map, Analyse and Prioritise Needs, Risks, Concerns and Issues..... | 24 |
| 3.2.2. Actions Decision-Making..... | 24 |
| 3.2.3. Monitor, Evaluate and Report..... | 25 |
| 3.3. Proposals and Recommendations | 25 |

| | |
|--|----|
| 3.3.1. Development Scenarios and Implications..... | 25 |
| 3.3.2. Technological Support Systems | 26 |
| 3.3.3. Supporting Water Use Allocations, Control and Management Systems..... | 26 |
| CONCLUSIONS AND WAY FORWARD | 27 |
| BIBLIOGRAPHY..... | 29 |

INTRODUCTION

In 2016, members of the Southern Africa Network of Water Centres of Excellence (SANWATCE) identified the Zambezi Watercourse as a case study area because it is highly representative of Southern African River Basins in terms of water management (quality and quantity), water-agriculture (food)-energy security and ecosystem value covering a wide spectrum of scales and issues.

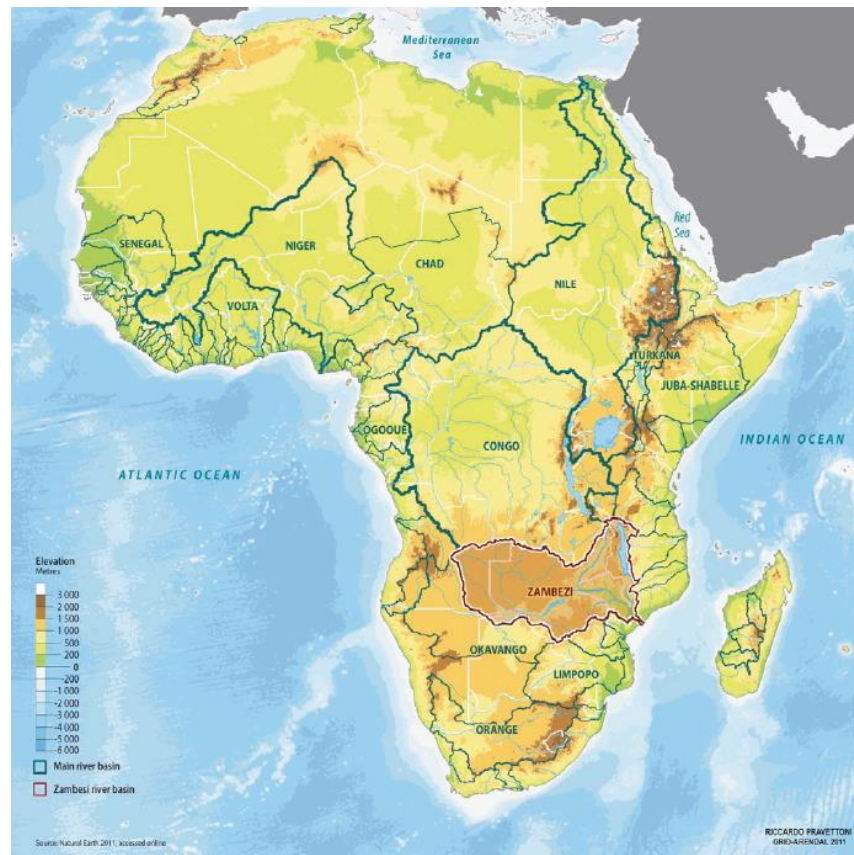


Figure 1. The Zambezi Watercourse in relation to other major river basins in Africa (Source: *Zambezi Environment Outlook*, 2015)

The transboundary Zambezi Watercourse, the fourth largest one in Africa (after the Nile, Niger and Congo)(Figure 1) and second largest in the SADC Region, presents many challenges from the perspective of Water-Energy-Food-Ecosystem (WEFE) nexus issues. Among others, these include: hydropower; reservoir multipurpose optimisation and release management; rain-fed and irrigated agriculture development; the impact of land use and agricultural practices (including livestock and fisheries); the role of ecosystem services (natural parks, wetlands); pressures on resources due to population increase and rapid urbanisation; and, climate variability/change and extreme events risks (drought and flooding). The challenges pose a significant challenge in how to address them individually and collectively at various scales within the watercourse. Left unattended, these issues would be a potential source of conflict. Conversely, well formulated and proactive interventions to address issues, in a manner which benefits affected parties, can also become a good basis for mutual cooperation among the various role-players.

Historically and traditionally at local levels, management of water resources was generally successfully undertaken based on indigenous knowledge systems (Mwenge Kahinda *et al*, 2019). Although there would be various localised competing demands for water resources across the entire basin, the extent and magnitude of the demands could be more easily managed and contained. However, in the current increasingly modern and globalised environment, with its attendant complexities and higher magnitude competing national and sectoral demands, local management approaches, while still relevant, have become inadequate for water resources management (WRM) at the larger, particularly national and basin-level geographic scales.

Scale-appropriate cooperation and governance systems therefore become imperative and are critical success factors in addressing water resources and associated issues and challenges in the Zambezi Watercourse, which has substantial socio-economic development potential. Through the Zambezi Watercourse Commission (ZAMCOM), relevant systems and structures have been developed. These are coupled with operational recommendations and implementation approaches, which are presented in several documents and reports.

This manual assesses the range of factors at play in the Zambezi Watercourse including the current governance approaches, structures and practices. It uses the scientific assessments from the ACEWater 2 Project, and further analyses the science in relation to socio-economic demands and socio-political expectations to inform water management and governance within the Zambezi Watercourse. The intention is for objective scientific evidence and facts to provide a basis upon which river basin management can be undertaken, providing member riparian states with credible scientific evidence and information upon which to premise development decisions for their individual (national) and collective mutual (multi-national) benefit. Where appropriate, the manual identifies gaps and makes recommendations to address these in order to enhance the current cooperation and governance approaches and initiatives. Its primary focus is to enhance the effectiveness of implementation and operationalisation of current governance approaches at their respective scales within the Zambezi Watercourse.

From the afore-going and for ease of reference and use, the manual is structured as follows:

INTRODUCTION - how and why the Zambezi Watercourse was selected for this study and sets the scene for water resources governance, cooperation and conflict.

PART I: provides the overall background and context to the study and the rationale and approach to compiling the manual.

PART II: presents the approach and methodology used in compiling the manual. This includes a Literature Review which focused mainly on literature published by ZAMCOM, although other documents and reports of relevance were also examined. A Situational Assessment was also undertaken as a high-level *status quo* analysis of the spectrum of factors that impact on cooperation, conflict and governance in the Zambezi Watercourse.

PART III: examines and proposes some implementation considerations. It includes: Critical Success Factors and Fatal Flaws - which identifies the key issues that require attention and the nature of their potential impacts, either beneficial or conflictual; A Six-Point Implementation Checklist - that provides primary indicators against which the effectiveness of governance implementation actions may be measured to mitigate conflict or enhance cooperation and governance; and, Proposals and Recommendations - indicates what steps would contribute to initiating or sustaining interventions relation to enhancing governance and strengthening cooperation.

CONCLUSIONS - summarises the key outcomes from this work package assessments and articulates some final thoughts regarding water and development in the Zambezi Watercourse.

PART I: BACKGROUND AND CONTEXT

As indicated above, the Zambezi River and its tributaries form the fourth largest river basin in Africa and the largest in SADC with a total basin area of 1,37 million km³ (Figure 2). It extends through eight (8) of the sixteen (16) SADC countries which are Angola, Botswana, Malawi, Mozambique, Namibia, Tanzania, Zambia and Zimbabwe. Almost all of Malawi, most of Zambia, about half of Zimbabwe, significant areas of Mozambique and Angola, but only minor areas of Tanzania, Botswana and Namibia occur within the basin (SADC-WD *et al*, 2008).



Figure 2. The Zambezi River Basin showing its sub-basins and riparian states. (Source: *Zambezi River Basin – Atlas of the Changing Environment*, 2012)

1.1. The Manual Perspectives

1.1.1. Why a Manual?

The manual purpose is to support enhanced cooperation and governance in water resources management in the Zambezi Watercourse at a basin level, by consolidating information and data and analysing these and other factors that support the enhancement of basin-wide governance and cooperation. Structural and functional gaps and potential flashpoint issues are flagged for attention and examples of mutual agreement and cooperation highlighted and showcased. Accordingly, Articles 5, 12, 13 and 14 of The ZAMCOM Agreement have a direct bearing on the purpose of this manual.

As part of the ACEWater2 Project, the manual gives effect to the WEF scientific assessments and analyses in order to enhance management and cooperation, to minimise or mitigate conflict where it currently exists, or to obviate conflict or the potential for it where the possibility/likelihood exists. Complementary to the manual is the development of a predictive tool within the project, the "Water Cooperation and Conflict Atlas" which has the capability

to map areas of potential conflict at different intensities (Farinosi *et al*, 2018). The precursors of conflict may, in many cases, not be water itself and may relate to land rights, access to water for domestic or commercial purposes, interruptions to or shortages of supply among others. Nevertheless, these conflicts have the propensity to upset the WEFE Nexus equilibrium and a predictive tool is important for maintaining nexus stability through proactive and preventative governance interventions.

The manual ambition is both as a WEFE governance reference checklist and a planning guide for extension work to enhance governance, support cooperation and mitigate conflict. During its preparation, it drew on references from both scientific and grey literature sources in order to enhance its value proposition as a practical document that will support extensive and sustainable WEFE Nexus implementation through a diffusion of WEFE understanding in the Zambezi Watercourse. It must be noted that while the manual focal point appears to be water resources governance, its applicability cuts across the energy and food/agriculture and land governance domains. Water, as the only natural resource of the three nexus focal points, is a powerful catalytic agent and integrator for nexus governance. Accordingly, equal emphasis must be given to integrating water, energy and food security in all nexus governance actions.

Regarding the document written style and lay-out, the manual is not a conventional scientific document, nor is it a popular magazine in the true sense of both these types of documents. Although having a scientific basis, it is best described as a synthesis document, drawing its inputs and insights from various scientific and related sources and presenting these in a popular format intended for wider readership and user appeal.

1.1.2. Linkages with other Project Work-Packages

The current ACEWater2 Project examines WEFE nexus interdependencies in the Zambezi Watercourse through reviews and scientific analyses and evaluates sustainable bridging-gap solutions for specific WEFE scientific issues. The scientific baseline from this project will contribute to ZAMWIS and is intended to complement and support enhanced water cooperation and governance, which is the primary purpose of this work package.

The project contributions provided the scientific basis for assessing the adequacy of existing governance approaches to current WEFE issues, and served to inform future governance and policy recommendations. Other current and earlier work in the Zambezi Watercourse was also reviewed for relevance to the manual.

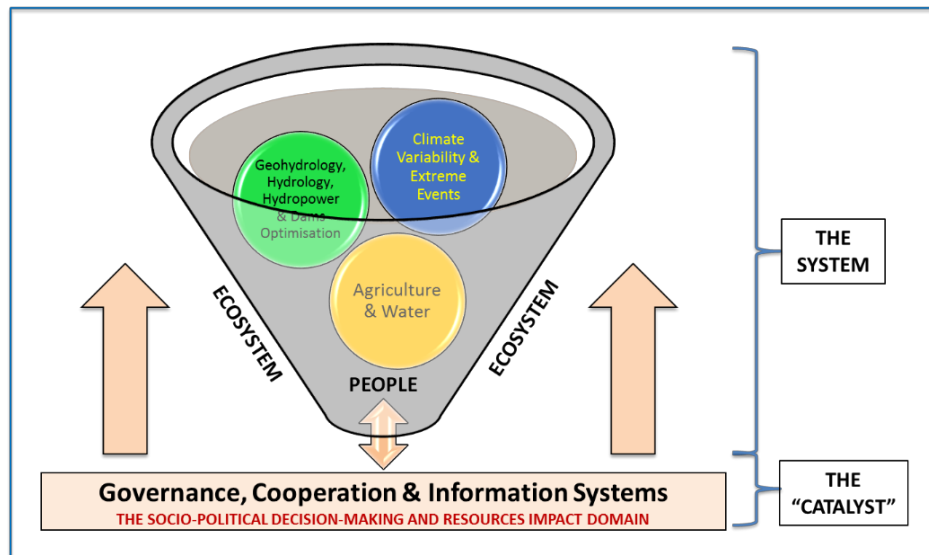


Figure 3. Inter-relationships among the work packages within the ACEWater2 Project.

It is envisaged that for future phases of the project, a further set of activities will be developed for implementation by regional scientific institutions and countries with contributions from, and supported by, the ZAMCOM Water Information System (ZAMWIS) resulting in its further improvement. Accordingly, ZAMWIS provides the scientific baseline, as well as scenarios and tools for decision making regarding water, energy and agricultural management within the river basin. It is the repository and point-of-reference for all decision-making information and data.

1.1.3. Contextualising Cooperation and Conflict

The global importance of water cannot be overstated; it is crucial for all life and important for human socio-economic wellbeing; hence its value is seen from the context as an environmental, social and economic good. The well-being of human society through the ages has been dependent on secure sources of water; conversely, its absence has seen the demise of often well-established societies. Equally, where different societies depended on water from a common source, this would result in competition when water was limited or in times of scarcity, which could escalate into conflicts among the competing parties. However, there are also many recorded instances of cooperation between competing societies for common water resources with little evidence of armed conflict for water itself, including in Africa (Ashton 2002 and 2007; Wolf, 1998 and 2009).

In recent times, but particularly since 2012, the World Economic Forum has tabled the global risk of water as a generally limiting resource in terms of its availability for social and economic well-being, a situation that continues to deteriorate because of the ever-increasing demands of modern society (population growth, urbanisation and technology changes), further exacerbated by climate changes (World Economic Forum, 2019). The concomitant potential for conflict for water where its availability is limited therefore cannot be understated, nor underestimated.

In this regard, the Zambezi Watercourse is an ideal basin in which to examine current practices and assess future socio-economic development proposals and prospects regarding WEFE demands in relation to water governance, cooperation and conflict, given the substantial socio-economic development possibilities and potential that exists for its growth and prosperity trajectory.

1.1.4. Relevance of the WEFE Nexus

The general assessment from the 3rd ZAMCOM Stakeholders' Forum held in Lilongwe, Malawi in October 2018 was that the SADC WEFE Nexus Conceptual Framework presented by Mndzebele (2018) had both pros and cons. Beukman (2018), in the following presentation, contextualised these in relation to the nexus institutional arrangements for implementation as follows (square bracket text is for emphasis or clarity of the point):

- “Dreams versus Realities”, i.e. the nexus idea and concept [dream] as opposed to on-the-ground existence [realities] for individuals and communities;
- Integrative, holistic approaches and the nexus are a continuation of, and building on, integrated environmental management (IEM), integrated water resources management (IWRM). The focus is on ‘why the Nexus?’ rather than considering its value addition and specific [beneficial] development outcomes;
- The SADC water agenda of “for...with...together” [to foster inclusivity];
- Development is water centric [as is nexus research];
- A prevailing silo approach relating to structures and policies and policy implementation. There is a requirement for the coordination and alignment of integrating mechanisms and processes; and,
- The absence of overall resourcing coordination to ensure sustainability.

With regard to governance mechanisms, a SADC WEF Nexus Working Group would be critical in driving the WEF Nexus agenda at all levels (NEXUS - The WEF Security Resource Platform, 2018). This would detract from the perception of the WEF Nexus concept as an “elitist, academic or theoretical concept” for the majority of people in the Zambezi Watercourse; a concept having little or no direct relevance or benefit to their daily lives. Despite this, there was also a desire by all stakeholders and roleplayers present at the forum to promote the concept as one with tangible and enduring benefits to the majority population resident in the watercourse, as shown in Figure 4.

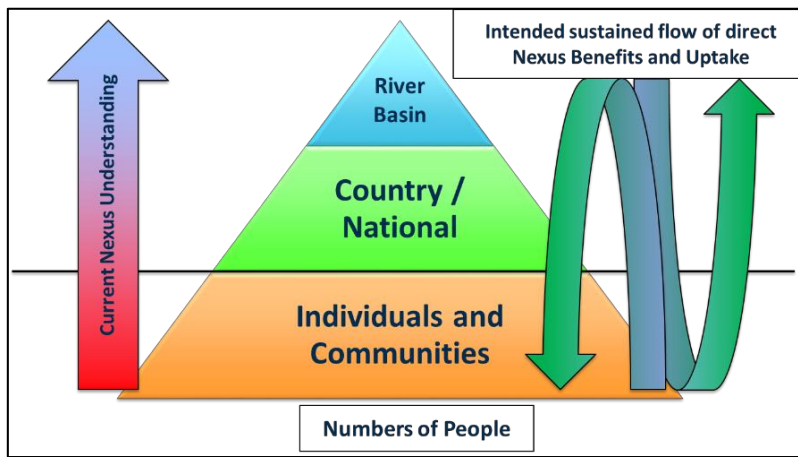


Figure 4. Current Nexus understanding (red-blue arrow) and the intended potential for sustained direct benefits and uptake of interventions at all geographic scales.

The keynote speech at the forum touched on historical, current and potential future issues relating to WEF Nexus challenges and opportunities for the Zambezi Watercourse. The individual sovereign state issues and its implications for the collective basin progress, as well as a wide range of related matters were comprehensively critiqued in the paper presented as part of the keynote speech (Swatuk and Tang Kai, 2018). Together with other related ZAMCOM documents, including the most recent Strategic Plan for the Zambezi Watercourse: 2018-2040 (2019), most of the issues are directly applicable to this manual and will not be repeated unless these have a direct bearing on the manual actions.

At the Southern African regional scale, there are many source and reference documents that have researched and discussed the WEF Nexus, either specific aspects or more generally. The SADC WEF Nexus Conceptual Framework is illustrated in Figure 5.

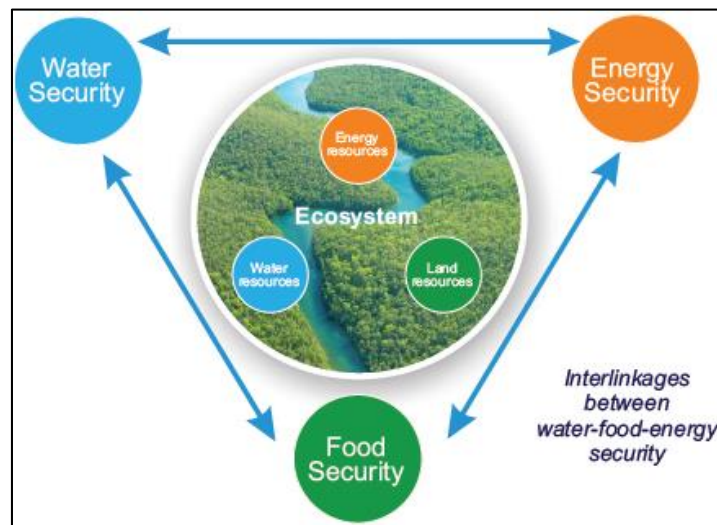


Figure 5. SADC WEF Nexus Conceptual Framework (SADC Factsheet, 2019).

Recent WEF-relevant activities and publications in the SADC region include the following, among others:

- Preparation of a SADC Nexus Operational Framework (commissioned in May 2018, for completion in 2019);

- SADC Ministers, at their Joint Meeting held in Namibia on 24 May 2019, urging member states to set up coordination mechanisms for Nexus initiatives in their respective countries and directing the SADC Secretariat to fast-track development of the Nexus Framework;
- The 9th SADC Multi-Stakeholder WEF Nexus Dialogue held in South Africa in March 2019 with the theme: “Promoting the Water-Energy-Food Nexus Approach and Youth Empowerment for Sustainable Development”. The dialogue background paper clearly articulated WEFE opportunities and challenges in the region and highlighted the need for youth engagement in WEFE and sustainability matters;
- A report to the South African Water Research Commission titled “Assessing the State of the Water-Energy-Food (WEF) Nexus in South Africa” (Mabhaudhi *et al*, 2018) which established that there are many models, tools and indices available to evaluate and quantify the WEF Nexus. However, these must be modified to be applicable to particular situations;
- Luxon *et al* (2018) in their research on the WEF Nexus and examining climate risks and opportunities in Southern Africa found that WEF Nexus challenges are generally similar in nature and an integrated approach at the regional level (SADC) would enhance opportunities and may bring the desired security and sustainability outcomes;
- Similarly, Mabhaudhi *et al* (2016) found there was a gap in water and energy sector planning in terms of policy alignment and technical convergence in the region. This hinders the delivery on socio-economic goals and impedes regional integration, while a more coordinated water-energy nexus focus would stimulate economic growth, alleviate poverty and reduce high unemployment rates; and,
- A review of regional and international literature by Mpandeli *et al* (2018) on climate change adaptation opportunities and challenges in Southern Africa from a WEF Nexus perspective which established that the WEF Nexus approach had merit in increasing the resilience of marginalised communities in the region by contributing towards attaining the Sustainable Development Goals, particularly SDG 1, 2, 3, 6, 7 and 13.

Many researchers have made constructive and valuable proposals and recommendations for approaches and frameworks in support of nexus implementation, usually at fairly coarse geographical and community scales. Few, if any, undertake a deep-dive to address practical WEFE nexus understanding and implementation at individual and grassroots community levels.

1.1.5. An African Perspective

Despite the extensive research and analyses undertaken in the water sector across the African continent and a consistent theme of generally well-articulated regional, national and even basin-level WEF Nexus policies and governance structures, a long-standing and enduring gap is the translation of these approaches, frameworks and policies into tangible benefits for the majority population nationally and in river basins. The Zambezi Watercourse is no exception. This may be described as the “Africa Conundrum” (Figure 6) and is well demonstrated in the continent’s sub-Saharan region having the poorest water and sanitation service delivery track record when compared to other regions globally.

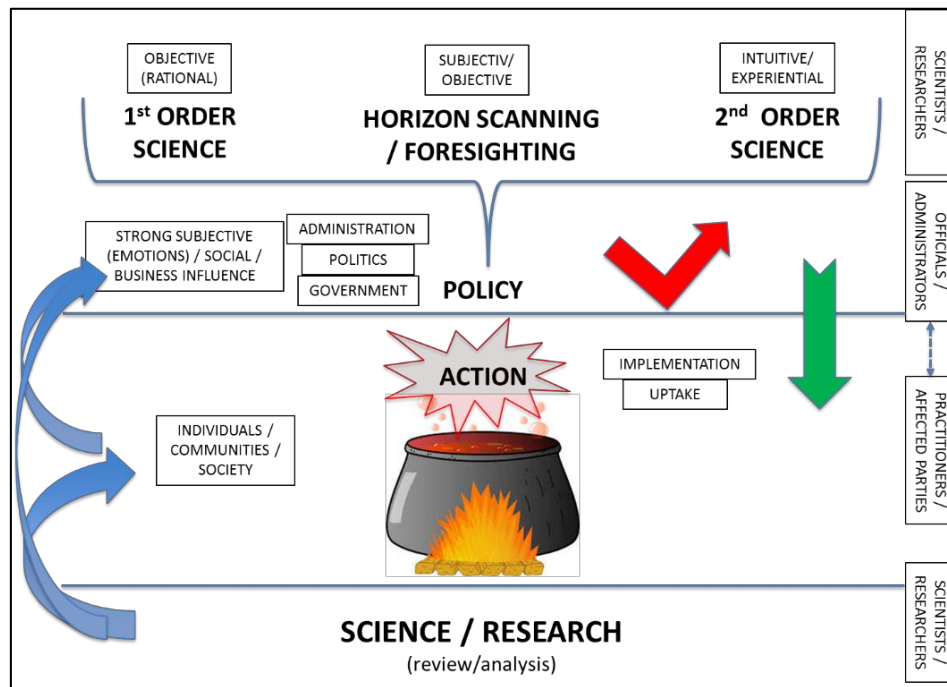


Figure 6. The African “Conundrum” depicts the science-policy-action relationship in many country situations (all the blue arrows). The intended translation of science and policy into action with tangible community benefits (green arrow) is currently often not realised (red arrow) beyond the policy domain.

From a practitioner’s perspective, the structural and analytical attributes of governance are addressed in the Zambezi Watercourse, although this may not be optimal. The weakest link lies with implementation and relates to a lack of adequate and competent human and sufficient material resources, and sustained funding. The key human resources responsible for implementation, shown in the vertical blocks adjacent to the green arrow in Figure 6, labelled “officials/administrators” and “practitioners/affected parties” are those that operate in the implementation action arena described in the Ostrom IAD Framework discussed in section 2.3.1. A deviation from the framework is that in practice, policy reform generally follows the situational context in Africa.

A recent study undertaken by Mwenge Kahinda et al (2019) has also provided evidence of the role and value of traditional and indigenous practices and knowledge systems in adapting to and resolving water resources management issues at local levels, particularly in times of difficulty (drought, floods, resource protection and sustainable use). While this has not been dealt with comprehensively in this manual, it warrants further investigation regarding the merits of this second order science in WEF nexus governance at local levels (see Figure 6). Where best practices are identified, the prospect of upscaling and mainstreaming these may also justify further attention.

The Zambezi Watercourse is the subject of much recent attention and investment focus, with commercial and research interests. While this is generally welcomed, a lack of coordination of the investments and activities would serve to destabilise efforts to have a coherent approach to realising the overall vision for the watercourse, as articulated in the ZAMCOM Agreement. Situations may also manifest, particularly where investing individuals or organisations (external and internal) are tempted beyond any philanthropic interests in the watercourse.

This will detract from the achievement of the watercourse vision and potentially set the basis for possible corrupt practices and corruption.

A document prepared by Transparency International, a global coalition against corruption, describes the impact of corruption on access to safe water and sanitation for people living in poverty (U4 Helpdesk, 2017). Agreed value systems and adequate measures in the form of monitoring vigilance and accountability provisions within the agreed governance frameworks would serve to proactively offset the likelihood of such eventualities, encourage principled behaviour and enhance the integrity of implementation processes in the watercourse.

Lastly, the abundant natural (including mineral) resources and largely unrealised human capital wealth of the Zambezi Watercourse confer strategic advantages to its potential future prosperity if appropriately harnessed. With the ZAMCOM shared vision, amalgamation of resources and galvanization of effort, there is much promise in realising the NEPAD Agenda 2063 and the vision for the Zambezi Watercourse.

1.1.6. A Living Document

This manual cannot be a “static” document with its potential value suspended only at this particular point in space and time. The dynamics and circumstances in the Zambezi Watercourse will continuously change at all scales, whether these changes are accidental or planned. In order for the manual to remain practically relevant and responsive to such changes, it must also be regularly reviewed and updated at least every five years as a minimum. Ideally, this should be done concurrently with the review of the ZAMCOM Agreement and specific action plans as part of the Agreement’s “adaptive and cycle planning and implementation”. ZAMCOM, at the basin-scale, would ideally be the institution responsible for this overall cyclical review process.

1.2. Literature Review

There is a huge body of knowledge and scholarly work relating to water sector governance, cooperation and conflict. This posed a substantial initial challenge with the compilation of the manual for several reasons:

- Firstly, the selection of appropriate references from this vast body of knowledge that would be of direct relevance to the Zambezi Watercourse, for a desk-top level study;
- Secondly, given this backdrop of extensive information and scholarly work, all of which had some degree of relevance and application in the Zambezi Watercourse, how could the manual be configured to be a unique and directly relevant document for the Zambezi Watercourse through ZAMCOM, and specifically applicable to it; and,
- Thirdly, there are varying temporal, geographical, cultural, socio-economic and political nuances across the basin among the eight sovereign basin states as well as within each of these. Any recommendations from the literature sources for governance, cooperation and conflict mitigation had to accommodate this variety of basin dynamics.

Following from the above, documents published by ZAMCOM were the primary focus for the literature review. How these related to ZAMCOM’s role and performance in matters

governance were then categorised according to the institutional delineation into its Programming Clusters and general communications and information documentation (Figure 7).

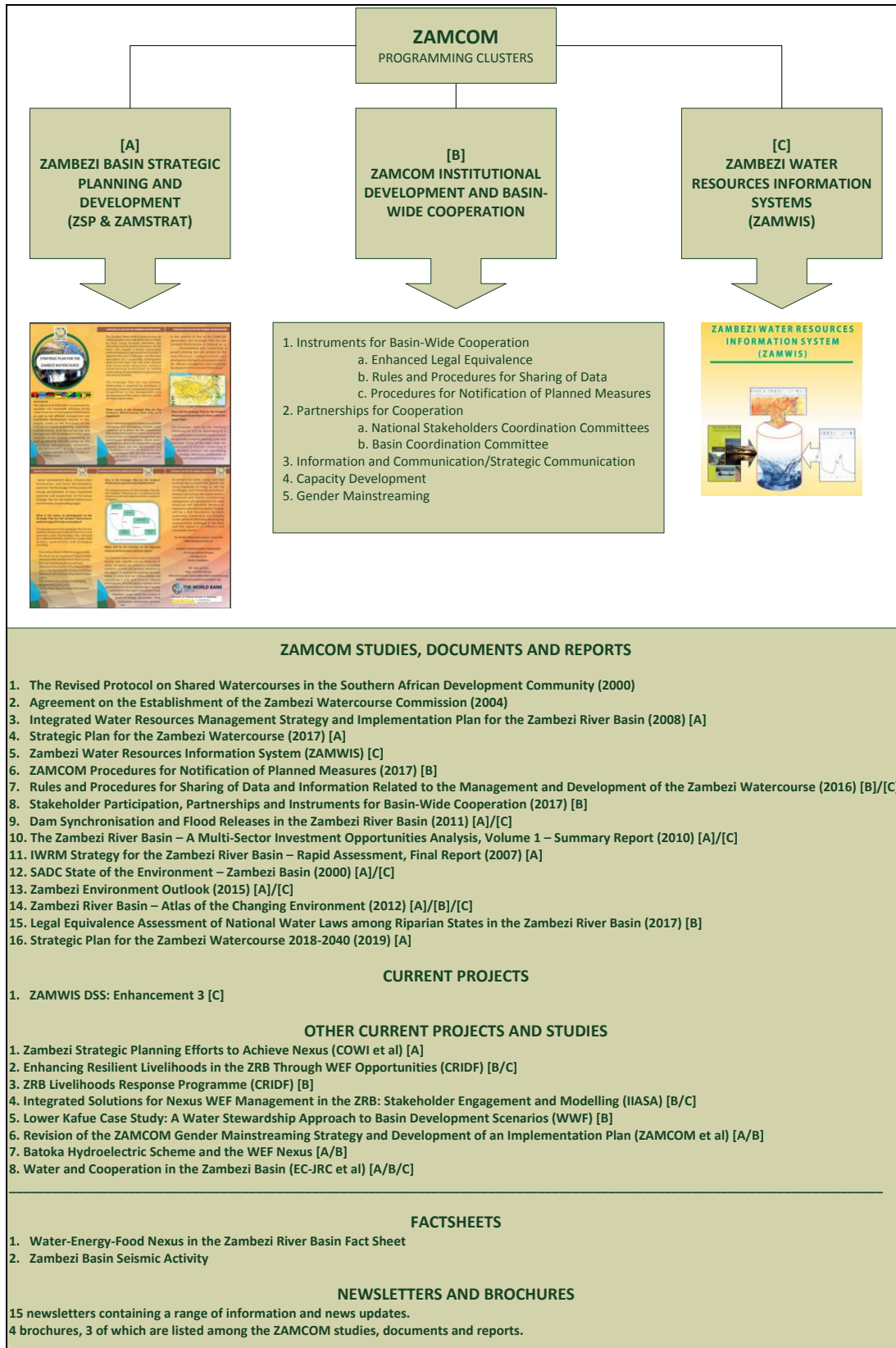


Figure 7. An inventory of ZAMCOM documents arranged according to its relevance and applicability to the three Programming Clusters. The figure requires updates as ZAMCOM documents are revised, projects completed and further studies commissioned.

1.2.1. Other Basin Information of Relevance

There is an extensive array of reports from research, studies and projects undertaken in the Zambezi Watercourse. Many provide valuable insights into different facets of the watercourse and could run the risk of the work being repeated if not easily available nor accessible. These would be a valuable addition to ZAMWIS.

As an ongoing exercise, information, documents and reports will be collected and an inventory prepared, again arranged to reflect their relevance to the three ZAMCOM Programming Clusters.

1.3. Situational Assessment

This section has recently been superseded by the ratification and publication of the Strategic Plan for the Zambezi Watercourse 2018-2040 (SPZW) in April 2019.

The Strategic Plan comprehensively examines and details all facets of the Zambezi Watercourse including the Institutional Context, Current Situation, Identification of Future Options, Platform of the Strategic Plan, the plan Components, Institutional Requirements, Financing, Implementation Planning and Monitoring and Evaluation. Accordingly, it renders the earlier situational assessment of the manual redundant.

1.4. Scientific Assessments and Analyses

Following the commencement and completion of the scientific assessments and analyses of the various ACEWater2 Project work packages, a template was sent to project team members to provide an indication of the risks identified from each particular work stream. Although the information provided is indicative at this stage, further investigation into each issue will give greater clarity and insights into the nature, likelihood, severity, impact, duration and spatial scale of the issues identified.

Table 1 provides a consolidated itemised list of some identified issues and their risk assessments. These are very brief indications at this stage and the risk assessment process will require further commitment from the teams to review in greater detail.

Table 1: ACEWater2 Project scientific assessments of Zambezi Watercourse risks

| Risk No. | Issue / Activity | Likelihood (high/medium/low) | Severity (high/medium/low) | Impact (high/medium/low) | Duration (long-, medium-, short-term) | Spatial Scale (localized, sub-catchment, basin-wide, etc) | Any Other Comments (e.g. level of confidence) |
|---|---|--|--------------------------------------|------------------------------------|---|---|--|
| Work Package: Groundwater Hydrology Characterisation | | | | | | | |
| 1 | Transboundary aquifer exploitation | High | Medium | High | Long | Basin-wide | Difficult to monitor |
| 2 | Transboundary aquifer pollution | Medium | High | High | Long | Basin-wide | Difficult to monitor |
| 3 | Poor groundwater quality | High, on-going | High | High | Long | Localised | Regular monitoring required |
| 4 | Lack of good data availability (groundwater quality and quantity) | High, ongoing | High | High | | Basin-wide | Monitoring programme required |
| Work Package: Dams for Hydropower | | | | | | | |
| 5 | Dams for hydropower | High | High | Medium | Long | Basin-wide | Cannot expand. Will not grow with economy |
| 6 | Hydropower generation | High | High | High | Long | Focused | Has a ceiling. May impact on economy |
| 7 | Data for modelling and management | High | High | High | Long | Basin-wide | Will need dedication from SADC |
| 8 | Effects of Climate Change on Hydropower | High | High | High | Long | Basin-wide | Will need learning from other river basins and very organized database to study all processes. Data sharing and accuracy are crucial |
| Work Package: Climate Variability Assessment | | | | | | | |
| 9 | Climate data availability | High, on-going | Medium | Medium | Long | Local data, Basin-wide | Regular monitoring required |
| Work Package: Hydrological Modelling | | | | | | | |
| 10 | Flow data records | High, on-going | Medium | Medium | Long | Local data, Basin-wide | Regular monitoring required |
| 11 | Wetland-River Channel exchange dynamics | Medium, on-going | Medium | Medium | Long | Basin-wide | |
| 12 | | | | | | | |

PART II: APPROACH AND METHODOLOGY

The ambition in the compilation of the manual was to develop a concise and practical document that would differ from other similar documents in being uncomplicated but comprehensive enough to address critical knowledge areas; practical yet stimulating intellectual discourse; and, consolidating applicable thought-pieces relevant to the Zambezi Watercourse.

This manual is **NOT** an attempt to provide an exhaustive or comprehensive analysis of water cooperation and governance theories and frameworks. Neither is it an academic or theoretical treatise on cooperation and conflict and the respective impacts of each. At this stage, it is also not an analysis of the current status of cooperation and conflict at various/different scales (geographical and temporal) within the basin.

The manual is a practitioner's perspective on governance, with a developmental and African nuance. Based on experience, it examines and proposes practical possibilities relating to what may or may not work to support Nexus governance and cooperation. The underlying intention is for Nexus impacts to translate into grassroots benefits to the current 40 million population in the Zambezi Watercourse and for future generations. It is selective about critical or key governance elements which, adequately addressed can enable multiple benefits (critical success factors or enablers). Equally, if not given sufficient attention, potential enablers may be governance fatal flaws (disablers).

The importance of intangible elements (and not just hard facts and research evidence) in the governance paradigm must not be underestimated nor undervalued. Intuitive and experiential knowledge, including Indigenous Knowledge Systems (IKS), is as important as empirical data and information; sometimes more so than is often appreciated.

2.1. Project Approach

Despite an extensive literature reference base on water governance, cooperation and conflict, and to ensure that the manual remained practical and enduring for its long-term reference and field use, certain key factors and principles were identified as the foundation requirements for governance, cooperation and conflict mitigation. Supplementary to the manual, these should be aligned to practical examples or case studies of typical practice to demonstrate the principle or factor. It would also allow for potential future and progressive updates or revisions of the manual using examples from the Zambezi Watercourse itself, as the basin progressed in its development.

It must also be emphasised that lessons are drawn from both successes and failures in governance, cooperation and conflict, particularly where these experiences have some resonance with the Zambezi Watercourse set of dynamics. These are invaluable for a critical analysis of what works and what does not, i.e. leading to recommendations for best- and worst practice! This latter provision has merit in making an allowance for practitioners and

researchers to have a common space for collaborative investigation to add to and enrich future editions of the manual.

2.2. Science and Policy for Cooperation and Governance

The role of science in policy making is an important starting point for all governance and cooperation initiatives. However, the science policy interface is often shrouded with uncertainty regarding the nature of the interplay between them; there is first-order empirical science, second-order experiential and intuitive science and future science. The question of which science is more relevant is a moot point, although there is no reason why all three should not have relevance, particularly in the African policy and governance context which has a strong traditions base.

Hodgson (2010) indicated that the current policy formulation required more than knowledge from scientific evidence to improve its effectiveness and that other aspects such as ethics, aesthetics or a view of the future were also required. In particular, futures thinking is not part of normal science. Thus, unless there was a clearer understanding of the interplay between objective science and subjective human judgement, the contradiction between evidence-based and practical policy making would remain. The manifestation of this contradiction has been evident from the suspicion and approach taken by some governments where in extreme cases, the science-policy interplay becomes undiscussable since policy is about power and agendas (hidden or obvious).

More recent indications by Hodgson and Leicester (2017) are that evidence-based approaches of policy and decision making used in government were increasingly falling short of the complexity, uncertainty and urgency of needed decision making. This was also the view of practitioners in policy and facilitators of change in society, whose intellectual concepts were strongly grounded in experience.

It is clear that the question of decision-making and policy formulation in practice is underpinned by factors which are all equally important rational (first-order, empirical science), those which cannot be reduced to rationality (second-order experiential/intuitive science) as well as future perspectives in the form of horizon scanning and futures thinking. While the latter two may not conform to the definition of conventional science, all three must nevertheless be treated in a scientific manner. In the African situation, Fourie (2018) showed that there is now an understanding that the use of research evidence in the implementation of development goals and agendas is not merely a technical processes. This applied to the millennium development goals and relate to the current sustainable development goals and water-energy-food-ecosystem nexus.

Fourie (2018) noted six barriers that make it difficult for African states to use research for policy:

- The **complexity of evidence** where researchers regard scientific papers as the most important form of evidence whereas policy-makers rely on practical knowledge and

political understanding. Furthermore, comparative scientific evidence on the same subject may often be contradictory and with different methodologies, perspectives and ideologies;

- An **absence of personal relationships** or direct engagement between researchers and policy-makers. This is identified as a key barrier, since strong personal relationships are important for the uptake of research evidence. Equally, weak relationships manifest in poor impact research and the timeframes for investigation. Furthermore, the use of technical and scientific terminology would exclude non-academic partners by excluding them from the knowledge creation process;
- Different **timeframes** between research and policy-making. Long and extended timeframes for peer-reviewed research do not synchronise with the urgency of policy formulation responding to sometimes pressing societal challenges and are often a barrier to research uptake;
- The perceived absence of research relevant to policymakers resulting in **irrelevant research**. This ties in closely with the manner in which the research is communicated where scientific norms, conventions and language may detract from the practical relevance of the research, as well as its implementation.
- A number of policy-making institutions, particularly government, lack the **analytical capacity** to analyse, interpret and support the uptake of research evidence. This is exacerbated when there are time pressures and excessive volumes of evidence available to them; and,
- Policy makers often have **budget constraints** and evidence-based policy interventions can be very expensive.

Notwithstanding these six barriers, Fourie (2018) has indicated that building relationships between policymakers and researchers based on expertise and mutual respect is a good response to overcoming the barriers. He further notes that “it is now understood that the use of research evidence isn’t merely a technical process” which is why the United Nation’s 2030 Agenda emphasises the importance of creating partnerships.

2.3. Selected Frameworks, Methodologies and Approaches

There are a myriad of frameworks, methodologies and approaches to water sector governance, cooperation and conflict, including some specifically for the Zambezi Watercourse. This study did not undertake an intensive nor exhaustive investigation or analysis of this extensive pool of information. Presented below are those which were chosen as being the most relevant during the development of this manual, particularly in relation to addressing the issues described throughout the manual: the science-policy interface and its impacts, Africa-relevance, issues of temporal and geographical scale and addressing complexity and uncertainty. The focus is on governance, complexity and uncertainty and Africa-relevance.

2.3.1. Policy, Institutions and Governance

The Ostrom Institutional Analysis and Development (IAD) framework and Rational Choice Model relating to governance effectiveness was deemed very relevant by the manner in which the framework disaggregates and examines the various components relating to policy, institutional formulation, structure and performance (Mcginnis, 2011; Ostrom, 2009), as illustrated in (Figure 8).

Its value to the Zambezi Watercourse is in specifying institutional performance in complex environments, particularly relating to action and impact or outcomes. Simplistically put, as shown in Figure 8, the “actor” (a decision-maker at any particular institutional level) analyses possible outcomes from collective choice situations in the “action arena” and implements these. In such situations, the “actor” is influenced by institutional arrangements, the socio-economic conditions and the physical environment.

While the model in (Figure 8) has been reconfigured to be more representative of the African reality relating to policy reforms being preceded by the situational context, the remaining components of the model provide excellent impact-associated role and performance definitions many of which could provide monitoring, evaluation and reporting indicators. When applied to the ZR Zambezi Watercourse B, components comprising the model can be translated into defined performance indicators and agreements among the various “action arena” roleplayers.

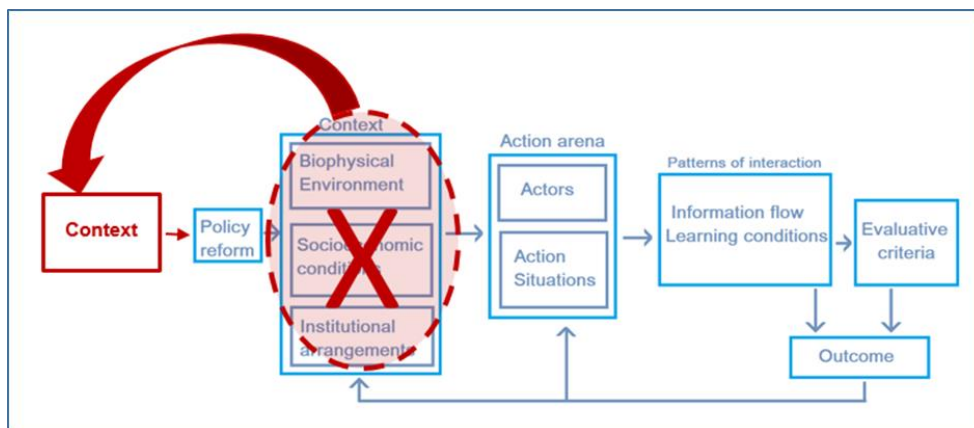


Figure 8. Ostrom’s Rational Choice Model illustrating the Institutional Analysis and Development Framework components, re-arranged to reflect a generalised African situation where policy reform usually responds to the situational context (adapted by Seetal, 2018 from the original diagram by Anupmehra, 2015).

2.3.2. Complexity and Uncertainty

The notion of complexity and uncertainty in dynamic systems is an irrefutable facet of natural systems and existence. This has become more apparent and is increasingly acknowledged with the recognition of the inter-connectedness and uncontrollability of many systems in modern society, irrespective of whether the situation is in the developed or developing world. The water-energy-food-ecosystem (WEFE) nexus and its inward and outward linkages are an excellent representation of this complexity. When coupled with climate change predictions, this complexity has the added and increased dimension of uncertainty.

Existence and co-existence requires unconventional attitudes and measures in order to engage and live in such situations of complexity and uncertainty. The Zambezi Watercourse is no exception and holds much promise in shaping and defining practical approaches to dealing with inherent and imminent dynamic complexity and uncertainty within the watercourse. This must manifest in a manner that provides benefits and security to the overall population within the basin. For the purposes of this manual, the manner in which complexity, ambiguity and uncertainty are addressed become important from the perspective of practical governance to provide the much needed benefits and security.

Systems thinker and complexity activist Wahl (2017) proposes “*we would do well to understand that any perspective - no matter how transdisciplinary or inclusive, no matter what science, research or philosophy supports it - is a limited view of underlying complexity. We need to let go of our cultural obsession with prediction and control and instead develop the wisdom and humility to sit with multiplicity, celebrate ambiguity and befriend uncertainty*”. The linkages between individual and collective responses to deal with complexity and complex systems are illustrated in Figure 9, which shows a number of scientific sub-fields addressing different aspects of complex systems. Several of these disciplines and approaches have already been applied in the Zambezi Watercourse.

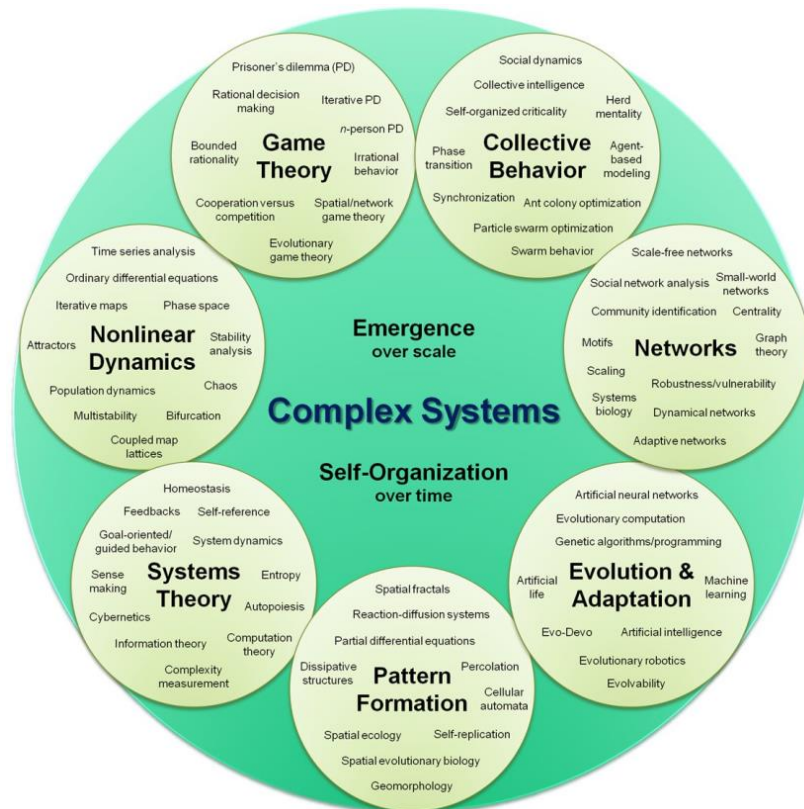


Figure 9. Organizational map of different scientific sub-fields that deal with the study of complex systems (Wahl, 2019 with graphic by Sayama, 2010)

Wahl (2019) indicates that the purpose of science should be to improve our ability to understand the dynamics and relationships of systems rather than to attempt to predict and control them, which would make our participation more appropriate.

2.3.2. Adaptive Management

Since the late 1990's adaptive management has been gaining recognition as a method having merit for water sector governance. This was primarily because of the complexity of water ecosystems and the absence of certainty regarding the eventual or possible outcomes and impacts of choices and decisions made in managing water resources, particularly in the medium- to long-term. Furthermore, at this time, the potential for climate change impacts on water resources started to emerge and added another layer of complexity and uncertainty. From a practical perspective, the likelihood of water sector management and performance "paralysis" was a highly likely consequence of this increasing complexity and uncertainty, including the desire for the "integrated management" of the resource because of its cross-cutting role in all systems.

Strategic adaptive management (SAM) was developed as a framework and stakeholder driven process for integrated water resources management in recognition of these issues and that catchments were complex entities, i.e. V-STEER (Values - Social, Technological, Economic, Environmental, Political). As a tool it facilitated the iterative development of a shared understanding and future-focused objectives for consensual decision-making (Rogers and Luton, 2010). Another similar but more technical approach was the preparation of a handbook to support practical decision-making for different groups of stakeholders and role-players in making decisions based on scientific assessments at different scales in South Africa (Stuart-Hill *et al*, 2012). Both frameworks and approaches included strong dimensions of stakeholder participation.

Currently, the DAFNE (**D**ecision-**A**lytic **F**ramework to explore the water-energy-food **N**exus) model is being implemented in the Zambezi Watercourse to explore options for sustainable and integrated future management together with stakeholders. This is a multi-step process that enables the quantification and comparative analysis of the WEF nexus with respect to trade-offs between conflicting objectives and facilitates a social understanding of the impacts (van Bers *et al*, 2018). According to Salmoral *et al* (2019), while the DAFNE Model has not explicitly addressed the degree of certainty relating to climate change complexities or political choices, nor the consensus of decisions made in the participatory process, it has encouraged collaborative adaptive management.

There are excellent insights provided from the work of Salmoral *et al* (2019) relating to the complementarity and benefits from the joint application of water diplomacy and nexus governance approaches. Importantly, these relate to Nexus governance in a transboundary context having to overcome the technical and 'most-rational solution' approach paradigm. It must capture political contexts and power constellations by including politics and dealing with normative questions, for example on resource (water and energy) allocations. Salmoral *et al* (2019) identified three primary Nexus governance challenges (Figure 11) and propose that water diplomacy offers several tools to complement nexus governance, including joint fact-finding, value creation and collaborative-adaptive management, together with a mutual gains approach, as illustrated in Figure 10.

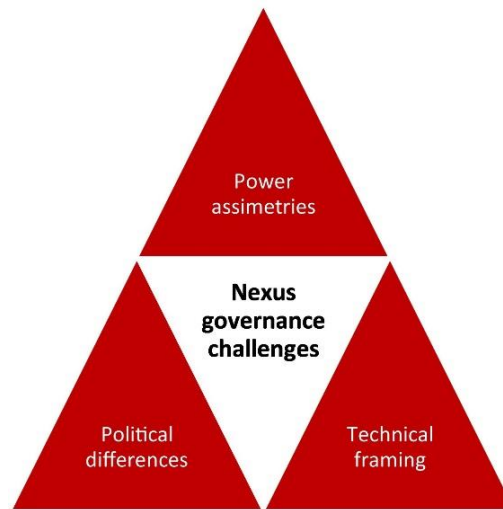


Figure 10. The three primary challenges to effective Nexus governance (Salmoral *et al*, 2019).

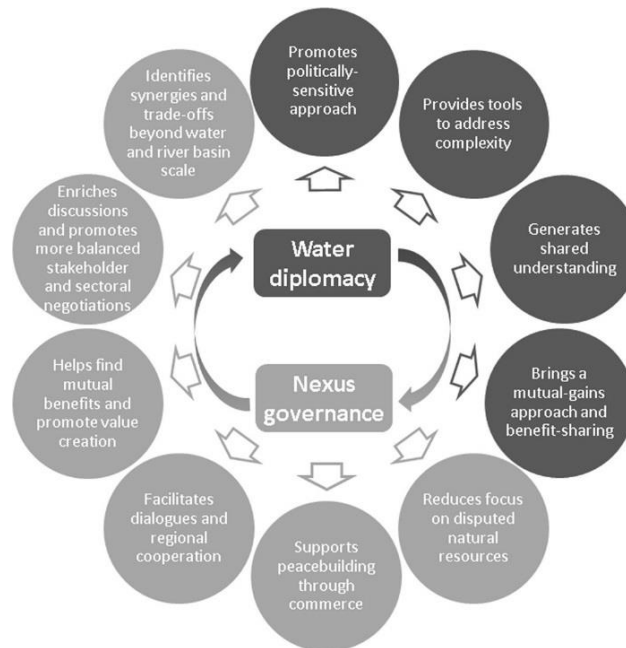


Figure 11. Nexus governance and water diplomacy complementarity factors (Salmoral *et al*, 2019).

It is interesting to note that the work of Salmoral *et al* (2019) support the view taken here that further, on-the-ground experiences and collaboration between researchers, policymakers and the private sector are needed to demonstrate and realise the complementarities of nexus governance and water diplomacy to achieve the outcome of promoting cooperation in the management of resources at a transboundary level.

PART III: WEFE NEXUS IMPLEMENTATION

A distillation and consolidation of the various considerations described in Parts I and II, and considering the various elements of the “Africa Conundrum” shown in Figure 6, the following WEFE Nexus Governance Implementation Framework is proposed (Figure 12). The discipline of horizon-scanning, futures-thinking and back-casting were not explicitly discussed in the manual but combining this with first- and second-order science considerations provides an uncomplicated and pragmatic framework to catalyse WEFE Nexus implementation in the Zambezi Watercourse. The majority of the building blocks are in place and all that is required is a commitment to action by the leadership and principals in the watercourse.

Action and continuity are key to the success of this proposed framework. Notwithstanding this, certain essential requirements would serve to enhance the implementation process and are briefly described in the following sections.

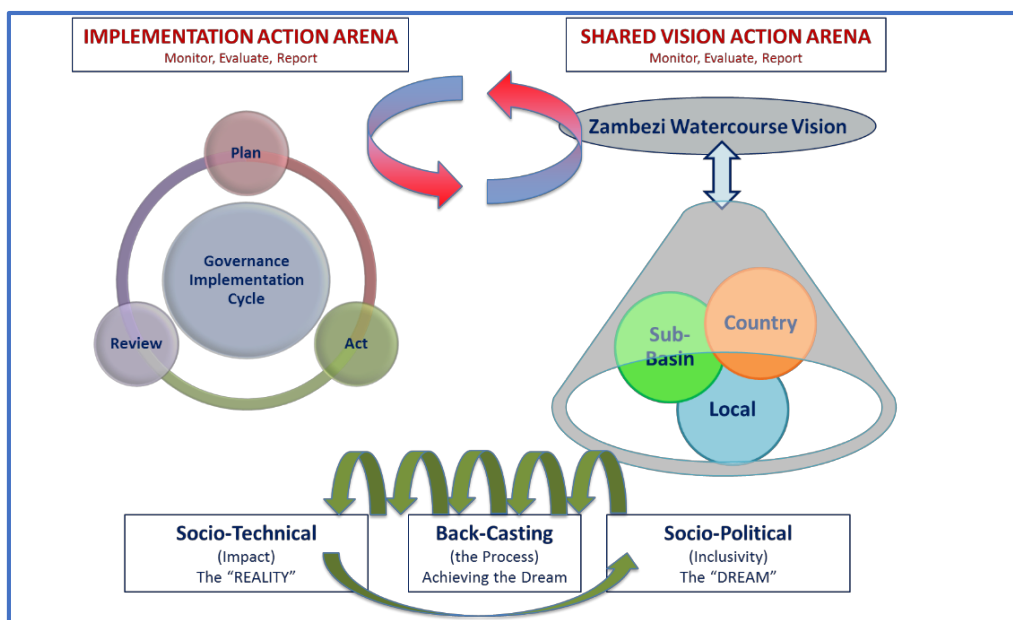


Figure 12. Zambezi Watercourse WEFE Nexus Governance Implementation Framework. The realisation of the watercourse shared vision can be achieved through back-casting, by setting in motion key step-wise actions that incrementally and iteratively lead to its progressive realisation.

3.1. Critical Success Factors and Fatal Flaws

The following non-exhaustive list of what would constitute critical nexus governance success factors may also conversely be fatal flaws. Managing these factors at their various scales of manifestation will be important in enhancing basin stakeholder cooperation and mitigating conflict.

- **Institutional strength** - includes structures (institutions) and instruments (scale-appropriate strategies, policies, guidelines) and resources at all Zambezi Watercourse scales (basin, sub-basin, national, regional and local)

- **Stakeholder knowledge of and understanding the relevance of the nexus and its impact** at different scales from the individual through to communities, nations and the basin is an important foundation for any meaningful intervention for NEXUS implementation
- **Needs at different basin scales** - if not addressed are a potential primary source of conflict; i.e. what may be important for an individual at the household or farm level will be different for the needs of a country or an economic region. It is as important to address the individual as it is for the larger scale needs and requirements
- **Impact of various nexus implementation interventions** - at the different scales can serve as a tangible demonstration factor in the implementation process
- **Extension services** - a cohort of field staff proficient in technical, socio-economic, socio-political disciplines to support a watercourse-wide outreach programme. Relates to institutional strength
- **Resourcing** - in a resource poor optimise creatively; e.g. share pockets of excellence, use citizen science for monitoring, unemployed youth can become an extension services cadre, etc
- **Watercourse monitoring and data** - disaggregated data at at-least three (3) geographic scales (watercourse, national and sub-basin/local) are an absolute need for effective management
- **Governance performance monitoring** - serving a key audit purpose and a safeguard to offset the potential for corruption
- **Monitoring-Evaluation-Reporting** - is key for performance assessments and a further mechanism to ensure the desired outcomes and impacts are achieved. The early likelihood of potential “unintended or perverse outcomes” may also be detected at an early stage for remedial action

3.2. Governance Implementation Cycle: 5-Point Checklist

The ACEWater2 Project Zambezi Watercourse governance implementation model follows the conventional and uncomplicated Plan-Act-Review cycle illustrated in Figure 13. Planning and implementation across the water-energy-food domains are underpinned by all aspects of scientific rigour, from the initial problems diagnostic through to performance assessment, review and reporting.

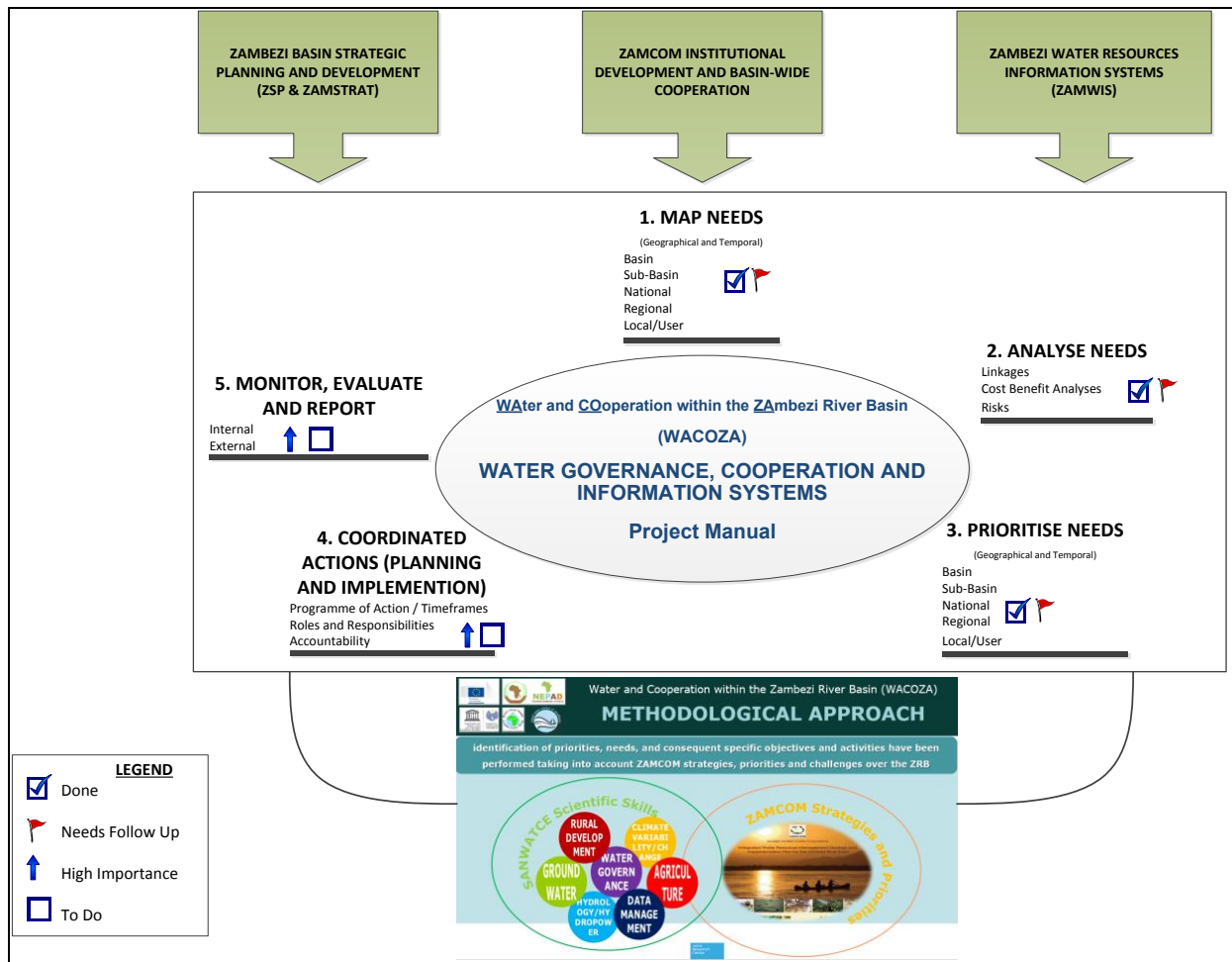


Figure 13. Zambezi Watercourse WEFE Nexus Implementation Cycle (Action Arena) - the Plan-Act-Review process 5-point checklist.

3.2.1. Map, Analyse and Prioritise Needs, Risks, Concerns and Issues

This covers three (3) of the five (5)-checklist points. The Zambezi Watercourse needs assessments are well documented in a number of studies, and are reaffirmed in the current Strategic Plan. It is important to establish the resonance of these needs and priorities across the entire geographical scale of the watercourse which is a major outreach activity, but essential to create a diffused and shared vision across the entire basin. It is also a key ingredient for nexus project and programme implementation sustainability.

A major benefit of such a process would be the increased and shared understanding of the nexus and nexus issues across the watercourse population spectrum, as well as fostering buy-in for any planned implementation initiatives and its subsequent uptake. Demonstrable successful local level cases will contribute to project upscaling and a potential groundswell of interest and support for any further nexus initiatives.

3.2.2. Actions Decision-Making

A logical follow-on from the map-analyse-prioritise exercise is to coordinate the integrated planning to implement the required actions. As with the needs evaluation process, actions also must be agreed upon by all interested and affected parties, ranked/prioritised and implemented.

Where several actions are required, attention should be given to inter-dependencies during implementation to optimise on resources allocation and achieve economies of scale. This is key to maximising benefits in a resource constrained environment.

Matters relating to human resource capacity requirements (including competence and capacity building), financing and joint working arrangements among different parties must be carefully planned and executed.

3.2.3. Monitor, Evaluate and Report

There are a number of tools available for the monitoring-evaluation-reporting (MER) process, which has become a specialised discipline. Provisions have already been made in the ZAMCOM processes to address certain MER needs. For example, the Annual State of the Zambezi Reporting on the status of management units delineated on the basis of agreed characteristics - hydrological, geographic, ecozones, etc - within the basin is one such approach. Others may include other mechanisms, both formal and informal, but have not been intensively dealt with in this manual.

Other creative options would include the role of research and researchers from the higher education institutions within and outside the watercourse. A further option is the use of the SADC WaterNet platform for undertaking research, assessments of progress and reporting on various WEFE Nexus interventions.

Appropriate selection and configuration of MER performance indicators and model selection must be carefully undertaken to ensure that the relevant measures are assessed for meaningful MER.

An important follow-up of the MER process are appropriate and agreed remedies in the event of failure or non-performance.

3.3. Proposals and Recommendations

A number of proposals have been made in the body of the manual already. However, given the interest in the watercourse and the number of activities underway at any one time, these may require almost dedicated monitoring and oversight to ensure alignment with specific watercourse ambitions. Importantly, this would lead to optimal benefits for all participants in such activities, particularly watercourse inhabitants.

Project and activities of value that generally do not attract much interest or funding are those which are non-infrastructure related. Where possible, opportunities to attract intervention support would relate to the following aspects:

3.3.1. Development Scenarios and Implications

Even though there have been and currently are projects underway examining various facets of nexus development scenarios, this will remain an ongoing activity and comparative assessments will enhance decision-making for implementation actions aligned to the watercourse vision.

3.3.2. Technological Support Systems

The current 4th Industrial Revolution emphasis also holds good possibilities for various watercourse needs taking advantage of the development and deployment of technologies and technological systems (earth observation, enhanced communications, static/near real-time/real-time monitoring, drones, etc).

3.3.3. Supporting Water Use Allocations, Control and Management Systems

Regular water use audits using a range of technologies and modelling tools, as well as a common basin-wide permits/authorisations process and administration system linked to ZAMWIS is an area worthy of immediate attention while the situation is currently manageable. Uncontrolled and unregulated water uses by various economic sectors, especially high-impact ones, may become difficult to manage once they entrenched in the watercourse.

CONCLUSIONS AND WAY FORWARD

To date there have been several interesting and substantive findings regarding governance and cooperation in the Zambezi Watercourse. While the “what” and “why” of governance and cooperation and their benefits are well articulated, of particular significance is the absence of the specific “how” this is to be achieved at all the scales of relevance in the Zambezi Watercourse. This “how” does not relate to the institutional landscape, which appears to be well established; but rather on the mechanics of implementing the “how”.

It is anticipated that this work package has provided some meaningful contribution regarding the mechanics of WEFE Nexus governance implementation for impact, in support of the ZAMCOM articulation of the benefits of cooperation and its stated ambition in the preamble to the ZAMCOM Agreement which reads as follows: **“Conscious of the advantages of regional cooperation with regard to the utilisation and development of [the] common water resources and the significant contribution which such cooperation could make towards the peace and prosperity of the Southern African region.”**

Furthermore, there is a body of good work that has established the benefits of cooperation as an enabler. Such benefits are multi-fold, documented and include:

- **“Peace dividends”** – resulting from a continuing and expanding open dialogue, problem solving and conflict-avoidance/resolution processes facilitated by ZAMCOM’s institutional arrangements
- **Poverty reduction** – through catalysing investments in improved, coordinated and sustainable water resources management and development – including the benefits of coordinated operation of new and existing water infrastructure
- **Increased regional economic benefits** through economies of scale from transboundary cooperation
- Regional approaches enabling **optimal planning and development of water-related infrastructure** to increase regional benefits and reduce costs
- Development and agreement of **basin-wide joint investment programmes** moving beyond unilateral or bilateral approaches with more limited benefits
- Enabling **co-ownership of infrastructure** with shared benefits and costs
- **Jointly addressing external threats** to the region – such as the negative impacts of climate change
- Increased **energy security** through jointly investing in hydropower production
- Increased **food security** through increased agricultural production from new irrigation
- Increased **employment opportunities** resulting from all types of investments in developing and managing the river basin
- Increased resilience supporting economic growth through **reduced exposure to floods and droughts**, and through investments in adaptation to climate change
- New and existing **water supplies secured** for domestic and industrial demands
- **Environmental flows** agreed and ensured in the Zambezi delta and other environmental hot spots

- **Tourism and mining** contribution to development jointly supported and increased
- **Fisheries production** enhanced through improved joint management and catalytic investments

There are water governance and diplomacy envisaged outcomes for the Zambezi Watercourse to enhance its socio-economic development trajectory and which may include support for the establishment of a dedicated competence and capacity building programme to support WEFE Nexus implementation by building a critical mass of youth extension support cadres. A next-step would be the presentation of the manual to key decision-makers in the watercourse as part of a value assessment and critique process.

Finally, in reflecting on the above ZAMCOM statements, the initial investigations for this manual indicate a good and solid foundation upon which this work package will seek to build. Its purpose will be to add value to current and future water governance and cooperation initiatives and activities throughout the Zambezi River basin, ideally at all the basin scales where its impact will be Catalytic, Pragmatic and Realistic!

BIBLIOGRAPHY

Beukman, R., 2018. *WEF Nexus in the SADC Region: Institutional Arrangements for Implementing the WEF Nexus*. Presentation made at the 3rd Zambezi Stakeholder's Forum, 8-9 October 2018, Lilongwe, Malawi.

Farinosi, F., Guipponi, C., Reynaud, A., Ceccherini, G., Carmona-Moreno, C., De Roo, A., Gonzalez-Sanchez, D. and Bidoglio, G., 2018. *An innovative approach to the assessment of hydro-political risk: A spatially explicit, data driven indicator of hydro-political issues*. *Global Environmental Change*, 52: 286-313.

Fourie, W., 2018. *Six Barriers that make it difficult for African states to use Research for Policy*. The Conversation Africa blog. <https://theconversation.com/six-barriers-that-make-it-difficult-for-african-states-to-use-research-for-policy-86492>

Hodgson, A., 2010. *Decision integrity and second order cybernetics*. In S. Wallis (Ed.), *Cybernetics and Systems Theory in Management: Tools, Views and Advancements* (pp. 52–74). Hershey, PA: IGI Global.

Hodgson, A. and Leicester, G., 2017. *Second-Order Science and Policy*. *World Futures*, 73(3): 119-178, DOI: [10.1080/02604027.2017.1319710](https://doi.org/10.1080/02604027.2017.1319710)

Luxon, N., Ndlela, B., Nhemachena, C., Mabhaudhi, T., Mpandeli, S. and Matchaya, G., 2018. *The Water-Energy-Food Nexus: Climate Risks and Opportunities in Southern Africa*. *Water* 2018, 10, 567; DOI: 10.3390/w10050567

Mabhaudhi, T., Simpson, G., Badenhorst, J., Mohammed, M., Motongera, T., Senzanje, A. and Jewitt, G., 2018. *Assessing the State of the Water-Energy-Food (WEF) Nexus in South Africa*. Water Research Commission, Pretoria, South Africa. WRC Report Number KV 365/18.

Mcginnis, M.D., 2011. *An Introduction to IAD and the Language of the Ostrom Workshop: A Simple Guide to a Complex Framework*. *Policy Studies Journal*, 39(1):169 - 183, DOI: 10.1111/j.1541-0072.2010.00401.x

Mndzebele, D., 2018. *Overview of the Regional Governance Framework - An Introduction*. Presentation made at the 3rd Zambezi Stakeholder's Forum, 8-9 October 2018, Lilongwe, Malawi.

Mpandeli, S., Naidoo, D., Mabhaudhi, T., Nhemachena, C., Nhamo, L., Liphadzi, S., Hlahla, S. and Modi, A.T., 2018. *Climate Change Adaptation through the Water-Energy-Food Nexus in Southern Africa*. *International Journal of Environmental Research and Public Health* 2018, 15, 2306; DOI: 10.3390/ijerph15102306

Mwenge Kahinda, J., Bahal'okwibale, P.M., Buduza, N., Mavundla, S., Nohayi, N.N., Nortje, K. and Boroto, R.J., 2019. *Compendium of community and indigenous strategies for climate change adaptation - Focus on addressing water scarcity in agriculture*. Rome, FAO.

NEXUS - The Water, Energy and Food Security Resource Platform, 2018. *Implementation - SADC's Draft WEF Nexus Operational Framework Reviewed at Transboundary River Basin*

Level. <https://www.water-energy-food.org/news/implementation-sadc-s-draft-wef-nexus-operational-framework-reviewed-at-transboundary-river-basin-level/>

Ostrom, E. 2009. *Beyond Markets and States: Polycentric Governance of Complex Economic Systems*. Nobel Prize Lecture, Workshop in Political Theory and Policy Analysis, Indiana University, Bloomington, Indiana and Centre for the Study of Institutional Diversity, Arizona State University, Tempe, Arizona, USA.

Rogers, K.H. and Luton, R., 2010. *Strategic Adaptive Management as a Framework for implementing Integrated Water Resource Management in South Africa*. Water Research Commission, Pretoria, South Africa. WRC Report Number KV 245/10.

SADC-WD/Zambezi River Authority, SIDA/DANIDA, Norwegian Embassy, Lusaka, 2008. *Integrated Water Resources Management Strategy and Implementation Plan for the Zambezi River Basin*.

Salmoral, G., Schaap, N.C.E., Walschobauer, J. and Alhajaj, A., 2019. *Water Diplomacy and Nexus Governance in a Transboundary Context: In the Search for Complementarities*. Science of the Total Environment, 690: 85-96.

Stuart-Hill, S., Schulze, R. and Colvin, J., 2012. *Hand Book on Adaptive Management Strategies and Options for the Water Sector in South Africa under Climate Change*. Water Research Commission, Pretoria, South Africa. WRC Report Number 1843/2/12.

Swatuk, L. and Tang Kai, N., 2018. *The Water-Energy-Food-Ecosystems (WEFE) Nexus in the Zambezi River Basin: Challenges and Opportunities*. Paper prepared for presentation at the Annual Meeting of the Zambezi River Basin Stakeholder Forum, Lilongwe, Malawi, 8-9 October 2018.

U4 Helpdesk, 2017. *The Impact of Corruption on Access to Safe Water and Sanitation for People Living in Poverty*. Transparency International in collaboration with U4 Anti-Corruption Resource Centre Helpdesk brief presented at the 2017 World Water Week. <https://knowledgehub.transparency.org/helpdesk/the-impact-of-corruption-on-access-to-safe-water-and-sanitation-for-people-living-in-poverty>

Van Bers, C., Scholz, G., Knieper, C. and Lumosi, C., 2018. *Supporting Decision Making for Sustainable Resource Management in the Zambezi and Omo Basins*. DAFNE Project presentation. <https://www.slideshare.net/DAFNEproject/dafne-project-presentation-supporting-decision-making-for-sustainable-resource-management-in-the-zambezi-omo-basins>

Wahl, C., 2017. *Facing Complexity means befriending Uncertainty and Ambiguity*. Medium, Age of Awareness blog. <https://medium.com/age-of-awareness/facing-complexity-means-befriending-uncertainty-and-ambiguity-46b7f576570>

Wahl, C., 2019. *A Brief History of Systems Science, Chaos and Complexity*. P2P Foundation blog. <https://www.resilience.org/stories/2019-09-12/a-brief-history-of-systems-science-chaos-and-complexity/>

Wolf, A.T., 1998. *Conflict and cooperation along international waterways*. Water Policy 1: 251-265.

Wolf, A.T., 2009. *A Long-Term View of Water and International Security*. Universities Council on Water Resources, Journal of Contemporary Water Research and Education Issue 142: 67-75.

World Economic Forum, 2019. *The Global Risks Report 2019, 14th Edition*.

ZAMCOM, 2019. *Strategic Plan for the Zambezi Watercourse 2018-2040*. Zambezi Watercourse Commission (ZAMCOM), Harare, Zimbabwe.