

Developing an equity and equality assessment method for water resources allocation in South Africa

by

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ABSTRACT

Water is a critical resource that drives socio-economic development and is central to achieving sustainability, environmental resilience, prosperity, and equity. Equity has been placed at the heart of global water policy, yet inequities in access to water and participation in water resources management persist; a crisis of inequitable access rather than availability. South Africa exemplifies this paradox, as progressive water laws exist alongside deep-rooted inequities in service delivery and allocation. Despite its prominence in water discussions, a definition of equity in water resources management remains elusive, the concept is considered complex and aspirational with a notable absence of mechanisms for monitoring it. This research addresses this gap by offering a definition of ‘water equity’, and a monitoring tool to enable the assessment and advancement of water equity in South Africa.

A systematic, stepwise research design beginning with a literature review to develop a definition of “water equity” and identify key water equity dimensions with potential for application was used. The Delphi Method was applied to gain expert consensus that was synthesised with legislative frameworks to develop eleven water equity indicators. The indicators were evaluated across three South African catchments to test their effectiveness as a monitoring tool.

While the proposed indicators offer an emerging tool for monitoring water equity in South Africa, their effectiveness is hindered by inadequate or fragmented data, limited administrative capacity, and the complex realities of informal and rural contexts that do not align with policy imperatives. Most indicators risk oversimplifying equity issues and require refinement to more accurately capture local, social, environmental, and geographic variations. Inequities in service delivery, resource protection, and commercial and customary uses remain entrenched, with hidden inequities exacerbated by unreliable infrastructure and informal or unregulated solutions that most heavily impact the poor.

The outcomes highlight the multidimensional and contextual nature of water equity and the need for monitoring tools that reflect specific contexts. It advances the field by providing a definition of water equity, elucidating the complex interlinkages between the human rights-based and social justice approaches, and demonstrating their interdependencies. The research transforms a theoretical notion into a practical, measurable framework and offers a methodological foundation that can be refined and adapted across diverse contexts. By introducing a measurable approach, this research fills a critical gap and provides practical means for stakeholders to assess, monitor, and advance water equity.

DECLARATION

The research described in this dissertation was carried out under the School of Agriculture and Science, University of KwaZulu-Natal, Pietermaritzburg from July 2019 to September 2025 under the supervision of Prof T.R. Hill (University of KwaZulu-Natal) and Prof R Meissner (University of South Africa).

The studies represent original work of the author and have not otherwise been submitted in any form for a degree or diploma to any University. Where use has been made of the work of others, it is duly acknowledged in the text.



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DEDICATION

Amanda Lynn Wild

17.09.1970 – 10.10.2018

To my big sister, for the critical role you played in my admission into UKZN, and for inspiring me to live my truth and complete this PhD.

The battle is over and now she dances with the angels.

To the other great loves that I lost whilst on this journey, you are part of this work too.

Soma

28.02.2012 – 30.07.2024

Nilay

14.01.2017 – 31.03.2025

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CHAPTER 1. Introduction

1.1 Introduction

Water, as both a critical resource and a driver of socio-economic development, holds a focal role in discussions regarding equity, sustainability, and prosperity (UN-Water, 2019 and 2024). Globally, water stress is intensifying due to a combination of escalating demand, increasing variability in supply, and declining water quality (UN-Water, 2024). Rather than a crisis of scarcity, the global water challenge is increasingly recognised as one of unequal access and inequitable distribution (UNDP, 2006). Water crises often result from the systematic marginalisation of vulnerable groups by laws, policies and institutions that favour water for commercial purposes (Schreiner, 2025), while climate change and environmental degradation further intensify the burden on already marginalised communities (Reade-Malagüeño et al., 2025). South Africa demonstrates this paradox, with one of the world's most progressive water laws (Williams, 2009), simultaneous with deep and persistent inequities in water allocation and access (Jegede and Shikwambane, 2021).

South Africa's National Water Act (Act 36 of 1998) and succeeding post-reform policies, including the National Water Resource Strategies (DWA, 2013; DWS, 2023), place equity at the core of water governance. Equity is of particular importance in South Africa, where governance and legislation, across all spectrums, are directed towards addressing equity, inequality and reform. Underpinned by human rights and Integrated Water Resource Management (IWRM), these frameworks aim to redress the legacy of apartheid-era water dispossession and to ensure that water contributes to alleviating poverty and inequality (Reade-Malagüeño et al, 2025). Despite post-apartheid water policy reform, inequality has persisted, and South Africa is considered one of the most unequal countries in the world (World Bank, 2019), with poverty and inequality remaining predominantly unchanged since the apartheid era (HRC, 2018). This trend is evident in water resources management, where equity has not been adequately addressed and the perpetuation of inequitable water allocation continues (Jegede and Shikwambane, 2021; DWA, 2023).

Within South Africa significant disparities in access remain, particularly in relation to commercial and economic uses of water. Agricultural water allocation exemplifies this contradiction. In the Breede-Gouritz Water Management Area, a mere 2% of water has been allocated for agricultural use to black African farmers and water for agricultural use is still predominantly in the hands of white commercial farmers (Sadiki and Ncube, 2020). Countrywide, only 5% of agricultural water is used by black African farmers (DWS, 2018). These worrying figures do not specify whether allocation to previously disadvantaged users includes women users (Anderson et al., 2008), despite water being set aside for such an expressed purpose (DWA, 2013).

While notable progress has been made in access to water for basic needs and sanitation services, some 3.4% of households depend on unsafe water sources, and 2% of households still practice open defecation (StatsSA, 2022). Inequalities become apparent when comparing the urban and rural settings. In predominantly urbanised provinces such as the Western Cape and Gauteng, the majority of households, 94% and 90%, respectively, have flush toilets. In contrast, in the Northern Cape, a predominantly rural province, 4.5% of households are dependent on bucket toilets, and an equal percentage lacks any toilet facilities at all (Matthews, 2024). Over the past four years, there has been little to no advancement in addressing service delivery backlogs (Matthews, 2024), with these backlogs remaining predominantly concentrated in rural municipalities (StatsSA, 2024). A concerning disparity persists across racial groups, with black African-headed households consistently reporting the lowest levels of access to piped or tap water since 2002 (StatsSA, 2019). A similar pattern of disparity is observed among women and children, who are disproportionately affected by inadequate access to water, often bearing the primary responsibility for collecting and transporting water over long distances (StatsSA, 2019).

The persistence of inequity is not unique to South Africa. Despite more than fifty years of global initiatives to address water injustices, widespread inequities persist worldwide (Reade-Malagueño et al, 2025). Persistent disparities in water access are fuelled by longstanding power imbalances, which stem from historical patterns of racial and class inequality as exploitative political structures, all of which continue to affect who has access to water (Reade-Malagueño et al, 2025). The international community has widely embraced equity as a goal in water policy alongside efficiency and sustainability (Peña, 2011; Goff and Crow, 2016), however, the term itself remains poorly defined and rarely operationalised (McDermott et al., 2013; Roa-García, 2014). As a result, equity in water governance is often stressed in policy discussions without being supported by practical frameworks or measurable indicators to ensure its implementation (Schreiner, 2025). This lack of conceptual clarity undermines accountability and allows entrenched inequalities to persist (Wilder and Ingram, 2016; Osman and Faust, 2021). Indeed, within the South African context, there is a single legal definition of equity in water resources management, and this definition is notably vague: *‘Fairness, justice and impartiality which supplements or overrides common and statute law’* (DWS 2018: 250). Despite the lack of a precise definition, South African water policy identifies equity as a priority in water resources management. To translate this policy commitment into practice, it is crucial to clearly define equity in the context of water allocation and use, and to develop practical methods for integrating equity into water management processes (Cullis and van Koppen, 2007).

The issue extends beyond how equity is framed in policy discourse to include how it is effectively monitored and evaluated (Osman and Faust, 2021). This has resulted in a significant methodological gap (Osman and Faust, 2021; Fletcher et al., 2022), although some recent work is beginning to offer guidance on what constitutes equity (e.g., Peña, 2011; Wilder and Ingram, 2016; Osman and Faust,

2021). Existing attempts to quantify equity, such as the use of equity and Gini coefficients in the Olifants River basin (Cullis and van Koppen, 2007; Prasad, 2006), methods to aid water utilities in develop water-quantity and -quality performance benchmarks (Osman and Faust, 2021), developing context-specific definitions and approaches (Fletcher et al., 2022), and equity metrics that contribute to equity in water projects (Seigerman, et al., 2022), have yielded useful, insights. These studies illustrate both the promise and the complexity of assessing equity in water use and point to the urgent need for more robust, context-sensitive methodologies that capture the multi-dimensional nature of water equity (Fletcher et al., 2022). As Goff and Crow (2016) argue, any meaningful pursuit of equity must engage with historical context, local power dynamics, and the lived experiences of water users.

This doctoral research addresses these gaps by developing a definition and monitoring tool for assessing equity and equality in water allocation in South Africa. Drawing on interdisciplinary theory, policy analysis, and investigational case studies, it probes how equity is conceptualised, operationalised, and experienced across three catchments. Ultimately, the research contributes to the global conversation on water justice by offering a monitoring tool and insights that can inform more equitable and accountable water governance, both in South Africa and beyond.

1.2 Research Aim and Objectives

This research aims to enhance both the conceptual understanding and practical application of equity and equality in the allocation of water resources in South Africa by developing a suite of indicators for assessment, and the evaluation of their validity and real-world applicability.

To achieve the aim, the following objectives have been established:

- to review the subjects of equity and equality with respect to their application in water resources management;
- to develop a methodology for assessing equity and equality for the allocation of water resources;
- to construct a system of indicators that can be used to evaluate equity and equality in water resource allocation, and
- to test the practicality and validity of the developed methodology and indicators by applying them to selected case studies in South Africa.

1.3 Thesis structure

This dissertation adopts a systematic structure to guide the reader through the progression of the research. Each chapter builds upon the preceding one, contributing to a cumulative and coherent analysis of water equity and its potential for measurement and monitoring (Figure 1.1).

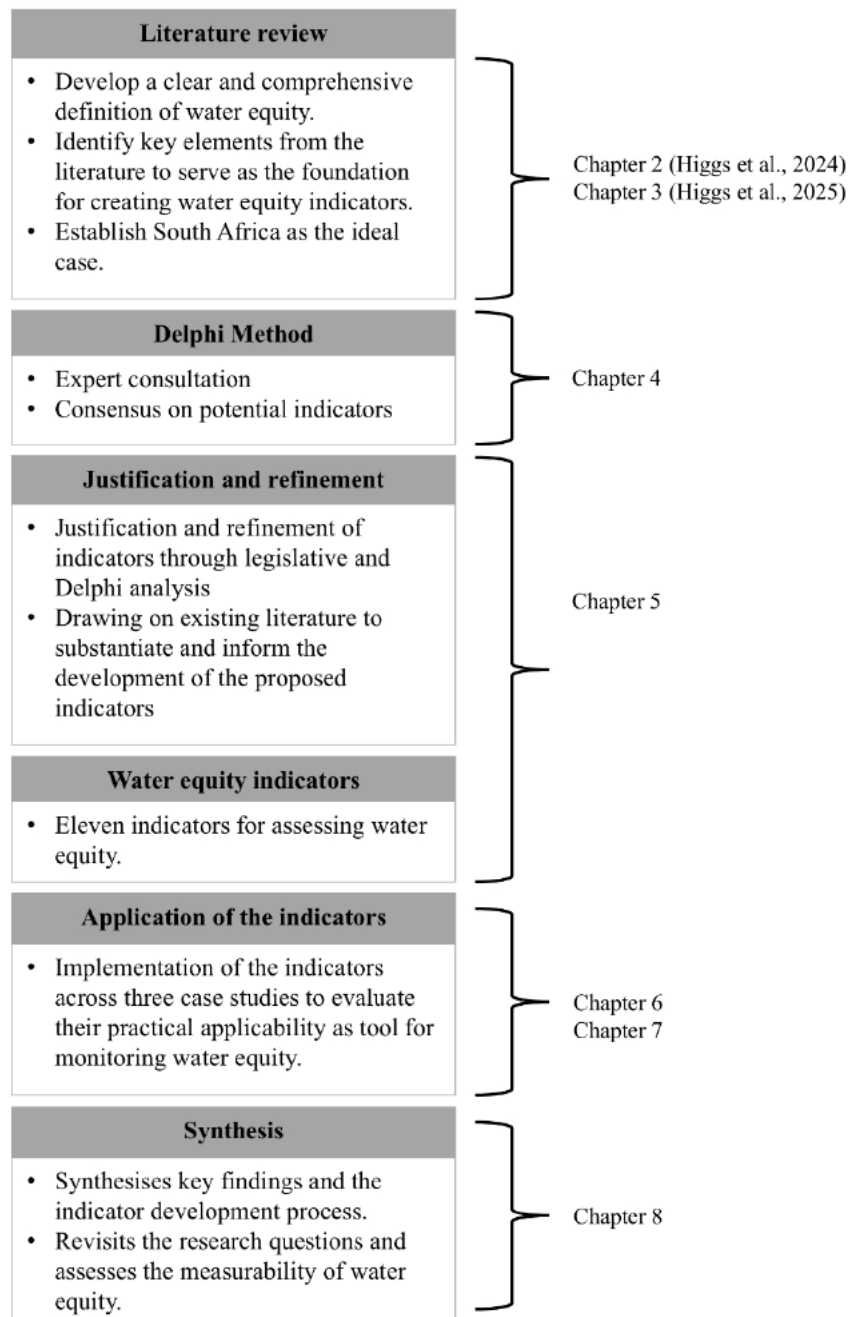


Figure 1.1 Overview of the dissertation’s multi-layered research design, illustrating the sequential structure guiding the reader through each stage of the research

- Chapter One introduces the research topic, outlines the motivation behind the research, and presents the research aim and objectives.
- Chapters Two and Three present the literature review, which culminated in two published papers (Higgs et al., 2024 and 2025). The literature review generated a broad list of elements relevant to water equity, which informed the subsequent stages of indicator development.

- Chapter Four outlines the Delphi Method used to achieve expert consensus on the most relevant and context-specific elements of water equity. Through iterative rounds, the process refined an initial list into a concise and prioritised consensus.
- Chapter Five synthesises the Delphi consensus with insights from the literature and pertinent legislative frameworks to develop a set of eleven water equity indicators. These indicators represent the core analytical tool of the research.
- Chapters Six and Seven test the practical applicability of the indicators as a monitoring tool. The indicators are applied to three case studies.
- Chapter Eight concludes the dissertation by synthesising research's findings, revisits the central research questions and evaluates whether water equity can be meaningfully measured, monitored, and ultimately, achieved. It makes suggestions, considers the importance and relevance of the research, and suggests lines of inquiry for further investigation.

This systematically advancing structure, from literature review to methods (Delphi) to results (indicators) to further methods (testing), provides a clear roadmap that demonstrates how each stage contributes to a comprehensive analysis of water equity indicators and their implications for achieving equitable water access.

This dissertation combines peer-reviewed academic papers with standalone thesis chapters, integrated into a cohesive narrative. While journal requirements for layout and referencing vary, a consistent layout and referencing style have been maintained throughout. The structure begins with two peer-reviewed, published academic papers derived from the literature review, which form the foundation for the research approach.

1. Higgs, C.J., Hill, T.R. and Meissner, R. 2024. Equity in water resource management: A theoretical dynamism. *Natural Resources Forum*, 49(3): 2736–2752. DOI: 10.1111/1477-8947.12501
2. Higgs, C.J., Hill, T.R. and Meissner, R. 2024. Water Equity: The South African case. *Society & Natural Resources*, 38(8), 888–901. DOI: 10.1080/08941920.2025.2475498

The remaining chapters detail the development of the indicators and the Delphi process, then their implementation in case studies. These chapters are intended for future publication as academic papers.

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CHAPTER 2. Equity in water resource management: A theoretical dynamism

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Abstract

Equity is an enigmatic concept that has been placed at the heart of global water policy, yet globally inequities in access to water and participation in water resources management persist. The global water crisis is one of inequitable access rather than availability. This critical review explores equity and equality in water resources management through multiple lenses, considering its numerous philosophical underpinnings, and offers a theoretical definition of ‘water equity’. We suggest that human rights, procedural and distributive equity (social justice), and cultural, socioeconomic, and political elements (context) are the pillars of water equity. The inter-relatedness between, and causal effects of each of the pillars are exposed, as are cross-cutting features. This contribution to theory building pertaining to ‘water equity’ suggests that water equity is a complex dynamism, a complexity of interrelated features that are constantly in flux. Acknowledging the inherent characteristics of water equity will facilitate its actualisation.

Keywords: water equity; equality; human rights-based approach; social justice.

2.1 Introduction

The world's freshwater supply is expected to become an increasingly stressed resource as the demand for water increases, availability becomes more variable, and the issue of poor water quality persists (UN-Water, 2019). The per capita availability of freshwater in the global water cycle is decreasing (UN-Water, 2019), with Africa particularly vulnerable where water stress over the past 20 years has more than doubled (FAO, 2018). The global water crisis is one of inequitable access rather than water availability (UN-Water, 2019) that entrenches inequalities, renders the disadvantaged more so, and divides nations, communities, and people (UNDP, 2006). The 2019 Human Development Report states that, with respect to inequality, 'many countries are approaching a precipice beyond which it will be difficult to recover' (UNDP, 2019: 4). Inequalities in access to water and sanitation persist (UN-Water, 2015), with three out of ten people lacking access to safe drinking water, and six out of ten people lacking access to safely managed sanitation services (UN-Water, 2019). There are significant inequalities in access to water and sanitation between and within communities, regions, and countries (UN-Water, 2019).

Equity is one of the three primary goals of Integrated Water Resources Management (IWRM) (GWP, 2012) and underpins water resources management concepts and frameworks such as water ethics (UNESCO COMEST, 2018), hydrosolidarity (Gerlak et al., 2011), hydropolitics (Cascão and Zeitoun, 2010) and the hydrosocial cycle (Boelens et al., 2016). Equity within water management has been deliberated across multiple disciplines such as the fields of water justice (e.g., Neal et al., 2014; Zwarteveen and Boelens, 2014), environmental justice (e.g., Kallohoff, 2014), social justice (Mirza and Mustafa, 2016), human rights (De Albuquerque, 2014a and 2014b), water ethics (e.g., Arnold, 2017) and social psychology (e.g., Nancarrow and Syme, 2004; Syme et al., 2015). While some scholars (e.g., Peña, 2011; Whiteley et al., 2008; Roa-García, 2014; Wilder and Ingram, 2016) have made notable contributions to account for equity within water resource management, the concept continues to evade definition (Wilder and Ingram, 2016). Water equity is depicted as complex, multifarious, contradictory, and mutable (Ingram et al., 2008) suggesting that it is aspirational and unquantifiable (Wilder and Ingram, 2016). It is well documented that despite its global uptake, the concept of water equity has not been operationalised in water policy (e.g., Mirza and Mustafa, 2016; Neal et al., 2014).

The complexity of equity in water resources management and that it has been deliberated across multiple disciplines lends the concept to being affected by disciplinary biases (Lu et al, 2014). Moreover, each discipline has deliberated the concept in isolation of the others. The study of equity requires a cross-sectional, multi-disciplinary approach (Lu et al, 2014; Gerlak et al., 2022) or another suitable strategy that considers the intricate, multi-disciplinary nature of equity, such as a transdisciplinary approach. This critical review explores equity in water resources management through multiple lenses. It reviews and analyses equity in water resources management, considering the multitude of philosophical underpinnings, and each of the disciplines that deliberate on the concept. It

attempts to disentangle and understand the core components of the concept that may help elucidate its theorisation. The realisation of equity and equality in water resources management is not possible without a clear understanding of what these concepts entail (Guy and McCandless, 2014). The purpose of this paper is to define water equity, to contribute to theory building about the concept, with the ultimate aspiration of aiding in the operationalisation of equity and equality in water resources management (the operationalisation of water equity is the focus of the author's ongoing research).

This critical review is organised as follows: First, we present the concepts 'equity' and equality' as they pertain to water resources management, two unique concepts that are often used synonymously. We then explore the academic literature, employing the critical review methodology, using peer-reviewed literature, as it pertains to each discipline that considers equality and equity in water resources management; the human rights and social justice approaches. At the end of each exploration, our reflections pertaining to each concept are presented in a summary diagram to aid in interpreting the discussion of each approach. Finally, we define water equity, and discuss the complexity and interrelatedness of its features.

2.2 Equity in water resources management

The term equity is linked to equality, and the two terms are often, erroneously, used interchangeably (Neumeyer and van De Lande, 2015; UN-Water, 2015). In the water resources management context, the United Nations (UN) offers definitions of the two terms that elucidate their differences. The UN define equality as 'The legally binding obligation to ensure that everyone can enjoy her or his rights equally' (De Albuquerque, 2014b: 19) and equity as 'The moral imperative to dismantle unjust differences based on the principle of fairness and justice' (De Albuquerque, 2014b: 19). Equality and equity in water resources management are primarily about human rights and social justice (e.g., Peña, 2011; Mirza and Mustafa, 2016). Equity is a procedural and distributive concept (Mirza and Mustafa, 2016). It involves decision-making that ensures all have an equal say in determining fair access to water (Roa-García, 2014). Water, being a source of life, is a basic human right (Mirza and Mustafa, 2016) and all should have access to sufficient water for basic needs (De Albuquerque, 2014a). Ecological integrity underpins this basic right and must be upheld and respected (Kallhoff, 2014). Furthermore, equality and equity are anchored in the local situation (or context), how inequalities and inequities have been caused, are experienced and perceived (Zwarteveena and Boelens, 2014), and the cultural values attached to water (Kallhoff, 2014).

2.3 Human Rights-Based Approach (HRBA)

The 2010 United Nations (UN) General Assembly formally recognised the human right to water and sanitation, acknowledging that clean drinking water and sanitation are essential to the realisation of all human rights (De Albuquerque, 2014a). Since then, the human rights-based approach (HRBA) has been well documented and progressed e.g., De Albuquerque (2014a and b); WaterLex (2017); Human Right

2 Water (2020 and 2021). The HRBA in water resources management necessitates that ‘basic human needs’ are prioritised in the allocation of water resources, prioritising the most vulnerable members of society (Neal et al., 2014). Vulnerable persons include: women, children, persons with disabilities, indigenous communities, older persons, and people living in poverty, who must not be subjugated in access to basic services, nor in the participation of water management and governance (WaterLex, 2019). The human right to water and sanitation is a component of international law and is legally binding upon all United Nations member States who must make water resources available for, and work progressively towards, achieving universal access to water and sanitation (De Albuquerque, 2014a). This right is underpinned by the principles of human rights law; non-discrimination and equality, access to information, participation and accountability must be assured in the realisation of the right to water and sanitation (De Albuquerque, 2014b) (Figure 2.1).

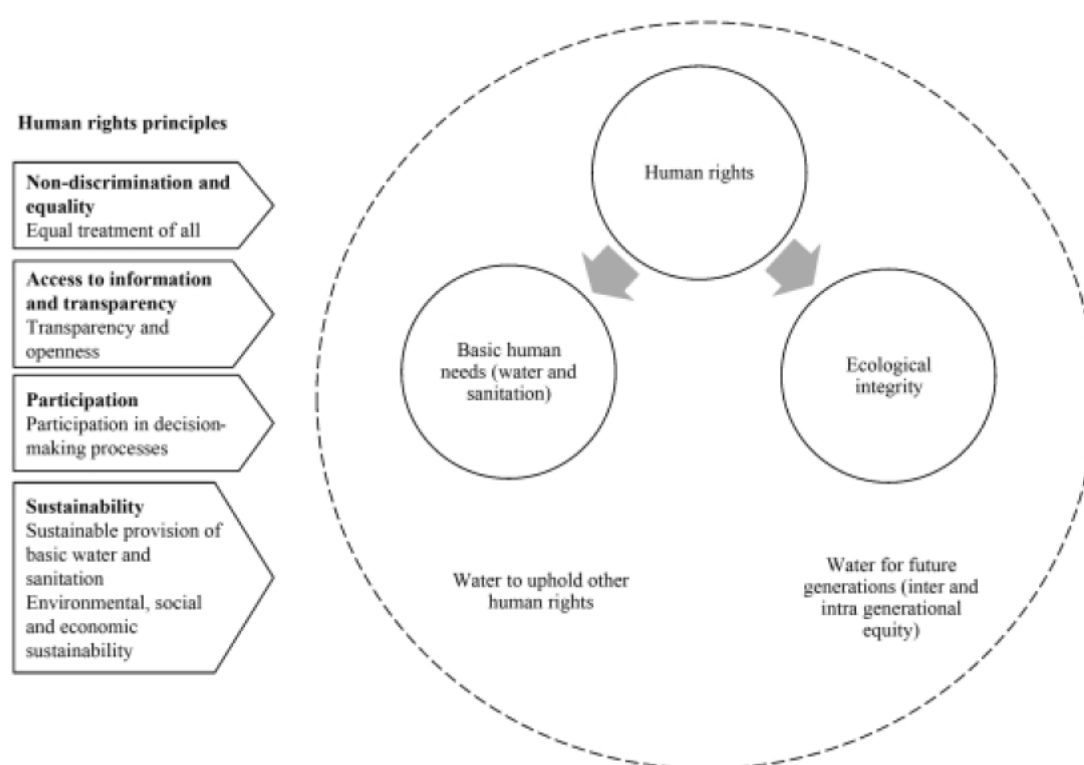


Figure 2.1 Features of the human right to water.

The human right to water, which provides legal recognition of every individual’s right to water for basic needs, is different from ‘water rights’ (Perreault, 2014). Water rights are limited to an individual or organisation who obtains the legal right to access a water source, typically through land ownership or in agreement with the landowner (De Albuquerque, 2014a). Water rights must not infringe on the human

right to water (Perreault, 2014), which must always take priority in water resources allocation (De Albuquerque, 2014a).

In water resources management, the HRBA recognises that environmental processes require water to sustain biodiversity and ecosystems (Winkler, 2012) for both current and future generations (UN General Assembly 2018). The human right to a safe, clean, healthy and sustainable environment underpins human health and well-being, and is necessary for the realisation of other human rights (UN General Assembly, 2018). Thus, environmental harm must be avoided, and ecosystems and biological diversity must be conserved. This necessitates that ecological integrity be upheld through pre-determined quantities of water, standards for water quality, and the timing of water flows must be such that environmental processes are sustained; known as water for environmental flows (Arthington et al., 2018) (Figure 2.1). Water for environmental flows must sustain aquatic ecosystems, livelihoods, human cultures and well-being (Arthington et al., 2018). Other needs and uses of water by river-dependent communities that must be regarded include the use of water for cleansing, religious and/or spiritual practices, subsistence fishing and livestock grazing, and transport should be included in environmental flows (Anderson et al., 2019). In prioritising these uses of water, the rights of indigenous people and future generations are (and must always be) upheld (Human Rights 2 Water, 2020). Other priority uses of water are those that enable the realisation of other human rights for example, the right to a healthy and productive life (Winkler, 2012). This may include water for food security, which underpins the right to food, water for productive purposes which underpins the right to work (Winkler, 2012).

Socio-environmental processes, such as climate change, must also be considered. The expected impact of climate change could be more extreme weather events, and unpredictable temperatures and precipitation (Mirza and Mustafa, 2016) which could affect water quantity and quality which could, in turn, impact the provision of water for basic needs, ecological integrity, and water for future generations (Lu et al., 2014).

The provision of water for basic needs has dominated the water management discourse, in isolation from, and overshadowing other, equally important priority uses of water. Water for basic human needs has been well defined (e.g., De Albuquerque, 2014a, b and c; UN General Assembly, 2020; WaterLex 2017 and 2019; Human Right 2 Water 2020 and 2021) and progressed e.g., through Sustainable Development Goals 6.1 and 6.2 (UN-Water, 2015; JMP, 2021), and many countries conduct nationwide monitoring programmes on aquatic organisms for freshwater ecosystem management (e.g., Park and Hwang, 2016; UN-Water, 2018). Other features of the human rights-based approach described in this section (Figure 2.1) have received less attention and there is a lack of a coherent approach to realising the human right to water in its entirety, and as it pertains to upholding other human rights (e.g., Goff and Crow, 2014; Hall, et al., 2014; Lu et al., 2014).

Moreover, the HRBA is viewed as being predominantly relevant to the least developed and middle-income countries where inequalities are evident (Broberg and Sano, 2017). The principles and uses of water described in this section are, however, universally applicable. Even the most developed nations must consider the basic services needs of the most vulnerable members of society as a priority, as per the principles of the HRBA (Figure 2.1) e.g., participation and sustainability. The protection of ecological integrity, must likewise, be prioritised, regardless of the socioeconomic standing of the nation (if the HRBA is to be realised).

2.4 Social Justice and Equity

Social justice is a procedural and distributive concept (Mirza and Mustafa, 2016) that promotes equity (Reisch, 2014). It is realised through procedural and distributive justice (Perreault, 2014); decision-making that ensures all have an equal say in determining fair access to water (Roa-García, 2014). While the term equity is associated with distributive justice, and fairness in procedural justice, the terms fairness, justice, and equity are often used interchangeably (Neal et al., 2014). Combining procedural and distributive justice results in fairness in the process and the outcome (Syme et al., 2015). Examining the nuances between these terms; fairness, justice, and equity, is beyond the purpose of this paper, and the term equity will be assumed i.e., procedural equity, distributive equity, etc.

2.5 Procedural Equity

Equity is about people, their perceptions, and the context in which they live, placing equity in a constant flux of learning and adapting due to the dynamic ever-changing nature of the subject. Social interactions and learning may indeed be the most important elements of water equity. Stakeholders prioritise procedural equity, having an equal say in decision-making, in determining equitable outcomes in the governance and allocation of water (Syme et al., 1999).

Equitable outcomes in water resource management are reliant on quality procedural equity (Wilder, 2008). The features of procedural equity that result in the perception of equity in decision making are well defined (e.g., Syme et al., 2015; UN DESA and UNDP 2020) (Figure 2.2). These are broad and inclusive of stakeholder representativeness. All stakeholders having the opportunity to participate (participation), to be heard and to influence the decision-making process (voice). Information provided in the decision-making process must be accurate, in an accessible format, whilst the decision-making process must be consistent, impartial, and ethical with suitable appeal mechanisms in place. The process must be continually cognisant of gender, power, political and economic inequities. At all times, stakeholders should be treated with dignity and respect (interactive justice), and in addition to equitable outcomes, the process should work towards collaborative social learning. Equitable decisions are contingent on adequate representation of all stakeholders (Peña, 2011), and equal consideration of their many values and viewpoints (Syme and Nancarrow, 2008).

Also known as public participation, participation is a widely adopted process in natural resource decision-making that espouses both procedural and interactive justice (Neal et al., 2014). While procedural equity is well covered in the water equity discourse, water justice (rather than water equity) theory suggests that interactive justice, while not as well defined, is critical (Neal et al., 2014). Interactive justice is about how people are treated by decision-makers; they must be treated with dignity and respect, and foster trust (Syme et al., 2015). In turn, a critical factor in fostering trust is the perceived fairness in procedural equity (Neal et al., 2014). One such process to achieve this outcome is through social learning which is important in the realisation of procedural and distributive justice goals and equitable outcomes (Balaz and Lubell, 2014). Social learning refers to a collaborative, iterative and ongoing process where multiple and varied stakeholders engage in synergistic learning (Pahl-Wostl et al., 2008). It has been shown to legitimise differing stakeholder knowledge and promote the representativity of marginalised groups thereby addressing inequities suffered by these groups (Balaz and Lubell, 2014).

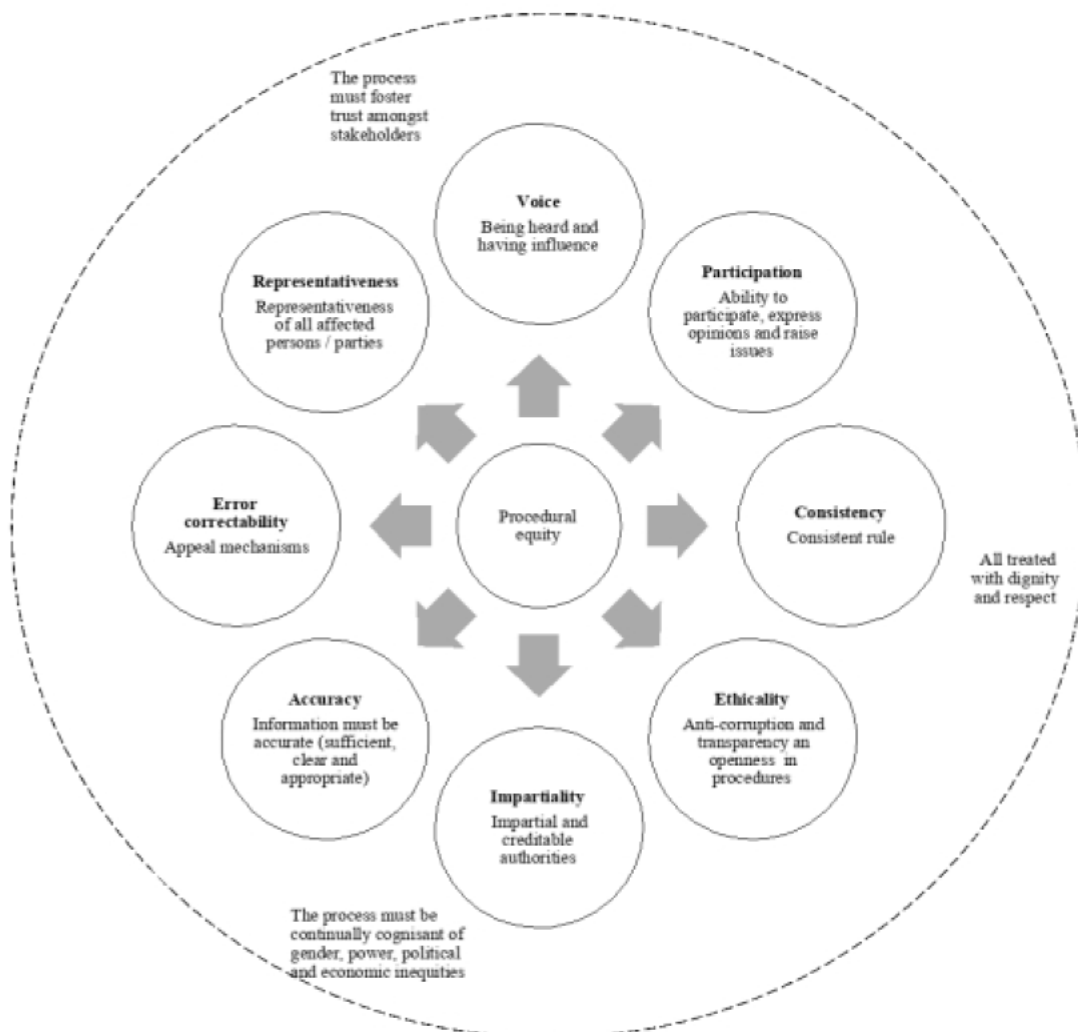


Figure 2.2 Features of procedural equity.

Gender inequities in water management are well documented (Peña, 2011). This, and any form of discrimination against other vulnerable groups, must not be tolerated in procedural equity (Peña, 2011). More so, and unfortunately, water is a high-risk sector for corruption, due to the diverse number of role players, a lack of accountability mechanisms and insufficient transparency (Peña, 2011). In some countries, there is evidence of systemic corruption that undermines procedural equity processes and can delay service delivery to those members of the population most in need (Muller, 2020; Meissner, 2021).

Procedural equity in water management is a high-risk area for inequities as one navigates interaction between a complex and diverse array of stakeholders (Perreault, 2014). These range from those who rely on water for their livelihoods to formalised institutions such as business and civil society organisations, government, and technical experts in specialised disciplines. As such, asymmetries in political and economic power, and knowledge in water procedural equity are commonplace (Ingram et al., 2008). Technical or expert information, which is necessary in water management, may be perceived as more valuable, shifting the power in decision-making to those with the means to interpret such information (Ingram et al., 2008). Inequities in procedural equity can exacerbate marginalization, such as poverty and exclusion, faced by the most vulnerable individuals and groups leaving them more vulnerable. Such risks should be viewed in terms of distributive equity.

2.5.1 Distributive Equity

There is a strong correlation between procedural and distributive equity in that procedural equity brings about distributive equity (Neal et al., 2014). The distribution of water and water benefits are considered equitable when they conform to stakeholders' perceptions, values, and ethics (Peña, 2011). That is, if procedural equity is demonstrated in the decision-making process, stakeholders consider water allocation decisions to be fair (Syme et al., 1999).

Distributive equity is about the allocation of water resources. The distribution of water (distributive equity) prioritises water for basic human and ecological needs, and water for cultural, symbolic, and religious uses (Figure 2.3). Water distribution must consider the full array of direct and indirect benefits and burdens derived from water, and the complexity of competing water uses and users (GWP, 2012). Water rights must be considered, this being water that is allocated to individuals or organisations who have obtained the legal right to certain water allocations, as must the distribution of responsibilities in water management (De Albuquerque, 2014a). What constitutes the equitable distribution of water may be assessed against different justice principles (Neal et al., 2014). This assessment must be done within the context of historical processes that have shaped current water distribution, within a defined geographic space with particular attention to gender equity and the role of women in water management (Figure 2.3).

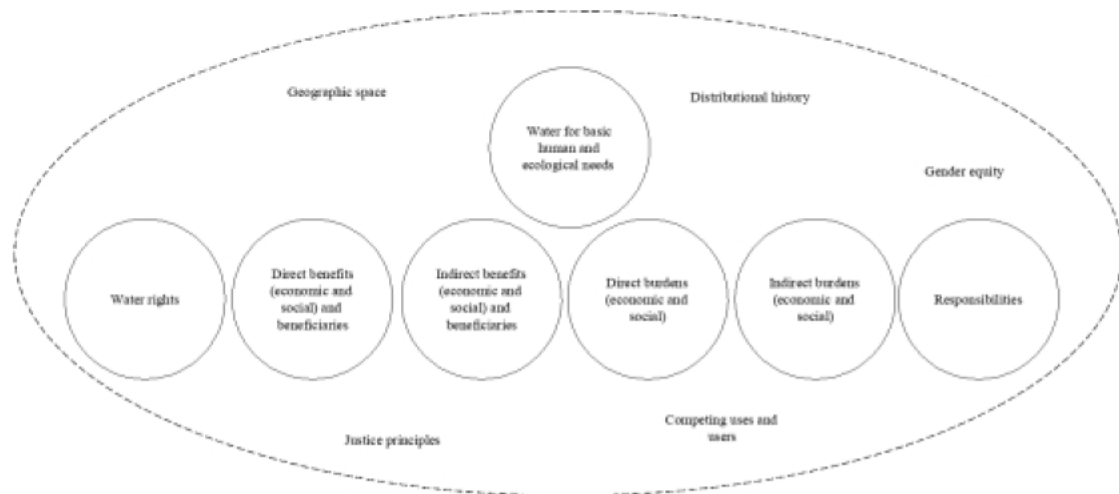


Figure 2.3 Features of distributive equity.

Once basic requirements have been allocated, the distribution of the remaining water can be assessed against different justice principles (Neal et al., 2014). ‘Proportionality’, ‘needs’, ‘equality’ and ‘self-interests’ are the most pertinent principles in determining the perception of water equity (Neal et al., 2014). ‘Proportionality’ allocates resources in relation to the contributions; ‘needs’ allocates resources based on the greatest need, ‘equality’ allocates resources equally, and ‘self-interests’ prefers allocations that are self-serving (Neal et al., 2014).

The distribution of the benefits derived from water, both direct and indirect, is a fundamental aspect of water equity (Peña, 2011). Water benefits can be assessed in terms of the economic (Peña, 2011) or social (Syme et al., 2008) value that they offer. The direct use of water to attain benefits, direct benefits, makes up a small portion of the benefits derived from water (GWP, 2012). The diverse array of benefits derived beyond those from direct use, indirect benefits, make up the bulk of water use (GWP, 2012), such as the realisation of social goals (social benefits) or in conserving water for future use or needs or projects (optional benefits) (Peña, 2011). Water benefits can also be unquantifiable, such as the symbolic or cultural benefits, and benefits preserved for future generations (the sociocultural value of water) (UN-Water, 2021).

Syme et al (2008) developed a ‘sphere of needs’ to assess the social value of water. They suggest that water for basic needs and health should be prioritised as this enables the enjoyment of all other water benefits. Next, the use of water for productive purposes (which they term wealth and economic welfare) as this fulfils the individual need to create an income (directly or indirectly) which is important for individual prosperity. Other social value benefits include social cohesion, recreation, the aesthetic value of water and the natural landscape, and cultural and spiritual benefits.

The concept of water burdens is not as well documented as water benefits (Neal et al., 2014), yet the negative impacts of water use are as wide-ranging as the benefits (Peña, 2011). Burden sharing is about sharing the risks associated with water management, and broader issues that impact water management such as population growth and climate change (Wilder and Ingram, 2016). From an economic standpoint, burden sharing is about the equitable distribution of costs and financing in water management (Peña, 2011). An accepted mechanism is the ‘polluters pay’ principle (e.g., EU, 2021), a principle of responsibility where the party responsible for causing environmental damage must carry the burden of remedying (Kallhoff, 2014). There is also the ‘ability-to-pay’ principle which concedes that sectors that profit from water use must contribute to, or subsidise, water management goals (Kallhoff, 2014).

When assessing water benefits and burdens, geographic inequities are pertinent (Ducrot and Bourblanc, 2017). Different communities will be exposed to different benefits and burdens within a watershed (Peña, 2011). Inequity problems are typical in the upstream-downstream distribution of benefits and burdens, for example, where a development upstream may have negative impacts on communities downstream (Ingram et al., 2008). Beyond benefits, beneficiaries and burdens, water justice (rather than water equity) theory suggests that the distribution of responsibilities in water management must be considered, for example, responsibility for water infrastructure, for water management at different management levels and among different water management agencies (Doorn, 2013).

2.6 Context and Equity

Achieving equality and equity in water resources management (which are underpinned by the HRBA and social justice approaches) is distinctly contextual, dependent on location and local circumstances (Wilder and Ingram, 2016) (Figure 2.4). For example, poor and developing countries may be concerned with the provision of water for basic needs (e.g., Broberg and Sano, 2017), while more developed nations, where the provision of water for basic needs is more advanced, may be concerned with the affordability of water, those whose water is shut off when they do have the funds to pay (e.g., Davis, 2016).

Context is important in the way people view fairness in water resources allocation decision-making (Nancarrow and Syme, 2004), as people’s perceptions and values shape equity and equity goals (Peña, 2011). Contextual elements are cultural, social, economic, political and temporal (Figure 2.4). Cultural elements include the symbolic, religious, and lifestyle uses and meanings of water (Ingram et al., 2008; e.g., Meissner et al., 2018). Whilst social elements include values, attitudes, and perceptions among users (Lu et al., 2014), socioeconomic factors include the role of gender in water management, ethnicity and economic status or class, as water affects these groups of people in different ways (Lu et al., 2014). Political factors are, for example, legal frameworks, political processes such as pressure group lobbying and the role of the state and non-state actors in water management (Meissner and Warner, 2021). This

includes water resources governance and management, for example, IWRM and water quality stipulations, and broader environmental governance as it may impact on water resources, for example, water and climate risk and resilience planning. Furthermore, equity is intertwined with time-based factors (Ingram et al., 2008). Historical processes, past negative impacts and effects, past pledges and past inequities which have led to the current situations, must be recognised and balanced (Peña, 2011). Whilst future access to water must be preserved and future water management decisions must not be hindered by present-day management (Ingram et al., 2008).

In addition to the economic value or benefits derived from water and the affordability (ability to pay for water) of water, other economic factors must be considered in determining water equity. Water equity must consider how individuals and institutions are taxed, and how those taxes are distributed. It must consider how persons and institutions are charged for water (Peña, 2011), who bears the cost of providing water and water services, how efficiently financial resources are used (Prasad et al., 2006), and how costs are recovered from water users.

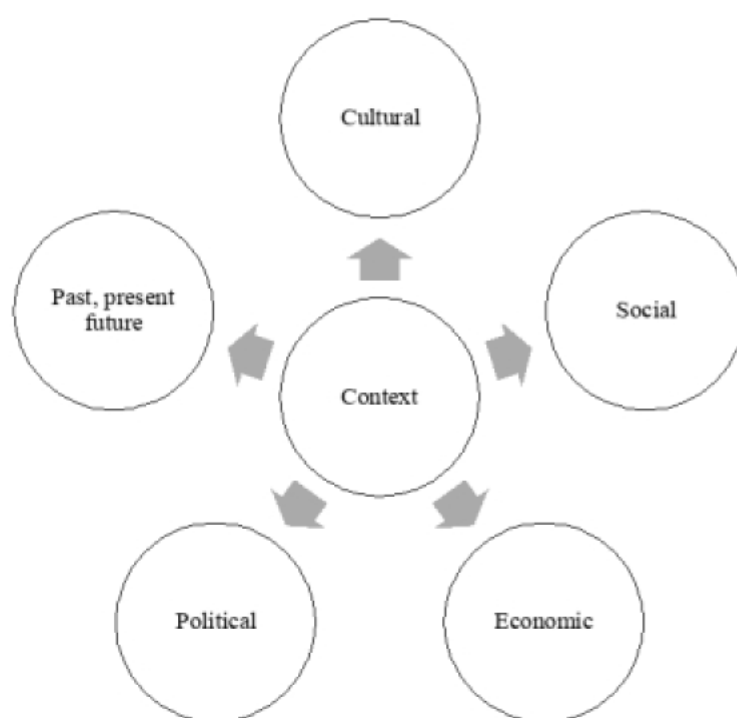


Figure 2.4 Contextual features of water equity.

The role of the state and/or states, as may be the case with transboundary water resources management for example, has direct implications for managing water and water equity. Past and present political goals directly result in equitable or inequitable outcomes and must be analysed and reassessed where necessary (Peña, 2011). Although the state, and its governing apparatus are often viewed as a central actor in water resources management, non-state actors also have a bearing on water management

(Meissner, 2005, 2015; Gondo et al., 2019). Traditional water governance systems can be perceived as more important and result in more equitable outcomes by local communities (Gondo et al., 2019). This suggests that where customary institutions exist, they are critical role players in procedural and distribute equity, and ultimately equitable outcomes in water management and allocation.

Ideally, water policy, international agreements and treaties should promote water distribution that is economically and socially beneficial, and that is neither harmful, wasteful nor unsustainable. It must prioritise water for basic human needs (human rights), environmental needs and customary uses (e.g., Meissner 2016; Meissner and Warner, 2021). In the case of shared international water resources, international treaties and inter-state agreements social justice principles must also be prioritised to ensure equal and equitable outcomes (Suhaibah et al., 2024; 4 Social Justice and Equity). Water equity cannot be considered solely within the water sector, and related policies and institutions must be examined for their impact on water equity goals (Peña, 2011). It is not only necessary to investigate formal policies and institutions, power relations emanating from non-state entities promoting certain norms, values and principles should be considered (Meissner and Jacobs, 2016).

‘Context’ is not explored as extensively as the HRBA and social justice approaches in the water equity discourse. This could be attributed to context elements being deeply interwoven into the two approaches, or that there are few, if any, instances of equity being achieved in water resources management. Indeed, the realisation of equity is not possible without a clear understanding of what it is (Guy and McCandless, 2014).

2.7 Discussion

2.7.1 Water equity defined

Water equity (Figure 2.5) is achieved through consultation and social learning. It is defined by people, their perceptions of equity and the processes, historical, social, cultural and political, that shaped these perceptions (Peña, 2011). Procedural equity is the mechanism used to determine distributive equity (Neal et al., 2014). In determining the equitable distribution of water (distributive equity) certain justice philosophies may be drawn upon (Neal et al., 2014), however, water for basic human and ecological needs must always take precedence (Winkler, 2012).

Access to water is recognised as a basic human right that must be prioritised in the allocation of water resources (De Albuquerque, 2014a). This right was formalised by the 2010 United Nations (UN) General Assembly and entitles everyone has access to basic water and sanitation services (UN General Assembly, 2015). In water management, the human rights-based approach (HRBA) recognises that environmental processes require water to sustain all living entities, flora, fauna and ecosystems (Winkler, 2012), and that there is an intrinsic relationship between the environment and people (Arthington et al., 2018). This necessitates that ecological integrity is upheld, which requires certain quantities of water and standards for water quality and environmental processes (environmental flows)

(Peña, 2011). Upholding ecological integrity enables the use of water to sustain aquatic ecosystems, human livelihoods, cultures and well-being (Arthington et al., 2018). It serves as the foundation for other rights, and the rights of river-dependent communities, such as access to water for cleaning, spiritual activities, and subsistence farming (Arthington et al., 2018).

The voice of vulnerable groups and future generations must be heard, and the potential effects of socio-environmental processes that may affect water such as climate change must be considered, continuously during the process.

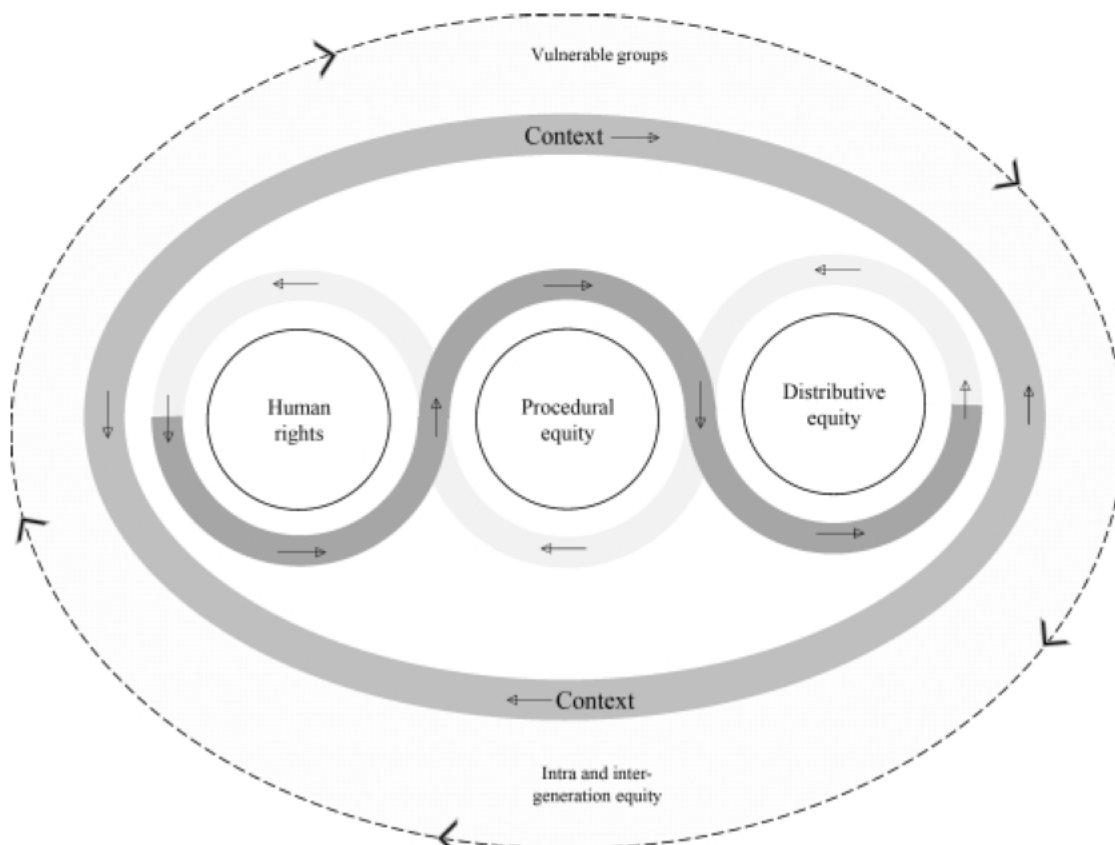


Figure 2.5 Water equity is realised through procedural and distributive equity (social justice), prioritises human rights and is contingent on context. It is an ongoing and iterative process that aims to continually move towards equitable outcomes.

Water equity is malleable in that it is subject to the context in which it exists and people's perceptions, which differ both spatially and temporally (Wilder and Ingram, 2016). This suggests that water equity is an iterative and continuous process. It is simultaneously, both a process and an outcome. Procedural equity ensures distributive equity. Once distributive equity has been determined and implemented, procedural equity must be repeated to ensure that the previous outcomes were indeed equitable. Water equity is, indeed, a process that aims to achieve better outcomes (Wilder and Ingram, 2016). Social justice underpins water equity, and social justice is a goal that is constantly pursued, rather than

completely attained (Reisch, 2014). The water equity principles developed by Peña (2011) and Wilder and Ingram (2016) would be useful in this process. Assessing outcomes against equity principles periodically could ensure that the process is moving towards equitable outcomes.

2.7.2 The Pillars of Equity

We suggest that human rights, procedural and distributive equity, and cultural, socioeconomic, and political elements (context) are the pillars of water equity (Figure 2.6). Materially, this review finds that water equity is fundamentally about human rights and social justice. Human rights must be prioritised and are achieved through the human rights pillar, and social justice is achieved through the procedural and distributive pillars. Moreover, water equity is shaped by context, which directly affects all pillars.

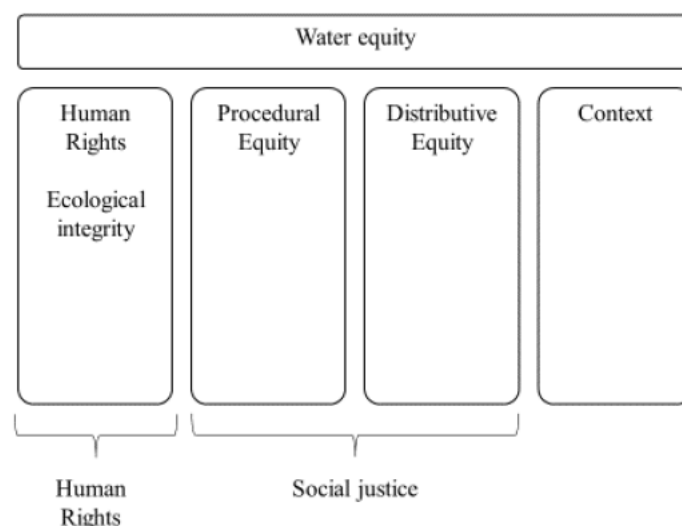


Figure 2.6 The pillars of water equity.

The two very distinct approaches, the human rights-based versus social justice approaches have been deliberated and discussed in isolation from each other within the water management discourse. This disjuncture suggests that the two concepts are not interrelated, and that human rights and social justice in the water management context can be achieved in isolation from each other. The human rights-based approach has tended to focus on access to water for basic needs. Scholars who have progressed the subject of equity and social justice in water resources management contend that the narrow focus of the human rights-based approach, solely on safe drinking water and sanitation, does not adequately address the multiple and complex factors necessary to achieve equity and equality in water management (Lu et al., 2014). This narrow focus prioritises human use of water over other elements of the human rights-based approach, such as water for indigenous people and water to uphold ecological integrity (Wilder and Ingram, 2016). Indeed, this narrowed focus undermines equity and social justice.

Peña (2011) elucidates that the two approaches are related. While the limited scope of the human rights-based approach takes priority, it fails to consider the complete spectrum of benefits and costs associated with water resources, and context. The human rights-based approach must be considered within social justice. Water resources management must consider both equity and equality (Winkler et al., 2014) with the human rights factors taking priority (Peña, 2011) (Figure 2.6). With regard to the allocation of water resources, equality does not imply equity nor vice versa. The equal sharing of water does not necessarily mean that it is equitable (Sivramkrishna and Jyotishi, 2006) and an equitable share of water does not necessarily mean an equal share (McDermott et al., 2013). Water equity (Figure 2.5) needs to consider equality as the omission of equality in the measure of equity, would render the measure of equity incomplete. In a circumstance where allocation is equal but not equitable, that circumstance would contradict equity. In instances where equal allocation is deemed inequitable, there is the possibility that this could lead to social conflicts, which would undermine the social justice approach.

When the Sustainable Development Goals (SDGs) came into effect, based on learnings from the preceding Millennium Development Goals (MDGs), the WASH sector recognised that the two approaches must work collaboratively (Winkler et al., 2014). Together, human rights and social justice, from a legal accountability perspective, strengthen each other in affecting each state's legal obligation to combat discrimination and eliminate inequalities (Winkler et al., 2014).

We suggest that the human rights-based, and social justice approaches must work together collaboratively, and that together they constitute 'water equity' (Figure 2.7).

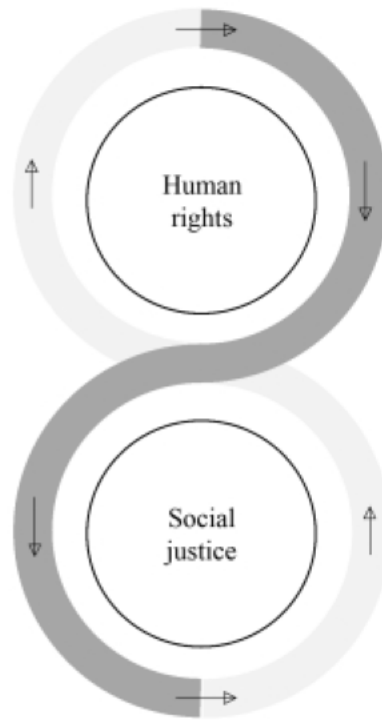


Figure 2.7 The human rights-based approach and equity social justice must work collaboratively to achieve equity and equality in water resources management.

The two approaches working collaboratively imply that the principles of the human rights-based approach (Figure 2.1) could work collaboratively with the social justice approach. For example, participation in the decision-making process is fundamental to both approaches, as is access to information transparency and openness. Being an ethical notion, certainly water equity should include the notions of non-discrimination, and being a pillar of sustainable development should include the principle of sustainability.

Furthermore, we suggest that there is a strong interrelatedness between the pillars of water equity, and the features that encompass each pillar (Figure 2.6), and that the pillars cannot work in isolation. For example, context affects each pillar and, and procedural equity directs impacts on distributive equity. In addition to the pillars, there are cross-cutting features; gender equity (and other vulnerable groups), intra- and intergenerational equity, socio-environmental processes such as water to sustain ecological integrity, and climate change. These elements are important features of water equity that must be considered under each pillar (Figure 2.6).

This has wide-ranging implications for water resources management, concepts such as Integrated Water Resources Management (IWRM), and the HRBA itself. The provision of water for basic needs must consider, with precedence, the voice of the people, highlighting the value of the principle of participation in the HRBA (Figure 2.1), rather than a simplistic, and often prescribed, provision of x litres per person per day (e.g., WHO, 2017). Concepts such as IWRM, where equity is one of the primary goals (GWP, 2012), need to evaluate that both approaches have been adequately encompassed if equity is to be achieved. It furthermore eludes the interrelatedness of the goals of IWRM; equity, economic efficiency and environmental sustainability (GWP, 2012), suggesting that achieving equity in turn contributes to sustainability. It is plausible that prioritising water for basic human needs and ecological integrity (as suggested in this synthesis) will contribute to the environmental sustainability of water resources. Indeed, the definition offered here (6.2 Water equity defined) stimulates debate and demands further investigation. For example, how does achieving equity contribute to economic efficiency (and other goals of water resources management)? While it seems intuitive, and how can water equity contribute to sustainability? Is water equity achievable in all contexts? Indeed, there is a dearth of examples where equity has been achieved. Certainly, the reader has more questions than this synthesis can answer.

2.8 Conclusions

The dynamic and complex nature of water equity has led to the concept being viewed as vague, ill-defined and aspirational. This raises concerns given the degree of significance and token attention it receives in legal and water governance frameworks. This review suggests that water equity can be defined and proposes a novel, theoretical framework (Figure 2.5). Good governance can lead to clear and attainable outcomes in each context or defined geographic space. As noted by Ingram et al (2008); there is no ‘one size fits all’ conception of equity, rather equity emerges in specific places under particular circumstances. Each region, state and international circumstance (e.g., transboundary catchments) must define water equity as they see it.

Being that achieving water equity is predominantly determined by procedural equity, the importance of the political environment cannot be overemphasised. Each element of procedural equity must be carefully defined and managed, fostering trust by, all stakeholders. Such parameters must be agreed upon and be enforceable by law (Peña, 2011). Water equity is embodied in a governance process, and seen as achieved when the process and the outcome of the process are viewed as representative, accountable, and fair (Wilder and Ingram, 2016).

The definition proposed in this paper implies that the human rights-based and the social justice approaches must work collaboratively in determining and achieving water equity. This synergy between the two approaches has been highlighted by Winkler et al (2014) and De Albuquerque (2014b) who state that equity must be considered in conjunction with equality and non-discrimination to ensure

accountability, and the strengthen human rights claims. Furthermore, equity complements the human rights-based approach, reinforcing human rights (Winkler et al., 2014). The absence of coherent and synergistic implementation of the two approaches can ultimately undermine the goals of each i.e., equity and equality. Skewed focus on the human rights-based approach omits social justice considerations such as benefits and burden sharing, and can result in circumstances that are equal but not equitable. A definition of water equity is imperative if equity and equality in water management are to be achieved. This review offers insights into how this may be accomplished; suggesting that achieving water equity is a complex reality, simultaneously a process and an outcome, a moving target yet achievable with good governance and processes. It is defined by people, swayed by their inevitable shifting perceptions and contingent on context. Water equity is a complex dynamism, a complexity of interrelated features that are constantly in flux. There is an array of interrelated variables (what we have described as pillars) interacting in a multitude of variations, resulting in complexity, uniqueness, and dynamism in each circumstance. Acknowledging the inherent characteristics of water equity will facilitate its actualisation.

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CHAPTER 3. Water equity: The South African case

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Abstract

This commentary introduces the concept of ‘water equity’ and examines its role in promoting equality and equity in South Africa’s water resources management. The concept assumes that equality and equity are achieved through human rights and social justice and that these two approaches constitute ‘water equity’. In South Africa, the human right to water addresses both human and environmental needs. Social justice is upheld through distributive equity, the allocation of water, and procedural equity, the decentralized participation in water management. The authors argue that focusing on access to water for basic needs is insufficient to alleviate inequality and inequity. Instead, water equity promotes the adoption of both the human rights and social justice approaches. The South African case underscores the interdependence of three suggested pillars of water equity: human rights, social justice, and context. Failure to uphold one pillar unavoidably fails in another, perpetuating inequalities and inequities.

Keywords: Distributive equity; Human right to water; Procedural equity; Social justice; South Africa; Water equity

3.1 Introduction

South Africa's water sector prioritizes equitable water and sanitation distribution, addressing historical inequalities perpetuated by the apartheid system by simultaneously advancing social progress, economic development, and environmental sustainability (DWS, 2018). This is reflected in the country's water policies and legislation, where equality and equity are key objectives (RSA, 1998). While equity and equality are connected concepts, they are not synonymous (UN-Water, 2015). An equal distribution of water may not always be equitable (Sivramakrishna and Jyotishi, 2006) and an equitable distribution does not necessarily imply equality (McDermott, Mahanty, and Schreckenber, 2013). In water management, equality stems from human rights principles, while equity focuses on addressing systemic injustices (UN-Water, 2015). Equality is encompassed in a legal requirement that mandates universal rights with regard to access to water, while equity embodies a moral duty to address and resolve systemic inequities through principles of fairness and justice (UN-Water, 2105).

South Africa offers an intriguing case for examining the nuanced dynamics of equality and equity in water resources. Historical policies, under the apartheid regime, denied access to water to non-white populations creating deep-rooted inequalities and inequities that persist today (Swatuk, 2010). The nation is grappling with water scarcity and consequently the management of water is confronted with a complex socio-economic quandary that disproportionately impacts marginalized communities (Hellberg, 2019). South Africa is a water-stressed nation, with projections indicating that demand will surpass supply by 2030 (Boccaletti, Stuchtey, and van Olst, 2010). The challenge extends beyond mere physical scarcity and social inequalities, the country also contains an uneven distribution of water for economic purposes, persistent poor water quality, and declining infrastructure that has resulted in frequent disruptions to supply (DWA, 2013). In contrast, the country is advanced in designating access to water as a human right (Williams, 2009), and equality and equity are prioritized in water policy (DWA, 2013). Improvements in equality and equity in access to water and in water resources management can substantially alleviate poverty and social and economic disparities (UN-Water, 2019), the very goals of South Africa's water policy. This is achieved through prioritizing the needs of marginalized and vulnerable groups, ensuring non-discrimination, increasing accountability, and addressing root causes of water inequity, thereby promoting more inclusive and equitable water policies and services.

South Africa's political history and water policy reforms are deeply tied to addressing inequality, inequity, and past injustices (Jegede and Shikwambane, 2021), creating an ideal setting for examining water equity. This commentary examines Higgs, Hill, and Meissner's (2024) water equity concept in South African water management. We have employed a critical review methodology, using peer-reviewed literature, to evaluate the complex dimensions of equality and equity in South African water resource management (Higgs, Hill, and Meissner, 2024). We explore the interconnectedness of these

two distinct concepts, equality and equity, illustrating how implementing policies aimed at achieving equality is crucial for achieving equity, and vice versa. The author’s concept of water equity has found that the pillars of water equity are human rights, social justice (procedural and distributive equity), and context (Higgs, Hill, and Meissner, 2024). The commentary is organized around these three pillars. Context plays a crucial role in shaping water equity, and the commentary commences with an overview of the South African context. Given the primacy of human rights in water equity, this pillar is examined first followed by social justice; procedural and distributive equity. The intricate interconnections between the pillars, and their impact on each other, are evaluated. The commentary concludes with a discussion of how South Africa has interpreted and progressed water equity.

3.2 The Theorisation of Water Equity

To understand ‘water equity’ and how to accomplish it, it is essential to conceptualize the topic. This has been reviewed by Higgs, Hill, and Meissner (2024), and a brief summary is provided below (Figure 2.7).

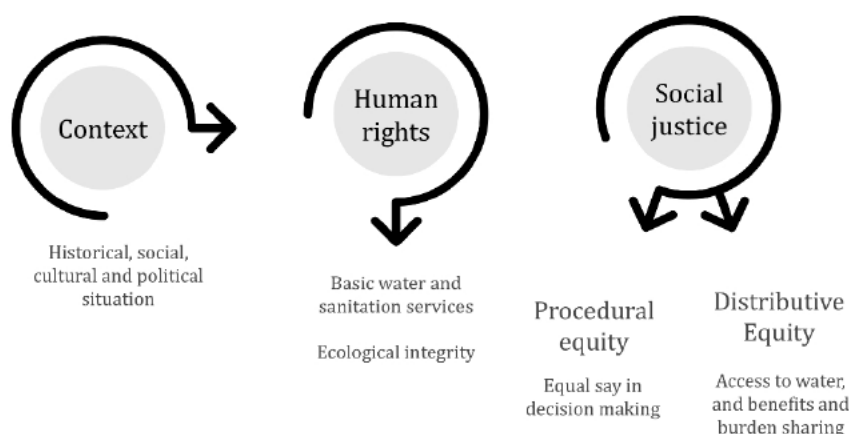


Figure 3.1 Water equity is realized through procedural and distributive equity, prioritizes human rights, and is contingent on context (Higgs et al., 2024)

Water equity is shaped by consultation, social learning, and people’s perceptions, which are influenced by historical, social, cultural, and political contexts (Peña, 2011). Access to water and sanitation is a fundamental human right (De Albuquerque, 2014) and adopting a human rights-based approach (HRBA) enforces the recognition of different water-related human rights (UN-Water, 2019). The HRBA in water management emphasizes the interdependence of environmental and human well-being, requiring that ecological integrity be upheld (Arthington et al., 2018). Social justice is both a procedural and distributive concept (Mirza and Mustafa, 2016) that advances equity (Reisch, 2014). It involves decision-making that ensures equal participation in securing fair access to water (Roa-García, 2014; Perreault, 2014). The rights of river-dependent communities, the voices of vulnerable groups and future

generations, and socio-environmental challenges, such as climate change, are priority considerations in promoting equity (Peña, 2011; Wilder and Ingram, 2016).

The author's concept of water equity (Figure 3.1) is distinctive in that it proposes that equality and equity are achieved through human rights (De Albuquerque, 2014) and social justice (Peña, 2011), and is shaped by social and political history (context). These three foundations of equity are well-defined and are interconnected. The water management discourse has, however, focused exclusively on human rights or social justice, often in isolation. This first theorization of water equity explores these foundations in unison and how they interact to promote equality and equity, using South Africa as an illustrative case.

3.3 The South African Context

South Africa has a complex history of water access deeply rooted in apartheid-era inequalities (Soyapi, 2017). Post-apartheid South Africa has implemented significant water policy reforms to address historical inequalities in water access (Swatuk, 2010), where the country's water policy has evolved with equity and equality becoming fundamental principles embedded in legislation, strategies, policies, and programs (van Koppen and Schreiner, 2014). South Africa was one of the first nations to enshrine the human right to water in its Constitution (Soyapi, 2017). The National Water Act of 1998 (RSA, 1998) is considered the cornerstone of policy reform that eliminated past discriminatory policies (Swatuk, 2010) and is heralded as one of the most progressive water policies globally (Williams, 2009). The Act aims to redress historical injustices and inequalities in water access and management (RSA, 1998) and explicitly aims to promote equitable access to water resources and services for all citizens. It establishes a comprehensive legal framework that recognizes water as a basic human right and adopts an integrated and decentralized water resources management approach (Jalisa, 2023). The constitutional provision of water as a basic right is reinforced and implemented through two key pieces of legislation: the Water Services Act of 1997 (RSA, 1997a) and the National Water Act of 1998 (RSA, 1998). The Water Services Act of 1997 focuses primarily on extending basic water services to previously disadvantaged South Africans who had been denied access under the apartheid political system. It places the primary responsibility for water service delivery on local authorities, to ensure more equitable distribution and management of water resources at the community level (RSA, 1997a). In addition, the National Water Resource Strategies (NWRS) provide a framework for managing water resources to ensure equitable, sustainable access to water and sanitation. It guides authorities, such as municipalities, in managing water resources and addressing water stress, loss, and supply-demand issues (DWS, 2023).

South Africa's water policy reforms represent a comprehensive and politically driven attempt to redress historical injustices and create a more just, and equitable society (Kaziboni, 2024). However, water remains inter-twined with the legacies of colonialism and apartheid, perpetuating socio-economic disparities, which has been termed 'water apartheid' (Jegede and Shikwambane, 2021).

3.3.1 The Human Right to Water

The 2010 UN General Assembly formally recognized the right to water and sanitation as a fundamental human right (De Albuquerque, 2014). This right underscores the principle that access to clean and safe water is a legal obligation and that basic human needs, particularly for vulnerable groups such as women, children, and indigenous communities, are prioritized in water resource management (Neal, Lukasiewicz, and Syme, 2014). To operationalize this right, the global water sector has adopted a Human Rights-Based Approach (HRBA) to water management which extends beyond access to water for basic water and sanitation needs. It compels authorities to guarantee that water and sanitation facilities meet specific criteria: they must be readily available, easily accessible, economically feasible, culturally appropriate, and of a standard that ensures public health and environmental safety (De Albuquerque, 2014). By addressing systemic inequalities, the HBRA ensures that impoverished and marginalized communities are not only prioritized with regard to access to water but are also empowered to participate in decision-making and to hold authorities accountable for fulfilling their obligations (WaterLex, 2017). The HRBA establishes a policy framework that prioritizes access to water for basic needs, specifically targeting systemic disparities and ensuring basic water needs are met across all societal groups (De Albuquerque, 2014).

The HRBA emphasizes the importance of environmental sustainability, requiring that water management supports biodiversity and ecosystems for current and future generations (Arthington et al., 2018). This includes ensuring environmental flows that sustain aquatic life and cultural practices (Arthington et al., 2018; Human Right 2 Water, 2020). Furthermore, climate change impacts, such as extreme weather and altered water availability, must be considered in water management to protect human rights and environmental integrity, for current and future generations (Mirza and Mustafa, 2016).

3.3.2 Water for Basic Needs in South Africa

South Africa's human rights approach stipulates the 'right to water', which includes water for basic human and environmental needs, known as the 'Reserve' (Takacs, 2016). The rationale is that water for environmental needs maintains ecological integrity, thereby protecting the ecosystem and water for basic human needs for both existing and future generations (Takacs, 2016). Ergo, legislation requires that water quality and quantity be upheld at predetermined levels to support aquatic ecosystems in a particular state that must remain in the national water resource (ecological reserve) and access to water for basic needs such as water for drinking, personal hygiene, and food preparation (basic human needs reserve) (RSA, 1998). The 'Reserve' is afforded the highest priority in water resources management and cannot be allocated for any other use (DWA, 2013). Prioritization of water for the 'Reserve' is intended to remedy social inequities and address environmental concerns (Williams, 2009).

South Africans are afforded the right to 'access to sufficient water' (RSA, 1996, 12), constitutionally guaranteeing access to adequate water for all. This is realized through the Water Services Act (WSA)

(RSA, 1997a) which stipulates ‘access to basic water supply and basic sanitation’ (RSA, 1997a, 2), providing each South African a free water supply for the basic needs of 25 litres per person per day and free basic sanitation service for indigent or poor households (DWS, 2017). Thereafter, water is charged based on an increasing block tariff that aims to address the problem of unequal income in accessing water (Dikgang et al., 2019). The policy objective ‘access to water by all’ is intended to alleviate poverty and inequality (DWAF, 2002). Access to sanitation is considered essential for poverty alleviation and reducing inequality, specifically gender inequality (DWS, 2016). The ‘right to water’ must be realized in conjunction with the constitutional right to equality and non-discrimination and dignity (Dugard, 2013). Water and sanitation provisions must be free from unfair discrimination and protect and respect each citizen’s dignity (RSA, 1996).

3.3.3 Water for the Environment in South Africa

The South African Constitution affords all citizens the right to an environment that is ‘not harmful to their health and well-being’ (RSA, 1996, 11). The designated ‘Reserve’ mandates that both water quality and quantity be maintained at specific levels to preserve aquatic ecosystems in a defined condition that must remain in the national water resource (ecological reserve requirement), and water for essential human needs (basic human needs reserve) (RSA, 1998).

The Constitution requires pollution prevention and the degradation of aquatic ecology, promoting conservation, ensuring ecologically sustainable development, and using natural resources responsibly (RSA, 1996). The National Water Act mandates and sets out measures for the prevention of, and remediation of, pollution and the protection of water resources (RSA, 1998). The National Water Resource Strategies establish guidelines for the equitable and sustainable protection, conservation, utilization, development, management, and regulation of the nation’s water resources (DWS, 2023). These policies, strategies, and programs safeguard South Africa’s water resources and are of key importance for achieving water equity. Preventing the degradation of the ecological reserve, safeguarding water resources for present and future generations, and fostering equity.

3.3.4 The Human Basic Needs and Ecological Reserve Dynamic

South Africa’s water policy and commitments align with the human rights approach presented by the authors, which includes water for human basic needs and for ecological integrity (Higgs, Hill, and Meissner, 2024). The human right to water, or in South Africa’s case, the basic human needs reserve, is prioritized in allocating water resources. The mandated ecological reserve protects freshwater ecosystems, safeguarding water for basic human and ecological needs. Upholding these two essential rights has the causal effect of upholding other human rights, such as the right to food, as is intended by the South African Constitution. This approach achieves the equity goals of water for basic needs for all and a healthy aquatic environment for all, both of which the South African government views as

essential for social and economic development (van Wyk et al., 2007) for poverty alleviation, and reducing inequality (DWS, 2016).

While South Africa exhibits an exemplary human rights paradigm for achieving equality and equity in water resource management (Figure 3.2), the country falters in the execution of these goals e.g., HRC (2014), Calverley and Walther (2022), Hutete and Sibanda (2022), DWA (2013, 2023), Cartwright, Walsh, and Gcanga (2024). Inequality concerning access to basic services persists (e.g., Nnadozie, 2013; HRC, 2014; Calverley and Walther, 2022), particularly for those of the lowest income brackets and/or residing in informal and tribal areas (e.g., Nnadozie, 2013; Cole et al., 2018; Calverley and Walther, 2022). Service delivery backlogs remain a critical challenge where a lack of, and disruptions to, services are common and have resulted in escalating service delivery protests across the country (Vyas-Doorgapersad, 2024). South Africa's ecological infrastructure is in a poor state, and it is acknowledged that stress on South Africa's water resources negatively affects water quality, quantity, and availability (DWS, 2023), the foundational requirements of the human right to water. This has the causal effect of compromising the quality and availability of water for basic human needs, with the most vulnerable members of the population drinking from, and bathing in, polluted rivers (DWA, 2013). This demonstrates the interconnectedness of both paradigms (as theorized by Higgs, Hill, and Meissner, 2024; Figure 3.2); the ecological reserve protects the human basic needs reserve and its essential role in building an equitable society. The South African situation contradicts the aspirations of the human rights approach. Violating the rights of the environment and South African citizens exacerbates, rather than remedying, poverty, inequality, and inequity. Further-reaching human rights impacts are poor quality water hindering the use of water resources for spiritual and customary purposes, the sustainability of the water supply, and the negative impact this would have on future generations.

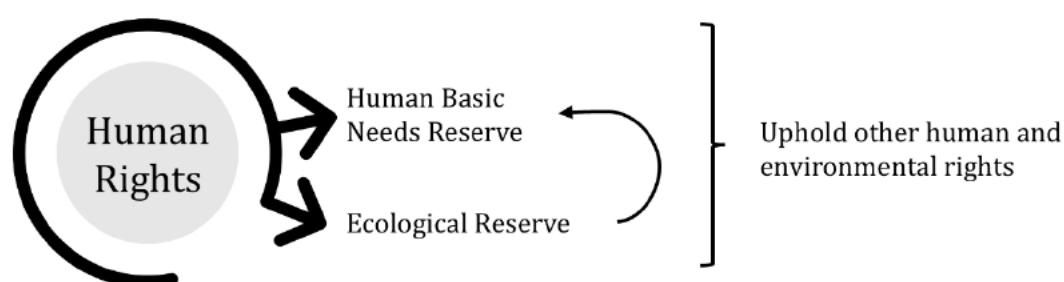


Figure 3.2 Upholding ecological integrity (ecological reserve) safeguards water for human needs (basic human needs reserve), which in turn protects other human and environmental rights

3.4 Social Justice and Water

Social justice is a concept encompassing both procedural and distributive elements (Mirza and Mustafa, 2016) that aims to achieve equity (Reisch, 2014). It is realized through procedural and distributive

equity (Perreault, 2014), which involves decision-making processes that ensure everyone has an equal say in determining access to water resources (Roa-García, 2014).

3.4.1 Participation in Water Resource Management in South Africa

Participation is a foundational principle in the human right to water and sanitation (De Albuquerque, 2014) and a constitutional right in South Africa (RSA, 1996). Procedural equity is critical for achieving equitable outcomes, and stakeholders prioritize procedural equity in determining equity in the governance and allocation of water (Syme, Nancarrow, and McCreddin, 1999; Neto and Camkin, 2022). The decentralization of, and public participation in, water resource management are instruments for achieving equitable access to, and redress in, the allocation of water (Chikozho et al., 2018). It enables the identification of issues at all levels and the development of solutions at a catchment or Water Management Area (WMA) level (Stuart-Hill and Meissner, 2018). Participation is facilitated by Catchment Management Agencies (CMAs), Water User Associations (WUAs), and other such water committees and fora (Stuart-Hill and Meissner, 2018). These fora are intended to facilitate participation by all interest groups, notably local communities, especially those from marginalized groups, for localized decision making, and to ensure equitable outcomes (Chikozho et al., 2018). These fora facilitate ongoing dialogue between government bodies and the public, ensuring a more participatory approach to water governance (Chikozho et al., 2018).

3.4.2 Allocation of Water in South Africa

In South Africa, the highest priority for water allocation is given to ‘The Reserve,’ in recognition of water as a fundamental right (Chikozho et al., 2018). Other competing priority allocations include water for fulfilling international commitments, water for poverty eradication, enhancing the livelihoods of the poor and marginalized, promoting racial and gender equity, water for strategically important economic contributions, and water for broader economic activities (DWA, 2013). Furthermore, in keeping with the socio-economic-political situation in South Africa, water allocation must contribute to Broad-Based Black Economic Empowerment (RSA, 2003), the country’s national economic reform program that aims to redress past racial injustices, and promotes gender equity by enabling black African- and women-owned enterprises access to water for economic purposes (DWAF, 2005).

Equity is one of the pillars of the National Water Act (NWA) (RSA, 1998) in which it is specified that it is ‘the National Government’s overall responsibility for and authority over the nation’s water resources and their use, including the equitable allocation of water for beneficial use, [and] the redistribution of water...’ (RSA, 1998, 1). On the introduction of equity in water administration, the South African government acknowledged that it was not immediately obvious what was meant by the equity in the water management context (RSA, 1997b) and suggested that it encompass three elements of equity: equity in access to water services (discussed in Section The Human Right to Water), ‘equity

in access to water resources’, and ‘equity in access to benefits from water resource use through economic, social and environmental development and management’ (DWA, 2013, 12).

‘Equity in access to water resources’ ensures the availability of water for productive and economic purposes, for example, agriculture, business, and industry (DWA, 2013). This, combined with the goal of redistribution, will be achieved through the water allocation reform (WAR) program (DWA, 2013), which distributes and prioritizes allocation to black African and women users via the water use licensing (WUL) system (DWAF, 2005). ‘Equity in access to the benefits from water resource use’ means that water must provide the greatest possible benefit to all, both directly and indirectly (DWA, 2013). Water use licensing (WUL) is an essential mechanism for achieving the equitable allocation of water for productive purposes in South Africa and is the primary mechanism of the Water Allocation Reform (WAR) program (DWA, 2013). WUL plays a critical role in pollution prevention by, for example, setting conditions for water use and preventing unauthorized discharges (RSA, 1998).

3.4.3 The Procedural and Distributive Equity Dynamic

Public participation is a key element of South African water policy and is a critical instrument for achieving fair access to, and redress in, the allocation of water (Chikozho et al., 2018), demonstrating that South African water governance is centered around procedural equity with a focus on marginalized groups. In addition to the role that procedural equity plays in deciding the equitable allocation of water resources, the country has instituted programs, e.g., WAR and WUL, with the specific goal of ensuring equitable water allocation, focusing on the redress of historical discrimination (Figure 3.3). This demonstrates that South Africa has distributive equity mechanisms that have been shaped by past social and political factors (context). The focus is on addressing past injustices, with policies and programs such as WAR and BBBEE designed to ensure redress. This emphasizes the deeply contextual nature of equity, where water policy has been aligned with the country’s socio-economic goals.

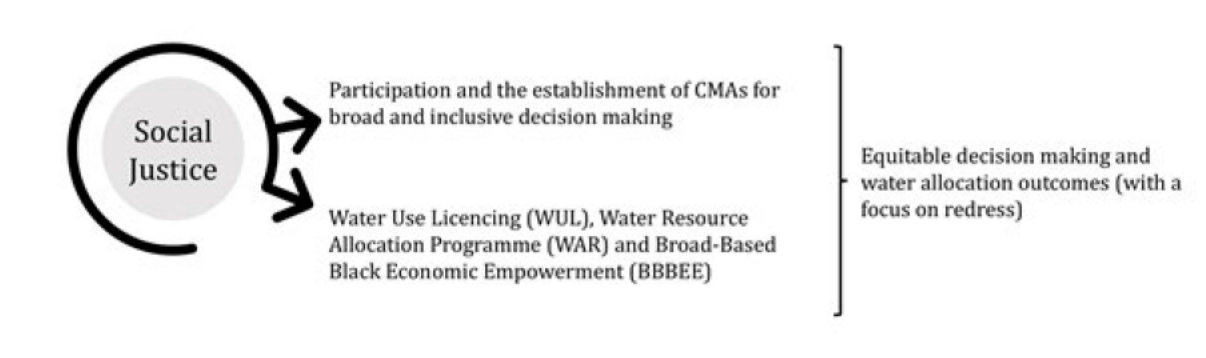


Figure 3.3 CMAs and other such water fora and committees are intended to uphold social justice by facilitating equitable access to water management and allocation decision-making. Specific water allocation programs, e.g., WUL and WAR, support equitable water allocation and ensure the redress of past discrimination in water allocation

However, there are significant shortcomings in procedural and distributive equity in water resources management in South Africa, which are critical for achieving water equity (Figure 3.3). Dysfunctional and delayed establishment of CMAs (Stuart-Hill and Meissner, 2018; Munnik, 2020) violates the rights of people to take part in water management decision-making, with the marginalized segment of the population being particularly unrepresented and capacitated, particularly women (Meissner et al., 2013; Fallon, Jones, and Keskinen, 2022). This, coupled with power and knowledge asymmetries (Ncube, 2018), has contributed to the failure of the WAR program (van Koppen and Schreiner, 2014; Sadiki and Ncube, 2020; Fallon, Jones, and Keskinen, 2022), perpetuating, rather than redressing, past discrimination in water allocation.

The technical nature of, and corruption in, the WUL system (Muller, 2020; Andresen, 2020) results in a lack of accountability and perpetuates inequitable access to water for productive purposes, water pollution, and the degradation of water resources. The causal effect is the negative impact on the human right to water, the exacerbation of poor ecological integrity and water quality, and the violation of citizens' right to water for basic needs. Moreover, this dynamic demonstrates the interconnectedness of the authors' three pillars of water equity: human rights, social justice, and context. Poor procedural equity negates the voices of the local community and marginalized groups, results in inequitable water allocation, and in the South African case, compromises the basic human needs and ecological reserves (the human right to water).

3.5 Discussion

South Africa's water policy, 'equity in access to water services,' refers to the human rights-based approach (HRBA) and encompasses water for basic needs and ecological integrity (the Reserve). The

country's other two equity goals, 'equity in access to water resources' and 'equity in access to the benefits from water resource use', refer to the allocation of water or distributive equity. Public participation is a cornerstone of the National Water Act and refers to procedural equity, which is about each affected individual or party having an equal say in decision-making (Perreault, 2014). In all three instances, South Africa perceives these mechanisms, the HRBA, and procedural and distributive equity, as necessary for achieving water equity.

South African water policy aligns with the framework for water equity proposed by the authors (Higgs, Hill, and Meissner, 2024). In South Africa, the human right to water considers water for human and environmental needs. Distributive equity addresses water allocation, and procedural equity considers participation in water management. The country prioritizes the human right to water. It stipulates mechanisms for the allocation (distributive equity) of, and participation (procedural equity) in, water resources management to ensure equal and equitable outcomes. Water policy is heavily skewed toward the human right to water; water for basic needs and ecological integrity, contextual issues; historical injustices, and the redistribution of water. This South African case represents a policy reform that promotes water equity.

South Africa flounders in implementing these equity mechanisms. There are areas for improvement in the allocation of water (distributive equity) that have failed to reallocate water equitably and to protect aquatic ecosystems. This, in turn, comprises the human right to water; poor ecological integrity results in poor water quality and negatively affects water quantity, compromising each citizen's right to water and to a healthy environment. Good procedural equity and accountability could mitigate this, and the development of Catchment Management Agencies (CMAs) is intended to uphold procedural equity. However, only two CMAs have been established and there is strong evidence of shortcomings in stakeholder participation (Munnik, 2020). Without good procedural equity, equitable outcomes in the allocation of water resources cannot be achieved.

There is a causal effect. Failure with one equity mechanism inevitably leads to failure in another. Failure in procedural equity results in failure in distributive equity i.e., failure to achieve equitable outcomes. This, in turn, compromises the human right to water. While this demonstrates the adverse causal effects of the foundations of water equity proposed by the authors (human rights, social justice, and context (Higgs, Hill, and Meissner, 2024; Figure 3.1), it implies that if each foundation were upheld, water equity could indeed be progressed. The human rights and social justice approaches must be adopted and implemented in unison, and the political and social context must shape tailored equity considerations. Despite honorable intentions, South Africa will unlikely achieve equitable access to water in the absence of operationalizing water policy objectives.

3.6 Conclusion

South Africa's post-apartheid reformed water policy is built on the foundations of water equity proposed by the authors: human rights, social justice, and context. However, South Africa has struggled to implement these mechanisms effectively. The interconnected nature of these equity mechanisms means that failure in one area inevitably leads to failure in another. South Africa appears to be shifting toward a downward spiral as the implementation of laudable policy objectives continues to fail, perpetuating inequalities and inequities in water management and allocation. South Africa needs to uphold its water policy and international commitments so that water equity may be achieved. Upholding each water equity approach, the human right to water, and the social justice approach is necessary to halt the perpetuation of unequal and inequitable allocation of water resources. Noble policy objectives are intended to achieve equitable outcomes, yet failure to operationalize each of the foundations of water equity (human rights, social justice, and context) will perpetuate inequities.

South Africa's water policy reform promotes water equity. The South African case illuminates the complex interrelationship between equality and equity mechanisms, both of which play pivotal roles in tackling systemic inequalities and inequities. Although these concepts are fundamentally distinct, their interdependent nature necessitates a unified approach to their implementation.

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CHAPTER 4. Methods: Delphi consensus for the development of water equity indicators for South Africa

4.1 Introduction

This chapter establishes the theoretical foundation and justification for developing a water equity monitoring tool in South Africa and presents the rationale and application of the Delphi Method for identifying suitable indicators. It explores the critical role of indicators in South African water governance, examining their necessity and current application in water resource management, and situates existing monitoring and reporting frameworks within the broader water equity framework developed in this research. A key focus is to justify the need for indicators to monitor and evaluate water equity effectively. Water equity involves both human and ecological dimensions, which, while not necessarily opposed, often present competing priorities that need to be carefully managed (Higgs et al., 2025). By tracing the historical development of water management indicators in South Africa, this chapter highlights the importance of a structured, data-driven approach to assessing and advancing water equity. The analysis is structured around key pillars of water equity: human rights, ecological integrity, procedural equity, and distributive equity, which emerged from the findings of our research (Higgs et al., 2024). This research demonstrated that these four pillars are fundamental to a comprehensive understanding of water equity, both in theoretical discourse and in practical application (Higgs et al., 2024). Ultimately, the aim is to identify the most appropriate reporting framework for monitoring water equity, ensuring that both human rights and ecological sustainability are adequately considered.

The Delphi Method is introduced as a qualitative research technique that is particularly effective for developing indicators through fostering consensus among experts from diverse fields, including water management, water governance, the human right to water, and social justice (e.g., Taylor and Ryder, 2003; Joji et al., 2014). The Delphi Method is particularly valuable for addressing complex issues that require input from diverse expertise (Grime and Wright, 2016), making it well-suited for developing water equity indicators where issues are multifaceted and intersect with various disciplines (Lu et al., 2014). By leveraging diverse perspectives, the Delphi approach can capture the complexity of water equity concerns, allowing comprehensive and nuanced insights from experts (e.g., Grime and Wright, 2016; Avella, 2016; Mukherjee et al., 2015; Yang et al., 2012). In addition, Delphi serves as a stakeholder engagement technique (procedural equity) focused on a specific yet highly relevant group of experts.

Regular monitoring and evaluation of water policies and governance is critical for improving decision-making, accountability, and service delivery while addressing priorities and formulating

effective responses (OECD, 2018). Indicators serve as critical instruments in monitoring and evaluation processes, translating theoretical frameworks such as Integrated Water Resources Management (IWRM) into quantifiable parameters for practical assessment and implementation (Bertule et al., 2017), are essential for identifying and monitoring priority interventions, and to highlight inequities or potential risks (Bertule et al., 2017).

Functioning as policy decision-making tools, indicators have gained widespread acceptance by the scientific community, international institutions, government, and the private sector in the monitoring and evaluation of water policies and governance (Pires et al., 2017). Numerous guidelines have been developed that define criteria to measure progress made in the implementation of water resource management and governance (e.g. GWP 2004 and 2006; Jacobson, et al., 2013; OECD, 2015 and 2018; GWP, 2016). These guidelines predominantly emphasise the use of indicators, provide detailed processes for developing indicators and classify the types of indicators that can be utilised to measure performance effectively (GWP 2004 and 2006; Jacobson, et al., 2013; OECD, 2015 and 2018; GWP, 2016).

The water sector is well-suited for applying indicators as monitoring and evaluation tools, due to its strong regulatory frameworks and systematic management practices which rely on measurable data to ensure compliance (OECD, 2018). These factors facilitate the effective use of indicators to monitor and enhance critical aspects such as water quality, availability, accessibility, and sustainability (e.g., WaterLex, 2017; Human Right to H2O, 2021). Indicators are commonly used in water resource management (e.g., Bertule et al., 2017; OECD, 2018) and for monitoring the human right to water (e.g., WaterLex, 2017; Human Right to H2O, 2021), and play a crucial role in evaluating progress and identifying inequities.

This chapter examines the role of indicators in monitoring and evaluating South African water policy and governance, assessing their effectiveness and suitability for monitoring and reporting on water management practices. It establishes the foundation and rationale for developing water equity indicators, aiming to create a practical monitoring tool that translates the concept of water equity, as defined by Higgs et al. (2024), into quantifiable measures. This approach seeks to bridge the gap between the theoretical framework established by this research (Higgs et al., 2025) and practical implementation in water governance in South Africa.

4.2 Water resources management monitoring and reporting in South Africa

South Africa has a well-defined and established monitoring and evaluation system for assessing government performance, supported by guidance documents, established developmental priorities, and targets and indicators. Monitoring and evaluation (Table 4.1) is overseen by the Department of Planning, Monitoring and Evaluation in the Presidency (DPME) (DMPE, 2020). The country's National Evaluation System (NES) is guided by Government-Wide Monitoring and Evaluation (GWM&E) (The

Presidency, 2007) and the National Evaluation Policy Framework (NEPF) (DPME, 2011). The GWM&E system is a monitoring and evaluation framework used throughout government that provides indicators of key activities to ensure that policy outcomes are achieved, particularly service delivery (The Presidency, 2007). The NEPF seeks to evaluate public policies and programmes in a bid to improve their effectiveness and impact (DPME, 2011).

Table 4.1 Monitoring and evaluation as defined by the DPME (DPME, 2014; 2)

Monitoring	<i>‘Monitoring involves the continuous collecting, analysing, and reporting data on inputs, activities, outputs, outcomes and impacts as well as external factors, in a way that supports effective management and continuous improvement in performance’.</i>
Evaluation	<i>‘Evaluation is the periodic and systematic collection and objective analysis of evidence on public policies, programmes, projects, functions and organizations to assess issues such as relevance, performance (effectiveness and efficiency) and value for money and recommend ways forward. Evaluation is critical for generating in-depth evidence for improving performance and decision-making’.</i>

Monitoring and evaluation, and the NES are integrated into national planning, including the National Development Plan (DPME, 2012), the Medium-Term Strategic Framework (DPME, 2019), Departmental strategic plans (e.g., DWS, 2020a) and annual performance plans (e.g., DWS, 2024). These plans focus on the implementation and impact of the government’s five-year strategic priorities (DPME, 2019). The role of women, youth and people with disabilities is prioritised, and these three cross-cutting focus areas are mainstreamed into all government programmes (DPME, 2019).

South Africa has adopted an outcomes-based approach to governance, emphasising the use of indicators for monitoring and evaluation across all government spheres (The Presidency of South Africa, 2007). This approach, underpinned by a logic model linking inputs, activities, outputs, outcomes, and impacts, aims to ensure meaningful improvements in public service delivery (DPME, 2010; Figure 4.1). The government has implemented a comprehensive framework for performance monitoring, with the Department of Performance Monitoring and Evaluation (DPME) playing a crucial role in coordinating and assessing government performance (DPME, 2011). Key to this approach is the identification and utilisation of specific, measurable, achievable, relevant, and time-bound (SMART) indicators that track progress against baseline information (The Presidency of South Africa, 2007). These indicators are integrated into departmental strategic plans and annual performance reports, covering various aspects such as economy, efficiency, effectiveness, and equity (DPME, 2019). This systematic use of indicators enables the government to measure progress, ensure accountability, and make evidence-based decisions for continuous improvement in public service delivery and policy implementation (DPME, 2011).

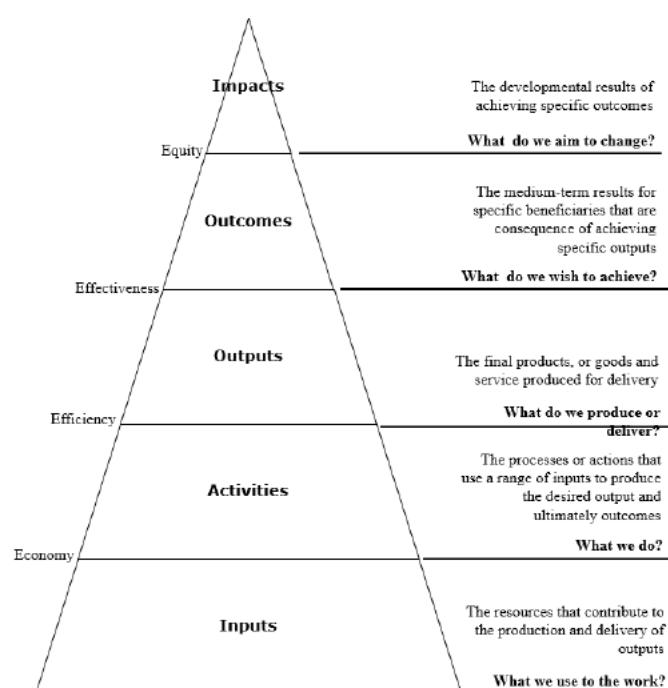


Figure 4.1 South Africa's monitoring and evaluation framework (National Treasury, 2007; DPME, 2010)

The Medium-Term Strategic Framework (MTSF) functions as a key tool for the government to implement and monitor progress toward development goals (DPME, 2011). The MTSF monitors 81 outcomes and 561 indicators aligned with national priorities and sustainable development goals (SDGs), with 20 goals directly linked to the SDGs and several addressing water equity (Higgs et al., 2024). Key focus areas aligned with water equity goals include access to water and sanitation, eliminating bucket toilets, equitable water use licensing, restoring water ecological infrastructure, and reducing water pollution (DPME, 2019). The Department of Water and Sanitation (DWS) has developed strategic priorities that align with these national goals, including protecting and restoring ecological infrastructure, improving raw water quality, regulating water and sanitation, managing effective water and sanitation services, redistributing water for transformation, and reducing water demand while increasing supply (e.g., DWS, 2020a and 2024).

4.3 Progress and gaps in water equity reporting in South Africa

4.3.1 Water for basic needs reporting (Human Rights)

During 2015, South Africa adopted the 2030 Agenda for Sustainable Development and tracks and reports on progress on the Sustainable Development Goals (SDGs) (e.g., StatsSA 2017; StatsSA, 2019). SDG 6: 'Ensure access to water and sanitation for all' sets eight goals including achieving universal and equitable access to safe and affordable drinking water (SDG 6.1), and adequate and equitable sanitation and hygiene (SDG 6.2) for all by 2030 (UN, 2018). Data from the Statistics South Africa

(StatsSA) General Household Surveys (e.g., StatsSA, 2023) provide data that support monitoring of the SDGs. As part of SDG reporting, South Africa is included in the Joint Monitoring Programme (JMP) and the UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS) reports, which are focused on water and sanitation (e.g., WHO, 2022).

National initiatives include the National Development Plan (DPMG, 2012), which is aligned to the SDGs, and the Medium-Term Strategic Framework (DPMG, 2014) that sets national targets for access to water and sanitation. South Africa's National Water Resource Strategy (e.g., DWA, 2013, DWS, 2023) responds to the priorities set out in the NDP. DWS in their strategic and annual performance plans (e.g., DWS, 2024) identifies several human rights performance indicators and targets, notably those that align with policy imperatives. The integrated water resources planning programme outlines indicators, targets and baseline information for the development of plans to ensure adequate water resource availability, quantity and quality, in an equitable manner (DWS, 2020b).

South Africa has adopted the human rights-based approach at a policy level and has made national and international commitments to providing all South Africans with access to water and sanitation e.g., DWS strategic and annual plans, UN SDGs and the African Ministers' Council on Water (e.g., UNEP-DHI, 2017 and WHO, 2022). National commitments are focused on policy imperatives at a planning level, and international commitments are aimed principally at the provision of drinking water and basic sanitation (e.g., SDG 6.1 and 6.2). The monitoring and reporting of the human right to water, along with the use of indicators for such reporting, is well-established in South Africa. However, it is predominantly focused on access to drinking water and the provision of basic sanitation services e.g., SDGs 6.1 and 6.2. This focus on service delivery reporting overlooks other, equally important elements of the right to water, such as water for other domestic uses, such as cooking (Goff and Crow, 2016), livelihoods and customary and spiritual uses (Peña, 2011). The right to water for these activities is crucial, as it supports other fundamental human rights, such as the right to food.

4.3.2 Water for the ecological integrity reporting

South Africa's National Water Act stipulates the establishment of a national monitoring and information system for the '*co-ordinated monitoring of various aspects of water resources*' (RSA, 1998:61). The Department of Water and Sanitation (DWS) are responsible for the eleven national water monitoring programmes that monitor surface- and ground-water data, water use, aquatic health, and the national water quality, eutrophication, and toxicity monitoring programmes (DWA, 2013a). The monitoring programmes are managed by the Resource Quality Information Service (RQIS) and feed into the National Integrated Water Information System (NIWIS). Data from these monitoring programmes and the NIWIS inform South Africa's SDG 6 and the African Ministers' Council on Water (AMCOW) reporting (StatsSA 2019).

To ensure sustainable water management, the evaluation of water supply and demand is evaluated through Water Reconciliation Strategies and All-Towns Studies (DWA, 2013b). These reports assess water demand and availability across catchments to balance consumption with ecological needs (DWA, 2013b). Building on this, the Regulatory Performance Measurement System (RMPS), a programme of the Department of Water and Sanitation (DWS) monitors Water Services Institutions' performance, including wastewater quality and efficiency, to promote sustainable water use and protect the ecological reserve (Solly, 2018).

Extending this focus, South Africa's National Aquatic Ecosystem Health Monitoring Programmes include several key initiatives. The River Eco-status Monitoring Programme (REMP), an annual monitoring programme, monitors abiotic drivers, instream and riparian biota, and uses habitat integrity and species indicators, such as fish and invertebrates (DWS, 2019). The National Estuaries Monitoring Programme (NEsMP) oversees estuary health, facilitating collaboration among stakeholders and monitoring both biotic and abiotic components (DWS, 2019). The National Wetland Monitoring Programme, currently in its implementation phase, aims to assess and monitor wetland extent and threats, with plans to track biological, physical, and chemical elements over time (DWS, 2019). Mandated ecological monitoring is required in catchments where the Ecological Reserve has been gazetted. In these catchments specific indicators for biological, chemical, and physical parameters are established; the Resource Quality objectives (RQOs). RQOs are determined at a sub-catchment level and are designed to maintain and ensure the ecological integrity of the aquatic ecosystems (DWA, 2011).

Water quality monitoring in South Africa is a well-established and ongoing priority, with robust programmes in place. Monitoring of aquatic ecosystem health focuses on assessing the ecological condition of aquatic environments. In catchments where the RQOs have been determined specific criteria to uphold ecological integrity have been set and are monitored. This supports the human right to water by ensuring water quality and quantity standards are being met, safeguarding both the human basic needs and ecological Reserves (Winkler, 2012).

4.4 Procedural and distributive equity reporting

Integrated Water Resource Management underpins water resource management in South Africa (DWA, 2013a). IWRM serves as a practical tool for implementing equity in water resources management (Mirza and Mustafa, 2016) through emphasising a participatory approach (procedural equity) (GWP, 2012). As part of South Africa's commitment to the Sustainable Development Goals (SDGs), the country reports on SDG 6.5, which monitors progress with the implementation of IWRM (UN, 2018). Reporting shows that there has been some improvement in the representation of rural women in water management processes however, the country scores low for participation (UN, 2018). This low score is primarily attributed to the incomplete establishment of Catchment Management Agencies (CMAs)

which would provide the platform for stakeholder participation (StatsSA 2019). In the absence of established CMAs, there are no formal stakeholder engagement procedures, nor monitoring thereof (Stuart-Hill and Meissner, 2018; Munnik, 2020).

Regarding the allocation (distributive equity) of water resources, Water use licensing (WUL) is the key mechanism for achieving equitable water allocation of water for economic and commercial purposes and serves as the primary mechanism of the Water Allocation Reform (WAR) programme (DWA, 2013a). The Water Use Authorisation and Registration Management System (WARMS) is a national register of water use and users in South Africa, providing information for managing equitable water allocation and environmental protection (DWS, n.d). WARMS is restricted to reporting on regulatory and economic water uses, such as water for agricultural irrigation, and does not encompass monitoring or reporting of the WAR programme. The WAR programme, dedicated to redressing inequitable water allocation in South Africa, lacks the necessary assessment and monitoring to determine its effectiveness (DWAF, 2008; Anderson et al., 2008).

4.5 Water equity reporting in South Africa

South Africa has well-established monitoring and evaluation systems that utilise a comprehensive set of indicators to assess government performance and track development progress. With extensive experience in target-based frameworks and indicator-driven assessments, the government is well-equipped to adopt specific metrics for measuring and monitoring water equity as defined by this research (Higgs et al., 2025). Leveraging the government's expertise with the use of indicators will enable the seamless integration of water equity indicators into existing governance monitoring and evaluation processes, effectively supporting the country's water equity goals. Furthermore, indicator-based systems are widely used in water resource management, particularly in Integrated Water Resource Management (IWRM) (e.g., Bertule et al., 2017; OECD, 2018) and human rights reporting (e.g., WaterLex, 2017; Human Right to H₂O, 2021), which form the basis of South Africa's water management strategy. The implementation of a water equity indicator system would facilitate broader engagement and accountability, enabling diverse stakeholders, including international organisations, to actively participate in assessing and improving water equity across various scales and contexts. By developing measurable indicators, this research provides a structured approach to evaluating water equity, enhancing decision-making, and promoting effective policy implementation.

South Africa's water monitoring and reporting systems align with the country's water policy objectives and international commitments, particularly in advancing the human right to water and addressing historical inequities in water allocation for commercial and economic purposes. However, these systems fall short of comprehensively monitoring water equity as conceptualised by this research. Current systems focus heavily on quantitative metrics for service delivery and ecological integrity but fail to integrate water's role in fulfilling interconnected rights such as water for food production, livelihood

support, and cultural practices, factors particularly important for rural and historically disadvantaged communities. Furthermore, the lack of standardised indicators to monitor the quality or outcomes of community engagement in CMA-led processes weakens accountability in equitable decision-making. Without mechanisms to monitor customary water use and agricultural needs, policymakers lack the data to address barriers faced by small-scale farmers and historically disadvantaged communities. This gap highlights the absence of a unified framework for defining, measuring, and operationalising water equity in measurable terms within the South African context (Crafford, et al., 2015). The Department of Water and Sanitation (DWS) has developed indicators primarily focused on policy objectives at a planning level (e.g., DWS, 2020a; 2020b), but these indicators do not fully encompass the multidimensional nature of water equity.

Water equity in South Africa has adopted two different approaches: human rights and social justice. This aligns with Higgs et al. (2024; 2025), who suggest these two approaches are complementary and must work in unison. This research is a first attempt to reconcile these two approaches in a monitoring framework. Developing water equity indicators for South Africa is complex, as the country must address historical inequalities, ensure universal water access, and promote economic growth while protecting ecological resources. Achieving equitable access to reliable water supply and sanitation services, and the equitable allocation of water for beneficial use, are policy imperatives in water resources management (RSA, 1998). The South African Constitution guarantees water for basic human needs and has adopted a human rights-based approach to water management (RSA, 1996). South African water policy defines equity primarily with the allocation of water: *‘equity in access to water resources’* and *‘equity in access to benefits from water resource use through economic, social, and environmental development and management’* (DWA, 2013:12). Furthermore, the development of water equity indicators must consider the cross-cutting priority areas of women, youth, and people with disabilities, which must be mainstreamed into all government programmes (DPME, 2019).

Bertule, et al (2017) and GWP (2006) emphasise the importance of stakeholder engagement in the development of indicators, and participation is one of the principles of human rights law that must be upheld (De Albuquerque, 2014). Stakeholders must be involved throughout the process of developing indicators. Since this research has developed a theoretical definition of water equity (Higgs et al., 2024) and is an attempt to bridge the gap between theory and practice, the Delphi technique was deemed a suitable research method and stakeholder engagement procedure. The Delphi technique allows expert stakeholders to participate in the development of indicators (Mukherjee et al., 2015). This approach yielded indicators that are valuable to a diverse range of stakeholders, including decision-makers, by incorporating diverse and expert perspectives through a participatory process.

4.6 The Delphi method

The Delphi method (hereafter referred to as Delphi) is a qualitative research technique that allows for consensus building among a group of experts or subject-knowledgeable individuals (Avella, 2016). It is an iterative or multi-round process where experts' knowledge and opinions are pooled, then feedback for review, repeatedly, until group consensus has been reached (Hsu and Sandford, 2007; Figure 4.1). Originally developed as a forecasting technique (Dalkey and Hemler, 1961), Delphi has evolved and proved effective in the fields of business, medical and education research, policy determination and resource utilisation (Hsu and Sandford, 2007). Specifically relevant is its application in water resources management (e.g., Taylor and Ryder, 2003; Joji et al., 2014) and in the development, and defining, of criteria and indicators for monitoring and reporting (e.g., Barzekar et al., 2011; Orsi et al., 2011).

Further justification for selecting Delphi to achieve the objectives of this research was:

- Water equity is complex and multifaceted (Nancarrow and Syme, 2004; Peña, 2011), often seen as ill-defined and difficult to conceptualise (Roa-García, 2014; Lu et al., 2014). Given the concept's complexity, evaluation of water equity relies on collective subjective assessments rather than quantitative analyses. The Delphi method proves valuable in such situations, particularly when information is lacking, problem-solving is required, and complex issues fraught with uncertainty are addressed (Grime and Wright, 2016; Richey et al., 1985; Avella, 2016; Mukherjee et al., 2015; Yang et al., 2012).
- Water equity is a multi- and cross-disciplinary concept (Lu et al., 2014). Considering equity through a single or a limited number of academic disciplines can result in disciplinary biases and restrict the scope of its analysis (Lu et al., 2014). As such, eliciting and combining expert opinions from varying disciplines is appropriate. Delphi is effective in correlating informed judgments on a topic spanning a wide diversity of disciplines (Hsu and Sandford, 2007; Yang et al., 2012; Mukherjee et al., 2015).
- Experts in the subject of water equity identified and invited to participate in this research were located across the globe, and experts in the South African context are located across the country. The number of experts and their geographical spread were too vast to facilitate effective face-to-face interaction. Delphi allows for input from a larger number of experts who are geographically dispersed (Mukherjee et al., 2015; Grime and Wright, 2016).

The Delphi process is a group facilitation technique where a panel of chosen experts is presented with an iterative series of structured questionnaires (commonly referred to as rounds) (Hasson and Keeney, 2000). This process allows participants to refine their opinion with each iteration or survey (Masse, et al., 2014). In each round responses are collated, major themes identified and statistical summaries generated (Mukherjee et al., 2015). Structured feedback is the statistical summary of results that are presented to participants after each round (Staykova, 2019). This allows experts the opportunity to

refine their opinion until consensus or majority ruling has been achieved (Avell, 2016). Two to three rounds or iterations are typically sufficient for consensus (Staykova, 2019).

A two-round Delphi was conducted to determine which ‘elements’ derived from the literature could be used to generate equality and equity criteria and indicators for water allocation in South Africa. As a sufficient level of consensus was achieved by the end of the second round, further iterations were deemed unnecessary. For this research, the guidelines for developing and implementing Delphi suggested by Richey et al (1985) and Mukherjee et al (2015) were adopted (Figure 4.2). These scholars propose that their guidelines are an inexpensive, rapid, and efficient means of accessing expert opinion about complex issues (Richey et al., 1985), and avoid some of the common limitations of the technique (Mukherjee et al., 2015; discussed in section 4.9.2 Second round).

This research aimed to address two key gaps (Chapter One): the need for a clear conceptual definition of water equity (Higgs et al., 2024) and an operational framework for monitoring water equity in South Africa. The use of indicators for monitoring purposes has been substantiated (4.5 Water equity reporting in South Africa). To develop these indicators, a questionnaire was developed based on thematic analysis of existing literature (Chapters Two and Three). An expert panel was assembled for validation, and the questionnaire underwent pilot testing and refinement (Figure 4.2). The research employed a two-round Delphi methodology. In the first round, questionnaires were distributed, responses were compiled, and statistical analysis was performed (Figure 4.2). This process was repeated once, resulting in a total of two Delphi rounds, to achieve consensus on the elements that participants agreed should be used to develop water equity criteria and indicators. The final output was a set of agreed-upon elements for constructing water equity criteria and indicators, derived through this participatory process (Chapter Five).

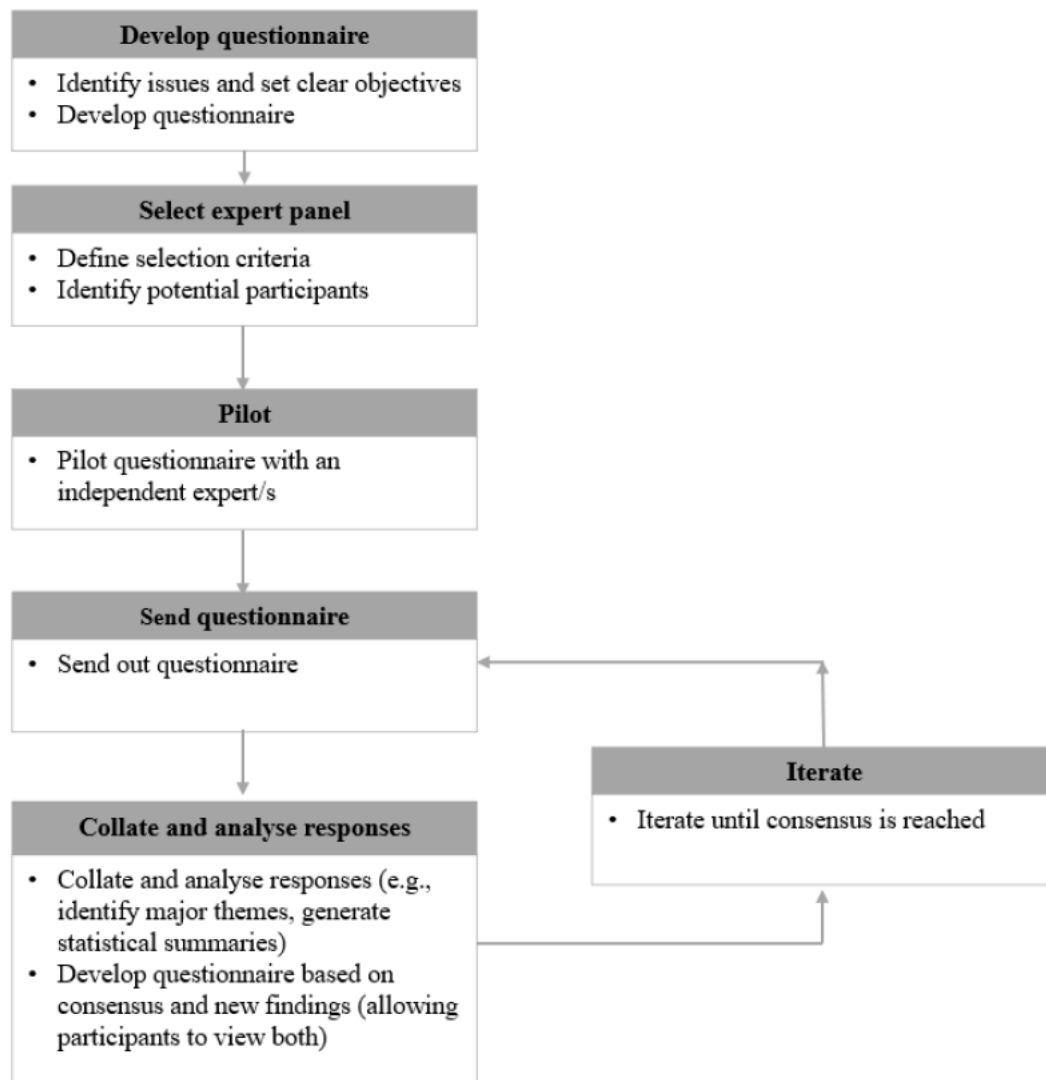


Figure 4.2 Stepwise format used for the development and implementation of Delphi (Richey et al., 1985 and Mukherjee et al., 2015) adopted for this research

The key characteristics of Delphi are anonymity, iterative surveys, and structured feedback. Complete anonymity allows experts to participate in the research independently, without knowledge of the other experts or their area of expertise (Yang et al., 2012). Anonymity in Delphi is critical as the opinions of individuals collected independently are often more accurate than opinions reached in collective or face-to-face group scenarios. Anonymity mitigates the influence of dominant individuals, the opinions of the majority and bias, allowing each participant freedom of expression (Avella, 2016). To ensure anonymity in this research, the researcher was the sole point of contact and custodian of participants' details and detailed responses.

The research was carried out under ethical policies and procedures stipulated by the University of KwaZulu-Natal (UKZN). Ethical clearance was obtained from UKZN's Human and Social Sciences

Research Ethics Committee (Appendix 1). Informed consent was obtained from each participant for each round. Each participant was informed that their participation was voluntary, that they could terminate the survey at any time, and that their identity and opinions would remain anonymous and confidential. All data were password-protected, as was the email account used for communication (as per UKZN's privacy policies) and personal interviews were not recorded.

4.7 Selection and composition of the expert panel

Selecting the expert panel may be the most critical step in Delphi as it directly impacts the results generated (Hsu and Sandford, 2007) and should be based on conditions that are thought to qualify the participant as an 'expert' (Avella, 2016). For example, having direct involvement in the subject which can be determined by the number of years' experience or peer-reviewed publications in local and international journals (Mukherjee et al., 2015).

Water equity is multifaceted and must be contemplated within relevant yet different disciplines (Wilder and Ingram, 2018) and navigate interaction between a complex and diverse array of stakeholders e.g., civil society organisations, government, and technical experts in numerous specialised disciplines (Ingram et al., 2008). This research focused on potential participants from a diversity of organisations and technical experts within the disciplines contemplated in this research. Experts from academic institutions, consultancies, civil society, and government, and with expertise in disciplines such as justice, human rights, and water governance and management (Table 4.2). The study area is specifically South Africa, and as such, it was important to include South African experts. The inclusion of international experts was equally valuable as the international agenda e.g., the United Nations 2030 Agenda for Sustainable Development, sets the tone for water management in South Africa.

Table 4.2 Selection criteria used to identify experts.

Relevant knowledge	• Water equity • Social justice in water resource management • Water justice • Human rights-based approach in water resource management • Equality in water resources management • Integrated water resources management (IWRM) • Environmental justice • Water ethics • Water resource management • Social anthropology (South Africa) • Water governance in South Africa • Political science in South Africa • Water policy in South Africa • Social scientist working in water resources management
Direct involvement in the subject of water equity	Published in the subject of water equity, water justice, social justice and/or the human rights-based approach in water resource management In a senior position in an organisation any of the listed relevant disciplines
Peer reviewed publications	At least one peer-reviewed publication on the subject of: • Water equity • Social justice in water resource management • Human rights-based approach in water resource management • Water justice • Environmental justice in water resources management
Organisations	• Academic institutions (Global and South Africa) • Civil society organisations (Global and South Africa) • Government (South Africa only) • Consultancies (South Africa only)
Location	Global, with a focus on South African experts

Experts were identified from three sources. First, those who had published articles, books or book chapters on the subject of water equity, water justice, social justice and/or the human rights-based approach in water resource management (South Africa and international). The databases Google Scholar, ResearchGate, Science Direct, EBSCOhost, Academic Search Complete and Sabinet were used to source such information. Second, an internet search for those with expertise and involvement in, or in a senior position in, an organisation with involvement in, any of the listed relevant disciplines, with a focus on South African experts (Table 4.2). Third, snowball sampling was adopted, a technique that identifies suitable research participants through the identification of an initial participant who is willing to provide the names of others. This allows the identification of concealed participants and increases the pool of potential participants (Lewis-Beck et al., 2004). On the distribution of each

questionnaire, experts were asked to refer other experts within their network who met the participation criteria (Table 4.2). The snowballing approach was successful, with some experts deferring to others whom they deemed suitably qualified to participate.

This yielded a list of 125 potential participants, all of whom were emailed with details of the research and invited to complete the questionnaire. For the first round of Delphi, 17 experts participated and 28 participated in the second round. This is a participation rate of 14% and 22% respectively. A total of 15 experts participated in both rounds. The increase in participation during the second round was unexpected and can be attributed to several factors. First, experts had more time available to contribute during this round, or they were better informed about the research objectives, which likely enhanced their engagement. The provision of an online meeting option facilitated the completion of the questionnaire, thereby increasing accessibility and encouraging more participants to contribute (explained below, 4.11 Questionnaire). Mukherjee et al., (2015) suggest that the number of experts participating in a study can be as few as two and as many as 183, however, less than 20 is typical. The participation rate for this research was within this range. After the initial invitation to participate in the research, a reminder was sent weekly. Some participants completed the questionnaire without the need for follow-up, while others after two or three reminders. Some declined to participate for various reasons; too busy and did not have time to participate, some felt their level of expertise was not sufficient to contribute meaningfully and one due to a conflict of interest (their own research had comparable objectives).

Most participants were located in South Africa (74%), with one participant each from Australia, Canada, Germany, the Netherlands, Sweden, Switzerland, the United Kingdom and the United States. Expertise in the areas of water management and governance (32%) and water and sanitation (7%) in the South African context constituted a large proportion of the expertise, with 16% of participants having expertise in water equity as defined by this research (Table 4.3). This represents a diverse range of expertise in water equity in both the South African and international contexts. The main area of professional activity was professorship (26%), followed by those in senior leadership (26%) or experts (16%) in their field. This provides many years of expertise and a high level of expertise for most participants in this research. Most participants were employed at universities (29%), research institutes (23%), or non-profit organisations (19.4%).

Table 4.3 Composition of the expert panel (n=31)

Characteristic	Number of respondents	Percentage
Location		
South Africa	23	74
Global (Australia, Canada, Germany, Netherlands, Sweden, Switzerland, United Kingdom, United States)	7	23
Applicable area of expertise		
Community-Based Research (South Africa)	1	3
Human rights (South Africa)	1	3
Water politics (South Africa)	3	10
Social and environmental justice (South Africa)	2	7
Water and sanitation (South Africa)	2	7
Water and society	1	3
Water equity	5	16
Water governance (international)	2	7
Water management and governance (South Africa)	10	32
Water Policy and rights (Africa)	1	3
Type of organisation		
Consultancy	3	10
Government department	1	3
Human rights institution	1	3
Non-profit organisation	6	19
Political party	1	3
Research Institute	7	23
State-owned entity	3	10
University	9	29
Main professional activity		
Management	5	16
Professor	8	26
Researcher	4	13
Senior leadership	8	26
Specialist	6	19

4.8 Questionnaire

Questionnaires are the data collection instrument of Delphi that allow each participant to communicate individually with the researcher, ensuring their anonymity (Childs et al., 2014). The first-round questionnaire is usually un- or semi-structured with open-ended questions allowing participants the opportunity to contribute their own ideas and elaborate on their responses (Staykova, 2019). Where evidence has been drawn from published literature to develop the questionnaire, semi-structured questionnaires may be more suitable (Mukherjee et al., 2015). Subsequent round questionnaires present

the statistically summarised findings of previous rounds, focusing on the topic and findings derived from the previous round (Daniels, 2017). This is achieved by allowing participants to review their initial contributions and the summarised outcomes of the other participants (Staykova, 2019).

The initial questionnaire was generated from a literature review (Chapters Two and Three). The purpose of the research is to develop a reporting framework for water equity, specifically water equity criteria and indicators. The questionnaire first introduced the concept of water equity, then was structured around the pillars of water equity identified in the literature review: human rights, social justice (procedural and distributive justice), and contextual factors (Appendix 2). Under each pillar, elements from the literature that could inform the development of water equity criteria and indicators were listed (Appendix 2). For the first round of Delphi, data are collected through either open-ended questions (Staykova, 2019) or using ranking or rating methods (Mukherjee et al., 2015). For this research, the literature review yielded a list of four pillars and 108 elements (Appendix 2) that could be used to develop criteria and indicators (Table 4.4). Participants first confirmed the pillars, then ranked the list of elements in order of importance, where 1 is the most important. No ranking was provided in cases where the element should have been excluded. Participants were encouraged to share their ideas and expertise and provided with space to comment after each element section/non-selection. Participants could share their rationale for the selection or exclusion of the pillar or element. They were requested to suggest additional elements that they would prioritise that did not appear on the proposed list. No additional elements were suggested by the participants.

Table 4.4 Number of elements listed per pillar of water equity

Pillars of water equity	Number of elements listed
Human rights	28
Procedural equity	29
Distributive equity	23
Context	23
Total	108

The second questionnaire (Appendix 3) presented a shortened list of ‘elements’ that the expert panel had previously (round 1) agreed could potentially be used to generate equality and equity criteria and indicators. Participants either agreed or did not agree that each element should be included. They were then presented with two elements that the expert panel had previously agreed should be excluded and were requested to confirm if each of the two elements should be excluded. The rest of the elements (low-ranking elements from the first round) were listed and participants could reconsider their element selection from the first round.

In both rounds the questionnaire was designed to be answered in approximately 20 minutes, or more depending on each participant's convenience, and the extent of commentary that they wished to contribute.

4.8.1 Pilot study

In Delphi, the initial questionnaire should be piloted by a small group of experts (Staykova, 2019). The first questionnaire was pilot tested by a supervisor of this research and an independent water research expert. Based on their advice, some minor changes were made to the manner in which certain elements of water equity were depicted and to the cover letter. This improved the clarification of this complex concept and the requirements of the questionnaire. A significant improvement suggested by the supervisor and water expert was converting the questionnaire, cover letter and informed consent letter to an online format, REDCap. REDCap is a secure web platform for building and managing online surveys that allows for download of collected data in Microsoft Excel and other statistical packages (Harris et al., 2009; 2019). Converting the questionnaire to an online format improved ease of participation and the participation rates. An email with multiple attachments would not have been optimal for encouraging participation.

4.9 Data collection and analysis

4.9.1 First round

The first questionnaire opened on 17 February 2021. Personalised emails were sent from a secure email account to each prospective participant with summarised details of the research and a link to the REDCap survey. The REDCap survey detailed the objectives of the research, stated its voluntary and confidential nature, provided evidence of ethical procedures, and requested that the questionnaire be completed within three weeks. Requests from numerous participants resulted in the deadline being extended by a further week. Some participants requested assistance with completing the survey, and one-on-one online meetings (Zoom or Microsoft Teams) were conducted to increase time efficiencies for those participants. One-on-one online meetings were not originally offered, but were conducted in response to requests and to improve the response rate. During these sessions, the researcher did not lead or probe the participants. The sessions were intended as a time-saving exercise for the participants, and the researcher's role was solely to complete the questionnaire. A total of 17 questionnaires were completed, most (71%) were fully completed, and some (29%) were more than 50% completed (Table 4.5).

To ensure controlled feedback in the Delphi process, participants received a descriptive statistical summary of the group's responses (Rowe and Wright, 1999). For Delphi, statistical feedback is generally the mean, median or frequency and an analysis of the rationale provided by each participant for their responses (Grime and Wright, 2016; Staykova, 2019). Central tendencies (mean, median, and mode values) and levels of dispersion (standard deviation and interquartile range) can be used

(Mukherjee et al., 2015). Data from the first-round questionnaire were exported from REDCap in Microsoft Excel for analysis. For each of the pillars, human rights, procedural equity, distributive equity and context, the elements with the five highest and two with the lowest frequencies of selection in priority ranking were identified. In addition to the rankings, a diverse, rich, and meaningful commentary was collected. It was clear that supplementary qualitative analysis of the data was required to enhance understanding and interpretation of the findings (Chapter 5).

A notable limitation was encountered with the first survey. Some participants (44%) contested the use of priority ranking of the elements. These participants expressed that in the practice of water management the ranking of elements is impractical, that ranking is superfluous as all elements are equally important and that the interrelatedness and relationships between elements make ranking unfeasible. Some participants (17%) suggested that the questionnaire i.e., the proposed pillars and elements, represented a framework that could be used to develop water equity criteria and indicators, and that the list of elements should not be reduced in number. These participants suggested that each element is equally important, and that all should be used in the development of a reporting tool. Some participants (22%) suggested ranking no more than four or ten of the elements per pillar. Priority ranking in the questionnaire was adopted to shorten the list of elements and to eliminate elements that the experts considered less important in the development of water equity criteria and indicators. The exercise of prioritising elements was not anticipated to be meaningful, nor practical in the implementation of water management. The number of participants contested that this approach could be attributed to a miscommunication in, or a misunderstanding of, the questionnaire instructions. Specifically, some respondents expressed confusion regarding the process for prioritising and ranking the elements in order of importance. This was clarified, and an alternative to ranking was used in the subsequent round (4.9.2 Second round).

A second limitation was the length of the questionnaire, with some participants (17%) claiming that it took more than 20 minutes to complete. Participants were informed that the questionnaire could take longer to complete, depending on their convenience, and the extent of commentary that they wished to contribute. This was reiterated in the second questionnaire. Despite this, questionnaire rates were high, 71% for the first, and 93% for the second round, with most partial responses exceeding 50% of the questionnaire (Table 4.5), and many experts provided commentary. Longer questionnaires can result in some experts losing interest or answering with haste, however, the high completion rates and detailed commentary suggest that most experts stayed engaged and considered their responses.

A few participants (11%) contested that the perceived similarity, or duplication of elements suggested that duplicate elements should be removed or merged with other similar elements. During a Delphi, information collected from the first round can be analysed for instances where there is an overlap in statements and similar or repeated statements can be collated and collapsed into a smaller number of

statements (Daniels, 2017). As such, elements were merged as suggested by the respective participants and presented in the shortened list in the second questionnaire. A few participants (11.1%) indicated that the interrelatedness of some elements hindered meaningful priority ranking. This was noted, and participants were asked to suggest how to overcome this in the second questionnaire.

4.9.2 Second round

The second questionnaire was opened from 21 May 2021 to 14 June 2021 in REDCap as per the first questionnaire. A total of 28 questionnaires were completed, with a small percentage (7.4%) partially completed (Table 4.5). Participants were presented with the findings of the first round, a shortened list of elements, and requested to confirm whether each element should be included or excluded. The remaining elements were included, and participants were allowed to review their selection of elements from the first round. Participants were provided with the opportunity to comment, as extensively as they deemed necessary. The second round of Delphi characteristically moves into the quantitative domain, adopting a ranking or rating method such as a 5-point Likert scale (Staykova, 2019; Daniels, 2017). However, based on participant feedback from the first round about the length and complexity of the questionnaire, and the imprecision of ranking, experts were requested to simply agree or disagree that an element should be included or excluded.

Table 4.5 Survey completion rates

	n	Survey completion rate			
		Survey 100% complete		Survey >50% complete	
		100% completed	%	>50% completed	%
Round 1	17	12	70.6	5	29.4
Round 2	28	26	92.9	2	7.4

The data were exported from REDCap in Microsoft Excel and analysed to determine whether consensus on the part of the participants had been reached. Delphi consensus ranges from 50% to 80% agreement, with 70% agreement being considered standard (Vernon, 2013; Staykova, 2019). Water equity is a multi- and cross-disciplinary concept that must be contemplated by many disciplines to avoid limiting the scope of its analysis (Lu et al., 2014) and participants were experts from various disciplines (Table 4.5). The diversity of expertise would result in a range of opinions and a high rate of consensus was therefore considered improbable. The lower end of the acceptable consensus range, more than 50% consensus, was adopted. Elements were more than 50% of participants agreed that the element should be included, was included.

This yielded a high rate of inclusion of elements (Table 4.6). There were incidents of elements that participants agreed should be excluded, which contradict South Africa's water policy and /or legislation and methodological guidelines. Regardless of the outcome of participant consensus, elements that are

water policy requirements were included (as a result, the research methodology was refined, explained in Chapter 5).

Table 4.6 Outcome of the second Delphi questionnaire

		Total number of elements	Number to be included	% to be included
Human Rights Elements	Water for basic human needs	17	12	70.6%
	Ecological integrity	11	9	81.8%
Social justice	Procedural equity	29	20	69.0%
	Distributive equity	23	20	87.0%
Context		23	19	82.6%
Total		103	80	77.7%

4.10 Reliability, validity and limitations

In qualitative research, ensuring validity, reliability, and applicability is essential for upholding the rigor and trustworthiness of the study's findings (Golafshani, 2003). Reliability refers to the replicability or repeatability of the research and consistency of the study's results (Hasson et al., 2000). Validity evaluates the extent to which research accurately represents what it aims to measure, encompassing both the general applicability of results (external validity) and the confidence in the study correctly measuring what it intends to measure, establishing cause-and-effect relationships (internal validity) (Hasson and Keeney, 2011).

The Delphi method, like other quantitative research methods, has come under scrutiny for its validity and reliability (Hasson et al., 2000; Staykova, 2019). A limitation of the Delphi is the reliability of the results. It is considered unlikely that different panels, at different points in time, would come to the same conclusions (Hasson et al., 2000). However, Landeta and Lertxundi (2023) note that expert opinion is subjective and that this is the nature of Delphi. Indeed, Delphi results should be considered relevant to each study, at that study's point in time and the reliability of results can be enhanced through triangulation with other sources of evidence for example Hasson and Keeney (2011) and Fink-Hafner et al. (2019). Other key weaknesses of the method include (Avella, 2016; Staykova, 2019):

- Researcher bias and shortcomings. The researcher has authority and influence over the process, and any bias on the part of the researcher would skew results, as would any prejudice on the part of the researcher (4.10.1 Researcher bias).

- Panel member instability: Difficulties in retaining the interest of panel members have been noted, as has panel member motivation and petulance during the Delphi process (4.10.2 The Delphi Panel).

4.10.1 Researcher bias

The independence and expertise of researchers can influence the outcomes of the research in a biased manner as their perspectives and assumptions may influence data interpretation and conclusions (Avella, 2016; Staykova, 2019; Landeta and Lertxundi, 2023). A limitation of this research is that the researcher has less direct experience in the subject compared to the Delphi participants, who were selected for their extensive experience and expertise. A researcher with greater expertise or one who possesses a deeper understanding of the subject matter may have arrived at alternative interpretations of the findings of this research. Conversely, this may have increased the research's validity, as limited prior knowledge would have eliminated any bias. The researcher was guided by two senior and experienced supervisors through the research process. Other subject matter experts were consulted when necessary, though these instances were infrequent.

4.10.2 The Delphi Panel

Landeta and Lertxundi's (2023) suggest that to increase the reliability and validity of Delphi for early phase studies, such as this research, seven or more experts increases the precision of the results. They suggest 15 to 30 experts for homogeneous panels. Mukherjee et al., (2015) suggest that fewer than 20 experts are typical. The panel for this Delphi totalled 17 for the first and 28 for the second round (Table 4.5), well within the number of experts recommended to increase the reliability and validity of the research. However, the panel for this research is not homogeneous, made up of experts from a diversity of disciplines. Five participants had direct expertise in water equity as defined by this research (Table 4.3).

The panel should be representative, spanning the field of study and the knowledge necessary to meaningfully contribute to the study (Landeta and Lertxundi, 2023). Experts represented the breadth of disciplines contemplated in this research, from those with direct expertise in water equity (as defined in this research), human rights, water governance and water justice (Table 4.3). Panellists were experts and located in South Africa and seven international experts (Table 4.3). This represents a diverse range of expertise in water equity in both the South African and international contexts. Motivation is the measure of engagement of the panel e.g., dropout rates and experts providing additional information (Landeta and Lertxundi, 2023). Scholars have noted that a weakness of the Delphi is that it is prone to high dropout rates e.g., Avella (2016), Fink-Hafner et al (2019). There was a high level of engagement for this research. In addition to completing the questionnaire, experts provided a rich commentary and, rather than dropping out of the study due to the time restraints, requested online meetings to assist with completing the questionnaire, and there was increased participation in the second round (Table 4.5).

Delphi can be enhanced through triangulation with other sources of information, utilising multiple sources of information to corroborate findings (Hasson and Keeney, 2011; Fink-Hafner et al., 2019; Landeta and Lertxundi, 2023). The consensus reached for each element was cross-referenced with existing literature. A comprehensive literature review was conducted to examine all ranked elements (Chapter Five). This investigation not only verified the Delphi consensus, but it also served as a basis for the creation of water equity indicators. The inclusion of each indicator was systematically justified by integrating Delphi consensus findings with supporting literature, ensuring a robust and evidence-based selection process (Chapter Five).

One potential limitation of the research was that the researcher failed to align the water equity elements presented to the participants with South African legislative requirements and policy priorities. This resulted in two outcomes: first, the questionnaire became lengthy and cumbersome; second, the Delphi consensus reached may not have been robust. To address this oversight, the research method was modified following the completion of the Delphi process by ensuring that legislative and policy imperatives were duly considered in the development of the indicators (Chapter 5).

4.11 Conclusions

Delphi's effectiveness in fostering consensus among experts from various disciplines provided a suitable approach for selecting water equity indicators for South Africa. The two-round Delphi allowed experts' knowledge and opinions to be collated, leading to an overall consensus on water equity indicators. The selection and composition of the expert panel were crucial to the success of the Delphi. By identifying experts with diverse backgrounds and expertise, the research was able to gather insights from a broad spectrum of knowledge, experience, and expertise. The high level of engagement and participation from the panel members enriched the research outcomes. Alongside achieving consensus on the indicators, the Delphi process generated an unexpected and valuable commentary that enriches the water equity elements derived from the literature review. The significance of this commentary indicated that relying solely on consensus was insufficient for the development of indicators. Consequently, the research adopted an approach that integrates Delphi consensus with the commentary, while aligning with South African policy and regulatory requirements (Chapter Five).

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CHAPTER 5. Results: Water equity indicators for South Africa

5.1 Introduction

This chapter outlines the development process of the water equity indicators, the result of integrating insights from the literature review and the outcomes of the Delphi. As opposed to only presenting results, the chapter focuses on the structured methodology used to identify, refine, and justify each indicator. It details the selection criteria, explaining why a Delphi process was chosen and how it was adapted for this research. The justification for each indicator's inclusion is analysed, providing a clear and robust rationale for its selection. A key focus is placed on prioritising legislative requirements when selecting and developing indicators. This approach assesses whether experts have overlooked legally mandated requirements or if the Delphi process has introduced new insights that go beyond the existing legislative frameworks. Finally, the chapter discusses the application and relevance of these indicators, emphasising their role in advancing water equity. By structuring the chapter in this way, the aim was to provide both a thorough justification of the indicators and a transparent account of the development process.

5.2 Water equity indicator development: an adapted Delphi approach

The research yielded a high rate of inclusion of water equity elements, confirming that assessing water equity is an inordinate task requiring a considerable number of indicators. The approach should be multi-tiered and predominantly stakeholder-driven to select indicators suited to each region or context. Delphi participants recommended a maximum of four indicators per water equity pillar (Table 5.1), and a maximum of eleven indicators in total. Limiting the number of indicators simplifies data collection and analysis, ensures clarity, reduces redundancy, accommodates resource and capacity constraints, and provides actionable insights that stakeholders are more likely to apply effectively.

While the proposed indicators (Table 5.1) do not represent the full notion of water equity, which would be complex, dynamic, and interrelated, the eleven proposed indicators serve as a first step in developing a monitoring tool to assess the state of water equity. These indicators align with legislative requirements and reflect water equity priorities within the South African context, and could be different in different geographical contexts.

Table 5.1 Proposed indicators from the Delphi process to assess water equity in South Africa. A summary of the results and the key outcome of the Delphi.

Pillars		#	Indicator	
Human Rights	Water for basic human needs	1	Quality of drinking water and the condition of sanitation services and programmes	Quality of drinking water
				State of sanitation facilities
		2	Interruptions to water services and reliability of sanitation services	Frequency and length of interruption to water services
				Reliability of basic sanitation services
		3	Physical accessibility of drinking water and sanitation facilities	Proximity of the water source to the household
				Proximity of the sanitation facility to the household
Procedural equity	Water for ecological integrity	4	Water for the Ecological Reserve	The Ecological Reserve has been determined for the water resource
		5	Protection of the Ecological Reserve	Resource quality objectives (RQOs)
		6	Stakeholder participation	Broad and inclusive stakeholder participation
Distributive equity		7	Stakeholder representativeness	Representation in participation
		8	Ethicality	Transparency in procedures
		9	Water for cultural, spiritual and customary practices	Water quality impacts on cultural, spiritual and customary water uses
		10	Provision of water for food production	Provision of water for food subsistence production
		11	Water for commercial and economic uses	Allocation of water for commercial and economic uses (Water Use Licensing)
				Distribution of the impact of the use of water for commercial and economic uses i.e., pollution

The development of the indicators was guided by a prioritisation process that ensured their relevance and applicability. This approach involved:

1. Delphi process outcomes: Incorporating both the consensus reached among experts and their detailed commentary to identify the most critical measures.
2. Alignment with legal requirements and water policy imperatives: Ensuring compliance with legislative frameworks to address regulatory obligations and support policy implementation.
3. Evidence-based insights: Drawing from established research and literature to align the indicators with water equity priorities specific to South Africa.

In addition to the Delphi consensus ratings, a rich body of expert commentary was collected and systematically analysed throughout the Delphi process. After each round, qualitative comments were thematically analysed to identify recurring issues, priority elements, and suggestions for further investigation. This analysis enabled the research team to extract key themes and insights, which were then used to guide the development of indicators. When selecting priority areas for indicator development, legislative requirements were prioritised, followed by issues frequently highlighted in the commentary as contributing to disparities in water management and access in South Africa. In this chapter, each section presents the top-rated elements from the Delphi, describes the regulatory environment and the South African context, and explains how both quantitative ratings and qualitative commentary informed the selection and justification of each indicator. This approach ensured that indicator development was both evidence-based and responsive to the nuanced expertise of the panel.

Table 5.2 Summary of Delphi consensus on the top five elements for each water equity pillar
(excludes cross-cutting elements)

Pillar		Element	Consensus
Human rights	Water for basic human needs	Quality: Safe for human consumption and protection of health and safety during use of facilities	96%
		Availability: Water for personal and domestic uses, and sanitation facilities	93%
		Accessibility: Physically accessible and secure water and sanitation infrastructure in the immediate vicinity	89%
		Level of use of water and sanitation services e.g., access in public spaces, at schools, at public health facilities	71%
		Affordability: Ability to pay for water and sanitation services and income levels in relation to access to water and sanitation costs	61%
	Water for ecological integrity	Water management to support a healthy human environment e.g., environmental water demand, measures of discharge, water quality, habitat integrity and biotic integrity	93%
		Water for biodiversity, including plants, animals, places, and habitats and livelihoods based on environmental resources	82%
Procedural equity		Participation: Must be open to broad participation of all affected parties, including through such mechanisms as networks, voluntary associations, and public/private partnerships	100%
		Ethicality: Anti-corruption and transparency (an openness in procedures, information, potential sources of conflict)	89%
		Representativeness: Representativeness of all affected persons/parties (road and inclusive participation of stakeholders, including all affected parties across the entire spectrum of water users and across scales)	82%
		Knowledge-sharing and learning: Mechanisms in place for knowledge sharing and learning	82%
		Institutional systems: Institutional systems that promote equity	79%
Distributive equity		Social benefits: Water contribution to society e.g., water for food security	100%
		Productive purposes: Water used for productive purposes and beneficiaries thereof e.g., irrigation, industry, hydroelectric energy	90%
		Financing in water management e.g., polluter's pay, ability-to-pay	92%
		Accountability: Mechanisms to ensure that public and private actors fulfil their duties and responsibilities	92%
		Participation in water-related productive processes (employment, payments, productive chains with other sectors)	81%

It was concluded that while a high level of consensus was reached on including the SDGs in a water equity monitoring framework, the SDGs would not be included. The SDGs are embedded in the country's water policy (Wilkinson et al., 2018) and are monitored and reported (StatsSA, 2019a). Their inclusion would be a duplication of effort and may detract from this proposed water equity monitoring framework and the significance of its broader view on water equity. While participants agreed that the SDGs are good indicators and could be included in a water equity monitoring framework, they highlighted issues with the availability of data, the scale of reporting, and target timeframes being unachievable. As noted by a Delphi participant, *'the SDGs are implemented at a national level, while regional and local levels have far more complexities that can best be managed and measured using more refined monitoring.'* Several participants (11%) pointed out the need for information at both local and national scales, underscoring a fundamental aspect of effective water equity monitoring in South Africa. This requirement is not merely a preference, but a necessity rooted in the country's complex socio-geographic landscape.

South Africa is characterised by a mosaic of diverse settings, including rural, urban, informal, and tribal areas, each operating under unique circumstances. These areas are served by different water boards and municipalities, each operating under varying governance regimes and facing unique contextual issues, such as disparities in resource availability, infrastructure, and population needs. Therefore, it is proposed that the water equity monitoring framework be applied at the local level to ensure its relevance and effectiveness. Localised application allows for tailored solutions that address specific challenges and promote equity within each unique setting (Table 5.3) Furthermore, local application fosters greater participation and engagement from stakeholders, including civil society organizations, who are instrumental in identifying issues and co-developing solutions at the municipal level. This approach aligns with South Africa's National Water Act and integrated water resource management policies, which promote decentralisation and the establishment of local governance structures such as Catchment Management Agencies to enable responsive and integrated water management. By grounding monitoring efforts in the specific socio-geographic realities of each locality, the framework enhances equity, effectiveness, and contextual relevance in water management across the country.

Given that equity is enshrined in South African policy and legislation, the indicators have been designed for use by government officials, and independent groups with a vested interest in equity, such as non-governmental organisations, and international agencies, who may place value on assessing and achieving equity (Table 5.3). The use of the indicators is not limited to these interest groups. Various interest groups can apply these indicators to assess their equity position. For example, ratepayers' associations in urban areas and communal interest groups in rural regions might find them of value. Ratepayers' associations in urban areas can use them to ensure equitable service delivery, while communal interest groups in rural regions may find them valuable for advocating resource allocation

that addresses local needs. By enabling such diverse applications, the indicators contribute to fostering a culture of accountability and advancing equity across different sectors and communities.

Table 5.3 Application of the water equity indicators summarised

The indicators have been formulated for application in South Africa, taking into account the unique characteristics of, and priority equality and equity concerns for the region. They would require adaptation for use in different geographical contexts.
The indicators are designed to be applied at a local or regional level, such as a catchment, sub-catchment, municipality or Ward.
The indicators have been developed for use by government and other interested parties, for example civil society organisations, and international agencies.

5.3 Structure and layout of the water equity questionnaire and indicators

Zafra-Calvo et al (2017) and the Convention on Biological Diversity (2010) propose that a first step in assessing equity, albeit in protected areas, is to use an uncomplicated questionnaire that gathers information requiring the proposed indicators facilitating a quick assessment of the state of equity (Zafra-Calvo et al., 2017). Given that this research introduces the concept of water equity and serves as a first step in assessing it, this approach is deemed fitting for this research purpose and has been adapted for the structure and presentation of indicators in this research.

The water equity indicators are qualitative and are presented in an assessment format (Table 5.6 Indicator 1 to Table 5.19 Indicator 11). The assessment form lists the proposed indicators, describes each indicator and asks for an assessment of the current state of each indicator. The current state can be evaluated as either inequitable (harming equity), ineffectual (having no impact on equity) or equitable (having a positive impact on equity). Beyond its evaluative function, the assessment serves as an invaluable educational resource, enhancing understanding of water equity concepts among potential users of the proposed monitoring framework and fostering informed decision-making and policy development (Zafra-Calvo et al., 2017).

The indicators have been structured in accordance with the water equity pillars delineated in this research: human rights, procedural equity, and distributive equity (Higgs et al., 2024). These indicators have been supplemented by (contextual) cross-cutting factors that have been incorporated into the evaluation of each water equity indicator.

5.4 The pillars of water equity

Most Delphi participants (96%) agreed that human rights, procedural and distributive equity, and context are the pillars of water equity (Table 5.4), and that the human rights-based and social justice approaches are intrinsically interlinked and should be operationalised in a single cohesive monitoring framework. Furthermore, in the water management context, human rights and procedural equity are

constitutional imperatives and legal requirements of the National Water Act, as are certain elements of distributive equity (Higgs et al, 2025). Accordingly, the water equity monitoring framework developed in this research integrates these four pillars into a single, cohesive structure (Table 5.4).

Table 5.4 The pillars of water equity

	Water equity criteria		Description
1	Human rights		Water for basic human, ecological and species needs, cultural uses and future generations
2	Social justice	Procedural equity	All having an equal say in water management decision-making and water allocation
3		Distributional equity	Equity in the distribution of water e.g., access to water for basic needs, for productive purposes, and benefits and burdens sharing
4	Context		Cultural, socioeconomic, and political elements

5.5 Context / cross-cutting indicators

This research (Higgs et al., 2024) highlights the contextual nature of water equity, it is dependent on location and local circumstances (Wilder and Ingram, 2016), the way people fairness is perceived by individuals or groups (Nancarrow and Syme, 2004), and the political and historical factors that have shaped current situations and perceptions (Peña, 2011). Most Delphi participants (88%) agreed that culture, social, economic, political and time-based factors are important contextual issues that must be considered when assessing water equity. Of the contextual elements presented to the Delphi participants, non-discrimination and the future use of water ranked amongst the greatest importance (92% consensus on each).

Non-discrimination and sustainability are two of five cross-cutting principles that must be met and realised in the right to water (Human Right to H2O, 2021). These factors are embedded in the South African constitution (RSA, 1996) and water legislation (e.g., RSA, 1998). Particularly, non-discrimination and the future use of water are critical considerations in all aspects of, and across the pillars of, water equity (Higgs et al., 2024) i.e., they are cross-cutting. These factors should not be assessed in isolation from other factors and should therefore be integrated into the assessment of each water equity indicator.

5.5.1 Non-discrimination

Non-discrimination and equality are foundational principles in human rights law and States are obligated to act ubiquitously without discrimination (de Albuquerque, 2014), with every individual being entitled to equal and fair treatment without discrimination (Jensen et al., 2014). The principle of non-discrimination applies to all human rights and pertains to every aspect of water utilisation (Winkler, 2012). This was recognised by the Delphi participants who ranked non-discrimination, in particular

against women and other vulnerable groups, in access to water and water management, highly across all elements (100% consensus). Furthermore, the South African Constitution affords all citizens equality and protection against unfair discrimination on the grounds of race, gender, disability, ethnicity and religion (RSA, 1996).

Gender inequalities in, and discrimination against, women and girls in access to water and water management is well documented (UN-Water, 2015). The elimination of discrimination against women and girls, and other vulnerable groups is an important element of water equity (Higgs et al., 2024). Other vulnerable groups include: persons with disabilities, children, those with certain illnesses such as HIV, migrants, and ethnic and other minorities (UN-Water, 2015). Women are particularly noted as an important group in South African water management (DWAF, 1997; Liphadzi, 2016), with South African water policy focusing on remedying historical gender inequity and promoting gender equity in all spheres of access to water and water management (DWAF, 1997). Despite efforts to address gender disparities in water management, women remain underrepresented in water fora and committees and lack access to water for commercial purposes e.g., irrigation for farming (Ncube, 2018; Anderson et al., 2008).

A comprehensive approach to water equity must therefore integrate non-discrimination as a cross-cutting principle, recognising that equity cannot be achieved without dismantling barriers faced by women, girls, and other vulnerable groups (UN-Water, 2015). The monitoring framework developed in this research responds to this imperative by embedding non-discrimination into every indicator. Each indicator is designed to assess not only overall progress in water equity but also its specific impact on women and girls, ensuring that the framework moves beyond summary statements to provide integrated, actionable insights that can guide targeted interventions.

5.5.2 Future use of water

Sustainability, a principle of human rights law, requires access to water and sanitation for both present and future generations, provided in a way that maintains the balance between economic, social, and environmental sustainability (Human Right to H2O, 2021). Intergenerational equity, equity between existing and future generations, underpins sustainable development and is fundamentally linked to distributive equity (Fleurbaey et al., 2014). The South African Constitution secures the right to water for future generations through environmental protection (RSA, 1996); the Human Basic Needs Reserve secures water for basic needs, and for existing and near future generations (RSA, 1998). The impact of global processes such as climate change is implicit when considering the needs of future generations, as this phenomenon is expected to affect the future availability and quality of water (Lu et al., 2014). Each indicator, therefore, considers potential impacts on future generations. Negative impacts on water resources, or the management thereof, will lead to disparities for future generations.

5.6 Human rights indicators

South Africa has adopted the human rights-based approach (HRBA) in water management (Higgs et al., 2025). The HRBA is legally mandated, and of high priority in South African water management, for example, through The National Water Act (RSA, 1998), the Water Services Act (RSA, 1997), and the National Sanitation Policy (DWS, 2016). The legal content of the right to water and sanitation encompasses five dimensions: availability, accessibility, acceptability, affordability, and quality (de Albuquerque, 2014). States that adopt the HRBA are obliged to continuously monitor and analyse the status of the realisation of the right to safe drinking water and sanitation based on these five criteria (WaterLex, 2017). It is therefore necessary that South Africa implement and monitor these dimensions. However, for the research, indicators will be limited to three critical areas, that the Delphi participants identified as priority (Table 5.5) and that are of priority concern for achieving water equity in South Africa: quality (96%), availability (93%), and physical accessibility (89%) (Table 5.5). The focus on these three of the five human rights dimensions prevents this monitoring tool from becoming primarily an HRBA assessment tool and instead maintains it as a broader water equity monitoring instrument.

All three dimensions are legislated in South Africa, primarily through the constitution mandating water as a human right (RSA, 1996), and are of key importance for water equity (Table 5.5). Water quality predetermines the legitimacy of the availability and accessibility of water, and all three of these dimensions have been identified as priority concerns for water equity in South Africa (Table 5.5).

Table 5.5 Human rights (water for basic human needs) elements selected for indicator development

Water equity element	Delphi consensus	Relevant legislation	Overview of priority water equity concerns stated by Delphi participants
Quality: Safe for human consumption and protection of health and safety during use of facilities	96%	The South African Constitution (RSA, 1996) The National Water Act (RSA, 1998) The Water Services Act (RSA, 1997)	The five legal dimensions of the HRBA are hierarchical. Water quality is a crucial factor that impacts the other dimensions. For water to be deemed available and accessible, it must meet drinking water quality standards. Many South African communities contend with poor water quality, largely as a result of discharges of untreated sewage directly into watercourses. Water quality data for rural areas is severely lacking, and the true impact on communities under documented.
Availability: Water for personal and domestic uses, and sanitation facilities	93%	The South African Constitution (RSA, 1996) The National Water Act (RSA, 1998) The Water Services Act (RSA, 1997)	Communities still lack access to water, and where there is access, water is limited by poor service delivery and water restrictions.
Accessibility: Physically accessible and secure water and sanitation infrastructure in the immediate vicinity	89%	The South African Constitution (RSA, 1996) The National Water Act (RSA, 1998) The Water Services Act (RSA, 1997)	Households are still without improved sanitation services, and some (2%) of the population still practice open defecation.

5.6.1 Quality of drinking water and the condition of sanitation services and programmes

Water for personal and domestic use must be hygienically safe and free of pathogens and substances that pose a threat to human health (UN, 2010). This can be measured quantitatively, and the World Health Organisation Guidelines for Drinking Water Quality should be adopted to ensure that water is safe for consumption (UN, 2010). To further protect human health and water quality, sanitation facilities must be hygienic, provide facilities for hand washing and sewage safely managed (Human Right to H2O, 2021). In South Africa, Water Service Authorities and Providers are responsible for ensuring that drinking water complies with the Compulsory National Standards for the Quality of Potable Drinking Water and other prescribed requirements (DWS, 2017). These standards extend to sanitation services, requiring that facilities be hygienic and equipped with handwashing facilities (DWS, 2017). Additionally, the correct disposal of excreta and effective sludge management are mandated to prevent environmental pollution (DWS, 2017).

In South Africa, the deficient treatment and management of sewage and wastewater from urban areas, and discharges and pollution from mining, agriculture, and industry have resulted in persistently poor raw water quality (Nel et al., 2011), which affects the quality of drinking water in many areas (DWA, 2013). There are general concerns that Water Services Authorities are not delivering the required quality of drinking water and sanitation (DWS, 2020b). Analysis of drinking water quality (DWS, 2023b) found that 51% of water supply systems i.e., drinking water providers, exhibit substandard microbiological water quality. Indeed, 7% of households perceive their drinking water as unsafe to drink (StatsSA, 2019a). A Delphi participant provided additional evidence of poor surface and drinking water quality: *“In my opinion, South Africa is unlikely to meet the 2030 Sustainable Development Goals, as the country continues to struggle with drinking water quality. Furthermore, municipalities are a major contributor to water quality issues, with wastewater treatment plants frequently discharging raw or untreated sewage into watercourses.”* Water users are not able to quantitatively measure water quality therefore, a qualitative measure is appropriate (Table 5.6). South Africa’s General Household Surveys measure perceptions of water quality; whether water is perceived as not safe to drink, not clear, not free from bad smells or not good in taste (StatsSA, 2019a). For practical purposes, this measure will be adopted as an indicator of drinking water quality (Table 5.6).

All South Africans are entitled to a ‘*basic level of sanitation*’; one that is hygienic, with a toilet and hand washing facilities and an appropriate system for disposing of human excreta (DWS, 2016: 8). However, where sanitation facilities are shared, users have noted poor hygiene (18%), the toilet pits are full (17%) or blocked up (5%) (which is unhygienic), the facility being poorly maintained (10%) and a lack of hand washing facilities (16%) (StatsSA, 2019a). Only two-thirds (68%) of the South African population can easily access hand washing facilities with soap in proximity to the sanitation facility (StatsSA, 2019a), and thus pose the risk of contracting sanitation-related diseases (DWS, 2016). The

impacts of poor sanitation and hygiene include diarrhoea and intestinal nematode infections, which can lead to malnutrition and cognitive impairment in children (Department of Health, 2015). Diarrhoea is the third leading cause of death amongst children under 5 years old in South Africa (Department of Health, 2015). An assessment of equity in relation to sanitation services must include a perceived level of hygiene and the presence of hand washing hygiene facilities to safeguard the health of all people, in particular the young and vulnerable (Table 5.6).

Table 5.6 Indicator 1 Quality of drinking water and the condition of sanitation services and programmes

Indicator	Inequitable (negative impact on equity)	Ineffectual (no impact on equity)	Equitable (positive impact on equity)	Cross cutting	
				Inclusion of women and other vulnerable groups	Consideration of the needs of future generations
Drinking water quality	Drinking water from a municipal water source is perceived as being of poor quality and/or unsafe to drink OR Drinking water is derived directly from an alternate water source (untreated water), e.g., springs, wells, dams, pools or from rivers and streams	Drinking water is from a municipal water source and is perceived as being of an adequate quality and safe to drink	Drinking water is from a municipal water source and is perceived as being of a high quality and safe to drink	Menstrual hygiene facilities are hygienic, and menstrual products are disposed of safely by the responsible authority	The responsible authority ensures environmental protection through effective and efficient solid waste management e.g., the safe disposal of excreta and good maintenance of sanitation facilities to prevent discharge into the environment
State of sanitation facilities	Sanitation facilities are unhygienic, and there are no handwashing facilities	Sanitation facilities are either unhygienic OR There are no hand-washing facilities	Sanitation facilities are hygienic and there are hand-washing facilities		

5.6.2 Interruptions to water services and reliability of sanitation services

Availability (Table 5.5) pertains to the right to sufficient and continuous water for personal and domestic uses such as drinking and personal sanitation (Grönwall et al., 2017). The World Health Organization guidelines of 50 to 100 litres per person per day should be adopted (Grönwall et al., 2017). South Africa allocates a free basic water supply of a minimum of 25 litres per person per day of potable water to households (DWS, 2017). A minimum sanitation service for the availability of community shared or communal sanitation facilities is 20 toilet seats, 50 urinals and one basin per four toilet seats (DWS, 2017). Together, these measures aim to ensure that all individuals have reliable access to the water and sanitation services necessary for health and dignity.

South Africa has made significant progress in, and monitoring of, access to water and sanitation (StatsSA, 2019b and 2023). Norms and standards for domestic water and sanitation are well defined i.e. DWS (2017). The country is, however, characterised by frequent service delivery protests, ignited by poor and interrupted, and inadequate water and sanitation services (Rodina and Harris, 2016). A Delphi participant contributed the following insight: *“Many communities still lack access to water, and some are subject to ongoing water restrictions. This limited access is largely perpetuated by poor service delivery from District and Local Municipalities”*. During 2022, almost one-third of homes in South Africa experienced issues with their water delivery service (StatsSA, 2023), suggesting that while progress has been made in the provision of sufficient water, the country falters in the continuity of water supply. This has been exacerbated in recent years by load shedding and rotating power outages, which significantly affect the water supply.

This evidence, coupled with the outcomes of the Delphi, suggests that a measure of continuity of water supply may be a more appropriate measure of availability (Table 5.5), and indeed the sufficiency of water supply in South Africa (Table 5.7). Measuring access to piped or tap water is inconsequential when the taps are frequently dry. Such a measure may be indicative of access to water by the marginalised portion of the population, who are more likely to experience frequent and prolonged service interruptions. South African norms and standards on the levels of services for the provision of water require that water is provided within 24 hours of a disruption, and service is restored within seven days (DWS, 2017). This measure can be adopted in assessing equity of the availability of water, as South Africa has set this standard as being equitable (DWS, 2017) (Table 5.7).

In terms of sanitation, there must be sufficient sanitation facilities to ensure the needs of each person are met, on the premises or within the immediate vicinity (Human Right to H2O, 2021). Facilities must meet hygiene requirements for menstrual hygiene management, and where sanitation facilities are shared, long queues and waiting times must be avoided (de Albuquerque, 2014). Despite the notable improvement in access to sanitation facilities in South Africa since 1994, there is an estimated 33% backlog in the provision of sanitation services (DWS, 2017). ‘Backlog’ indicates that people do not

have access to adequate sanitation facilities or practice open defecation (DWS, 2017). The reliability of water and sanitation services is estimated at 57% due to aging infrastructure and poor operations and maintenance (DWS 2020b). Furthermore, some 26% of households use shared toilet facilities, 13% of which have reported long waiting times (StatsSA, 2019a), suggesting an inadequate sufficiency in number of sanitation facilities. South African norms and standards of a free basic sanitation service level require the provision of a reliable toilet in the homestead and maintenance of the facility is the responsibility of the service provider (DWS, 2017). Where the basic service is acquired through a subsidy, maintenance is the responsibility of the household. A measure of the reliability of sanitation services can be adopted in assessing equity in the availability of sanitation services (DWS, 2017) (Table 5.7).

Table 5.7 Indicator 2 Interruptions to water services and reliability of sanitation services

Indicator	Inequitable (negative impact on equity)	Ineffectual (no impact on equity)	Equitable (positive impact on equity)	Cross cutting	
				Inclusion of women and other vulnerable groups	Consideration of the needs of future generations
Frequency and length of interruption to water services	Frequent interruptions, water is not provided within 24 hours, and service is not restored after more than 7 days	Infrequent interruptions, water is provided within 24 hours of interruptions and service is returned within 7 days	No interruption, or service is returned within 24 hours	Menstrual hygiene facilities are reliable*	Where water and sanitation services are shared and/or unreliable, the responsible authority is rectifying and expanding these services
Reliability of free basic sanitation	Sanitation facility (community facility) is shared and unreliable*	Sanitation facility in the yard, which is unreliable*	Sanitation facility in the yard, that is reliable*		

* Sanitation facilities must be functional at all times, with prompt repair services.

5.6.3 Physical accessibility of drinking water and sanitation facilities

Water and sanitation facilities should be physically accessible, without discrimination and threat to personal safety (Human Right to H2O, 2021). The World Health Organization guidelines of the water source being within 1 000 m, and a water collection time of no longer than a 30-minute round trip from the household, should be adopted (Grönwall et al., 2017). Sanitation facilities should be within proximity of the household and accessed in a manner that ensures the personal safety of users, in particular women and girls (De Albuquerque, 2014). Water and sanitation services should be provided at public facilities such as schools, hospitals, and police stations (UN, 2010).

South African norms and standards on the provision of water require that where water is not provided in, or at the boundary of, the homestead, it must be within 100 m of the household (DWS, 2017). Similarly, at schools and other public facilities, the water source should be within 100 m of the building (DWS, 2017). Sanitation facilities must be safe and private, and where the facility is not located in the homestead, it should be within 200 m of the household (DWS, 2017). At schools, sanitation facilities should be gender separated, within proximity of the classrooms, and provide privacy and personal safety (DWS, 2017).

Some 14% of South Africans rely on communal water sources (StatsSA, 2019a). Of the households that must travel to reach a water source, 39% must travel more than 200 m, and almost 38% of these people are black Africans (StatsSA, 2019a), rural and women-headed households living furthest from water sources (StatsSA, 2016). Where sanitation facilities are shared, users have noted threats to their physical safety (12%) and improper or inadequate enclosure of toilets (9%) (StatsSA, 2019a). Women and girls are at risk, specifically the risk of assault and rape, when using sanitation facilities situated a distance from their home (HRC, 2014). South Africa is notorious for the provision of poor sanitation facilities at schools, notably the incident of a 5-year-old boy who drowned in excrement in a pit latrine at his school in Limpopo in 2014 (Louton et al., 2015). School sanitation facilities are inadequate, unreliable and unhygienic (Louton et al., 2015) with a study conducted during 2021 finding that 336 of a total of 16,805 schools reported having no water (HRC, 2021).

This indicates disparities in physical access to water and sanitation, particularly affecting women and other vulnerable groups. and nonfulfillment of South Africa's norms and standards for access to water and sanitation. An assessment of access to these facilities should, at a minimum, assess compliance with these norms and standards, which would in turn indicate whether equity is being achieved with regard to access (Table 5.8).

Table 5.8 Indicator 3 Physical accessibility of drinking water and sanitation facility

Indicator	Inequitable	Ineffectual	Equitable	Cross cutting	
	(negative impact on equity)	(no impact on equity)	(positive impact on equity)	Inclusion of women and other vulnerable groups	Consideration of the needs of future generations
Proximity of the water source to the household	Water is obtained from a communal water source more than 200 m from the household	The water source is located less than 200 m from the household	The water source is in or at the boundary of the household yard	Women and other vulnerable persons can safely (physical and personal safety) access sanitation facilities	At schools, the water source and sanitation facilities are within 200 m of the building, are accessible to all and there is no risk of physical harm
Proximity of the sanitation facility to the household	The sanitation facility is more than 200 m from the household, and access to the facility potentially puts one at risk of physical harm	Sanitation is shared and within 200 m of the household and there is no risk of physical harm	The sanitation facility is located within the household yard, and is safe and private		

5.7 Water for ecological integrity

Human rights are intertwined with environmental rights (Knox, 2018), and it is increasingly accepted that the human rights-based approach applies to the protection of the environment, specifically the right to a safe, clean, healthy and sustainable environment (Human Right to H₂O, 2021). Protection of the environment is directly linked to the right to water and sanitation (Human Right to H₂O, 2021); protection of water resources safeguards the quality and quantity of water necessary to realise the human right to water (Winkler, 2012). Thus, environmental harm must be avoided, and ecosystems and biological diversity conserved (Knox, 2018). This necessitates that ecological integrity be upheld through pre-determined quantities of water and standards for water quality and environmental processes (Peña, 2011).

Moreover, the South African Constitution affords all citizen's the right to an environment that is '*not harmful to their health and well-being*' (RSA, 1996: 11). The mandated 'Reserve' requires that water quality and quantity be upheld at predetermined levels to maintain aquatic ecosystems in a particular state that must remain in the national water resource (ecological reserve requirement), and water for basic needs (basic human needs reserve) (RSA, 1998).

The Constitution mandates the prevention of pollution and ecological degradation, the promotion of conservation, the pursuit of ecologically sustainable development, and the responsible utilisation of natural resources (RSA, 1996). The National Water Act mandates and sets out measures for the prevention of, and remediation of, pollution and the protection of water resources (RSA, 1998). The National Water Resource Strategies establish guidelines for the sustainable and equitable protection, use, development, conservation, management, and control of the nation's water resources (DWS, 2023a). These policies, strategies, and programmes safeguard South Africa's water resources and are of key importance for achieving water equity. Preventing the degradation of the ecological reserve, safeguards water resources for present and future generations, and fosters equity (Table 5.9).

Table 5.9 Human rights (water for ecological integrity) elements selected for indicator development

Water equity element	Delphi consensus	Relevant legislation	Overview of priority water equity concerns stated by Delphi participants
Water management to support a healthy human environment e.g., environmental water demand, measures of discharge, water quality, habitat integrity and biotic integrity	93%	The South African Constitution The National Water Act (RSA, 1998) Gazetted Resource Quality Objectives	While there are legislative mechanisms to protect the ecological reserve, water resources are poorly protected, polluted and degraded. Polluted water is a significant and widespread problem in South Africa.
Water for biodiversity, including plants, animals, places, and habitats and livelihoods based on environmental resources	82%	Gazetted Ecological Reserve	

5.7.1 Water for the Ecological Reserve

Requirements of the National Water Act (RSA, 1998), as they pertain to the protection and sustainable use of water resources, are implemented through Resource Directed Measures (RDMs) (Ginsburg et al., 2010). RDMs set objectives for water resource management, put measures in place to limit impacts, and provide benchmark indicators for quality and quantity, assessing the effectiveness of water management interventions (DWS, 2018b). RDMs are implemented at a catchment level (DWS, 2022), and are implemented through the classification of water resources, the determination of Resource Quality Objectives (RQOs) and the setting of the Ecological Reserve (Ginsburg et al., 2010).

The Ecological Reserve, also known as Environmental Water Requirements (EWRs), is the quality, quantity and reliability of water required to protect aquatic ecosystems (RSA, 1998). EcoSpecs are the data used in the determination of the Ecological Reserve, and are quantifiable, measurable criteria for ecological characteristics such as flow, water quality, and habitat and biological integrity. They define the Recommended Ecological Category (REC) or recommended future state of the resource (Kleynhans and Louw, 2007), and establish specific objectives regarding resource quality that guide the implementation of the Ecological Reserve. RECs range from A (natural) to F (highly impacted), reflecting a hierarchy with diminishing levels of conservation for freshwater aquatic species and their habitats, or escalating levels of risk associated with them (Kleynhans and Louw, 2007). Ecological Categories A to D can be recommended as future states, and Categories E and F are regarded as ecologically unacceptable (Kleynhans and Louw, 2007).

EcoSpecs set Thresholds of Potential Concern (TPCs), quantifiable descriptors of water quantity and quality, and habitat and biotic integrity (Kleynhans and Louw, 2007). They define thresholds, ensuring that the resource remains within acceptable limits of change to meet the REC (DWS, 2024), and inform ecological reserve implementation, monitoring requirements and management (DWA, 2011). They inform the RQOs, which include broader social and economic objectives, and establish auditable objectives of the REC (DWS, 2024). RQOs and the Reserve are gazetted by DWS and are supported by law (Kleynhans and Louw, 2007). They provide either numerical or narrative descriptors that outline the conditions that must be fulfilled to attain the desired management scenario for the resource (DWS, 2022).

DWS has financed and overseen research for the classification and the setting of RQOs and basic data are available for major rivers, those with significant hydrological importance (Reinecke et al., 2018). Some 69% of the catchments have completed the RDM process and 18% are in progress (Makanda et al., 2022). Reserve determinations for seven catchments and two WMAs have been gazetted (DWS RDM website). In some catchments (at least two), RQOs have been implemented and are monitored through the surface water resources monitoring programmes (DWS, 2022).

While allocation of water for the Reserve is the highest allocation priority (RSA, 1998), the ecological reserve urgently requires additional water allocation (DWS, 2024). It is estimated that 98% of available water resources in South Africa are already allocated, with a predicted deficit of 17% by 2030 (DWS, 2022). In addition to the water deficit, there are high levels of illegal water use and water wastage due to leakage from poorly maintained infrastructure (DWS, 2023a), thus the water balance in South Africa is in a critical state.

Where water for the Reserve has not been allocated i.e., where the Reserve has not been gazetted and/or where water has been overallocated, represents an inequitable situation. It violates the Constitutional rights of the people of South Africa, compromising the sustainability of the resource and the country's ability to provide water for all other uses. Monitoring of water for the Reserve is an appropriate indicator of equity in the South African context (Table 5.10).

Table 5.10 Indicator 4 Water for the Ecological Reserve

Indicator	Inequitable (negative impact on equity)	Ineffectual (no impact on equity)	Equitable (positive impact on equity)	Cross cutting Consideration of the needs of future generations
Water for the Ecological Reserve	The Ecological Reserve has not been, or is not in the process of being determined	The Ecological Reserve has been, or is being determined but has not been gazetted	The Ecological Reserve has been gazetted, is monitored, and is enforced	An Ecological Category of C or higher is being maintained or improved

5.7.2 Protection of the Ecological Reserve

Pollution control is essential to protect water resources, ensure that RQOs are being met and safeguard ecological integrity (Palmer et al, 2005; Winkler, 2012). The National Water Act (NWA) presents two methods for safeguarding water resources, the Resource Directed Measures (RDMs) and Source Directed Controls (SDCs). Applied in unison, these two measures aim to protect water resources, while utilising them for social and economic gain (RSA, 1998).

Where the Resource Directed Measures (RDMs) establish the required level of protection for water resources, Source Directed Controls (SDCs) operationalise these standards by implementing a combination of regulatory measures and economic incentives to prevent water pollution and degradation, thereby ensuring that Resource Quality Objectives (RQOs) are achieved (DWA, 2011). Regulatory measures such as wastewater discharge and abstraction licences, along with penalties and fines, are complemented by economic incentives such as levies and fees, all of which serve to control negative impacts on water resources (DWA, 2011). A key example of an SDC is Water Use Licensing (WUL), which mandates a thorough assessment of potential impacts on the resource before a licence is granted (DWS, 2023a). EcoSpecs can be integrated into the conditions of WULs, providing specific criteria for water resource protection and facilitating ongoing monitoring of the resource's condition.

South African water resources have a history of being under pressure from ongoing population growth, poor land use practices, over-abstraction and pollution, all of which are exacerbated by the impacts of climate change (DWS, 2022). Pollution and over-abstraction are the most significant threats to South Africa's aquatic ecology (RSA, 2022). A total of 13 water quality management challenges have been identified in South Africa, the most significant being pollution from malfunctioning wastewater treatment works that results in eutrophication (DWS, 2023), which is a persistent and significant

environmental threat to aquatic ecosystems (DWS, 2021). The country's extensive water quality programmes and monitoring have failed to address water pollution (DWS, 2023a) consequently, 64% of river systems and 79% of wetland ecosystems are threatened (two-thirds of which are critically endangered) (RSA, 2022).

The River Eco-Status Monitoring Programme (REMP) (formerly River Health Programme (RHP)) is the primary monitoring tool for the ecological condition of river ecosystems (DWS, 2013). REMP establishes a baseline condition against which the condition of the ecosystem can be monitored and management interventions informed (DWS REMP website). Conditions, or Ecological Categories, range from A, unmodified or being in a natural state to F, being critically or extremely modified and basic ecosystem functions have been destroyed (DWS, 2021). Almost 60% of aquatic ecosystems are in a moderately modified state; however basic ecosystem functioning remains unchanged (DWS, 2022).

Protecting the Ecological Reserve protects water resources for current and future generations, protects water for human needs and protects the rights of all to water and a safe environment. In a country where 3% of the population derive their water from the rivers themselves, this could not be more important (StatsSA, 2022). In South Africa, monitoring and meeting the RQOs achieve an equitable outcome as this signifies that the water resource is in a good ecological condition. A minimum of an Ecological Category C is acceptable as these resources are still functioning, resilient and can recover with management. Class D or below signifies resources are under severe stress and are therefore not being protected (Table 5.11).

Table 5.11 Indicator 5 Protection of the Ecological Reserve

Indicator	Inequitable (negative impact on equity)	Ineffectual (no impact on equity)	Equitable (positive impact on equity)	Cross cutting Inclusion of women and other vulnerable groups
Protection of the Ecological Reserve	RQOs have not been determined OR RQOs have been determined and are not being met and/or the resource class is deteriorating	RQOs are being met AND the resource class is being maintained (where the Ecological Category is at least C)	RQOs are being met and/or the resources class is improving (where the resource class is at least C)	Water for the Reserve is given the highest priority in the allocation of water, and sufficient water has been allocated for the Ecological Reserve

5.8 Procedural equity indicators

Procedural equity considers how decisions are made in water resource management and provides legitimacy to water allocation decisions (Neal et al., 2014). When evaluating procedural justice, eight critical components must be assessed: voice, participation consistency, ethicality, impartiality, accuracy, error correctability and representativeness (Syme, et al., 2015). A diverse range of stakeholders must be included in decision-making (representativeness), they must be able to participate (participation), and be heard and have influence (voice). Additional components that can be assessed include the accuracy of communication (Syme, et al., 2015), the inclusion of minority and vulnerable groups (non-discrimination) (Peña, 2011) and the impartiality on the part of decision makers (impartiality) (Neal et al., 2014; Table 5.9).

South Africa is a country that boasts an ethnically diverse population, however it is also marked by significant social and economic disparities as a result of its political history (StatsSA, 2023). A wide array of stakeholders are included and actively participate in decision-making processes to promote equity (Table 5.12). Furthermore, South Africa has had to contend with state capture and systemic corruption (Lund and Cois, 2018), both of which significantly undermine equity at all levels. Corruption-whether occurring within decision-making processes or perpetrated by any stakeholder group-erodes trust, distorts resource allocation, and ultimately impedes the achievement of equitable water access and management (Table 5.12).

Table 5.12 Procedural equity elements selected for indicator development

Water equity element	Delphi consensus	Relevant legislation	Overview of priority water equity concerns stated by Delphi participants
Participation: Must be open to broad participation of all affected parties, including through such mechanisms as networks, voluntary associations, and public/private partnerships	100%	The National Water Act (RSA, 1998)	It is difficult for people of marginalised communities to participate. There is a need for capacity building to bridge knowledge gaps in a sector where technical expert knowledge is critical for decision making. They may also lack the means, such as affordable transportation, to attend stakeholder meetings.
Representativeness: Representativeness of all affected persons / parties (road and inclusive participation of stakeholders, including all affected parties across the entire spectrum of water users and across scales)	82%	The National Water Act (RSA, 1998)	There is significantly inadequate representation by marginalised sections of the population, particularly those from rural and traditional areas.
Ethicality: Anti-corruption and transparency (an openness in procedures, information, and potential sources of conflict)	89%	The South African Constitution (RSA, 1996) The Public Audit Act (RSA, 2004)	Corruption is evident at all levels of government in the water sector.

5.8.1 Stakeholder participation

Proactive participation is critical in water equity, a point confirmed by the Delphi participants with 100% consensus on this element (Table 5.12). Participation ensures all interested and affected parties' participation in the stakeholder engagement process, which must be broad and inclusive (Neal et al., 2014) and is equitable when the decision-making process is open to and includes all affected parties (Wilder and Ingram, 2016).

In South Africa, participation in water governance is facilitated through Catchment Management Agencies (CMAs), Water User Associations (WUAs), and various water committees and fora (Higgs et al., 2025). These platforms enable the involvement of all interest groups in localised decision-making processes and promote equitable outcomes (Chikozho et al., 2018). However, despite the formal

establishment of these structures, meaningful public participation remains limited, and South Africa continues to face challenges in effectively engaging a wide cross-section of stakeholders (Stuart-Hill and Meissner, 2018). As noted by a Delphi participant, “*There is a fundamental equity issue in South Africa in public participation. Local people, and those in rural areas are often those with least income, have to participate at their own expense when transport costs to attend these sessions are beyond their means*”. Ensuring the inclusion of a diverse range of stakeholders, particularly those from marginalised groups is essential for achieving equity. Without such inclusive participation, decision-making processes risk being dominated by the majority or powerful interests, resulting in outcomes that do not adequately reflect the needs and perspectives of all affected communities (Table 5.13).

Table 5.13 Indicator 6 Stakeholder participation

Indicator	Inequitable (negative impact on equity)	Ineffectual (no impact on equity)	Equitable (positive impact on equity)	Cross cutting	
				Inclusion of women and other vulnerable groups	Consideration of the needs of future generations
Broad and inclusive stakeholder participation*	Limited number of stakeholders and/or the dominance of certain stakeholders or stakeholder groups	An intermediate number of stakeholders have participated in decision-making, including marginalised groups	A broad range of stakeholders and stakeholder groups have participated in decision-making	Women and other vulnerable groups have participated in decision-making	Youth have participated in decision-making

* Degree of inclusiveness and diversity of a broad range of institutional (formal and informal) and individual stakeholders

5.8.2 Stakeholder representativeness

Participation is associated with inclusive representation, in particular subgroups of the population affected by decisions, who have the least power and are often overlooked (Peña, 2011). Participation is equitable when the interests, concerns and values of all parties are considered (Peña, 2011). Participation in water management in South Africa is characterised by the persistent problem of insufficient participation by marginalised groups, notably resource-poor farmers (Meissner et al., 2013). This is compounded by the issue of CMAs, WUAs and other water committees and fora remaining untransformed, and under- and unrepresented by marginalised groups (Ncube, 2018). The Delphi participants reinforced this perspective, with one noting, “*There is very little local community*

representation, this needs to be addressed in South Africa". A gauge of representativeness in South African water equity can be evaluated by the representation of marginalised groups and their concerns (Table 5.14).

Table 5.14 Indicator 7 Stakeholder representativeness

Indicator	Inequitable	Ineffectual	Equitable	Cross cutting	
	(negative impact on equity)	(no impact on equity)	(positive impact on equity)	Inclusion of women and other vulnerable groups	Consideration of the needs of future generations
Representation in participation*	A limited number of poor and marginalised groups are represented	Some poor and marginalised groups are represented	Poor and marginalised groups are represented	Women are represented	Youth are represented

* Representation of stakeholders and recognition of their concerns in water management decision-making

5.8.3 Ethicality

Ethicality is critical in procedural equity, encompassing both transparency in procedures and the absence of corruption (Syme et al., 2015). Information regarding the procedural process should be available to stakeholders, including the media (UNDP and UNDESA, 2020). The water sector is particularly vulnerable to corruption, which poses a significant threat to equity (Peña, 2011), and can take many forms, including deception, bribery, collusion, fraud, extortion, and nepotism (González de Asís et al., 2009). Such corruption can occur at any level, from ‘petty’ acts involving lower-level utility staff to ‘grand’ corruption involving politicians, senior officials, and contractors, in particularly in the context of large contracts and financial transactions (González de Asís et al., 2009).

Worldwide, corruption has been observed in the allocation of water use licences, the distribution of water, pollution control and environmental protection, and decision making (Peña, 2011). Corruption in South Africa, particularly within the water sector, has been identified as a critical issue, manifesting at various levels of water management and governance (Muller, 2020). This concern is underscored by a consensus among 89% of Delphi participants, who emphasised the necessity of monitoring ethical practices in the South African water sector (Table 5.12). Evidence of corruption is an indicator of equity in the water sector and water resources decision-making (Table 5.15).

Table 5.15 Indicator 8 Ethicality

Indicator	Inequitable (negative impact on equity)	Ineffectual (no impact on equity)	Equitable (positive impact on equity)	Cross cutting	
				Inclusion of women and other vulnerable groups	Consideration of the needs of future generations
Transparency in procedures* (information about the engagement process)	No transparency in procedures	Some transparency in procedures	Procedures are transparent and are followed	Women play an equal role in procedures, and identifying where procedures are/are not transparent	Where procedures are not transparent, there is evidence of the responsible authority rectifying these issues

* The degree of corruption, and transparency in procedures including, water decision making, water resources planning and management and water governance

5.9 Distributive equity indicators

Water for basic human and ecological needs, and for cultural, spiritual and customary uses must be prioritised in the allocation of water (Peña, 2011). Other priority uses of water are those that uphold other human rights e.g., the right to food (Winkler, 2012). Thereafter, the allocation of water must consider the full array of the positive and negative, direct and indirect benefits and burdens derived from water (GWP, 2012).

The South African government is responsible for controlling, regulating and allocating of water resources (RSA, 1998) where water allocation priorities have been influenced by the social, economic and ecological values of water (DWA, 2013). In the context of limited availability and competing uses, five priorities are outlined for the allocation of water in South Africa (DWA, 2013):

1. Water for the Human Basic Needs and Ecological Reserves (*cf* 5.6 Human rights indicators).
2. Water for meeting international water requirements (shared river basins).
3. Water for poverty eradication, the improvement of livelihoods of the poor and the marginalised and uses that will contribute to greater racial and gender equity.
4. Water for uses that are strategically important to the national economy.
5. Water for general economic purposes.

It is essential to strike a balance among these priority uses to protect each citizen's rights (Winkler, 2012) and to ensure that water allocation is equitable (Peña, 2011). Ideally, this would involve a comprehensive understanding of the multifaceted value of water, and the temporal and spatial impacts, both positive and negative, of its use. However, both the literature and South Africa's legal context (Higgs et al., 2025), and the Delphi consensus, emphasise that priority water uses should be grounded in human rights (Table 5.16). Distributive elements related to human rights must therefore take precedence in water allocation decisions. Accordingly, this research evaluated human rights aspects alongside distributive equity elements identified through the Delphi process to develop appropriate distributive equity indicators. Strong anecdotal evidence from Delphi commentary, corroborated by findings in the literature (Higgs et al., 2025), informed the selection of these elements (Table 5.16). As a result, the research shaped unique distributive indicators for South Africa, reflecting the country's indigenous cultures-such as the use of water for customary purposes, and addressing the unequal allocation of water that hinders marginalized groups from participating in water-dependent economic activities (Table 5.16)

Table 5.16 Distributive elements selected for indicator development

Water equity element	Delphi consensus	Relevant legislation	Overview of priority water equity concerns stated by Delphi participants
Water for livelihoods, customary uses and spiritual purposes	93%	National Water Resources Strategy (DWA, 2013 and 2023a)	Noted as an under-recognised and under-documented use of water in South Africa, this is of high concern as a substantial section of the population relies on water for domestic food cultivation and spiritual practices.
Water for food production at a household or community level	46%	The South African Constitution (RSA, 1996) National Water Resources Strategy (DWA, 2013 and 2023a)	Water allocation for food production was noted as a high priority in the South African context, as this is where tremendous racially based inequalities remain. There is a direct correlation to the use of water for customary purposes above.
Water used for productive purposes and beneficiaries thereof e.g., irrigation, industry, hydroelectric energy	90%	The National Water Act (RSA, 1998)	There is anecdotal evidence from the Delphi participants that the WUL process is skewed and biased (inequitable). Inequities in the granting of WULAs is persistently racially skewed.

5.9.1 Water for cultural, spiritual, and customary practices

Many societies, cultures, and religions consider water sacred, emphasising the importance of protecting the cultural values associated with water (Kallhoff, 2014). The cultural rights and cultural and spiritual uses of water must be safeguarded and upheld as a human right (Pena, 2011; Winkler, 2012).

A significant portion of the South African population resides on, and are governed by, traditional leadership (Tapela, 2015), who embrace indigenous cultural, spiritual and customary practices (Kapfudzaruwa and Sowman, 2009). Such practices may include: domestic food production and the right to food (6.10.2 Water for subsistence food production), or use of water in spiritual ceremonies and the right to freedom of religion, belief and opinion. Poor water quality and availability affect these communities' spiritual practice, livelihoods, small-scale local economic development and community wellbeing (Wilson et al., 2016).

In the South African context, measuring access to water for cultural, spiritual, and customary uses (Table 5.17) is essential and is highly valued by a significant portion of the population and supports other fundamental human rights enshrined in the South African Constitution, such as the right to religious freedom. Supporting this view, a Delphi participant noted that: *“This is very important in South Africa, people are very unaware of how important this is”*.

Table 5.17 Indicator 9 Water for cultural, spiritual and customary practices

Indicator	Inequitable	Ineffectual	Equitable	Cross cutting	
	(negative impact on equity)	(no impact on equity)	(positive impact on equity)	Inclusion of women and other vulnerable groups	Consideration of the needs of future generations
Water quality impacts on cultural, spiritual and customary water uses	Poor water quality hinders cultural, spiritual and customary water uses, and has resulted in the loss of ecosystems, fauna and flora that are essential to these practices	Water quality impacts on cultural, spiritual and customary water uses and some loss of ecosystems, fauna and flora are essential to these practices	Water quality does not affect cultural, spiritual and customary water use nor the ecosystems, fauna and flora that are essential to these practices	Water quality does not affect women's cultural, spiritual and customary uses of water	Where water quality does negatively affect cultural, spiritual and customary water uses, there is evidence of the responsible authority improving water quality and availability

5.9.2 Water for subsistence food production

All of the Delphi participants (100%) agreed that waters' social value in contributing to national food security is a priority measure in water equity in South Africa (Table 5.2). While only 46% (Table 5.2) of participants agreed on water for food production at a household or community level, this was noted as a priority concern in the South African context as many households rely on subsistence farming for food security. The right to sufficient water and food, are a human right enshrined in the South African Constitution.

In South Africa, irrigation agriculture is the largest user of water (Maila et al., 2018) and the country is reportedly food secure at a national level (StatsSA 2019c). However, the country is not food secure at a household level, as not all households have access to adequate food (Oluwatayo et al., 2021). In 2017, almost 20% of South African households had inadequate or severely inadequate access to food and 1,6 million households experienced hunger (StatsSA, 2019c). Rural households are the most food insecure, particularly black African-headed households, and households that house a large number of young children (StatsSA, 2019c). These disturbing trends were exacerbated by the COVID-19 pandemic (Caretta et al., 2022).

Subsistence farming has been identified as critical in securing food security in South Africa, and the South African government has instituted a number of programmes to strengthen subsistence farmers' food systems (DALRRD, 2021). Subsistence farming provides food and supplements food and income to households in rural and urban food-insecure households (DALRRD, 2021). In 2017, some 2.5 million households were involved in subsistence farming activities such as growing food crops, fruit and vegetables, and livestock farming (StatsSA, 2019c). Most of these activities were undertaken to supplement food for the household (StatsSA, 2019c).

The Human Rights-based approach (HRBA) goes beyond the provision of water for domestic purposes (Peña, 2011). Countries that adopt the HRBA, such as South Africa, must ensure that water is available for food production at the household, community and national level to support the right to food (Winkler, 2012). The right to water for food production, in particular subsistence agriculture, should be guaranteed. Households where subsistence farming is a significant or the sole source of food should have sufficient water resources near their dwelling (Winkler, 2012). Providing water for subsistence farming not only enhances food security and livelihoods but also upholds human rights and serves as a key indicator of equity (Table 5.18).

Table 5.18 Indicator 10 Water for subsistence food production

Indicator	Inequitable	Ineffectual	Equitable	Cross cutting	
	(negative impact on equity)	(no impact on equity)	(positive impact on equity)	Inclusion of women and other vulnerable groups	Consideration of the needs of future generations
Provision of water for food production	Household relies on subsistence farming for food or to supplement food, and do not have adequate water for subsistence farming	Households do not rely on subsistence farming for food, or to supplement food	Household relies on subsistence farming for food, or to supplement food, and has adequate water for subsistence farming	Women-headed households that rely on subsistence farming for food, or to supplement food, have adequate water for subsistence farming	Where water for subsistence farming is not adequate, there is evidence of the responsible authority rectifying and expanding water for subsistence farming

5.9.3 Water for commercial and economic uses

Water use licensing (WUL) and exemptions from water licences are two important administrative tools used in the allocation of water in South Africa (Grönwall et al., 2017). Water licensing allows the State to regulate the way water is used and balance competing uses of water (Grönwall et al., 2017). Section 21 of South Africa's National Water Act (NWA) (RSA, 1998) outlines the commercial and economic water uses that require licensing, for example, activities that alter or impact watercourses and water availability, and the discharging of wastewater (NWA, 1998). Water Use Licences (WULs) are valid for specified periods and stipulate the purpose and the conditions under which water may be used (RSA, 1998). By regulating water use through licensing and exemptions, the State can support the National Water Act's priority of achieving equity in water allocation, particularly for productive economic purposes and the redress of historical disparities.

Equity is one of the priorities of the National Water Act (RSA, 1998) that aims to achieve the equitable allocation of water for productive economic uses, primarily through the redress of past race and gender disparities (DWA, 2013). 'Equity in access to water resources' is South Africa's interpretation of equity in access to water for productive economic purposes, such as water for agriculture, business and industry (Higgs et al., 2025). Water Use licensing (WUL) and the Water Allocation Reform (WAR) programme

are the primary mechanisms for achieving the equitable allocation of water for productive purposes (DWA, 2013).

In South Africa, non-compliance with, and a lack of reporting on, non-compliance with WUL requirements is widespread (Boyd et al., 2018) and there is corruption at multiple levels within the WUL process (Muller, 2020). Disparities within the water use licensing system were highlighted by a Delphi participant, who observed: *“water use licence authorisations are often not scientifically defensible. Different standards are applied to different entities, which is highly inequitable”*. The dysfunctional WUL system has resulted in degradation of water resources, the consequences of which are not evenly distributed across society (IRR, 2016). The poor suffer disproportionately through direct contact with contaminated water (drinking, bathing and domestic cleaning) and from food grown using contaminated water at a household/community level (IRR, 2016). A Delphi participant underscored the negative impact on disadvantaged communities, stating: *“Most communities are forced to use polluted water.”* Another participant noted: *“Many poor communities are exposed to raw sewage flowing through their outside living areas, and plastic pollution is widespread in many rivers”*. Monitoring these negative impacts on local water resources serves as an indicator (Table 5.19) of inequity, where segments of the population are disproportionately negatively affected by polluted water.

WUL is the primary mechanism of the WAR programme, a programme that allocates and prioritises the allocation of water for productive economic purposes (mostly for irrigation) to black African and women users (DWS, 2013). Uptake of the WAR programme has been poor, and the majority of water remains allocated to white commercial farmers, leaving smallholder farmers without water for their farming activities (Sadiki and Ncube, 2020), perpetuating racial and gender disparities in access to water for productive economic purposes (Higgs et al, 2025). Monitoring changes in the allocation of water to a more racially and demographically representative allocation would indicate a more equitable situation (Table 5.19).

Table 5.19 Indicator 11 Water for commercial and economic uses

Indicator	Inequitable (negative impact on equity)	Ineffectual (no impact on equity)	Equitable (positive impact on equity)	Cross cutting	
				Inclusion of women and other vulnerable groups	Consideration of the needs of future generations
Allocation of water for commercial and economic uses	Water for economic and commercial use is disproportionately allocated to White-owned farms and businesses	Water allocation continues the status quo, without addressing past imbalances	Black African farmers are allocated a fair share of water for economic and commercial use	Black African women are prioritised and receive a fair share of water for economic and commercial use	Where water for economic and commercial use has a significant negative impact on water quality (e.g., water pollution), there is evidence of the responsible authority rectifying the situation
Distribution of the impact of the use of water for commercial and economic uses	Water used for commercial and economic purposes has a significant negative impact on local water resources e.g., water is heavily polluted	Water used for commercial and economic purposes harms local water resources e.g., water is polluted	Water used for commercial and economic purposes does not impact local water resources e.g., water is not polluted		

5.10 Discussion

The development of water equity indicators for South Africa represents a significant advancement in addressing inequalities and inequities, and ensuring just water management practices. The set of eleven indicators derived from the Delphi (Table 5.1) serves as the first monitoring tool for assessing and monitoring water equity within the country. Notably, this is the first water equity monitoring tool developed at a global scale. However, since the tool is specifically designed for the South African context, other regions would need to adapt and customise regional-specific indicators to ensure relevance to their unique water equity challenges and conditions. This research potentially provides a robust method for this purpose.

Limiting the number of indicators to eleven enhances clarity, reduces redundancy, and ensures the practical applicability of the indicator framework. It is important to emphasise, however, that these indicators do not encompass the entire concept of water equity; instead, they highlight the key priority areas that must be addressed as a foundation for advancing water equity. The indicators encompass the pillars of water equity (Table 5.4) and are designed to recognise cross-cutting contextual factors (*cf.* 5.5 Context / cross-cutting indicators). The integration of non-discrimination and future use of water as cross-cutting factors in the assessment of each indicator ensures that these critical issues are considered holistically rather than in isolation. Given South Africa's persistent socio-economic inequalities, this approach strengthens the indicator framework's ability to address long-standing disparities.

The focus on three (of the five) critical areas of the human rights-based approach (HRBA), quality, availability, and physical accessibility, as identified by Delphi participants, demonstrates a pragmatic approach to monitoring (*cf.* 5.6 Human rights indicators). It prevents redundant monitoring, as other government reporting, such as the General Household Surveys, already covers these elements. More importantly, it ensures that the water equity monitoring tool remains focused on equity rather than being disproportionately skewed toward service delivery reporting, a domain that is already well-established in South Africa. The exclusion of the Sustainable Development Goals (SDGs) from the framework helps prevent duplicate reporting and further avoids an excessive focus on service delivery. A key strength of this approach is its shift away from attention on the HRBA (and service delivery), rather the water equity monitoring tools emphasise other fundamental human rights, such as the right to food, offering a more comprehensive view of equity. However, this approach may come at the cost of reduced international comparability of the results. The exclusion of affordability and acceptability, two of the five legal components of the HRBA, (*cf.* 5.6 Human rights indicators), might overlook important aspects of water equity, particularly in a country with significant economic disparities.

The indicators are descriptive rather than quantitative. This assessment-based method (*cf.* 5.3 Structure and layout of the water equity questionnaire and indicators), while efficient and makes the tool widely accessible, introduces a degree of subjectivity in assessing equity (inequitable, ineffectual, or equitable)

and may oversimplify the complex factors that shape water equity and lead to inconsistencies in results across different regions and administrative settings. However, this approach enables a quick evaluation and helps educate stakeholders regarding water equity, an often poorly understood aspect of water governance. As a first step in measuring water equity, these indicators lay a strong foundation for ongoing refinement and future advancements. The effectiveness of the indicators will only be revealed through real-world testing and refinement, potentially evolving into more quantitative measures as understanding of water equity grows. Despite these limitations, the indicators offer valuable insights into the status of each pillar of water equity, providing a structured framework for identifying equitable or inequitable situations. This approach can catalyse informed policy discussions and decision-making processes, potentially driving more equitable water governance practices. As this assessment tool is applied in diverse real-world scenarios, its capacity to influence policy and promote equity-driven water management will become clearer, paving the way for more (or less) sophisticated and tailored approaches to measuring and ensuring water equity across different contexts.

The indicators are intended to be applied at a local level of governance, which aligns with the nature of water equity which is contextual; dependent on location, local circumstances, perceptions of fairness, and historical factors (Higgs et al., 2024). This nuanced understanding is crucial in a country such as South Africa, with its diverse socio-geographic landscape and complex history of inequality which necessitates an adaptable and locally sensitive monitoring system. By applying this framework at the local level (catchment or sub-catchment), regional disparities can be assessed, enabling targeted interventions where inequities are most pronounced. Comparisons between different equity pillars allow for a deeper understanding of disparities. Some regions may experience pronounced inequities in the distributive pillar while showing relatively better outcomes in the human rights pillar, providing actionable insights for authorities.

While this framework attempts to measure water equity, the indicators must be assessed both holistically and individually. Each aspect of water equity interacts with others, making it essential to analyse them in relation to one another. For instance, even if service delivery is equitable, water distribution for commercial use may be inequitable, and water pollution could hinder spiritual practices (inequitable). This interconnectedness reinforces the relationship between the pillars of water equity and their respective indicators, as highlighted by previous research findings (Higgs et al., 2024; Higgs et al., 2025). For example, Indicator 4, which measures whether the ecological reserve is upheld, directly impacts both Indicator 1 (water availability) and Indicator 9 (drinking water quality). If the ecological reserve is not maintained, inadequate water quantity and poor water quality will affect overall availability and drinking water standards. Deteriorating water quality can hinder its use for spiritual practices, further demonstrating the interdependence of these indicators.

Achieving water equity is indeed a complex and arduous task. These indicators are designed to help the South African authorities, as custodians of water governance, assess and advance equity by highlighting factors that support or hinder progress. While not a panacea, the water equity indicators serve as a preliminary tool to aid its realisation.

An unexpected but significant outcome of this research, is that the adapted Delphi approach applied (*cf.* 5.2 Water equity indicator development: an adapted Delphi approach) provides a robust method that could be used universally for developing water equity indicators. Throughout the Delphi process, participants argued that the water equity elements identified (and presented in the initial Delphi questionnaire) form a comprehensive framework suitable for any region. They emphasised that, despite being extensive, the number of elements presented in the initial Delphi questionnaire should not be reduced, as each plays a critical role in capturing the full scope of water equity. Although prompted, no additional elements were proposed, suggesting that the elements presented comprise a comprehensive water equity framework.

5.11 Conclusion

This research advances water equity in South Africa by creating a tailored monitoring tool through an adapted Delphi process, yielding eleven indicators that assess water equity across diverse socio-geographic and administrative contexts. These indicators encompass the pillars of equity established by this research, avoiding an overemphasis on service delivery. The framework integrates cross-cutting elements, non-discrimination and future needs, ensuring that these critical issues remain central to water equity assessments. Designed for practicality, the water equity monitoring tool balances depth with user-friendliness, leveraging descriptive indicators to foster stakeholder engagement and learning. While subjective by nature, this approach enhances accessibility and adaptability, offering a replicable model for other regions to develop context-sensitive water equity metrics.

Though not exhaustive and the indicators may not capture every aspect of water equity, they draw attention to key areas in need of improvement and offer a foundation for ongoing refinement and future quantification. By bridging theory and practice, the water equity monitoring tool marks a significant step forward. It delivers a clear and actionable structure to inform policy, guide decision-making, and inspire similar initiatives worldwide.

The methodological approach employed in this research has yielded significant outcomes, both in terms of immediate applicability and broader methodological innovation. It has successfully developed a comprehensive set of water equity indicators tailored to South Africa's unique socio-economic, environmental, and cultural context. The research has established a replicable and adaptable methodological framework for developing context-specific water equity indicators, which can be adopted by other regions.

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CHAPTER 6. Case study approach: Assessing the practical applicability of the water equity indicators

6.1 Introduction

This chapter outlines the case study approach to assess the practical application of the proposed indicators (*cf* Table 5.1) as a tool for monitoring water equity within two of South Africa's Catchment Management Agencies (CMAs) and an informal water governance structure (The Umzimvubu Catchment Partnership Programme (UCPP)). It introduces the case study method, which was used to examine both formal (CMAs) and informal (community-driven partnership) models of water governance. Subsequent sections detail the data collection process, including the use of semi-structured questionnaires, expert interviews, and the integration of diverse perspectives from government officials, municipal representatives, civil society, and external consultants. The chapter addresses key ethical considerations, the measures taken to ensure participant confidentiality and data security, and the reliability and validity of the findings.

6.2 Case study research

Case study research is a method that entails a detailed examination of a specific phenomenon, policy, institution, or real-world setting from diverse perspectives to obtain a deep contextual understanding of the complexities and connections in play (Simons, 2014). It is a well-established method that is applied across a diversity of academic disciplines (Crowe et al., 2011). Typically, it involves one or a small number of cases and employs qualitative or mixed research methods, such as interviews, observations, and document analysis, for the purpose of gathering rich, contextual information (Simons, 2014). The objective is to develop a comprehensive understanding of the system or systems being examined by exploring their distinct characteristics and underlying dynamics (Schoch, 2019). The adaptability of the case study methodology makes it ideal for investigating complex research questions, as it allows the research design to be specific to the context of the case. Case studies are valued for their ability to inform policy, contribute to theoretical development, and provide deep insights into contexts that are rich in complexity and require a nuanced understanding (Simons, 2014). The case study method was thus deemed suitable for testing the practical application of the eleven proposed water equity indicators. The application of the indicators to selected case studies in South Africa enabled the researcher to evaluate how effectively the indicators could potentially assess the complexities of water equity within defined catchments and institutional governance units. The use of qualitative methods such as questionnaires, interviews and document analysis, within the case study method, enabled evaluation of the practical relevance of the indicators. For example, the case study method has been employed in recent research

to assess water service provision and social equity in South Africa (Hutete and Sibanda, 2022; Sambo et al., 2021). In addition, case studies have been used to propose and test indicators within the broader resource management context in South Africa (e.g., Braid and Görgens, 2010; Wade et al., 2012;), and to investigate the performance and effectiveness of Catchment Management Agencies (CMAs) as institutional governance structures (e.g., Meissner et al., 2016; Rogers and Luton, 2016). These applications illustrate the adaptability and value of the case study method in addressing complex issues of equity, governance, and indicator development within the South African water sector. The case study method not only revealed how the indicators performed in practice but also identified limitations and challenges in their implementation, and areas for improvement. The method provided a systematic approach for testing and improving the water equity indicators, ensuring they are relevant as a water equity monitoring tool.

6.2.1 Catchment level approach

A case study begins with a clear definition of the case and demarcating its boundaries (Schoch, 2019). Selecting a case involves clearly defining what the case represents, what specific phenomenon or issue it is intended to explore and setting the boundaries that determine what is included or excluded from the study (Simons, 2014; Hyett et al., 2014). Boundaries may be determined by institutional structures, roles, regions, or policies, and the scope can range from individuals to entire systems (Simons, 2014).

A Catchment Management Agency (CMA) is a body established under the National Water Act (RSA, 1998) to decentralise the management of water resources in South Africa, aiming to ensure the long-term equitable, effective, and sustainable management of water resources (DWS, 2012). CMAs are mandated to promote equity by ensuring water resource management is more responsive to the needs of poor and marginalised communities, ensuring that the voices of small users and disadvantaged groups are heard, and prioritising redress and equity (RSA, 1998). The core responsibilities of a CMA are investigating and advising on the protection, use, development, conservation, management, and control of water resources within its designated Water Management Area (WMA) (Figure 6.1), and coordinating the activities of water users and related institutions (RSA, 1998). CMAs are tasked with developing catchment management strategies, coordinating and promoting the activities of water management institutions, and fostering community participation (RSA, 1998).

The National Water Act mandates Catchment Management Agencies (CMAs) a central role in managing, monitoring, conserving, and protecting water resources within their designated Water Management Areas (WMAs) (RSA, 1998). CMAs are ultimately responsible for monitoring the state of water resources in their WMAs. They are responsible for monitoring both the quality and quantity of surface and groundwater to support their Catchment Management Strategies. These efforts must align with the National Water Information System (*cf.* 4.2 Water resources management monitoring and reporting in South Africa) overseen by the Department of Water and Sanitation (DWA, 2010). In

addition, CMAs are tasked with safeguarding water resources by maintaining ecological integrity, which includes fulfilling the requirements of the Ecological Reserve and Resource Quality Objectives (Pollard and Du Toit, 2010). CMAs are further required to oversee and monitor authorised water uses within their WMAs (RSA, 1998) which entails monitoring conditions related to authorised water uses, such as monitoring abstraction volumes and ensuring compliance with pollution control measures (Mazibuko and Pegram, 2006).

CMAs must carry out the monitoring needed to support their Catchment Management Strategy and ensure effective water management in their regions (DWA, 2010). For example, the Inkomati-Usuthu Catchment Management Agency (IUCMA) has installed 28 river flow gauges for real-time hydrological monitoring to ensure water requirements for the Ecological Water Requirement and International Obligation (IUCMA, 2013). In addition, their Protection and Use of Water Resources Programme covers water quality monitoring, compliance monitoring and data and information management to ensure that data are collected, managed and stored for monitoring (IUCMA, 2023).

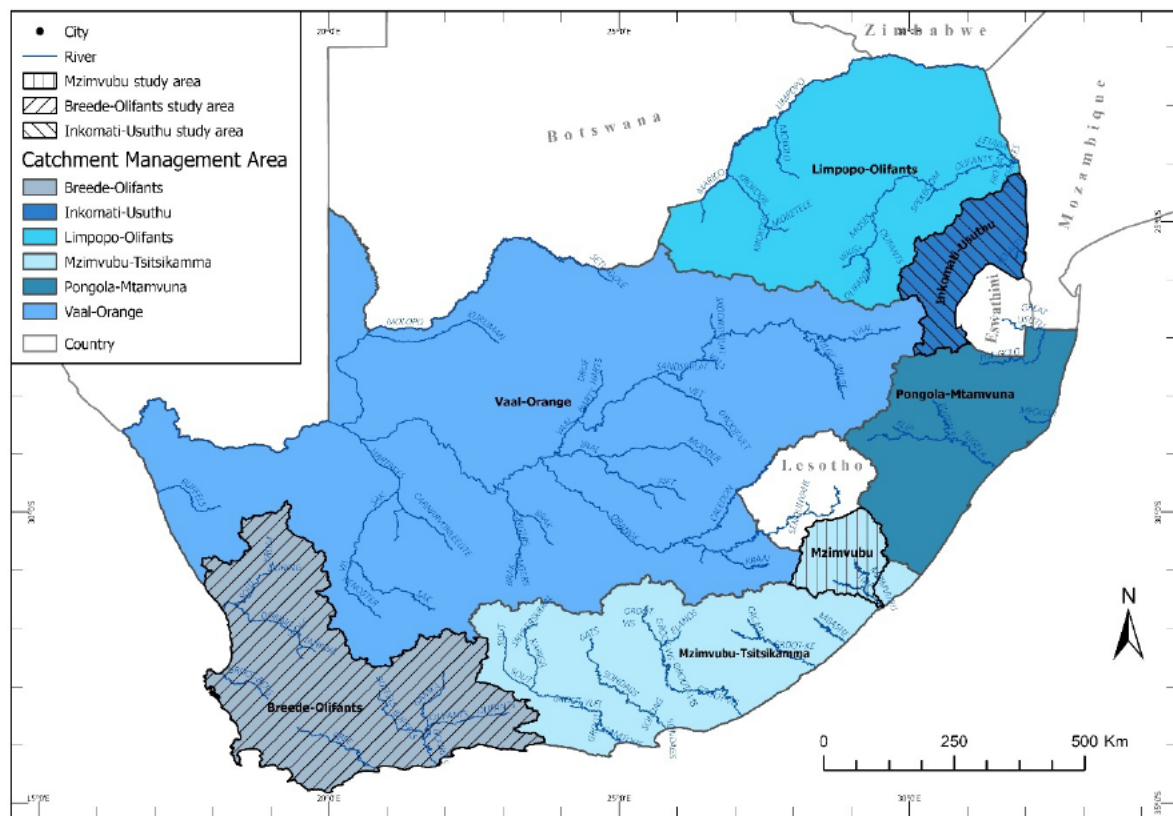


Figure 6.1 Map of South Africa's six Catchment Management Areas (CMAs) and Water Management Areas (WMAs) (DWS, 2023)

A Catchment Management Agency (CMA) (Figure 6.1) represents a compelling and fitting case for this research as CMAs are explicitly mandated to promote equitable access to, and monitor water resources, they have clearly defined boundaries and are unique institutional structures. A CMA is bounded by a specific Water Management Area (WMA) and is governed by the National Water Act, which delineates its responsibilities and powers, making it a well-defined institutional unit of analysis. The selection of a CMA as a case is further justified by its uniqueness. South Africa is one of the few countries that have adopted such decentralised, participatory models for water management, and given them the power to oversee policy implementation (Herrfahrdt-Pähle, 2010). CMAs are the vehicles responsible for the promotion and progression of equity in water management, where they play a coordinating role with other government departments for this purpose (RSA, 1998).

South Africa has gazetted the establishment of six CMAs (Figure 6.1). While the initial proposal called for nine CMAs within nine Water Management Areas (WMAs), ongoing organisational restructuring has led to a consolidation into six WMAs and six corresponding CMAs (DWS, 2023). All six CMA Boards have been appointed. However, only two, the Breede-Orlants (BOCMA) and Inkomati-Usuthu (IUCMA), are operational and have demonstrated progress in fulfilling their duties (DWS, 2024). For this reason, they were selected as two case studies for this research. The remaining four CMAs are still

in the process of assuming full responsibility for water resource management and continue to operate under the management and oversight of the Department of Water and Sanitation (DWS, 2024).

Many CMAs remain semi-operational, leaving a gap in understanding water management in informal governance alternatives that may achieve similar objectives. Including an informal governance case in this research serves as a means to explore whether key policy goals, such as equity, can be monitored and realised outside the formal institutional structure of a CMA. Incorporating a developing CMA case enables a comparison between different governance models and assesses whether the indicators are broadly applicable or specific to the CMA case. Relying solely on CMA cases risks attributing their success to the institutional model rather than the indicators themselves. If the indicators remain meaningful under different governance models, this will strengthen their validity as a measure and a means of monitoring water equity.

The Umzimvubu Catchment Partnership Programme (UCPP) was selected as a non-CMA case study. The UCPP was identified and selected by returning to key participants from the Delphi panel (*cf.* 4.7 Selection and composition of the expert panel), and consulting academic staff at the University of KwaZulu-Natal with expertise in water governance and informal institutional arrangements. This participatory approach ensured that the chosen case was both active and widely regarded as effective in its catchment management efforts. The UCPP stood out as a strong candidate, having been consistently recommended by multiple experts as a long-standing, innovative, and functional example of a community-driven informal governance structure (*cf.* 6.2.1.3 The Umzimvubu Catchment Partnership Programme).

6.2.1.1 The Inkomati-Usuthu Catchment Management Agency (IUCMA) and Water Management Area (WMA)

The Inkomati-Usuthu Catchment Management Agency (IUCMA), covering the Inkomati-Usuthu Water Management Area (WMA), is located within the north-eastern region of South Africa (Figure 6.1). The WMA spans approximately 36,256 km², stretching from the Drakensberg Mountains in the west to the sub-tropical Lowveld in the east, and shares transboundary river systems and an inter-basin transfer agreement with Mozambique and Eswatini (Figure 6.2) (IUCMA 2024 and 2023). The WMA is divided by four main rivers into the Sabie-Sand, Crocodile, Komati, and Usuthu sub-catchments (IUCMA 2024 and 2023). Komati and Usuthu are notable for their roles in inter-basin water transfers, particularly supplying strategic water needs for power generation facilities such as SASOL Secunda and ESKOM, and industry, alongside forestry and irrigation (IUCMA, 2024 and 2023).

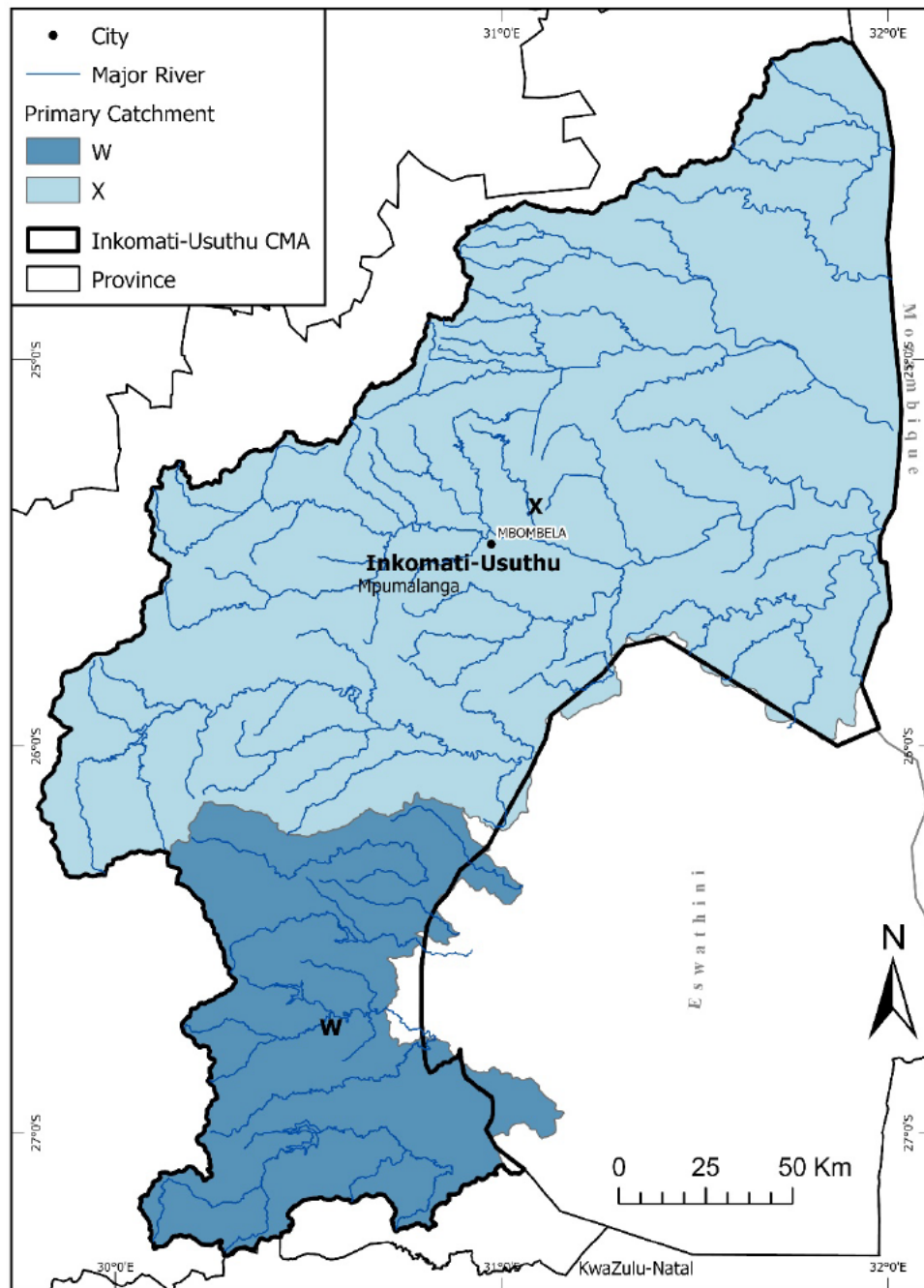


Figure 6.2 The Inkomati-Usuthu Water Management Area (Maliba et al., 2024)

The Inkomati-Usuthu WMA is a region characterised by rapid population growth, urbanisation, and socio-economic inequalities. The region faces the challenge of water scarcity, exacerbated by climate change, resulting in tensions among competing water users (DWA, 2012). While the WMA supports affluent agricultural and industrial sectors, many rural and peri-urban communities still lack reliable access to clean drinking water (IUCMA, 2024). The WMA is water-stressed, and demand exceeds supply. This imbalance is exacerbated by decreasing groundwater levels and deteriorating water quality,

primarily attributed to mining activities, wastewater treatment works discharge, and sewage overflows (DWA, 2012). The ecological health of the WMA is classed as moderately modified, with most river systems falling into ecological category C. This status reflects impacts from commercial forestry, agriculture, mining, water abstraction, and rural settlements, which have led to changes in natural habitats and biota (IUCMA, 2024).

6.2.1.2 The Breede-Olifants Catchment Management Agency (BOCMA) and Water Management Area (WMA)

The Breede-Olifants Catchment Management Agency (BOCMA), covering the Breede-Olifants Water Management Area (WMA) is primarily situated in the Western Cape Province of South Africa, with smaller sections extending into the Eastern and Northern Cape Provinces. The WMA is bounded by the Atlantic Ocean in the southwest, the Orange WMA in the north, and the Mzimvubu-Tsitsikama WMA in the east (Figure 6.3) (BOCMA 2012 and 2024). The WMA consists of diverse ecological sub-catchments each supporting differing socio-economic activities. The Upper and Central Breede support intensive agriculture; the Riviersonderend features key dams and supplies water for irrigation and urban use; the Lower Breede is vital for estuarine health and tourism; the Overberg West and East rely on rain-fed farming, with the East being more rural; and the Olifants sub-catchment supports rural and agricultural needs (BOCMA 2012 and 2024).

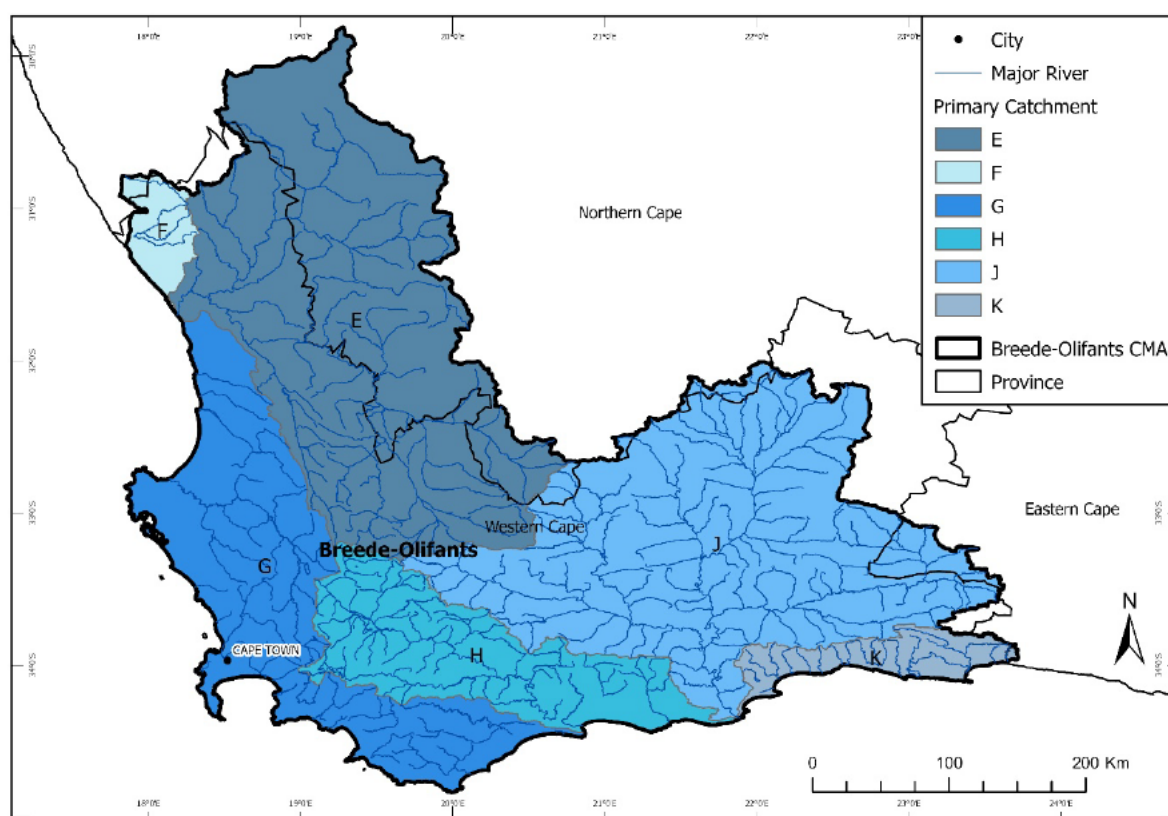


Figure 6.3 The Breede-Olifants Catchment Water Management Area (WMA) (DWS, 2023)

While the region is predominantly rural, agriculture and agro-processing (fruit, wine, livestock and cereal) account for approximately 23% of the region's economic activity and employing 58% of the rural poor (DWA, 2022). However, seasonal employment offered by the agriculture sector exacerbates income instability for rural families and income inequality is pronounced (BOCMA, 2012 and 2024). Significant population growth, driven in part by migration for seasonal agricultural and industrial work has resulted in the proliferation of informal areas that lack basic amenities. Many rural settlements and small towns in the region face challenges in accessing a reliable water supply and sanitation. (BOCMA 2012 and 2024). Water and agricultural land remain predominantly controlled by the White minority, reflecting a legacy of social and economic inequality, with water reform lagging (BOCMA 2012 and 2024).

Water resources are increasingly under pressure, with irrigated agriculture using 75–95% of the total supply. Despite the presence of large storage dams, water availability is limited by variable rainfall and the impacts of climate change. Balancing supply and demand is further challenged by water for environmental needs, water quality issues, and water allocations exceeding sustainable yields. These pressures are expected to intensify competition for water resources (BOCMA 2012 and 2024). The

WMA includes rivers, wetlands, and estuaries with varied ecological conditions. Mountain headwaters are mostly in good condition (Category B), while foothill streams and tributaries are often moderately to heavily modified (C/D) due to agricultural activities. Mainstem rivers improve downstream, but water quality declines from urban and irrigation flows (BOCMA 2012 and 2024).

6.2.1.3 The Umzimvubu Catchment Partnership Programme

The Umzimvubu Catchment Partnership Programme (UCPP) is a voluntary alliance that was formed in 2013 in Matatiele, Eastern Cape, for the purpose of protecting the Umzimvubu River catchment and promoting the well-being of the communities that depend on its resources (Matela et al., 2024). Bringing together a diverse consortium of local NGOs, government departments, research institutions, and traditional authorities, the UCPP serves as a platform for decentralised catchment management. The UCPP addresses sustainable land and water management, promotes rural livelihoods, and rehabilitates ecological infrastructure in a participatory, community-driven manner. It has become a model for inclusive, community-based water governance, and has put to use the collective expertise and local knowledge to solve complex environmental and socio-economic challenges (Mubangizi, 2024).

The Umzimvubu River catchment lies within the Mzimvubu to Tsitsikamma Water Management Area, however, the Mzimvubu to Tsitsikamma Catchment Management Agency is still being established (Figure 6.2) (Aller, 2021). It covers approximately two million hectares within the Eastern Cape and parts of KwaZulu-Natal. The catchment originates in the Maloti-Drakensberg, it flows over 200 km to the Indian Ocean at Port St. Johns. Its major tributaries include the Tsitsa, Kinira, Tina, and Mzintlava rivers (Figure 6.4) (Conservation International, 2022). The Umzimvubu River catchment faces significant challenges balancing water demand and supply mainly due to domestic use, subsistence farming, and livestock needs. Lesser demands come from commercial farming, forestry, small industries, and local businesses (ERS-CSA, 2011). The Umzimvubu River system is one of the least altered in South Africa. It is a key freshwater resource that includes two Strategic Water Source Areas that, while covering just 10% of the land, provide 50% of the annual runoff (Conservation International, 2022). Water quality is generally good upstream but worsens downstream due to runoff from farming and poor wastewater treatment. Soil erosion, vegetation loss, and invasive species have weakened the catchment's ability to control sediment and protect water quality (Conservation International, 2022).

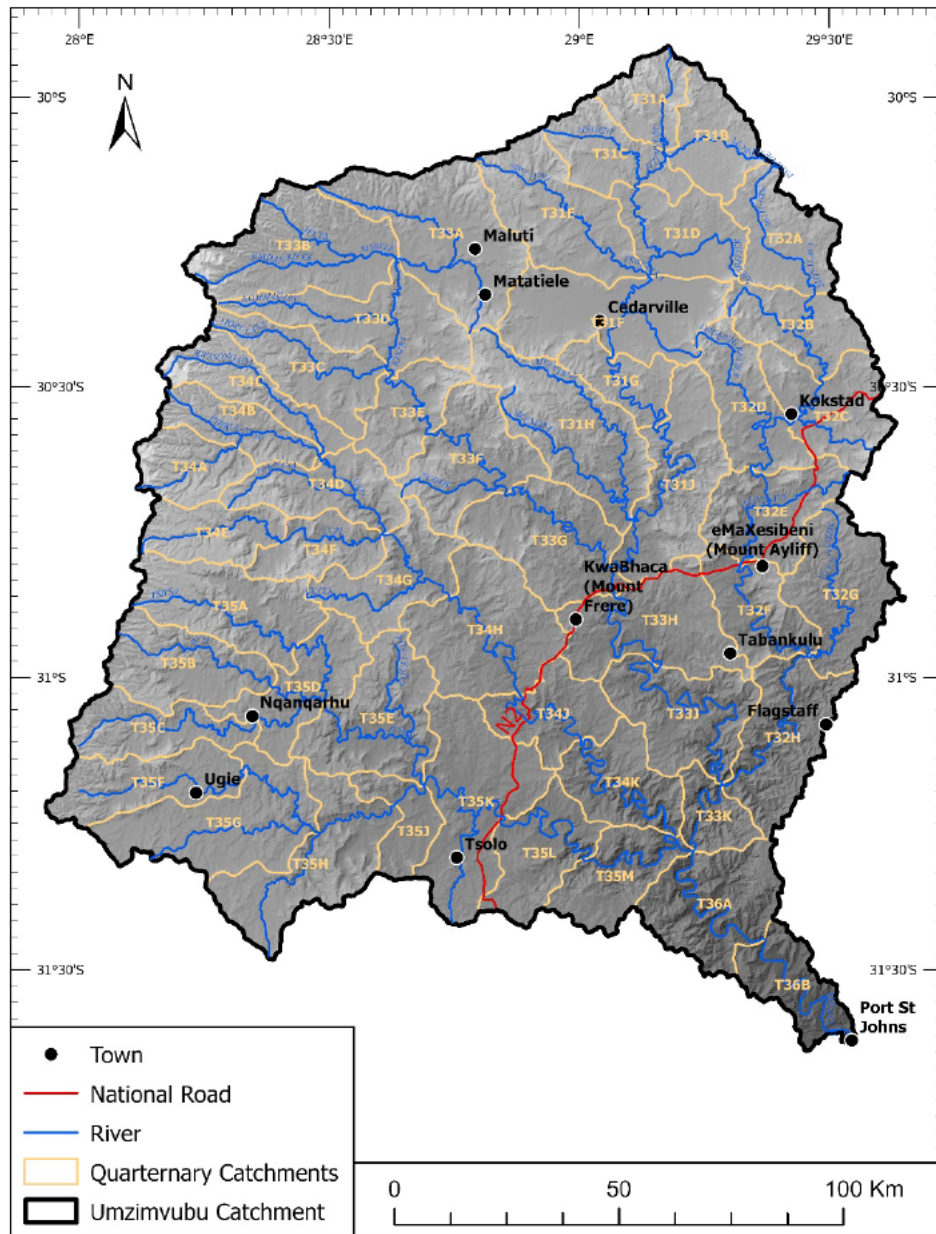


Figure 6.4 Umzimvubu River Catchment (Conservation International, 2022: 4)

The Umzimvubu River Catchment is home to over 2 million people and is among South Africa's poorest rural areas. Around 70% of the land is communally owned (tribal land), with most residents relying on subsistence farming and natural resources. The region faces ongoing socio-economic issues such as high unemployment and low incomes. Piped water infrastructure coverage is significantly limited and characterised by frequent shortages and degraded, unreliable infrastructure (Conservation International, 2022). Only 40% of rural households have access to piped water, most of the population (60%) relies

on untreated sources such as rivers, springs, and streams for their domestic water needs (Conservation International, 2022). The majority of households use pit latrines or have no formal sanitation facilities (Conservation International, 2022).

6.3 Data collection

Case study data collection features multiple methods to bring together diverse perspectives and enhance the credibility of findings (Sibbald, 2021). Techniques such as interviews, focus groups, observation, and document analysis are commonly employed to develop a rich, in-depth understanding of the case (Crowe et al., 2011). The use of both qualitative and quantitative data, e.g., questionnaires and interviews, increases the validity of the findings and draws a rich, contextual understanding of complex phenomena that are otherwise complex (Sibbald, 2021). This research employed a semi-structured questionnaire and conducted live remote interviews with key experts, providing both flexibility and in-depth data collection. In addition, key documents, such as Catchment Management Strategies, CMA annual and resource quality status reports, were consulted to further deepen the understanding of each case.

6.3.1 Questionnaire

Case study research questions are crucial for shaping the research focus and influencing the depth and quality of the analysis. Questions can be either structured or flexible, depending on the research objectives (Simons, 2014). Well-crafted case study questions align closely with the research objectives and contribute to developing a coherent and meaningful understanding of the case within its specific context (Schoch, 2019). A semi-structured questionnaire served as the primary data collection tool for this research, which offers a balance between structured inquiry and the flexibility needed to explore specialised knowledge in depth (Brinkmann, 2014).

The design of the semi-structured questionnaire was informed by the research objectives (*cf.* 1.2 Research Aim and Objectives). These objectives underpinned the purpose of the questionnaire: to assess the practical applicability of the proposed indicators as a tool for monitoring water equity. The questionnaire was structured around each indicator (Appendix 4) and involved three steps (Appendix 5). In the first step, experts were asked to assess the current state of equity within their respective catchment by choosing one of three options: equitable, ineffectual, or inequitable. This question was intended to evaluate how effectively the indicators can be applied in practice, rather than to measure the level of equity within a catchment. The question encourages experts to reflect on whether the indicators are easy to understand and apply and whether they will provide meaningful insights in their catchment. This approach helps identify practical challenges, gaps in usability, and areas where refinements are required, making it a tool for testing indicator effectiveness rather than assessing equity itself.

Next, participants rated each indicator based on clarity, effectiveness, and ease of data collection, using a five-point Likert scale. Finally, the questionnaire included three open-ended questions to capture

expert insights on the effectiveness of the indicators, suggestions for improvement, and reflections on their overall practicality and applicability.

6.3.2 Likert scale data analysis

The Likert scale is a vital, and commonly used tool in qualitative studies (Tanujaya et al., 2022). It is a structured tool used to measure intangible concepts such as attitudes or opinions by offering a range of response options, usually 4 to 7 points, so respondents can express their level of agreement or disagreement (Joshi et al., 2015). This enables the conversion of subjective opinions into measurable data for statistical evaluation (Koo and Yang, 2025). This research employed the widely used five-point Likert, “Strongly Disagree”; “Disagree”; “Neither Agree nor Disagree”; “Agree”; and “Strongly Agree” (Koo and Yang, 2025) to gather expert opinions on three statements (Table 6.1) evaluating the clarity, effectiveness, and ease of data collection for the proposed water equity indicators. These subjective qualities of these statements make the Likert scale well-suited for capturing expert judgment (Joshi et al., 2015). A further three open-ended questions were included as open-ended questionnaires to allow respondents the opportunity to share insights that may not emerge through closed questions and can uncover unexpected perspectives, thereby enriching the overall data collected (Appendix 5) (Kusmaryono et al., 2022).

Table 6.1 Three statements with a 5-point Likert scale used to collect respondents’ perceptions of indicator clarity, effectiveness, and ease of data

Statement 1	S1	The indicator is clear and understandable
Statement 2	S2	This indicator effectively assesses whether the situation it is designed to measure is equitable or inequitable
Statement 3	S3	It will be easy to collect the data required for this indicator

Odd-numbered response scales, particularly five or seven-point scales, have been shown to offer reliability and validity in data measurement, a benefit that becomes particularly important when working with small sample sizes (Kusmaryono et al., 2022; Koo and Yang, 2025). The 5-point Likert scale demonstrates strong reliability and validity across various research contexts. Its ease of use, clarity, and well-established psychometric properties continue to support its widespread application in both academic and applied research (Kusmaryono et al; 2022).

6.3.3 Expert selection and composition

Research participants are selected specifically as they possess unique, relevant knowledge or lived experience regarding the research topic (Schoch, 2019). Participants for this research were identified by approaching a governing board member from the Inkomati-Usuthu Catchment Management Agency, the Breede-Olifants Catchment Management Agency and the Umzimvubu Catchment Partnership Programme with details of the research in an email. In all three cases, the governing board member

appointed senior staff members to participate, and contacted other relevant government departments, the Department of Water and Sanitation (DWS) and municipalities within their respective catchment area, requesting they support the research. To identify the appropriate experts, the governing board members grouped the indicators into three areas of expertise (Table 6.2) based on how roles and responsibilities are assigned to personnel within the CMA. The areas of expertise were service delivery (indicators 1 to 3), which fall under the responsibility of the municipalities. The second was public participation (indicators 4 to 6), which is the responsibility of the CMAs. The third included both the ecological reserve (indicators 4 and 5) and water allocation (indicators 9 to 11), which are the responsibility of the CMAs, but implemented by DWS.

Table 6.2 Indicator groupings based on interview participants' areas of expertise

Pillars		#	Indicator	Area of expertise
Human Rights	Water for basic human needs	1	Quality of drinking water and the condition of sanitation services and programmes	Service delivery
		2	Interruptions to water services and reliability of sanitation services	
		3	Physical accessibility of drinking water and sanitation facilities	
	Water for ecological integrity	4	Water for the Ecological Reserve	The Ecological Reserve and RQOs
		5	Protection of the Ecological Reserve	
Procedural equity		6	Stakeholder participation	Public participation / stakeholder engagement
		7	Stakeholder representativeness	
		8	Ethicality	
Distributive equity		9	Water for cultural, spiritual and customary practices	Water for customary and economic uses (water quality and water use licensing)
		10	Provision of water for food production	
		11	Water for commercial and economic uses	

In total, sixteen experts participated in the research (Table 6.3): six from senior leadership at the CMAs (e.g., Acting Executive: Water Resource Management), three from senior leadership at municipalities within each case (e.g., Municipal Manager), one from the Department of Water and Sanitation (DWS), three from civil society organisations (e.g., NGO Director) and four consultants. This diverse composition of participants ensured a balanced and comprehensive approach to evaluating the indicators.

Table 6.3 Expert participation (n=16)

Case	Number of participants	Examples of roles and responsibilities
Inkomati-Usuthu Catchment Management Agency (IUCMA)	6	Chairperson (civil society organisation) Data management Municipal Manager Stakeholder relations Water resource management
Breede-Olifants Catchment Management Agency (BOCMA)	5	Catchment management Freshwater ecology Municipal Manager, Stakeholder relations Water use specialist
Umzimvubu Catchment Partnership Programme (UCPP)	5	Director (civil society organisation) Freshwater ecology Freshwater technical specialist Municipal manager Water resources planning and management

As the UCPP is a civil society organisation, the experts consulted for this case were primarily drawn from civil society organisations. In addition to participation by members of the UPCC and government officials, the researcher requested each CMA and the catchment partnership to recommend a consultant to participate in the research. This ensured an external perspective, helping to minimise bias and prevent outcomes that might be overly influenced by the viewpoints of the CMAs. However, as CMAs hold primary responsibility for water equity-related responsibilities, their representatives remain the central experts and are thus the most appropriate participants for this research. For this reason, only four consultants were specifically targeted for inclusion resulting in a distinct set of perspectives complementary, rather than dominant, to those provided by CMA representatives.

6.3.4 Interviews

Interviews were scheduled at each participant's convenience and conducted via Microsoft Teams. Remote interviewing allowed for participation across South Africa and mitigated the need for costly logistics arrangements. In advance of each interview, ethical clearance (Appendix 1), an informed consent letter, a covering letter, the relevant indicators, and the questionnaire were shared via email, to provide each expert time to familiarise themselves with the research, indicators and questions. During each interview, the relevant indicator was presented through Microsoft Teams, and the researcher systematically worked through the questionnaire, taking notes throughout the interview. Interviews

were not recorded; however, each participant agreed to allow the researcher to follow up for clarification if required.

Participants were initially invited to dedicate 20 minutes to complete the questionnaire during a live interview. Remarkably, despite this request, nearly all experts showed deep interest in the topic and engaged in extensive discussions. Only two participants concluded within the allotted 20 minutes, the majority exceeded this time, with some interviews lasting well over an hour and, in one case, up to two hours. An unanticipated result was the experts highlighting the importance and applicability of the topic to their respective CMAs, expressing a strong willingness to learn and to progress equity within their respective catchments.

6.3.5 Document analysis

In case study research, the review and analysis of pertinent documents is essential for gaining a thorough and unbiased understanding of a programme or policy and to help answer the research question (Simons, 2014). All relevant, publicly available documents for each CMA were consulted e.g., CMA Business Cases, Catchment Management Strategies, annual reports, annual performance plans, annual resource quality status reports, and gazetted Ecological Reserves and Resource Quality Objectives (RQOs). This comprehensive document analysis provided context and corroborative evidence to support the findings of the research (Chapter 7).

6.3.6 Ethical considerations

The research was carried out under ethical policies and procedures stipulated by UKZN. Ethical clearance was obtained from UKZN's Human and Social Sciences Research Ethics Committee (Appendix 1). Informed consent was obtained from each participant for each round. Each participant was informed that their participation was voluntary, that they could terminate the survey at any time, and that their identity and opinions would remain anonymous and confidential. All data were password protected, as was the email account used for communication (as per UKZN's privacy policies) and personal interviews were not recorded.

6.4 Reliability, validity and limitations

In case study research, reliability and validity are critical to establishing the quality and trustworthiness of the findings (Kaman and Othman, 2016). Like any other qualitative research method, the case study approach has its inherent limitations (Crowe et al., 2011). These limitations are often attributed to a perceived lack of rigour, and the method's inherent flexibility and creative freedom, ironically, some of the very qualities that make case studies valuable (Hyett et al., 2014; Simons, 2014). However, scholars have developed guidelines to strengthen the method, helping to improve both its reliability and validity (Ali and Yusof, 2011; Kamana and Othman, 2016; Yin, 2017; Quintão et al., 2020). Four key validity and reliability criteria are recommended to ensure rigor in case study research (Yin, 2017). Construct validity involves accurately measuring the concepts under study, often by using multiple data sources

and participants. Internal validity ensures that observed relationships reflect true cause-and-effect rather than false associations. External validity refers to the extent to which study findings can be generalised beyond the specific contexts in which the study was conducted. Reliability demonstrates that the study's procedures can be consistently replicated with similar results (Yin, 2017). This research focuses on evaluating the proposed water equity indicators in terms of their construct validity, reliability, and external validity (Yin, 2017).

6.4.1 Construct validity

To strengthen construct validity in case study research, data must be gathered from multiple sources, a logical and transparent link between the data collected and the conclusions drawn must be triangulated and key informants must review the draft report to ensure there are no misinterpretations (Kamana and Othman, 2016; Yin, 2017). This research included participants from various areas of expertise and different types of organisations. For example, consultants were included to balance the heavy representation of government officials. This diversity of perspectives helped strengthen the construct validity of the research by capturing a wide range of insights. However, a limitation was the relatively small number of participants (n=16) and that only one perspective on each indicator was collected from each case. Increasing the number of participants and gathering multiple viewpoints on each indicator could have further improved the construct validity and depth of the research findings.

6.4.2 External validity

The research question can improve external validity by focusing on general ideas instead of just one case (Yin, 2017). To strengthen this, it is important to explain why cases were chosen, describe the setting of each case clearly, and look for common patterns that help apply the findings to other situations (Quintão et al., 2020). Planning these steps early with the right theory makes the results more useful beyond the specific cases studied (Quintão et al., 2020). The researcher examined multiple cases, including both formal governance structures (CMAs) and an informal one (catchment partnership). This approach allowed the water equity indicators to be tested in different contexts, which strengthened the construct validity of the research. However, a limitation of the research is the small number of cases included. Assessing more cases, in particular more informal governance structures, could have strengthened the validity and generalisability of the findings. For instance, the research included only one informal governance case, which limits the ability to draw firm conclusions regarding the applicability of the indicators in such contexts.

6.4.3 Reliability

To make case study research more reliable, it is important to carefully document the research process, keep detailed records, and clearly connect the evidence to the conclusions (Yin, 2017). This helps ensure the same method can be applied consistently across different cases, making the study repeatable and comparable (Yin, 2017). Doing so reduces errors and bias, strengthens the credibility of the research,

and allows others to verify and replicate the results (Yin, 2017). The researcher established a clear chain of evidence by documenting the research process in this chapter and its appendices. This included detailed explanations of case selection (*cf.* 6.2.1 Catchment level approach), data collection and analysis (Chapter 7). The straightforward approach and focused research objectives helped maintain a clear and transparent line of evidence. Comprehensive records, such as participant information, completed questionnaires, and all data analyses, were securely stored using Microsoft Excel and Word on the host University server. In addition, data triangulation was employed by using multiple sources of evidence, including interviews and documents, to support each water equity indicator, demonstrating how the evidence aligns from multiple sources.

6.5 Conclusions

The case study method established a foundation for evaluating the application of the proposed water equity indicators within both formal and informal water governance contexts in South Africa. By employing a well-designed case study approach, including diverse data collection methods and a broad range of expert participants, the research approach ensured the rigour of the research. However, it is important to consider the limitations of the research. The limited number of cases and constrains the generalisability of the results, and the inclusion of only one informal governance structure limits the ability to draw firm conclusions regarding the applicability of the indicators outside formal institutions. The reliance on one expert opinion in each case, and four experts for each indicator, may have limited the complexity of the analysis and representativeness of the findings. Despite these constraints, the methodological choices position the research to generate meaningful insights into the application and effectiveness of the water equity indicators, while highlighting areas for potential refinement and broader application.

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CHAPTER 7. Case studies

7.1 Introduction

This chapter examines the proposed eleven water equity indicators, drawing on findings from three case studies, the Inkomati-Usuthu Catchment Management Agency (IUCMA), the Breede-Olifants Catchment Management Agency (BOCMA), and the Umzimvubu Catchment Partnership Programme (UCPP) (6.2.1 Catchment level approach). Although the analysis is based on a limited number of responses across the indicators, its value lies in the differing levels of institutional maturity and the diversity of geographical and socio-economic contexts. The respondents represent critical actors in each catchment, including CMA employees, community partners and consultants, and their perspectives produced a wide coverage of governance issues and local realities. The semi-structured interviews provided nuanced insights that revealed how different institutional and socio-economic settings either constrained or enabled water equity. This chapter presents the respondents' insights through descriptive analysis and verbatim quotations, ensuring that their perspectives were accurately reflected. This approach enabled the research to reveal trends and contrasts that would likely have been overlooked in a cohort that comprised uniform backgrounds or institutional contexts.

The chapter evaluates the indicators sequentially (Table 7.1), starting with a concise description of each indicator (a detailed justification for each indicator drawing on relevant scholarly sources is outlined in Chapter 5), then exploring the clarity and comprehensibility of each indicator, their effectiveness in assessing equity, the practical viability of data collection, and the respective strengths and limitations, and suggestions for improvement. The indicators were applied to assess equity in each case study, and exposed notable inequities, and limitations to South Africa achieving policy imperatives and ultimately, water equity. These are significant contributions to the water equity discourse in South Africa, a country that prioritises, but consistently fails to achieve, equity.

Table 7.1 Proposed indicators from the Delphi process to assess water equity in South Africa. A summary of the results and the key outcome of the Delphi.

#	Indicator	Inequitable (negative impact on equity)	Ineffectual (no impact on equity)	Equitable (positive impact on equity)		Inclusion of women and other vulnerable groups	Consideration of the needs of future generations
1	Drinking water quality	Drinking water from a municipal water source is perceived as being of poor quality and/or unsafe to drink OR Drinking water is derived directly from an alternate water source (untreated water), e.g., springs, wells, dams, pools or from rivers and streams	Drinking water is from a municipal water source and is perceived as being of an adequate quality and safe to drink	Drinking water is from a municipal water source and is perceived as being of a high quality and safe to drink		Menstrual hygiene facilities are hygienic, and menstrual products are disposed of safely by the responsible authority	The responsible authority ensures environmental protection through effective and efficient solid waste management e.g., the safe disposal of excreta and good maintenance of sanitation facilities to prevent discharge into the environment
	State of sanitation facilities	Sanitation facilities are unhygienic, and there are no handwashing facilities	Sanitation facilities are either unhygienic OR There are no hand-washing facilities	Sanitation facilities are hygienic and there are hand-washing facilities			

#	Indicator	Inequitable (negative impact on equity)	Ineffectual (no impact on equity)	Equitable (positive impact on equity)		Inclusion of women and other vulnerable groups	Consideration of the needs of future generations
2	Frequency and length of interruption to water services	Frequent interruptions, water is not provided within 24 hours, and service is not restored after more than 7 days	Infrequent interruptions, water is provided within 24 hours of interruptions and service is not restored within 7 days	No interruption, or service is not restored within 24 hours		Menstrual hygiene facilities are reliable	Where water and sanitation services are shared and/or unreliable, the responsible authority is rectifying and expanding these services
	Reliability of free basic sanitation	Sanitation facility (community facility) is shared and unreliable	Sanitation facility in the yard, which is unreliable	Sanitation facility in the yard, which is reliable			
3	Proximity of the water source to the household	Water is obtained from a communal water source more than 200 m from the household	The water source is located less than 200 m from the household	The water source is in or at the boundary of the household yard		Women and other vulnerable persons can safely (physical and personal safety) access sanitation facilities	At schools, the water source and sanitation facilities are within 200 m of the building, are accessible to all and there is no risk of physical harm
	Proximity of the sanitation facility to the household	The sanitation facility is more than 200 m from the household, and access to the facility potentially puts one at risk of physical harm	Sanitation is shared and within 200 m of the household and there is no risk of physical harm	The sanitation facility is located within the household yard, and is safe and private			

#	Indicator	Inequitable (negative impact on equity)	Ineffectual (no impact on equity)	Equitable (positive impact on equity)		Inclusion of women and other vulnerable groups	Consideration of the needs of future generations
4	The Ecological Reserve has been determined for the water resource	The Ecological Reserve has not been, or is not in the process of being determined	The Ecological Reserve has been, or is being determined but has not been gazetted	The Ecological Reserve has been gazetted, is monitored, and is enforced		Water for the Reserve is given the highest priority in the allocation of water, and sufficient water has been allocated for the Ecological Reserve	An Ecological Category of C or higher is being maintained or improved
5	Resource quality objectives (RQOs)	RQOs have not been determined OR RQOs have been determined and are not being met and/or the resource class is deteriorating	RQOs are being met AND the resource class is being maintained (where the Ecological Category is at least C)	RQOs are being met and/or the resources class is improving (where the resource class is at least C)			
6	Broad and inclusive stakeholder participation	Limited number of stakeholders and/or the dominance of certain stakeholders or stakeholder groups	An intermediate number of stakeholders have participated in decision-making, including marginalised groups	A broad range of stakeholders and stakeholder groups have participated in decision-making		Women and other vulnerable groups have participated in decision-making	Youth have participated in decision-making

#	Indicator	Inequitable (negative impact on equity)	Ineffectual (no impact on equity)	Equitable (positive impact on equity)		Inclusion of women and other vulnerable groups	Consideration of the needs of future generations
7	Representation in participation	A limited number of poor and marginalised groups are represented	Some poor and marginalised groups are represented	Poor and marginalised groups are represented		Women are represented	Youth are represented
8	Transparency in procedures (information about the engagement process)	No transparency in procedures	Some transparency in procedures	Procedures are transparent and are followed		Women play an equal role in procedures, and identifying where procedures are / are not transparent	Where procedures are not transparent, there is evidence of the responsible authority rectifying these issues
9	Water quality impacts on cultural, spiritual and customary water uses	Poor water quality hinders cultural, spiritual and customary water uses, and has resulted in the loss of ecosystems, fauna and flora that are essential to these practices	Water quality impacts on cultural, spiritual and customary water uses and there is some loss of ecosystems, fauna and flora that are essential to these practices	Water quality does not affect cultural, spiritual and customary water use nor the ecosystems, fauna and flora that are essential to these practices		Water quality does not affect women's cultural, spiritual and customary uses of water	Where water quality does negatively affect cultural, spiritual and customary water uses, there is evidence of the responsible authority improving water quality and availability

#	Indicator	Inequitable (negative impact on equity)	Ineffectual (no impact on equity)	Equitable (positive impact on equity)	Inclusion of women and other vulnerable groups	Consideration of the needs of future generations
10	Provision of water for food production	Household relies on subsistence farming for food or to supplement food, and does not have adequate water for subsistence farming	Households do not rely on subsistence farming for food, or to supplement food	Household relies on subsistence farming for food, or to supplement food, and have adequate water for subsistence farming	Women-headed households that rely on subsistence farming for food, or to supplement food, have adequate water for subsistence farming	Where water for subsistence farming is not adequate, there is evidence of the responsible authority rectifying and expanding water for subsistence farming
11	Allocation of water for commercial and economic uses	Water for economic and commercial use is disproportionately allocated to White-owned farms and businesses	Water allocation continues the status quo, without addressing past imbalances	Black African farmers are allocated a fair share of water for economic and commercial use	Black African women are prioritised and receive a fair share of water for economic and commercial use	Where water for economic and commercial use has a significant negative impact on water quality (e.g., water pollution), there is evidence of the responsible authority rectifying the situation
	Distribution of the impact of the use of water for commercial and economic	Water used for commercial and economic purposes has a significant negative impact on local water resources e.g., water is	Water used for commercial and economic purposes harms local water resources e.g., water is polluted	Water used for commercial and economic purposes does not impact on local water resources e.g., water is not		

#	Indicator	Inequitable (negative impact on equity)	Ineffectual (no impact on equity)	Equitable (positive impact on equity)		Inclusion of women and other vulnerable groups	Consideration of the needs of future generations
	uses	heavily polluted		polluted			

7.1.1 Indicator 1. Quality of drinking water and the condition of sanitation services and programmes

This indicator assesses the quality of drinking water and the condition of sanitation services by examining whether these services are safe and hygienic. It evaluates the adequacy of menstrual hygiene provisions to ensure women’s needs are met and examines solid waste disposal systems for effectiveness and long-term sustainability (Table 7.1).

7.1.1.1 Indicator qualitative assessment

Three respondents agree, and one strongly agrees that the indicator is clear and understandable (Figure 7.1). All four respondents agree that the indicator effectively assesses equity (Figure 7.1). This suggests that the indicator is clear and sufficiently targeted to the issue of equity in the provision of water and sanitation services. However, one respondent stated, “*I didn’t understand what was meant by equitable/inequitable until we discussed it today*”. This suggests that further efforts may be needed to enhance the indicator’s clarity by explicitly defining what equity means within the context of water and sanitation service provision.

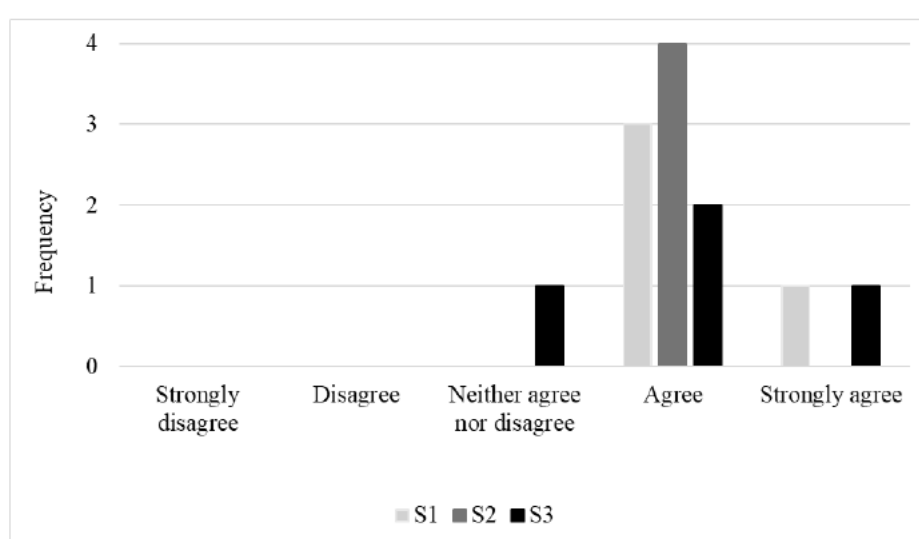


Figure 7.1 Respondents’ perceptions of indicator (S1) clarity, (S2) effectiveness, and ease of data collection (S3)

Responses on the ease of data collection were varied; one strongly agreed, two agreed, and one neither agreed nor disagreed that it would be easy to collect data for this indicator (Figure 7.1). Both drinking water and sanitation services are monitored at the national scale through the General Household Survey (GHS) and the Sustainable Development Goals (SDGs) (StatsSA, 2023). However, respondents indicated that at the local level, data collection is often limited, highly variable, and not feasible at the catchment scale due to insufficient financial resources and staffing within local government structures.

A respondent explained that *“collecting drinking water quality data at the scale needed, is not happening and is not feasible. There are not enough staff and budget is limited. Government don’t have capacity”*. This is location dependent, for example, in some more affluent urban regions with well-functioning infrastructure and monitoring systems, drinking water quality is tested weekly at the source, reservoir, and tap, enabling comprehensive oversight. Regarding sanitation services, in areas with government provided sanitation services, there is currently no available data on menstrual hygiene disposal.

These findings indicate that while there is general agreement on the clarity and equity focus of the indicator, challenges with local-level data collection limit its practical application.

7.1.1.2 Equity assessment

One respondent considered circumstances to be equitable, with perceptions influenced by the specific conditions observed across the catchment. For example, in rural or tribal areas, drinking water may be derived directly from the water source, whereas in urban areas, municipalities supply drinking water directly to the household. Where water is supplied by the municipality, water quality is tested and usage monitoring through metering at a household level and an associated billing system. However, respondents indicated that some urban areas continue to face issues with drinking water quality, predominantly attributed to aging infrastructure and failing treatment works. In peri-urban areas and villages where water is supplied by the municipality, however water use is not billed e.g., water via a water tanks, bore hole or standpipe, usage is not monitored. As a respondent remarked, *“we cannot measure this, and we do not know if people are getting enough water”*.

Similarly, for sanitation services, one respondent viewed the circumstances as equitable. Equity was only perceived in urban areas where households had flush toilets. In non-urban areas, inequities were predominantly noted due to a lack of handwashing facilities.

For both drinking water and sanitation services, a significant barrier to data collection and monitoring is the proliferation of self-constructed toilets and water connections in privately owned, informal dwellings. Due to insufficient and failing government service provision, those with the financial means have resorted to digging their own pit latrines, and boreholes, and establishing independent water pipelines directly from municipal or local sources (illegal connections). Many dwellings have been constructed with showers, baths, and septic tanks (illegal development), which occur without consultation or coordination with government authorities. This has increased water demand, as one respondent observed, *“the demand for water is booming, even informal car washes are popping up all over the townships. The municipality cannot keep up with the demand and we cannot control or monitor this”*. The rapid emergence of these new informal settlements, often established through so-called *“land grabs,”* further complicates monitoring efforts, as these communities do not pay for water and sanitation services, and they impose additional financial strain on already stretched municipalities.

Another pertinent and emerging concern described by one respondent as “*hidden inequities*” is associated with varying levels of pollution in drinking water, which is dependent on the water source. For example, endocrine disruptors, micropollutants that standard water treatment technologies cannot effectively remove, pose substantial risks in certain contexts. Historic mining regions experience contamination from heavy metals, while agricultural areas are impacted by persistent toxins from pesticide use. The extent of exposure is influenced both by the type of water source, being generally diminished in treated municipal supplies and amplified in water sourced directly from the environment, and by geographic proximity to mining or agricultural operations. These inequities disproportionately affect the poor, who are more likely to rely on untreated water for both drinking and subsistence agriculture. The subsequent uptake of toxins into local food supplies results in compounded health impacts over time. As one respondent remarked, “*there is increasing prevalence of ADHD in children and severe mental health issues in young adults, linked to heavy metal toxicity, and significant physical health impacts.*”

None of the respondents perceive water and sanitation services for women and future generations as equitable. Municipalities do not provide informal sanitation services, such as pit latrines. When households construct their own pit latrines, they are solely responsible for their maintenance. A respondent explained that “*pit latrines are not serviced by the municipality and this having a big impact on local water quality*”. There is a marked lack of investment in the development of new sanitation infrastructure, with one respondent warning that “*we are going to run short imminently and there is no budget for more*”. Municipalities do not provide facilities for the disposal of menstrual hygiene products, underscoring further gaps in equitable service provision.

These results highlight ongoing inequities in water and sanitation services, shaped by the lack of, deteriorating, or failing infrastructure; and varying levels of municipal service provision related to geographic location e.g., urban vs tribal areas. These challenges are intensified by limited government resources and the widespread unregulated development of informal settlements. Environmental hazards further compound these issues, placing the heaviest burden on the most marginalised communities.

7.1.1.3 Indicator limitations and improvements

Respondents suggested that the indicator lacks sufficient depth, stating that issues surrounding water and sanitation extend beyond basic water quality and service provision measures. The indicator lacks consideration of geographical context, as service provision is dependent on the type of area being assessed e.g., tribal versus informal area. As a broad overarching measure that does not consider geographical context, it was suggested that access to water and access to sanitation would serve as a more meaningful measure. Reflecting further, one participant expressed that their difficulty in evaluating the indicator stemmed from the absence of sub-indicators within the broader indicator

descriptions. They argued that incorporating more granular metrics, for example, tracking reductions in nitrate levels or the frequency of *E. coli* exceedances, would add clarity and usability.

7.1.2 Indicator 2. Interruptions to water services and reliability of sanitation services

This indicator assesses interruptions to water services and the reliability of sanitation services by evaluating how consistently these services are provided, the timeframes within which interruptions are resolved, and whether they are functional and reliable for all users. It evaluates the adequacy of menstrual hygiene provisions to ensure women's needs are met, and the reliability of shared sanitation services for long-term sustainability (Table 7.1).

7.1.2.1 Indicator qualitative assessment

Two respondents strongly agree and two agree (Figure 7.2) that the indicator is clearly worded and easy to interpret. Similarly, three agree and one strongly agrees (Figure 7.2) that the indicator effectively measures equity. This suggests that the indicator is regarded as clear and effective in measuring equity.

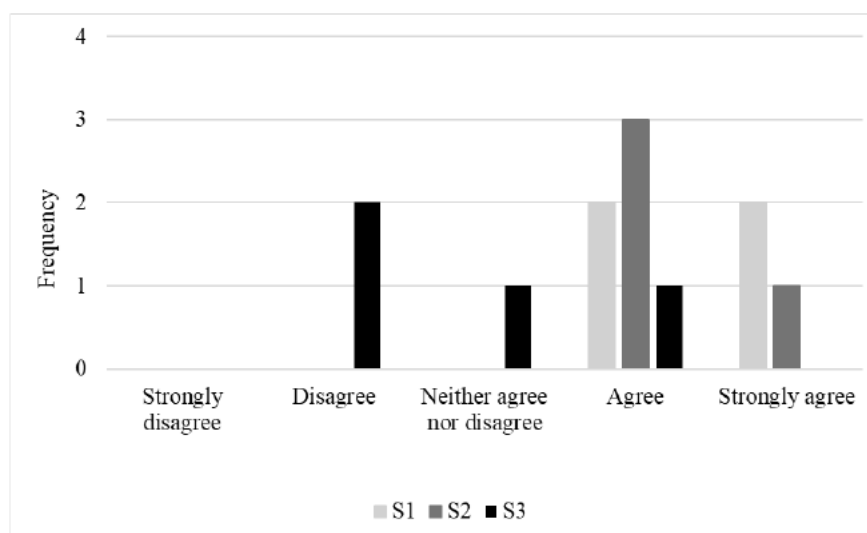


Figure 7.2 Respondents' perceptions of indicator (S1) clarity, (S2) effectiveness, and ease of data collection (S3)

Perceptions regarding the feasibility and ease of data collection were mixed; two respondents disagreed, one remained neutral and one agreed (Figure 7.2 b). The extent to which water supply interruption data can be obtained and monitored is context dependent. In urban areas where water is piped directly to houses, well-established billing mechanisms and fault-reporting procedures are in place. Service disruptions are reported to municipal call centres, which maintain detailed records and operate under service level agreements, often aiming for reconnection within 48 hours. In contrast, informal areas lack such monitoring infrastructure, and in cases involving illegal water connections, data collection is not possible (*cf* 7.1.1.1 Indicator qualitative assessment). With respect to sanitation services, municipal management and monitoring are absent. While some systems may have been envisaged during the

implementation of government housing developments, this has not transpired. Moreover, the widespread proliferation of self-constructed sanitation facilities means that reliable data on service reliability or interruptions is unavailable (*cf.* 7.1.1.1 Indicator qualitative assessment).

7.1.2.2 *Equity assessment*

One respondent (one of four) perceived both the frequency and duration of water supply interruptions, and the reliability of sanitation services, to be equitable. Service reliability is location-dependent. In urban areas, one participant noted that *“we (our municipality) comply with the norms and standards, and service level agreements”* for restoring water supply following interruptions, with water tankers deployed to affected areas when immediate restoration is not possible. This predominantly urban municipality is characterised by formal housing with in-house flush toilets; no communal sanitation facilities are present, and pit latrines, where they exist, are situated in proximity to the household.

In contrast, interruptions to water services in informal areas are frequent and present a significant challenge. Respondents reported that in these areas, when disruptions occur, residents may wait up to four weeks for water, although intervals of once every second week are more typical. Contributing factors include: load shedding (planned rotational power outages), cable theft, and the unreliability of failing water treatment works. As one respondent explained, *“people are on a permanent water rota because the treatment works are not reliable.”* Another respondent noted that the indicator may have limited applicability in rural areas, as in rural areas *“most people are collecting water from the river with a bucket”* and to gain reliable access to drinking water, some communities have pooled financial resources to drill community boreholes. In some cases, municipal-funded borehole projects were left incomplete when contractors absconded. Where boreholes are functional, water access remains vulnerable due to unreliable electricity supply, and pumps are frequently stolen or vandalised, leaving communities without a viable means of obtaining water.

Another respondent observed that the indicator fails to capture certain *“hidden inequities,”* emphasising that *“excluding financial inequity from this indicator is a significant oversight.”* In informal areas, where municipal water supply is unreliable or unavailable, enterprising individuals source water from illegal municipal connections or directly from rivers, then transport it into communities for resale at a profit. According to the respondent, *“rural people are paying between 10 to 100 times more for water per litre than those located in the most affluent areas of South Africa.”* The water sold through these channels is of inconsistent quality and may not be safe for consumption.

Regarding sanitation services in informal areas, conditions are location-dependent. In some rural areas, investment in the provision of drinking water has been prioritised, resulting in a lack of budget for, and significant backlogs in the development of sanitation services. Consequently, households with the financial means often construct their own pit latrines or septic tanks without consultation with local authorities and without adherence to environmental regulations (illegal developments). As one

respondent observed, “*these illegal pit latrines and septic tanks are causing pollution.*” Whereas in other rural areas, no communal sanitation facilities exist, and the extent of government-provided sanitation services is minimal.

None of the respondents regarded the circumstances for women or for future generations as equitable. Communal sanitation facilities are rare. Sanitation services are not maintained by the municipality, and their expansion is constrained as budgetary priorities are directed towards the provision of drinking water.

These findings reflect the pronounced inequities in water and sanitation services across urban and rural contexts. While some urban municipalities meet service standards, rural communities face frequent and prolonged disruptions, minimal sanitation provision, and disproportionately high costs for often unsafe water.

7.1.2.3 Indicator limitations and improvements

While the indicator was considered conceptually clear, it was suggested that its application would benefit from greater specificity regarding geographical context e.g., urban, rural, township and tribal areas, as variations in equity, and the factors influencing it, were observed across different geographical contexts, between catchments, and within the same catchment. Explicitly accounting for differences in locational would help ensure consistent interpretation and comparability across diverse settings. Hidden inequities, for example, instances where water is supplied by private providers at increased costs, should also be considered. As with the recommendations for the first indicator, it was proposed that the inclusion of sub-indicators specifically assessing affordability could enhance the indicator’s relevance and practical applicability.

7.1.3 Indicator 3. Physical accessibility of drinking water and sanitation facilities

This indicator assesses the physical accessibility of drinking water and sanitation facilities by evaluating how suitably located and securely accessible these services are. It considers whether water and sanitation facilities have been designed with the needs of women, vulnerable groups, and future generations in mind (Table 7.1).

7.1.3.1 Indicator qualitative assessment

Two respondents agreed, whilst one strongly agreed that the indicator is clear and understandable; however, one respondent strongly disagreed (Figure 7.3). A single strongly disagree response indicates that one participant found the indicator unclear. This respondent suggested a need for clearer phrasing, particularly to specify how the indicator assesses equity in relation to women and vulnerable youth. Regarding whether the indicator effectively captures equity or inequity, perceptions were mixed; one respondent strongly agreed, one agreed, one remained neutral and one strongly disagreed (Figure 7.3).

This points to some uncertainty regarding how effectively the indicator addresses equity in physical access to water and sanitation services.

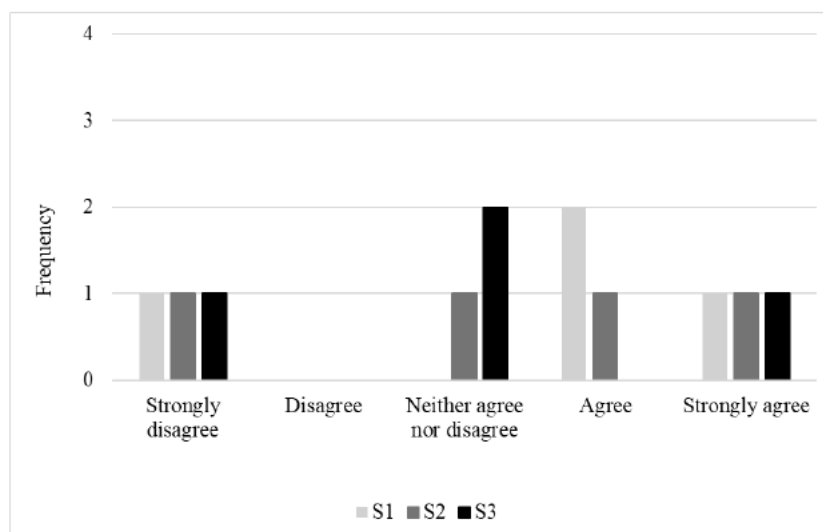


Figure 7.3 Respondents' perceptions of indicator (S1) clarity, (S2) effectiveness, and ease of data collection (S3)

Similarly, opinions regarding the ease of data collection were mixed; one respondent strongly agreed, two remained neutral due to uncertainty, and one strongly disagreed (Figure 7.3). One respondent suggested that certain government departments may hold relevant data, but this would need to be verified. Another participant remarked that “*government does not have the resources to capture data at this level of refinement,*” adding that such data would require community involvement, and raising the question of how this could realistically be implemented. These differing views highlight challenges in obtaining reliable data.

7.1.3.2 Equity assessment

One respondent (one of four) perceived the proximity of the water source to the household as equitable, none (zero of four) perceived the proximity of the water source to the sanitation facility as equitable. While access to water and sanitation services is context-dependent, two respondents regarded this measure as immaterial in real-world situations. As one explained, “*this is not relevant; the issue is not how close to water source the people are, it is that we are not getting water to people. The real issue is frequency and adequacy, not accessibility.*” In urban areas, households typically have piped water and indoor flush toilets, with tankers deployed during service interruptions. Rural communities that rely on communal sources, such as water tanks or boreholes, typically within 200 m of households, and in many cases the water source is located within the household yard. However, in certain rural areas, water sources may be more than 200 m away, with communities collecting water directly from the water source.

One respondent (one of four) perceived that safety for women and other vulnerable groups in accessing sanitation services was equitable. While safety was identified as a concern for women and vulnerable individuals using communal sanitation facilities, communal toilets are rare. A more prominent concern arose regarding situations in which women queue to collect water from communal sources, often at night, leaving them vulnerable when walking home in the dark. According to this respondent, incidents of crime have occurred in such circumstances. The same participant noted that “*young, unemployed men are extremely vulnerable*” in these situations.

None perceived equitable circumstances for future generations. In rural schools, water is delivered by trucks, but funding constraints persist as the Department of Education does not currently cover these costs and needs to assist municipalities that lack a budget for this. Sanitation is a significant concern. Schools use ventilated improved pit (VIP) toilets, yet these are not maintained by the municipality and, despite being the Department of Education’s responsibility, remain in poor condition. Many of the VIPs are full and non-functional, and there are not enough toilets to meet school needs, resulting in them filling up quickly. This situation has become a significant problem, prompting strong concern and outcry from affected communities.

These findings illustrate that equity in access to water and sanitation is marked by significant disparities between urban and rural settings. While proximity to services is considered inconsequential in urban areas, rural communities face ongoing challenges related to distance, infrastructure quality, and safety, particularly for women and vulnerable groups. Rural schools lack adequate management of sanitation facilities, creating significant risks to both health and personal dignity, and the environment.

7.1.3.3 Indicator limitations and improvements

Two respondents considered the indicator to be irrelevant in most contexts as the majority of South African’s have physical access to water or sanitation services. They proposed that a 50 m threshold, or access within the household yard, would serve as a more appropriate measure. From their perspective, considerations of physical proximity were secondary to the reliability and quality of service provision, thereby making this indicator irrelevant within the context of equitable access assessments. Building on this perspective, another participant suggested that a more reliable measurement could be achieved by incorporating sub-indicators within the indicator descriptions. For example, they proposed that “standpipe within 200 m” functions more appropriately as a sub-indicator rather than as part of a general indicator description. More granular measures, they argued, could provide a clearer basis for assessing and explaining the performance of the core indicators.

7.1.4 Indicator 4. Water for the Ecological Reserve

The indicator evaluates whether water for the Reserve has been allocated and safeguarded in accordance with legislative requirements, ensuring the realisation of the Constitutional rights to water for basic needs and a safe and healthy environment, thereby promoting equity (Table 7.1).

7.1.4.1 Indicator qualitative assessment

Three out of four respondents found the indicator clear and understandable (strongly agree), suggesting effective communication of its wording and purpose (Figure 7.4). Similarly, most respondents agreed (three of four) that the indicator is effective for assessing equity, suggesting it is aligned with its intended purpose (Figure 7.4). One respondent neither agreed nor disagreed, explaining that “... the indicator seems biased to the Ecological Reserve, and needs a balance with the Human Basic Needs Reserve”. The respondent explained that, depending on the context, either the Ecological or Human Basic Needs Reserve may take priority in water allocation. The Reserve balances both and excluding the Human Basic Needs Reserve may be a limitation when measuring equity and is ill-aligned with policy imperatives that balance both.

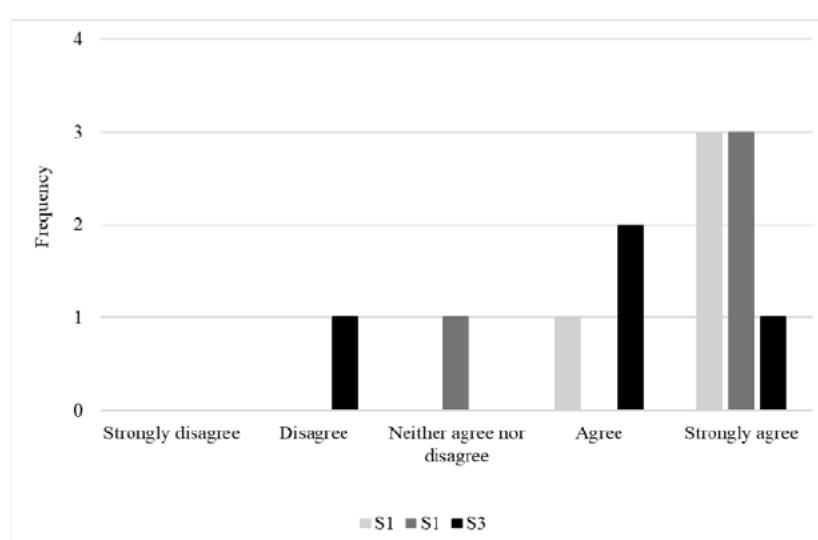


Figure 7.4 Respondents' perceptions of indicator (S1) clarity, (S2) effectiveness, and ease of data collection (S3)

Responses to the question regarding ease of data collection were mixed; one strongly agreed, two agreed, and one disagreed that it would be easy to collect data for this indicator (Figure 7.4). Established CMAs, such as the IUCMA, publish annual reports e.g. IUCMA (2023), for the purpose of monitoring biophysical elements (e.g., water quantity and quality, and aquatic organisms) within the WMA to ensure that the target ecological category is being met and maintained. As a result, these CMAs are well-positioned to collect data for this indicator. In CMAs where reporting is less advanced, respondents noted challenges with data collection. In some catchments, there is no monitoring due to the absence of the necessary equipment and functional networks (e.g., flow meters), with no systems in place to capture or manage data. *In-situ* monitoring equipment is often vandalised or stolen. In other cases, while some data are gathered, it is fragmented and used by different departments, e.g., DWS for different purposes, with no coordination or interpretation of the data. This is attributed to limited human and technical

capacity within DWS, particularly a lack of expertise to interpret biological data, which is currently collected but not assessed. As one respondent noted, “... *the water sector is not financially sustainable and is on the verge of collapse. DWS is barely functional*”. This respondent noted that DWS is doing the “*bare minimum*” to keep the water sector functioning. As a result, there is insufficient data coordination and interpretation to ensure compliance with the Reserve.

7.1.4.2 *Equity assessment*

One respondent (one of four) considered circumstances in their catchment to be equitable, demonstrating that the determination and enforcement of the Ecological Reserve has led to a perceived equitable outcome. Two cases were rated as ineffectual, indicating that while the Ecological Reserve has been determined, it is not being enforced. As noted by a respondent, “*The Reserve has been determined and gazetted, we have no equipment to collect data and so we cannot monitor or enforce the Reserve*”. One case was considered inequitable, indicating that the Reserve has either not been formally determined or requires redetermination due to outdated boundaries or criteria. This outcome suggests that while determining the Ecological Reserve is an important policy imperative, it does not guarantee the effectiveness of the Reserve or equity. Moreover, progress toward those outcomes continues to be hindered by significant resource constraints, which limit sustained monitoring and enforcement of the Reserve.

7.1.4.3 *Indicator limitations and improvements*

An area of improvement suggested by one respondent was to include the Human Basic Needs Reserve rather than focusing on the Ecological Reserve. However, if the Human Basic Needs Reserve were included, the respondent noted that it would make it more difficult to collect data for this indicator. Another respondent perceived the indicator as an “*excellent measure of equity*”. This highlights the need to achieve a balance between an ideal, legally sound measure and the practical feasibility of implementing the indicator. Indicators that are narrowly defined may be easier to collect data for and implement, whereas adding further dimensions and complexity risks making them impractical.

Another suggested improvement for this indicator could be to consider merging two indicators, Water for the Ecological Reserve (*cf.* 7.1.4 Indicator 4. Water for the Ecological Reserve) and Protection of the Ecological Reserve (*cf.* 7.1.5 Indicator 5. Protection of the Ecological Reserve), into a single indicator. Resource Quality Objectives (RQOs) are often determined in conjunction with the Reserve. However, in some instances, this is not the case, for example, the Reserve can be set independently, and sometimes determining the RQOs may delay the setting of the Reserve. Furthermore, all measurements related to aquatic ecosystems fall under the RQOs. When one aspect of the system is compromised, such as water quality, it can impact other elements, including aquatic life. RQOs may serve as a more refined and accurate indicator of ecosystem health, as the decline or disappearance of

certain species can act as an early warning sign of broader system deterioration or potential failure. Therefore, RQOs have the potential to be a more sensitive and earlier indicator of ecosystem stress.

On reflection, refining the indicators to better integrate both human and ecological needs, and ensuring closer alignment between RQOs and Reserve determinations may enhance the robustness of this indicator.

7.1.5 Indicator 5. Protection of the Ecological Reserve

This indicator assesses whether Resource Quality Objectives (RQOs) have been established and implemented, and whether these objectives are effectively being maintained or the Resource Class is improving. Achieving RQOs is an indicator of equity, demonstrating that the water resource is in a healthy ecological state and available to meet the needs of all stakeholders and uphold the human right to water (Table 7.1).

7.1.5.1 Indicator qualitative assessment

Respondents agreed (two of four) or strongly agreed (two of four) that the indicator is clear and understandable, indicating that its wording and intent are effectively communicated (Figure 7.5). Two respondents strongly agreed, one agreed, and one was neutral on whether the indicator effectively assesses if the situation is equitable (Figure 7.5). One respondent noted that while they personally found it easy to understand the indicator due to their water sector experience, they suggested that those without this experience might not understand how establishing and meeting RQOs leads to equitable outcomes. Another respondent took a neutral stance, viewing the narrowed focus on RQOs as an omission and suggesting that measures of the Basic Human Needs Reserve should be included in the indicator (as discussed for the previous indicator, 7.1.4.1 Indicator qualitative assessment).

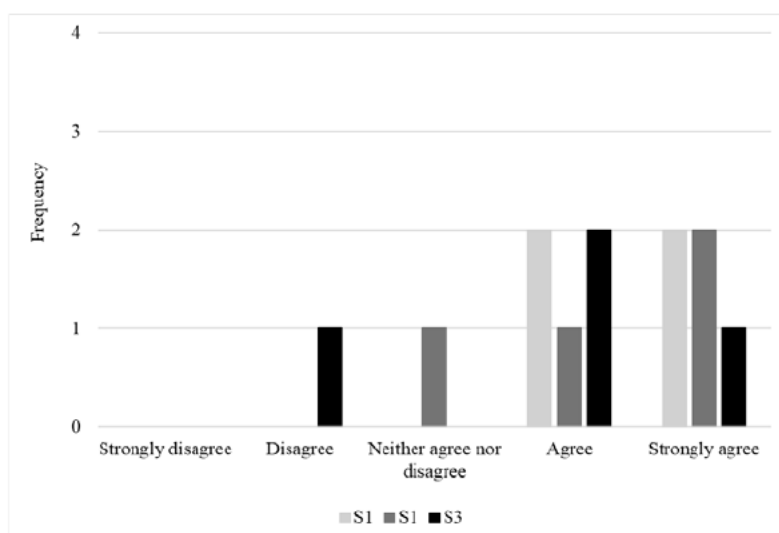


Figure 7.5 Respondents' perceptions of indicator (S1) clarity, (S2) effectiveness, and ease of data collection (S3)

Responses on the ease of data collection were varied; two strongly agreed, one agreed, and one neither agreed nor disagreed that it would be easy to collect data for this indicator (Figure 7.5). The data collection challenges identified for the previous indicator were reported as relevant to this indicator (cf. 7.1.4.1 Indicator qualitative assessment).

While most found the indicator clear, responses highlight the importance of potentially broadening its focus and improving accessibility for those less familiar with the water sector.

7.1.5.2 Equity assessment

One (one of four) respondent considered circumstances in their catchment to be equitable, demonstrating that fulfillment of RQOs or an improvement in the Ecological Category correlates with a positive impact on equity. One case was rated as ineffectual, indicating that the RQOs are being met, or the ecological category is maintained at least at Category C. Another respondent remarked, “*Honestly, the RQOs are not monitored so we can’t tell if the category is improving or not*”. Two cases were deemed inequitable, signaling either the absence of RQOs or a decline in the Ecological Category, both of which undermine equity. Another respondent commented, “*the RQOs are simply not being met,..., there are no interventions to reach the RQOs. Water quality in the catchment is deteriorating, especially due to malfunctioning WWTPs and sewage effluent running directly into streams.*” The same respondent observed that “*... there is an underdevelopment catchment from a governance perspective*”.

This outcome suggests that while some progress has been made in protecting the Ecological Reserve, there is a need for more proactive resource management and monitoring to ensure equitable outcomes. However, these measures are currently impeded by resource constraints.

7.1.5.3 Indicator limitations and improvements

Respondents identified key limitations and suggested improvements to the indicator. To provide context, water resource classes typically decline from upstream (Categories A and B, with minimal human impact) to downstream, where Categories C (balanced water use and ecological preservation) and D (significant issues requiring intervention) are more common. This decline reflects the increased anthropogenic pressure as one moves downstream through the catchment. Category E, though rare, signifies a tipping point where essential services can no longer be sustained. Categories A, B, C, and D are considered acceptable, each reflecting different levels of use and protection (cf. 5.7.2 Protection of the Ecological Reserve).

A limitation of the indicator is the spatial inadequacy of applying a single resource class (such as C) across an entire catchment, as management objectives often vary by reach. Upper sections may target high ecological status (A or B), while Category D may be appropriate and sustainable in downstream areas with greater human use. Thus, the relevant resource class should reflect the intended use and ecological function of each river segment, suggesting that catchment-wide indicators should instead

reference the established class for each geographical unit. Alternatively, if a catchment-wide resource class is employed, designating a Category D may be more suitable. A seldom-encountered exception arises when local populations depend directly on the resource to meet essential needs; under such circumstances, the resource should be designated Category A or Category B.

A second limitation is relying solely on the resource class as an indicator of ecological integrity. According to a respondent, “*water quality and quantity must be assessed in conjunction with the RQOs, they are intertwined*”. Resource classes must be used in conjunction with RQOs, which set specific targets for water quality and quantity. Since these parameters are interdependent (for example, dam operations affect both), a robust indicator should integrate Class, RQOs, and both water quality and quantity metrics. This approach acknowledges that ecological integrity depends on a more nuanced and granular assessment than resource class alone.

These findings suggest that while setting a resource class as a defining criterion provides a valuable benchmark, its application as a catchment-wide indicator is subject to important spatial and contextual limitations.

7.1.6 Ecological Reserve cross-cutting indicators

The cross-cutting aspect of the indicator (Table 7.1) reflects whether water allocated for, and the protection of, the Ecological Reserve actively prioritises the needs of women and other vulnerable groups, while ensuring that management strategies maintain or improve an Ecological Category of C or higher to support the long-term sustainability of the resource for future generations.

7.1.6.1 Cross-cutting indicator assessment

Two (two of four) respondents perceived the situation in their catchments as being equitable, specifically by prioritising the needs of women and other vulnerable groups in water allocation for the Ecological Reserve. However, all four respondents perceived the management of the Ecological Reserve as inequitable for future generations, since none maintained or improved an Ecological Category of C or higher, highlighting a significant gap in intergenerational equity. As explained by a respondent, “*Rivers in the catchment are of very poor quality, mainly caused by raw sewage in the water*”.

For the needs of future generations, one respondent rated ‘partial equity’ as monitoring environmental flows (e-flows) has not been implemented throughout the entire catchment. The Hydrology Department within the CMA monitors e-flows daily to ensure real-time adherence with the water quantity requirements of the Reserve. This monitoring approach considers seasonal variations, ensuring that assessments reflect natural changes throughout the year. Whenever e-flow reserves exceed established thresholds, potentially indicating stress on aquatic ecosystems, relevant stakeholders are promptly notified, and action is taken to prevent the use of water allocated for the Reserve. This ongoing, daily-

and seasonally responsive monitoring helps balance ecological needs with human demands, supporting sustainable water resource management for current and future generations.

While efforts are being made to ensure that benefits from the RQOs are distributed equitably, questions arose regarding whether women are truly benefiting from these outcomes and whether they are actively involved in the Reserve determination process. Historically, this field has been dominated by men, both in terms of participation and decision-making, often resulting in women and youth being marginalised. In addition, the technical nature of work related to RQOs has created further barriers, making it difficult for women and younger individuals to gain the necessary skills and opportunities to participate meaningfully. Addressing these disparities is essential for achieving equity and ensuring that Reserve determination processes include the needs and perspectives of women, the vulnerable, and youth.

7.1.6.2 Indicator limitations and improvements

Two respondents critiqued the current articulation of the indicator for the inclusion of women and other vulnerable groups as being ambiguous and inadequately defined. They emphasised the lack of clarity regarding how the allocation of water within the Reserve specifically advances equitable treatment for these groups, as envisaged by the indicator. A respondent remarked, *“How does allocation of water for the Reserve relate to equity for women and vulnerable groups? As a beneficiary of the Reserve, there is no emphasis on women; the Reserve is for all”*. This critique underscores that the indicator, as currently framed, is both ambiguous and imprecise, necessitating revision to better capture and address the intended outcomes of the indicator.

Another respondent noted that separating women as a distinct group for measurement purposes is problematic when the Reserve is designed to benefit everyone. This narrow focus risks overlooking the vulnerabilities experienced by other groups, many of which are shared by both men and women within local communities. The respondent explained that *“... men and women are equally vulnerable in some communities, not just women”*. The indicator overlooks the broader and sometimes more pressing vulnerabilities faced by entire local communities. Therefore, the indicator should be revised to explicitly recognise and incorporate and address the needs of all vulnerable members of a community, recognising that vulnerability is often collective rather than limited to specific demographic categories.

These critiques collectively suggest that the current indicator is not only imprecise in its formulation but also may be misaligned with the realities of community-level vulnerability.

7.1.7 Indicator 6. Stakeholder participation

This indicator is a measure of inclusive stakeholder participation in decision-making. It assesses whether a diverse range of groups, including women, youth, and other vulnerable populations, have participated in, and had influence on, decision-making (Table 7.1).

7.1.7.1 Indicator qualitative assessment

All respondents strongly agreed that the indicator is clear and understandable (Figure 7.6). This suggests that the indicator is clear and that there is potential for consistent interpretation of the indicator. Three (three of four) respondents strongly agreed, and one agreed that the indicator effectively assesses equity (Figure 7.6). This reflects high confidence among respondents in the indicator's relevance to its intended purpose. According to one respondent, *"participation is a high priority on our agenda, the CMA makes every effort to ensure that everyone is included. We even provide transport or money for transport to meetings to make sure that everyone can attend"*.

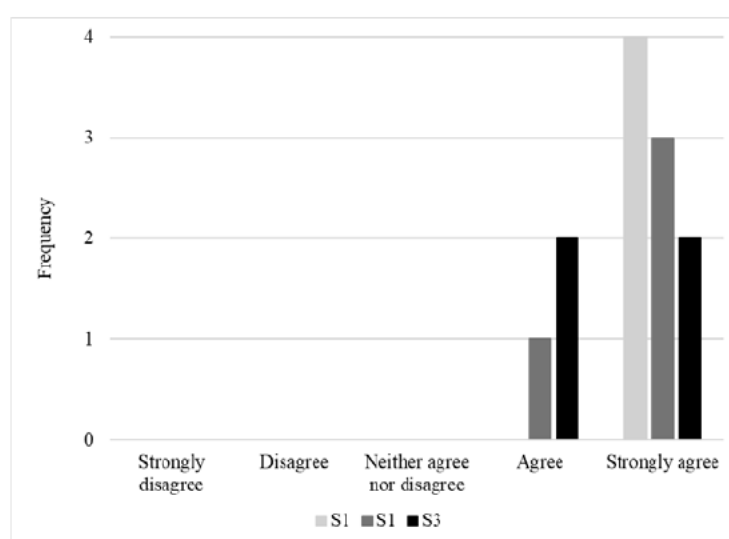


Figure 7.6 Respondents' perceptions of indicator (S1) clarity, (S2) effectiveness, and ease of data collection (S3)

Responses are evenly split (two agreed and two strongly agreed) that data for this indicator will be easy to collect (Figure 7.6). This suggests general confidence regarding the practicality of data gathering for this indicator. Respondents indicated that various forms of attendance and participation information are routinely recorded. It is a procedural requirement that an agenda, an RSVP list, and an attendance register are recorded for every meeting. This information is reported to the CMA Board quarterly and is subject to verification by external auditors. The registers commonly record demographic details, such as youth, women, and persons with disabilities, which could be used to assess the breadth of stakeholder engagement. For example, a respondent explained *"the registers often ask about youth, women, disabled, etc."*. However, this information is not collated or analysed for monitoring purposes. As one respondent stated, *"there is no current measure but this would be easy, we have this information"*.

In the context of the informal governance structure, where such information is not a procedural requirement, attendance registers serve as the primary source of participation information. Demographic information is readily available, for example, a respondent explained that *"there is data*

about tribal chiefs, youth, NGOs, community members, and the frequency that they attend meetings. We have this information". This information is not used for monitoring purposes; however, it has previously been used by independent researchers to conduct gap assessments and specific research purposes outside of the activities and purposes of the informal governance structure.

The findings suggest that effective data collection systems are in place, ensuring relevant information is both routinely gathered and readily accessible. However, there is a gap in the analysis and application of these data for ongoing monitoring of stakeholder participation and representativeness (*cf.* 7.1.8 Indicator 7. Stakeholder representativeness).

7.1.7.2 *Equity assessment*

All respondents viewed the situation in their catchment as equitable, indicating that fulfillment of board and inclusive engagement practices is positively associated with improved equity. A respondent observed that *"engagement is very broad"*, while another remarked that *"our network is large covering a large number and type of stakeholders"*. In addition, another respondent noted that *"our meetings are well attended, even people who were not formally invited attend"*. However, the frequency and scale of meetings influence both attendance and the diversity of participation. Quarterly or smaller meetings tend to attract a narrower audience, while larger meetings are generally better attended and more inclusive.

For women, other vulnerable groups, and youth, two of four respondents perceived the situation in their catchment as equitable. While women and youth are actively encouraged to attend meetings, for example, through CMA-led competitions and educational initiatives in schools and higher education institutions intended to stimulate engagement, youth remain underrepresented. Furthermore, Water User Associations and Irrigation Boards are still predominantly attended by White males. A respondent explained that *"there is a dire need for transformation within Irrigation Boards and Water User Associations, it is a real struggle to get women participation"*. The respondent explained that, *"most farmers are White men, it is not that men don't women to have a voice"*.

These findings indicate that while stakeholder engagement covers a broad range of participants in all catchments, persistent challenges remain regarding the inclusion of women, youth, and other vulnerable groups.

7.1.7.3 *Indicator limitations and improvements*

None of the respondents proposed any improvements to this indicator. On the contrary, one participant remarked, *"the cross-cutting themes are an excellent idea, the first of their kind that I have seen"*.

7.1.8 Indicator 7. Stakeholder representativeness

This indicator assesses the extent to which different stakeholder groups, in particular poor and marginalised groups, women, and youth, are included and have a voice in water management institutions and decision-making processes (Table 7.1).

7.1.8.1 Indicator qualitative assessment

Three (three of four) respondents strongly agreed, and one agreed that the indicator is clear and easy to interpret (Figure 7.7). For effectiveness in assessing equity, three respondents strongly agreed, and one agreed, demonstrating confidence that the indicator accurately measures equity in their catchment (Figure 7.7). This high level of agreement suggests this indicator is both well-constructed and readily applicable for monitoring stakeholder representativeness. Similar comments were raised as with the previous indicator (*cf.* 7.1.7 Indicator 6. Stakeholder participation); every effort is made to ensure inclusive participation, including the provision of educational resources and transport to facilitate attendance at meetings. Promoting inclusive engagement remains a high priority for catchments.

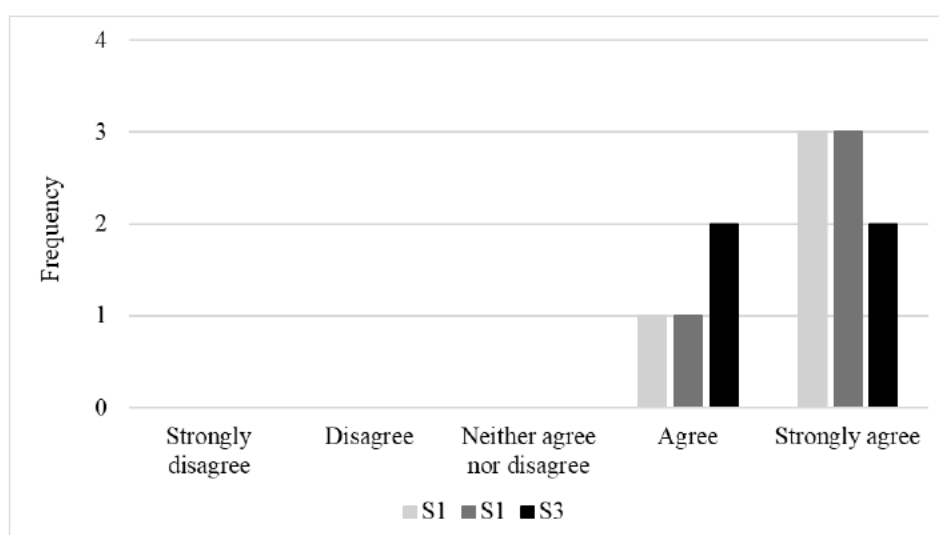


Figure 7.7 Respondents' perceptions of indicator (S1) clarity, (S2) effectiveness, and ease of data collection (S3)

Regarding the ease of data collection, two strongly agreed and two agreed (Figure 7.7), signifying consensus that the collection of necessary data is manageable. As with the previous indicator (*cf.* 7.1.7 Indicator 6. Stakeholder participation), attendance registers could serve as a primary data source and typically contain some demographic information. Although this information is readily accessible, it is not collated or analysed for monitoring purposes.

7.1.8.2 Equity assessment

All respondents viewed the situation in their catchment as equitable, reflecting a decision-making environment where marginalised and diverse groups have a voice in decision-making. As observed by a respondent, *“there is good representatives in our catchment”*. Half the respondents (two of four) indicated “equitable” inclusion of marginalised groups in their catchments. Similarly, two respondents found the inclusion of future generations’ concerns to be equitable. While marginalised Black men are represented, there is a persistent issue of overall representativeness being disproportionately skewed toward male participants; as one respondent observed, *“men, including marginalised men, have a larger voice than women.”* This imbalance is especially pronounced within Water User Associations and Irrigation Boards, despite deliberate efforts to engage marginalised groups through targeted training sessions designed to build the capacity and confidence of potential participants outside formal meetings. Youth participation remains particularly challenging, with respondents reporting that, despite targeted initiatives in schools and tertiary education institutions, *“youth seem uninterested in agriculture and do not seem to want to participate in water issues”*.

One respondent highlighted notable success in the participation of persons with disabilities, attributing this achievement to the leadership of the CMA chairperson, who is herself a disabled woman and has inspired targeted efforts to foster inclusivity. Within the informal governance structure, success in engaging marginalised groups, youth, and women was ascribed to the organisation's long history (some 23 years) and the consequent trust established within the community. As the respondent explained, *“people feel safe and can speak freely; we also allow people to use their native language to help them feel confident to speak up.”* Furthermore, in this catchment area, the predominance of women among tribal chiefs has fostered an environment in which women feel safe and empowered to participate. An education programme for youth was cited as a factor contributing to their active involvement in decision-making processes.

These findings demonstrate that while participation is broadly strong, gender imbalances and limited youth engagement, in particular within the CMAs, are an area of concern. This underscores the need to strengthen mechanisms that promote intergenerational and the interests of women. In contrast, the experience of the informal governance structure demonstrates that community trust and culturally sensitive practices can facilitate meaningful inclusion of marginalised groups, women, and persons with disabilities.

7.1.8.3 Indicator limitations and improvements

As with the previous indicator (*cf.* 7.1.7 Indicator 6. Stakeholder participation), no respondents offered suggestions for the improvement of this indicator.

7.1.9 Indicator 8. Ethicality

This indicator aims to assess the ethical dimensions of decision-making processes, focusing on, the degree of transparency in procedures, the presence or absence of corruption, and the inclusion of women, youth, and other vulnerable groups (Table 7.1).

7.1.9.1 Indicator qualitative assessment

Three respondents strongly agreed, and one agreed that the indicator is clear and understandable (Figure 7.8). This suggests that the indicator's purpose and criteria are understood, with minimal risk of misinterpretation. Three (three of four) respondents strongly agreed that the indicator effectively measures equity, while one respondent remained neutral (Figure 7.8). This reflects support for the indicator's ability to assess equity, with hesitation from one participant. The hesitation stems from the informal governance initiative's lack of a legal obligation to enforce transparency procedures. Although they are supported by the Department of Water and Sanitation (DWS) to follow mandated stakeholder engagement practices, compliance is not required, which led to uncertainty in their assessment of the indicator's effectiveness to measure equity.

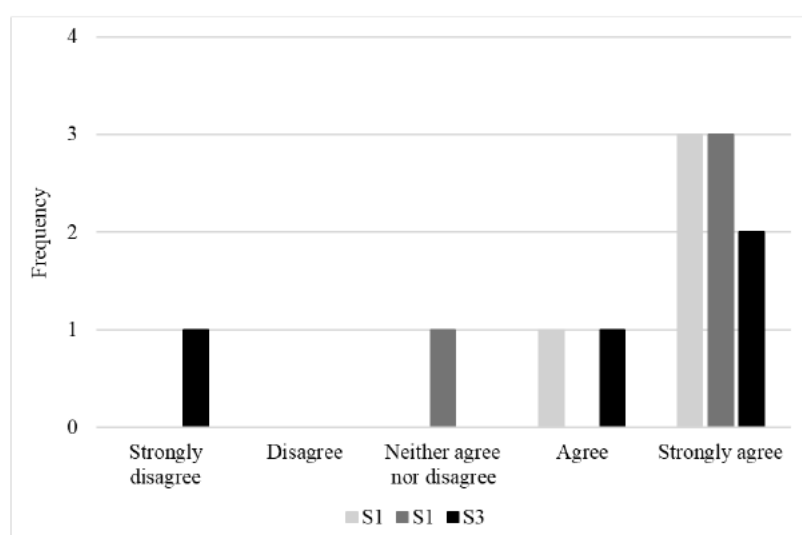


Figure 7.8 Respondents' perceptions of indicator (S1) clarity, (S2) effectiveness, and ease of data collection (S3)

Two respondents (two of four) strongly agreed, and one agreed that data collection for this indicator will be possible, as CMAs have well-documented procedures and outcomes that are readily accessible (Figure 7.8). These procedures serve as a monitoring tool, with strict adherence and corrective action when necessary. In contrast, while the informal governance initiative follows regulatory procedures, it does not use this information for monitoring, considering such activities beyond its mandate.

These findings support the indicator's clarity, relevance, and practical application. The catchments' decision-making procedures themselves function as monitoring mechanisms, and data required for additional types of monitoring, including for water equity, are readily available.

7.1.9.2 *Equity assessment*

All respondents strongly agreed that there is transparency in procedures, reflecting that they perceive the decision-making processes in their catchments as equitable. CMAs have well-defined, documented and strict transparency in procedures for decision-making. Procedures are thoroughly documented, and adhered to, with all stakeholders, including women and youth, actively involved and informed at every stage. Oversight mechanisms are robust with strict adherence to procedures. A respondent explained that *"procedures have to be followed by the book, there are layers of governance and accountability throughout the process that are overseen by various committees, if a step is missed or not compliant, the entire process is stopped"*. For example, annual spending and tariff processes are transparent, with detailed communication and training provided to ensure a broad understanding and accessibility. All related documents are readily accessible to the public on each CMA's website.

Two respondents (two of four) perceive the role of women in the transparency of procedures as equitable, with three respondents perceiving equity for future generations as sufficiently addressed. Regarding women and youth participation, a respondent observed that *"women are strongly involved in decision-making. Youth seem less willing to participate, I don't know why"*. A single respondent commented on the issue of ethicality in relation to corruption. DWS administers a questionnaire to stakeholders, inviting them to raise any concerns or dissatisfaction, which serves as an independent check on the CMA. This creates an additional layer of governance to uphold transparency. Importantly, the questionnaire includes space for comments on potential corruption, reinforcing accountability and oversight throughout the process.

In the case of the informal governance initiative, while it is not required, all activities align with mandated public participation procedures. The organisation works closely with DWS to ensure ongoing compliance. While most projects proceed without issue, minor challenges occasionally arise, primarily due to resource and staffing limitations within DWS.

These findings demonstrate that transparency is integral to catchment procedures and is widely perceived to have led to equitable outcomes.

7.1.9.3 *Indicator limitations and improvements*

No respondents offered suggestions for improving this indicator. One remarked, *"these indicators are excellent; I have seen a plethora of research, and none of it adds value in a practical sense. The CMAs need more of this type of research and practical insights"*.

7.1.10 Indicator 9. Water for cultural, spiritual, and customary practices

This indicator assesses the extent to which water quality supports or hinders cultural, spiritual, and customary water uses, with particular attention to women and other vulnerable groups. It considers whether water quality negatively affects these practices or the ecosystems, fauna, and flora (Table 7.1).

7.1.10.1 Indicator qualitative assessment

Two respondents agreed, one remained neutral, and one declined to respond due to uncertainty concerning the clarity and understandability of the indicator (Figure 7.9). While there was a tendency towards agreement that the indicator is clear and understandable, the variability in responses suggests the clarity could be improved, or that the indicator may be difficult to interpret. Three respondents agreed while one declined to respond, expressing doubt that the indicator was a suitable measure of equity (Figure 7.9). This respondent remarked, “*this is not about equity*”, suggesting that the respondent did not see a clear link between the impacts of water quality on cultural, spiritual, and customary practices and equity.

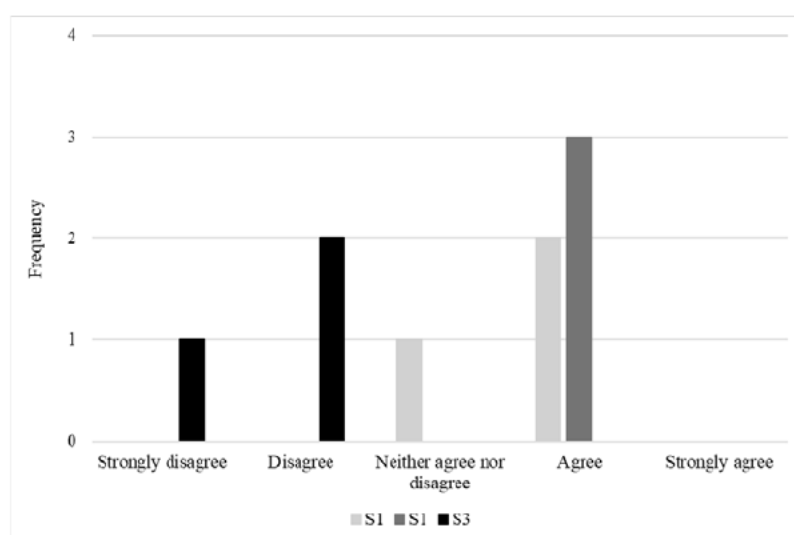


Figure 7.9 Respondents' perceptions of indicator (S1) clarity, (S2) effectiveness, and ease of data collection (S3)

Two respondents disagreed, one strongly disagreed, and one declined to respond due to uncertainty (Figure 7.9), reflecting a prevailing view that data collection for this indicator may present challenges. Water quality data are readily available, and biodiversity data for catchments are generally available and of a high standard. However, as a respondent explained, “*we have water quality and biodiversity data but it would need to be collated and related to customary water of uses. I am not sure how we could do this, possibly a community survey*”. Another respondent echoed this “*there is extensive water quality data, it is easy to measure. The social impacts of water are not easy to measure, and there is no easy way to measure the cultural impacts of water*”. These responses indicate that while the necessary

data are available, there are challenges in collating the data and the absence of a methodological approach for evaluating whether the impact of poor water quality on cultural, spiritual, and customary practices can be effectively measured.

7.1.10.2 Equity assessment

Two of three respondents rate the circumstances in the catchment as equitable, indicating that water quality does not negatively affect cultural, spiritual and customary practices. In these catchments (Breede-Olifants Catchment Management Agency and Inkomati-Usuthu Catchment Management Agency), the Department of Water and Sanitation (DWS) has established procedures for dealing with transgressors, and municipalities are legally required to remediate any water quality issues caused by their WWTP releases. This includes upgrading WWTPs and securing funding for these improvements. A major challenge is the persistent lack of resources, particularly funding. In addition to DWS efforts to prevent pollution and protect water quality, a respondent explained that *“most rivers in the CMA have safe enough water to bath in or for spiritual practices. However, the fauna and flora for use in these practices have been heavily impacted by poor water quality”*. They further elaborated that *“there is the problem of invasive fish species that affects subsistence fisherman”*.

One respondent perceives the situation in the catchment as ineffectual, indicating some negative impacts or partial ecosystem impacts that affect these practices. The respondent noted that while water for cultural, spiritual and customary practices in the catchment is widespread, specific impacts are neither measured nor monitored, despite some reference to these impacts in the RQOs.

None of the respondents perceived the situation as equitable for women, indicating that women’s cultural, spiritual and customary practices are negatively affected. Although women are the primary users of water for basic needs such as cleaning and bathing, there was broad agreement that the extent and nature of these impacts are poorly understood and difficult to assess or comment on. With respect to future generations, one respondent considered circumstances to be equitable, indicating that from that one perspective, current water management practices do consider and protect the needs of future generations regarding cultural, spiritual, and customary water uses. However, the prevailing view was that the impact on future generations is likely to be negative, a concern primarily attributed to the widespread deterioration of water quality within the catchments.

These findings highlight that regulations are in place to protect water quality and that there are some positive perceptions, equity challenges in relation to cultural, spiritual and customary practices, especially for women and future generations are commonly experienced across the catchments.

7.1.10.3 Indicator limitations and improvements

A key limitation identified is that the phrase “cultural, spiritual, and customary practices” encompasses a diverse array of activities. These may include spiritual uses of water, subsistence activities such as

fishing, or customary uses such as bathing and washing, practices that may hold cultural significance within certain communities. This breadth makes the indicator difficult to interpret and introduces multiple dimensions that will complicate assessment and monitoring. In addition, the inclusion of ecosystems, fauna, and flora essential to these practices adds another layer of complexity. A respondent observed that *“if the indicator is aiming to measure the impact on spiritual practices alone, I would suggest only focusing on this and removing the reference to ecosystems. Ecosystems is an entirely different measure”*. Another suggestion was to streamline the indicator to assess only the impact of water quality on cultural, spiritual, and customary practices.

These findings reveal that the indicator would benefit from reducing its scope to focus exclusively on a specific water use, such as spiritual practices, and by restricting its assessment to the impacts of water quality alone. This refinement would enhance the indicator’s interpretability while simplifying data collection.

7.1.11 Indicator 10. Provision of water for food production

This indicator assesses whether households that rely on subsistence farming for food have access to adequate water for food production, with particular attention to the inclusion of women-headed households, and the consideration of long-term, sustainable water provision (Table 7.1).

7.1.11.1 Indicator qualitative assessment

Most respondents agreed (two strongly agreed and one agreed) that the indicator is clear and understandable, while one respondent disagreed (Figure 7.10). One respondent recommended amending the indicator to improve its conciseness. This suggests that the indicator is generally perceived as clear; however, some improvement will ensure clarity for all users. Two respondents strongly agreed, and one agreed the indicator is effective in assessing equity, with one respondent neutral. This suggests confidence in the indicator’s ability to measure equity in access to water for subsistence food production.

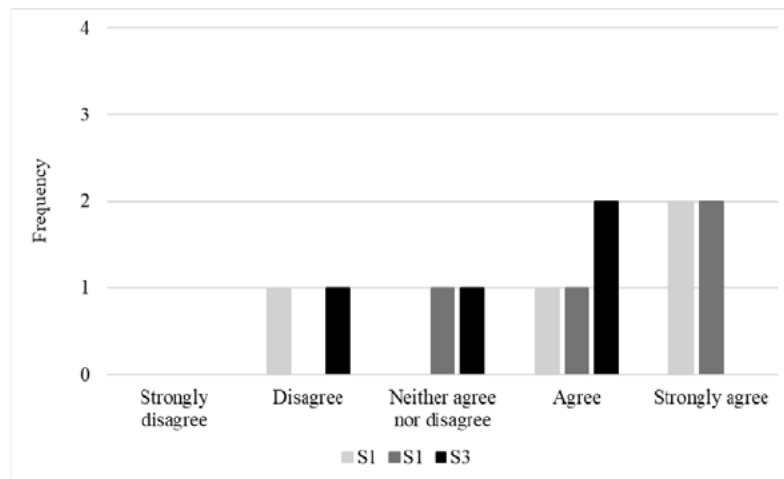


Figure 7.10 Respondents' perceptions of indicator (S1) clarity, (S2) effectiveness, and ease of data collection (S3)

Two respondents agreed that data collection will be uncomplicated, while one is neutral and one disagreed (Figure 7.10). This response indicates varying perceptions regarding the feasibility of collecting data for this indicator. There is currently no data or measure of water for subsistence farming within the catchments, and this topic is poorly understood. While in some catchments a register of smaller subsistence farmers is kept, these data are rudimentary, uncollated, and not subject to any analysis. In addition, it was noted that collecting data would be challenging, particularly in tribal authority areas. It was suggested by two respondents that other government departments, e.g., the Department of Agriculture, may possess some relevant data, although challenges with cross-government Department data sharing were noted.

These findings highlight that while the indicator is regarded as clear and effective in measuring equity, its articulation could be improved and there are challenges with the collection of relevant data.

7.1.11.2 Equity assessment

Two respondents perceived circumstances as equitable; they perceived that households relying on subsistence farming generally have adequate access to water. There is significant are widespread subsistence farming activities across these catchments. A respondent explained that "*the Eastern Cape region is characterised by the presence of numerous dams, a post-apartheid era legacy when many were constructed specifically to supply water for subsistence farming*". Given the scale of these operations, some subsistence farmers meet the threshold to apply for a General Authorisation or an exemption from a water use licence. Water access for households is generally good in this region (Breede-Olifants Catchment Management Agency) with those residing further from the river making use of boreholes, which were developed with assistance from the Department of Rural Reform. Another

respondent remarked that “*the CMA provides grants to support subsistence farming*”, and that many of these grants supported women-headed households, projects that support persons with disabilities, and food gardens at schools.

In contrast, one respondent indicated that no households in the catchment are reliant on subsistence farming. Another respondent assessed the circumstance as inequitable, indicating that households that rely on subsistence farming for food do not have access to sufficient water to produce food. A respondent observed that “*it depends on the context*”. Specifically, in this catchment, households located near surface water sources such as rivers were able to access water for subsistence farming, whereas those situated further from these sources faced challenges in securing adequate water.

These findings suggest that respondents perceive water access for subsistence farming as broadly equitable, supported by historical infrastructure and ongoing grant programmes, benefiting women, youth and persons with disabilities. There is, however, some variability at the household level in other catchments, highlighting contextual factors.

7.1.11.3 Indicator limitations and improvements

Only one limitation was noted. While the indicator is clear, it lacks conciseness. The indicator could be made more concise by streamlining its language and combining overlapping statements. This may enhance the clarity and usability of the indicator.

7.1.12 Indicator 11. Water for commercial and economic uses

This indicator assesses whether the use and allocation of water for commercial and economic purposes is equitable, environmentally responsible, and whether negative impacts from commercial and economic activities on water resources are effectively addressed (Table 7.1).

7.1.12.1 Indicator qualitative assessment

For both the clarity of the indicator and its effectiveness in measuring equity, three respondents (three of four) agreed, and one strongly agreed (Figure 7.11). This demonstrates confidence in the indicator’s purpose and design for these aspects. One respondent remarked that, although the structure and layout of the indicator were “*very good*,” refining the wording could further enhance its clarity.

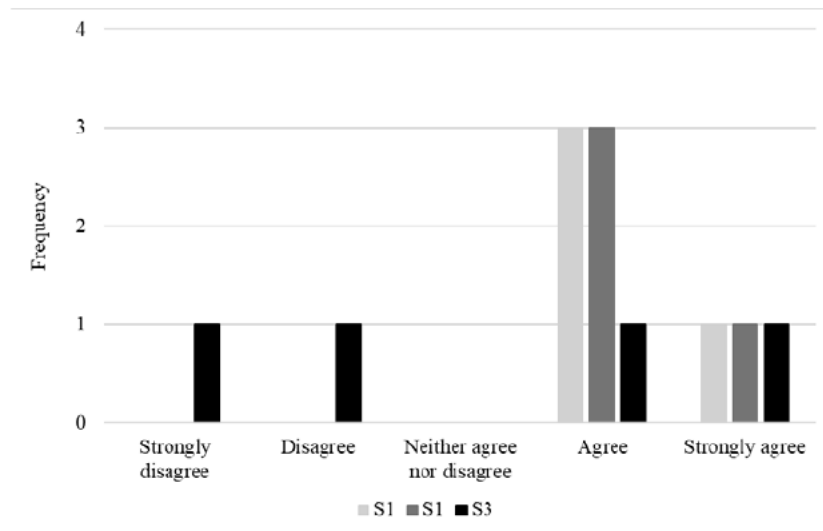


Figure 7.11 Respondents' perceptions of indicator (S1) clarity, (S2) effectiveness, and ease of data collection (S3)

Responses were mixed regarding the ease of data collection; one respondent strongly agreed, one agreed, one disagreed and one strongly disagreed (Figure 7.11). This signals challenges with obtaining data for this indicator. Records exist in the Water Use Authorisation and Registration Management System (WARMS) for Water Use Licensing (WUL) registrations (4.4 Procedural and distributive equity reporting). WARMS functions primarily as a database of registered water users and contains some basic demographic and socio-economic information. WARMS however, is not actively monitored, nor was it considered a suitable data source. In addition, CMAs do not have access to these datasets. A respondent explained that while suitable data are contained in WARMS *“this data would be very difficult to gather, there are too many different role players holding different data sources that would be challenging to coordinate”*.

While there is consensus on the clarity and relevance of the indicator itself, significant barriers remain in its practical implementation due to fragmented data systems and limited access to suitable information.

7.1.12.2 Equity assessment

For the allocation of water for commercial and economic uses, all four respondents perceived circumstances as inequitable, suggesting that water use is disproportionately allocated to White-owned entities. The majority of water allocated for commercial and economic uses remains concentrated among White-owned businesses, particularly in the agricultural sector. This inequitable distribution is a direct consequence of the legacy of apartheid, land has historically been owned by White farmers, and policies that intertwined water rights with land ownership. While circumstances remain inequitable, existing policies are designed to redress these historical imbalances. Although there are ongoing

challenges to effective reform, respondents expressed optimism that these policies will gradually bring about positive change. A respondent resounded that *“historical impacts are being addressed”* and *“compulsory licensing will rectify these imbalances”*. However, significant barriers persist. Too few Black individuals are applying for WULs, which results in licenses remaining predominantly in the hands of White-owned entities. A respondent remarked that *“Black people don’t have the capacity to apply for WULs, it’s too difficult and expensive”*. Moreover, there is insufficient support to assist Black-owned businesses in developing the capacity needed to compete with established, highly commercialised White-owned enterprises. A respondent suggested that *“more needs to be done to help Black farmers, they need support to become commercialise their business and become economically profitable”*.

None of the respondents perceived the situation as equitable for women, making mention that Black-African women have not been allocated an equitable portion of water for commercial and economic uses. While South Africa’s Broad-Based Black Economic Empowerment (BEE) policy mandates that every WUL application addresses demographic and racial transformation, and affords priority to Black women- and youth-owned businesses, implementation remains inconsistent. One respondent viewed these requirements as having a positive effect on racial reform within water use licensing, whereas another pointed out that *“this is not happening in reality; women are not being allocated WULs.”*

The distribution of the impact of commercial water use was perceived as inequitable by one respondent and ineffectual by three respondents with none perceiving circumstances as equitable for future generations. This suggests that negative impacts, such as water pollution, are prevalent across the catchments and are not being adequately addressed or remedied. In two catchments, pollution from commercial wastewater treatment and agriculture was described as *“significant,”* and although such pollution is illegal, respondents noted that enforcement against polluters is insufficient. In the other two catchments, while water is polluted from commercial activities, this pollution was not perceived as significant. This was attributed to the absence of large industrial or commercial areas and more effective legal enforcement by local authorities.

Water allocation for commercial and economic uses remains inequitable, skewed towards White-owned businesses and leaving Black South Africans, particularly Black women, at a disadvantage, despite reform policies. Barriers include a complicated licensing process, limited support for the development of Black-owned businesses, and inconsistent policy implementation. The negative environmental impacts of commercial activities are not being adequately addressed, resulting in persistent pollution of water resources across some catchments.

7.1.12.3 Indicator limitations and improvements

Participants raised concerns regarding how equity should be measured in relation to water pollution. One noted uncertainty around the very definition and assessment of equity as outlined by this indicator,

acknowledging, "*I don't have the answer.*" Two respondents noted that the indicator's wording may need refinement, as varied interpretations could affect consistent application. It was suggested that the indicator would benefit from distinguishing between different water users, specifically, mining, irrigation, and forestry, due to their fundamentally different patterns of water use and pollution. For example, irrigation consumes large volumes of water, in particular during winter months, often depleting river flows and affecting downstream users. In contrast, while mines use less water in volume, their impact on water quality can be substantial. Forestry, too, is a significant water user and may warrant separate consideration. To enhance its clarity and practical implementation, the indicator may need to be refined to provide clear definitions and to distinguish between different types of water use.

7.2 Discussion

7.2.1 Practical application of the water equity indicators

Respondents engaged effectively with the indicators, categorising them as “equitable”, “ineffectual”, or “inequitable”, and supported each selection with narratives that demonstrated an understanding of equity concerns in their catchments. This includes indicators covering technical ecological dimensions, mandated stakeholder engagement procedures, and cross-cutting equity dimensions. This suggests comprehension and usability and supports the suitability of indicators as tools for monitoring water equity in South Africa.

While the clarity of the indicators was not in question, respondents expressed concerns regarding their alignment with equity outcomes and, more importantly, their ability to reflect real-world circumstances (Table 7.2). This suggests that while the respondents were both comfortable with, and capable of, using the indicators to assess water equity, further clarification is needed on the mechanisms by which they relate to equitable outcomes. Recommendations included revising existing indicators to incorporate more detailed sub-indicators to provide a clearer basis for assessing and explaining the performance of the core indicators. Some respondents suggested adjusting certain thresholds, for example, an ecological category D may be more suitable than category C for the Resource Quality Objectives (Table 7.2, indicator 5). Other indicators require refinement to more specifically target equity issues. For example, refining impacts on cultural, spiritual and customary water uses to assess only the impacts of water quality on particular uses of water (Table 7.2, indicator 9), or developing indicators that clearly distinguish between the specific impacts of different water uses on water resources, such as mining, agriculture, forestry, and industry for the impacts of water from commercial and economic uses (Table 7.1, indicator 11). Overall, these recommendations highlight the need to re-examine both the content and structure of specific indicators.

When considering the capacity of the indicators to reflect real-world circumstances, the service delivery indicators (Table 7.1, indicators one to three) highlight the limitations of aligning indicators to national and international reporting frameworks. Although these indicators were aligned to the norms and

standards for service delivery (DWS, 2017), General Household Surveys (StatsSA, 2019a) and the Sustainable Development Goals (StatsSA, 2019b) to support data collection and analysis, and ease of reporting, in reality, these indicators proved to be of limited practical value. Alignment, while convenient for reporting, does not necessarily make it a meaningful or effective measure. This suggests that dedicated water equity-focused indicators, developed independently rather than adapted to fit within existing global frameworks, may be more suitable in the South African context.

A significant barrier to the implementation of the indicators is data availability, quality, and integration, attributed to both financial and human constraints (Table 7.2). For some indicators, no data are available; for example, sanitation services are unmanaged by local government and records are absent. Similarly, there is limited information on the use of water for subsistence farming, customary and spiritual purposes. In many instances, different government departments are responsible for different datasets and cross-departmental data sharing is complex. There is also the challenge of data that exists but is not fit for purpose. Although collected for other reporting needs, some of these data could be adapted to support the equity indicators. In such cases, additional resources and capacity building would be required to make the data useful. Consequently, data availability and quality vary between regions, and between and within catchments. Some catchments have robust systems with openly available reporting e.g., IUCMA, while others face equipment shortages, vandalism, or a complete absence of monitoring networks. These limitations directly impact the fulfilment of the Ecological Reserve and the achievement of RQOs. Even where the Reserve is formally determined and has been gazetted, many catchments lack the monitoring capacity to enforce compliance, undermining the equity objectives these policy instruments are designed to protect. This highlights the dual challenge of scale and fragmentation in assessing water equity. CMAs carry the mandate to evaluate equity at the catchment scale, while municipalities collect and manage service delivery data at the municipal level, and DWS collect and manage ecological and surface water quality data at a sub-catchment or river system scale. This creates a conflict of scale in the application of the indicators, as the data available are often misaligned with the spatial requirements of CMA assessments, or too specific in location to be applicable across an entire catchment. At the same time fragmented, inconsistent, or absent data across municipalities and other relevant government departments, catchments and even river systems, further hinders the ability of CMAs to conduct evaluations at the catchment level. Addressing both the resourcing constraints at a municipal level, and the misalignment between municipal, sub-catchment and catchment scales, is essential for equity monitoring.

Differences in geographic and contextual conditions significantly affect the applicability of the indicators (Table 7.2). A marked disparity exists between rural and urban contexts. In urban areas, proximity to infrastructure is largely inconsequential due to the prevalence of piped distribution networks and in-home flush toilets. In contrast, in rural areas, service provision varies from being completely absent, to long distances to and waiting times at communal water points, to unreliable tanker

deliveries, often supplying water every second week, and sanitation services not being maintained by the local government. Similarly, the safety of drinking water is location-dependent. Urban areas typically receive treated water through municipal supply systems, whereas rural communities are often compelled to construct their own infrastructure, purchase unsafe water from private vendors or collect water directly from water sources. This has led to community-financed, developed and managed infrastructure e.g., community boreholes and, in many cases, the establishment of private services by homeowners at their own expense, such as septic tanks and illegal water connections for water for household needs. These disparities reflect deficiencies in service delivery, which, under the mandated norms and standards (DWS, 2017), the National Water Act (RSA, 1998), and the Constitution (RSA, 1996), the government is obliged to provide equitable and safe access to water. As a result, some indicators, for example, the service delivery indicators (Table 7.2, indicators one to three), lack relevance in certain rural settings, where the prescribed service conditions do not exist.

Table 7.2 Recommended improvements for water equity indicators and associated implementation challenges

#	Indicator		Currently monitored or existing comparable measure	Legislative requirement	Improvements	Limitations
1	Quality of drinking water and the condition of sanitation services and programmes	Quality of drinking water	Yes	DWS (2017)	• Indicator needs refinement to improve clarity • Enhance the indicator's depth to better capture the complexities of water and sanitation beyond basic service provision and water quality • Consider geographical context in assessments • Assessing access to water and sanitation may provide a more meaningful and contextually relevant measure • Introduce sub-indicators or detailed metrics to improve clarity and usefulness	• Local-level data collection is often limited and variable, attributed to a lack of capacity within local government structures • No data for communal water sources • The proliferation of informal settlements, which establish their own water and sanitation systems without government oversight (illegal connections), leaves authorities unable to manage or monitor these services • "Hidden inequities" arise from varying pollution levels in drinking water, with untreated sources near mining and agriculture exposing poorer communities to greater health risks
		State of sanitation facilities	Yes	DWS (2017)		• Municipalities do not provide informal sanitation services, which are consequently not monitored • No available information on menstrual hygiene products disposal

#	Indicator		Currently monitored or existing comparable measure	Legislative requirement	Improvements	Limitations
	sanitation services	Frequency and length of interruption to water services	Yes	DWS (2017)	• The measure does not adequately reflect practical, real-world conditions • The measure does not account for variation in service provision across the catchment • Measure does not consider geographical location context e.g., tribal vs urban area	• Reliable data are only available in urban areas • The proliferation of informal settlements, which establish their own water and sanitation systems without government oversight (illegal connections), leaves authorities unable to manage or monitor these services
		Reliability of basic sanitation services	Yes	DWS (2017)	• Measure fails to capture financial inequalities arising from community-led interventions implemented to compensate for shortcomings in government service delivery	• Municipalities do not provide informal sanitation services, which are consequently not monitored
3	Physical accessibility of drinking water and sanitation facility	Proximity of the water source to the household	Yes	DWS (2017)	• Indicator needs refinement to improve clarity and effectiveness in assessing equity	• Challenges in obtaining reliable data
		Proximity of sanitation facility to the household	Yes	DWS (2017)	• The measure does not adequately reflect practical, real-world conditions and was considered an inappropriate measure	

#	Indicator		Currently monitored or existing comparable measure	Legislative requirement	Improvements	Limitations
					• The measure does not account for variation in service provision across the catchment • Introduce sub-indicators or detailed metrics to improve clarity and usefulness	
4	Water for the Ecological Reserve	The Ecological Reserve has been determined for the water resource	Yes	RSA (1998)	• Integrate both human and ecological needs (Human Basic Needs and the Ecological Reserve) • Closer alignment between RQOs and Reserve determinations • Merge the two indicators, Water for the Ecological Reserve and Protection of the Ecological Reserve (indicators 4 and 5) into a single indicator • Community-level vulnerability may be a more suitable measure than the focus on women and vulnerable groups	• Data availability is limited in regions where CMAs are not yet fully operational or established • Physical monitoring activities are constrained by both equipment shortages and vandalism • Poor data management, inadequate data coordination, and insufficient data interpretation driven by resource constraints

#	Indicator		Currently monitored or existing comparable measure	Legislative requirement	Improvements	Limitations
5	Protection of the Ecological Reserve	Resource quality objectives (RQOs)	Yes	RSA (1998)	• Focus needs broadening to improve clarity for those less familiar with the water sector • Resource Class D may be more suitable (than Class C) for a cross-catchment assessment • Assess Resource Class in conjunction with RQOs • Community-level vulnerability may be a more suitable measure than the focus on women and vulnerable groups	• Assigning one resource class to an entire catchment does not account for spatial variation across the catchment • Data availability is limited in regions where CMAs are not yet fully operational or established • Poor data management, inadequate data coordination, and insufficient data interpretation driven by resource constraints
6	Stakeholder participation	Inclusive stakeholder participation	No	No	• No improvements suggested	• While data collection systems are in place, data is not collated or analysed for monitoring purposes
7	Stakeholder representativeness	Representation in participation	No	No	• No improvements suggested	• While data collection systems are in place, data is not collated or analysed for monitoring purposes
8	Ethicality	Transparency in procedures	Yes	No	• No improvements suggested	• Well-documented and governed transparency procedures that serve as a monitoring mechanism
9	Water for cultural, spiritual and customary practices	Water quality impacts on cultural, spiritual and	No	No	• Indicator needs refinement to improve clarity and effectiveness in assessing equity	• No data on the use of water for cultural, spiritual and customary practices • While the necessary water quality and biodiversity data are available, there

#	Indicator		Currently monitored or existing comparable measure	Legislative requirement	Improvements	Limitations
		customary water uses			• Narrow scope to focus exclusively on specific water uses e.g., spiritual uses of water, or a single customary practice such as subsistence fishing • Reduce the complexity of the measure by removing reference to ecosystems, fauna and flora • Restrict assessment to the impacts of poor water quality alone	are challenges in collating data and the absence of a methodological approach for the indicator, which was perceived as difficult to postulate • Difficulties with cross-government department data access and sharing
10	Provision of water for food production	Provision of water for food subsistence production	No	No	• Improve clarity by more precise articulation	• Limited understanding of this topic • Available data are basic, uncollated, and unanalysed • Data collection is challenging in certain areas, such as tribal regions • Difficulties with cross-government department data access and sharing
11	Water for commercial and economic uses	Allocation of water for commercial and economic uses (Water Use Licensing)	No	RSA (1998)	• Improve clarity by more precise articulation	• Available data are basic, uncollated, and not analysed (WARMS database) • Difficulties with cross-government department data access and sharing

#	Indicator		Currently monitored or existing comparable measure	Legislative requirement	Improvements	Limitations
		Distribution of the impact of the use of water for commercial and economic uses i.e., pollution	No	No	- Indicator needs refinement to improve clarity and effectiveness in assessing equity - Provide a more accurate assessment of pollution impacts - Provide a clear distinction between the specific impacts of different water uses on water resources e.g., mining, agriculture, forestry and industry	- Available data is basic, uncollated, and not analysed (WARMS database) - Difficulties with cross-government department data access and sharing

The variability across geographic and contextual settings reduces the applicability of some indicators (Table 7.2). For example, safety concerns for women accessing sanitation facilities may be negligible in urban areas with widespread availability of in-home toilets but significant in rural communities reliant on communal facilities. Similarly, indicators related to cultural and customary water use may hold considerable relevance in regions with strong traditional practices, yet be predominantly inapplicable in urbanised environments. Catchments will likely encompass a range of settlement types, land uses and degrees of infrastructural functionality or absence. This emphasises the difficulty of accounting for scale when assessing water equity. Indicators must account for the varying circumstances across different localities, within and between catchments. As participants suggested, disaggregation, for example, through the use of sub-indicators may offer a way to capture local realities and enable analysis at the broader catchment scale.

Indicators assessing stakeholder participation and representativeness were generally perceived as clear and easy to interpret, and their assessment of equity was not questioned. These indicators are feasible to measure (Table 7.2, indicators four to six), as procedural attendance records and demographic information are routinely maintained for public meetings. The inclusion of demographic information, such as youth, women, and disabled individuals, in attendance registers offers potential for monitoring procedural equity. However, respondents highlight that this information is not collated or analysed, and therefore not monitored. Resource constraints may present barriers to establishing data monitoring systems for these indicators.

7.2.2 Multidimensional and contextual water inequities

The purpose of respondents assessing equity was not to evaluate water equity, but rather to test the usability and practical application of the indicators and to provide broader insights into the strengths and limitations of the indicators (*cf.* 6.3.1 Questionnaire). The exercise revealed entrenched inequities, showing that water equity is shaped by geography, human settlement type, land use, the reliability of infrastructure, and social norms, such as the customary uses of water that can be at odds with policy imperatives. This illustrates the limitations of broad, overarching indicators as they do not capture the nuanced and complex aspects of water equity at a local level.

Equity was found to vary considerably between and within catchments. Human settlement types, urban, rural, township, and tribal areas, each face distinct challenges with disparities even within the same types of communities. In some rural areas, households had access to drinking water from communal sources such as boreholes or standpipes, and sanitation services within the household yard, while others relied on distant, polluted rivers as their only water source. These disparities illustrate that water equity is intrinsically linked to geographic context, specifically the socio-economic circumstances of the region, a relationship that has been well-documented e.g., Peña (2011), De Albuquerque (2014); Wilder and Ingram (2016); Higgs et al., (2024 and 2025). This provides further evidence that water equity is

not a steady state but rather a variable, evolving result of deeply contextual factors (Wilder and Ingram, 2016; Higgs et al, 2024), and highlights the complexity of capturing the variations of equity and inequity across different geographical scales and local contexts in a monitoring tool.

The most pronounced disparities were evident in-service delivery, with infrastructure decline being a significant contributor. Aging, poorly maintained water treatment works, and bulk water distribution pipes compromise both the reliability and quality of service delivery, exacerbated by planned rotational power outages. While the resolution of service interruptions of 48 hours is the norm in wealthier urban areas, poorer areas often experience repeated failures with drinking water being provided every two to four weeks, and even when it is provided the quantity is insufficient to meet basic needs. In these circumstances, the poorest communities frequently collect water from polluted water sources, exposing them to health risks. This violates each citizen's protected constitutional right to water and health (RSA, 1996).

Sanitation services, unlike the drinking water supply, have been deprioritised. Municipalities do not service rural or school sanitation services, leaving households responsible for maintenance, typically the poorest households. There are no dedicated facilities for menstrual hygiene product disposal. These unmanaged facilities often cause groundwater contamination. Government budgetary constraints reinforce this neglect, as resources are directed towards drinking water, leaving sanitation underdeveloped. This results in inequities not just in health but also in environmental sustainability, creating long-term risks for future generations.

Beyond visible disparities lie 'hidden inequities' that are difficult to detect and address. Service delivery failures in rural areas have created a market for private entrepreneurs who resell water from unsafe sources, priced significantly higher than municipal tariffs. Households with sufficient financial means have been forced to construct their own services through illegal developments and connections. These circumstances highlight 'hidden' financial inequities. While beneficiaries of illegal connections do not pay for water, the poorest households, unable to afford such alternatives, pay inflated prices for drinking water, despite it being both a constitutional guarantee and a fundamental human right. This water is typically unsafe for consumption, carrying health consequences that disproportionately affect poor households. Furthermore, polluted water undermines food security by compromising the food derived from subsistence farming, thus linking inequity in water directly to inequity in nutrition and health. Data collection and monitoring for these 'hidden inequities' are absent, and the actual circumstances of these inequities remain unknown. This knowledge gap is particularly problematic, as it allows these 'hidden inequities' to persist unaddressed. A key limitation of the water equity indicators is that they do not capture the interconnected effects of water insecurity on nutrition, health, and livelihoods. Although this research has demonstrated the interrelationship of pillars and dimensions of water equity, and the

knock-on effect of failing to uphold each pillar (Higgs et al., 2024), translating this multidimensional reality into a monitoring tool remains a significant challenge.

Inequities and ‘hidden inequities’ are evident in the failure to attain or monitor RQOs, and weak enforcement of water use licence conditions. Pollution from untreated sewage, mining effluent, and agricultural and industrial waste compromises access to, and the use of, safe water and undermines the Ecological Reserve. The malfunctioning of wastewater treatment plants is a significant contributor to the deterioration of surface water across catchments. Communities depending directly on rivers for drinking or irrigation are exposed to polluted water sources through drinking, or accumulation of toxins in their food through subsistence farming using polluted water for irrigation and suffering significant mental and physical health impacts. Furthermore, the impacts of polluted water on cultural, spiritual, and customary practices are unknown highlighting another ‘hidden inequity’ where neither law nor data provides sufficient protection. Efforts to establish a monitoring framework are impeded by the difficulty of illuminating and quantifying these ‘hidden’ inequities.

In South Africa, water is central to household, cultural, spiritual, and customary practices in rural and tribal areas. However, declining water quality impedes these uses, posing risks particularly to women and children who interact most frequently with water sources for daily needs. Declining water quality compromises human health, threatens cultural connection, and disadvantages intergenerational equity. In rural and tribal areas, subsistence farming is widely practiced but is not consistently supported. In certain catchments, historical investments and government grants (often directed toward women-led households or school-based food gardens) provide adequate access to water. However, the role of water in sustaining agriculture at the household level is poorly understood and is not monitored. A limitation of the indicators is identifying and selecting appropriate, measurable parameters in the absence of data, limited data, or a lack of understanding of the local context. This poses a challenge in ensuring that the indicators reflect the local situation and are relevant.

While women and vulnerable groups are emphasised in global water discourses (UN-Water, 2015), this research identifies an overlooked layer of vulnerability in the South African context, that of entire communities, and young unemployed men. Water scarcity, pollution, and service disruptions undermine dignity and health at a community level, leading to inequities that extend to a general account of marginalised people. While the inclusion of women, future generations, and other vulnerable groups in the indicators was viewed positively by respondents, the lack of discrepancy between individual and community vulnerabilities was perceived as a limitation of the indicators. This finding further supports the limitation of generalised or overarching indicators, which fail to capture the nuanced and complex nature of water equity.

Access to water for commercial agriculture and commercial purposes remains in the hands of historically advantaged, White-owned businesses and farms. While reform mechanisms and policies

exist to address these inequities, progress is slow, and imbalances persist. Policies such as Broad-Based Black Economic Empowerment (BEE) exist, but the implementation of measurable outcomes remains limited. The result is that equity goals for livelihoods and economic activity lag behind progress in procedural equity.

Catchments demonstrate advancements in procedural equity, with broad stakeholder engagement, inclusivity of women, and recognition of persons with disabilities in decision-making processes. However, youth participation, despite targeted initiatives, remains weak. Moreover, the legacy of apartheid continues to shape representation, with irrigation boards and water user associations disproportionately dominated by White males. Even where race and socio-economic factors are equalised, women often lack sufficient voice or decision-making power, and youth are typically not active participants. This demonstrates that power in decision-making remains inequitable.

7.3 Conclusion

Inequities in service provision, the protection of water resources and the commercial and customary uses of water are stark and persistent. Challenges such as the proliferation of unregulated water and sanitation solutions, unreliable infrastructure, and pollution are proliferating “hidden inequities” that disproportionately affect vulnerable and poorer populations. Water inequities in South Africa, although embedded in policy, are not being realised, are profoundly contextual and shaped by geography, settlement type, infrastructure quality, and social dynamics. They are multidimensional, interlinked and dependent on local circumstances.

The water equity indicators demonstrate strengths in clarity, application, and legitimacy, suggesting that indicators are a suitable and viable monitoring tool for water equity in South Africa. However, their practical application is limited by a range of considerations from completely lacking to fragmented data, limited administrative capacity and cross-coordination of data, and the complex realities of rural and informal areas where water services are often improvised or illegal. Service delivery indicators were aligned with water laws for convenient reporting but held limited practical value, as government failures in service delivery and the rise of community, and household-level solutions fell outside the scope of official policy. In their current form, most indicators, apart from those addressing procedural equity, risk oversimplification and require refinement to enhance clarity, strengthen their ability to assess equity and better reflect local realities, and are better able to capture social, environmental, and geographic variations. These limitations reveal the challenges of translating the nuanced and multidimensional nature of water equity into a monitoring tool. Recommendations included integrating detailed sub-indicators as a possible way to improve local and catchment scale assessments. However, for indicators where knowledge is limited and data are lacking, the development of a monitoring tool is constrained, as ‘hidden inequities’ remain concealed and therefore cannot be reliably quantified.

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CHAPTER 8. Synthesis

8.1 Introduction

The purpose of this research was to advance both the theoretical understanding and applied implementation of equality and equity in South Africa's water resource management. This was achieved by reviewing the definition and application of these concepts in water governance, management, and allocation, resulting in a working definition of “water equity” (*cf.* Chapter 2; Figure 8.1). For this research, South Africa was an ideal context for a theoretical assessment of water equity, demonstrating the complex interactions and interlinkages among the pillars of water equity (*cf.* Chapter 3, Figure 3.1, Figure 3.2, and Figure 3.3). The research explored national approaches to monitoring policy objectives and found that indicators are a suitable tool for assessing water equity in South Africa (*cf.* Chapter 4). A set of eleven water equity indicators was developed (*cf.* Chapter 5; Table 7.1) and applied to test their effectiveness (*cf.* Chapters 6 and 7). This chapter synthesises the research's findings, assesses the extent to which its objectives have been achieved, and offers key conclusions. It makes suggestions, considers the importance and relevance of the research, and suggests lines of inquiry for further investigation.

8.2 Review equity and equality with respect to their application in water resources management

This objective was addressed in Chapter 2 and culminated in a peer-reviewed academic paper (Higgs et al., 2024). The research developed a working definition of what it terms “water equity” (Figure 8.1). The definition is distinctive in proposing that human rights, social justice, and context are interconnected foundations for achieving equity and equality in water resource management, and by establishing a definition that is universally applicable across diverse scales and settings (*cf.* 2.7.1 Water equity defined). The proposed definition identifies human rights, distributive equity, procedural equity, and context as the pillars of water equity (*cf.* Figure 2.6). It suggests that water equity is achieved through distributive and procedural justice, prioritising human rights and adapting to local contexts. As an ongoing, iterative process, it continually seeks to advance equitable outcomes.

Whilst the water management discourse has predominantly focused on human rights and, to a lesser extent, social justice, and often in isolation from each other, the research's theorisation of water equity is distinguished in that it explores these foundations in unison and how they interact to promote equality and equity (*cf.* Figure 2.7). Water equity requires the integration of human rights and social justice, underpinned by both distributive and procedural dimensions. Human rights and social justice must not be operationalised in isolation, as equal outcomes are not inherently equitable, and equity without equal recognition of rights undermines the very intent of equity.

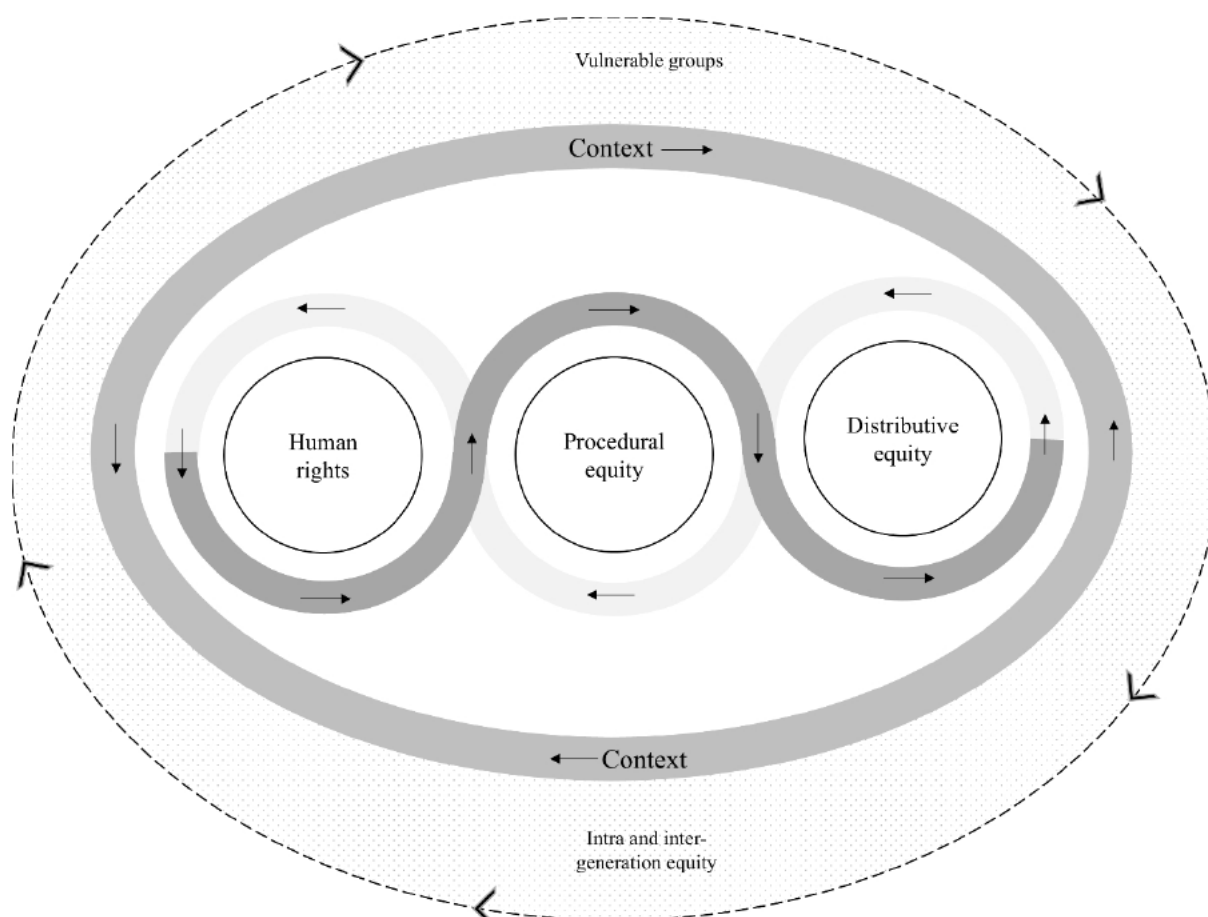


Figure 8.1 Water equity is realised through procedural and distributive equity (social justice), prioritises human rights, and is contingent on context. It is an ongoing and iterative process that aims to continually move towards equitable outcomes (Higgs et al., 2025; 2745).

South Africa was identified as an ideal case to theoretically examine water equity, as equity is embedded in the country's water policy. The South African case exemplifies the relationship between human rights and social justice, and demonstrates that both dimensions must be upheld for water equity to be realised (Chapter 3). This component of the research culminated in a second peer-reviewed publication (Higgs et al., 2025), which, to the researcher's knowledge, is the first to theoretically demonstrate how the pillars of water equity are interconnected and to reconcile these two approaches in a monitoring framework (Chapters 6 and 7). The South African case revealed that a failure to uphold any single pillar triggers cascading effects on the others, ultimately perpetuating inequalities and inequities in water management and allocation (Higgs et al., 2025). This was attributed to failure, on the part of the South African government, to operationalise each of the pillars of water equity (human rights, procedural and distributive equity). Indeed, by applying the water equity indicators across three South African catchments (Chapters 6 and 7), this research revealed that South Africa suffers from enduring and complex inequities in service delivery, resource protection, and water uses. Unregulated solutions, inadequate drinking water and sanitation facilities, and pollution cause hidden inequities that

disproportionately impact vulnerable populations. These multidimensional and context-dependent water inequities are entrenched in policy but not fully realised in practice (*cf* 8.5 The practicality and validity of the water equity indicators).

8.2.1 Significance of the findings

The research represents the first scholarly attempt to unambiguously define “water equity” and distinguishes water equity from equality and the human rights-based approach (which is typically associated with drinking water and service delivery) within the field of water resources management. It provides a definition that can be applied to any context and at any scale. It offers a framework that represents a novel contribution to the field by designating human rights, procedural equity, distributive equity, and context as its four pillars. This enables the concept to be operationalised, and applied in practice, moving water equity beyond an idealistic and abstract notion. The South African case provides a theoretical demonstration of how these four pillars intertwine, demonstrating that neglecting or weakening one pillar undermines the others. This insight on the “knock-on effects” of the pillars is an original contribution to water governance theory. It provides a foundation for operationalisation by identifying parameters for how water equity could be monitored, in particular in contexts where equity is a policy imperative, such as South Africa.

8.2.2 Recommendations

The theoretical definition of water equity advanced by this research establishes a foundation for embedding water equity into both academic discourse and management practice. It is recommended that future research build upon the recognition that water equity constitutes a dynamic concept upheld by four interconnected pillars: human rights, distributive equity, procedural equity, and context, and that all four pillars, rather than human rights in isolation, are necessary to advance water equity (*cf.* Figure 2.6).

While the South African context has provided a compelling case for the interconnectedness of the four pillars, future research should be conducted in other jurisdictions where equity is central to water policy. Comparative studies in other national and regional settings will yield deeper insights, elucidating the universality of the definition. Such lines of inquiry will not only test the theoretical construct outside South Africa but will also enrich the evolution of water equity as a practically actionable concept for global water resources management.

8.3 A methodology for assessing water equity

This objective was achieved in Chapter 3. The literature review revealed that the South African government employs a structured monitoring and evaluation procedure, with indicators serving as the principal tools for monitoring progress against legal mandates and policy commitments, including those related to water. The Department of Water and Sanitation, for example, develops, monitors, and reports

on indicator-based performance in annual reports and financial planning. South African authorities have expertise in the use of indicators for monitoring and evaluation in the water sector.

Further supporting the use of indicators as effective monitoring tools is that they are widely adopted across the field of water governance and management, and the human rights-based approach. Indicators have demonstrated effectiveness in operationalising both water governance principles and human rights frameworks, serving as critical tools for assessing water management in diverse contexts.

8.4 Indicators for the evaluation of water equity in water resource allocation

In identifying the pillars of water equity; human rights, distributive equity, procedural equity, and context (*cf.* Figure 2.6) the research offers a distinctive perspective by disaggregating the pillars of water equity into dimensions that served as the foundation for developing measurable indicators (*cf.* Figure 2.1, Figure 2.2, Figure 2.3, Figure 2.4, and Appendix 2). Building on this foundation, the research applied the Delphi Method and synthesised expert consensus with policy imperatives to identify a set of eleven water equity indicators (*cf.* Chapters 3 and 4). This approach not only translated a complex and theoretical concept into measurable indicators but also established a replicable methodology with broader applicability. The method can be adapted by other regions, institutions, or catchments to develop locally relevant indicators of water equity. The outcome, therefore, was twofold: a set of eleven water equity indicators and a novel methodology for developing water equity indicators across diverse contexts.

8.4.1 Significance of the findings

This research advances the field by operationalising the concept of water equity, transforming it from a theoretical concept into a practical and measurable framework suitable for monitoring and evaluation. It introduces the first actionable system for implementing water equity in assessment, monitoring, and reporting. While the Human Rights-Based Approach (HRBA) has been operationalised, this research is distinctive in embedding both HRBA and social justice within the same framework, an advancement that has not been realised before. This represents a pioneering step for equity within water resources management.

In terms of methodology, it demonstrates that the Delphi Method provides a repeatable strategy for creating contextually relevant indicators that can be modified for use outside of South Africa when synthesised with legislative and policy requirements. The findings provide policymakers with tools to incorporate water equity into reporting, planning, and accountability mechanisms by demonstrating how water equity can be incorporated into current monitoring and evaluation frameworks. By carrying this out, the research improves governance systems' ability to transform equity from a concept to a practical reality. This represents a significant advancement for the water sector, a domain that has long prioritised equity in the governance, management, and allocation of water resources, yet has historically lacked tools and frameworks to effectively describe or measure the concept. By introducing a

measurable approach, this research fills a critical gap and provides practical means for stakeholders to assess, monitor, and advance water equity.

8.4.2 Recommendations

By translating water equity from a theoretical concept into a measurable framework, this research establishes a foundation for further scholarly research into the operationalisation of water equity. The methodology adopted by this research should be tested across diverse settings and evaluated for effectiveness in developing context-specific water equity indicators. Comparative studies in different countries and regions are essential to determine the universality and adjustability of the definition and the methodology presented in this research, and will guide future methodological refinements.

8.5 The practicality and validity of the water equity indicators

This objective was achieved in Chapters 6 and 7 by applying the water equity indicators to three South African catchments, where their effectiveness and practical application were tested. While indicators were considered a suitable tool for monitoring water equity, important challenges were identified. Issues of scale emerged, as equity concerns varied across geographical and socio-economic contexts. While the indicators align with legal mandates, they do not fully capture the complex realities on the ground, resulting in some becoming irrelevant or inapplicable in certain contexts. In addition, it is necessary to strengthen the connection between each indicator and its practical implications for equity, to ensure authorities fully understand their relevance. Ageing infrastructure, fragmented or limited data, constrained resources, and insufficient coordination among government departments, further limit the practical application of the indicators. The difficulty of exposing and quantifying ‘hidden’ inequities further hindered the applicability of the indicators. While the indicators represent a first step, refinement and consolidation are required to better capture real-world circumstances.

This research employed a systematic approach, from establishing a definition of water equity through literature review (Chapter 2), to employing the Delphi Method for expert consensus and legislative synthesis, ultimately deriving eleven water equity indicators (Chapters 4 and 5). Applying the indicators across three catchments served as the test of the methodology, demonstrating its effectiveness both in refining an exhaustive list of equity dimensions and aligning priorities with legislative frameworks (Chapters 6 and 7). The case studies revealed the challenges of regional variability and scale, highlighting the complexity of operationalising and measuring water equity across diverse settings. This demonstrates the importance of contextual research in identifying discrepancies between legislative requirements and practical implementation (Seigerman et al., 2022). For example, despite South Africa’s laws mandating water access within 200 metres of households (DWS, 2017), local realities expose failures in service delivery and varied community responses to these shortcomings. These findings suggest that the methodological approach was effective, the obstacles to realising water equity reside in governance and implementation challenges, which may be particularly pronounced within the

South African context, a country distinguished by progressive water laws but persistent service delivery failures and inequities (Hutete and Sibanda, 2022).

The case studies highlighted challenges related to variability and scale, reaffirming Ingram et al (2008)'s assertion that no single solution is universally applicable to water equity. This complexity is the result of the intersections between measures of water equity (the eleven indicators) and the varied socio-economic, geographies, resource conditions, land use, and settlement types within and between catchments. These concerns are therefore not unique to South Africa; rather, they are likely to be both inherent and widespread in water equity evaluations across diverse settings e.g., Osman and Faust (2021); Gerlak et al., (2022); Seigermann et al, (2022). While this research does not resolve the complexity and difficulties in operationalising water equity measures, it meaningfully advances the scholarly discourse on the complexity of operationalising and monitoring water equity. It provides a practical illustration of these challenges at a national level and offers tangible evidence of their complexity. The findings highlight the importance of developing and applying context-specific indicators to better capture the diverse realities of water equity across different settings.

While the indicators were developed within the South African context, the methodology represents the first attempt to operationalise water equity at a national scale. Both the definition and the method are intended to be universal, allowing application in any context and scale. The methodology provides a pathway for adaptation in other geographic settings. This research highlights the need for each country or context in which they are being applied, to start from first principles and explore each dimension of water equity (*cf.* Chapter 4; Appendix 2), since applicability is context-dependent and cannot be known *a priori*. In this sense, the methodology does not offer a fixed template, but rather a flexible set of water equity dimensions that can be adapted to diverse hydrological, institutional, and socio-cultural contexts, thereby extending its application beyond South Africa (Chapter 4).

While this research draws on evidence from three distinct catchments, selected for their contrasting levels of institutional maturity and diversity of geographical and socio-economic contexts, the limited sample size increases the possibility of bias and may limit the representativeness of the findings (Yin, 2017). The small sample size can provide meaningful insights; however, it risks that results may not adequately capture the diversity of experiences and perspectives across South Africa.

8.5.1 Significance of the findings

The application of water equity indicators across differing geographical and socio-economic settings demonstrates the potential and limitations of operationalising water equity. It reveals the difficulties in uncovering layers of interconnected, yet hidden inequities, and accounting for them in a monitoring system, while illustrating how persistent inequities are generated and perpetuated, suggesting that they are not solely the result of policy failures but reflect a web of socio-economic, cultural, and infrastructure-related factors. The findings bridge the gap between a theoretical concept, water equity,

and the practical difficulties of real-world monitoring. They provide insights into how indicator-based frameworks can be adapted to better capture multi-dimensional and hidden inequities. The research provides a foundation for future innovations in water equity research and practice.

8.5.2 Recommendations

The indicators themselves require refinement to better reflect the diverse realities across different geographical and socio-economic contexts in South Africa, and to address the unique challenges of various settlement types, ensuring their relevance to local circumstances. The connection between the indicator and how it supports equitable outcomes requires clarity.

As data and resource constraints are the most significant limiting factors, it is recommended that the South African authorities invest in improving data collection systems and improving coordination amongst government departments for the collection and management of reliable data. Authorities ought to consider promoting integrative data sharing platforms so that catchment managers, municipalities, and national bodies can access the same set of quality data for decision-making. Consideration should be given to investment in human resources and the provision of training to build technical capacity for implementing and applying the water equity framework, and ensuring that the indicators are used effectively at the local level.

8.6 Areas of future research

This research lays the foundation for a future inquiry within South Africa, focusing on:

- Increasing the number of case studies to enhance representativeness and prevent potential bias in the findings.
- Examining the gap between policy objectives and the realities on the ground in South Africa, evaluating the extent to which water policies do not align with realities on the ground, especially in-service delivery and the use of water for customary purses and livelihood and subsistence farming.
- Further research is required to understand how water equity indicators can be scaled and tailored to varied geographical and socioeconomic settings.
- Further research to investigate how the nuanced dimensions and complexities of water equity can be captured and integrated into monitoring tools.
- While this research revealed a range of ‘hidden’ inequities. Further research is needed to identify both the extent and impact of these ‘hidden inequities. Research should explore how ‘hidden inequities’ interact, and whether they are reinforcing or undermining each other. Importantly, further inquiry is needed to determine how to include these inequities, and their interrelatedness into a monitoring tool.

- Research into the factors resulting in limited participation by youth and women in water management decision-making, and water for commercial purposes, specifically agriculture, is critical. Despite targeted initiatives, these populations continue to be excluded, and inequities in decision-making and water for commercial uses persist. Exploring both institutional and societal factors hindering effective engagement will be essential for advancing water equity in South Africa.

By moving water equity from an abstract notion to a defined and measurable, actionable framework, this research equips policymakers, practitioners, and scholars with the tools and practical methodologies required to identify, address, and redress water inequities in South Africa. In so doing, it closes a critical gap in the water governance discourse by making water equity both measurable and actionable, laying the foundation for more equitable, inclusive, and actionable water resources management, offering a distinctive contribution to both academic scholarship and policy practice.

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APPENDICES

Appendix 1 Ethics approval



14 February 2021

Mrs Carla Jane Higgs (962079479)
School Of Agri Earth & Env Sc
Pietermaritzburg Campus

Dear Mrs Higgs,

Protocol reference number: HSSREC/00002341/2021

Project title: Developing an equity and equality assessment method for water resources allocation in South Africa
Degree: PhD

Approval Notification – Expedited Application

This letter serves to notify you that your application received on 25 January 2021 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted **FULL APPROVAL**.

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number. **PLEASE NOTE:** Research data should be securely stored in the discipline/department for a period of 5 years.

This approval is valid until 14 February 2022.

To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

All research conducted during the COVID-19 period must adhere to the national and UKZN guidelines.

HSSREC is registered with the South African National Research Ethics Council (REC-040414-040).

Yours sincerely,



Professor Dipane Hlalele (Chair)

/dd

Humanities and Social Sciences Research Ethics Committee

Postal Address: Private Bag X54001, Durban, 4000, South Africa

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Founding Campuses: Edgewood Howard College Medical School Pietermaritzburg Westville

INSPIRING GREATNESS

09 September 2024

Carla Jane Higgs (962079479)
School of Agri Earth & Env Sc
Pietermaritzburg Campus

Dear CJ Higgs,

Protocol reference number: HSSREC/00002341/2021

Project title: Developing an equity and equality assessment method for water resources allocation in South Africa

Approval Notification – Recertification Application

Your request for Recertification dated 04 September 2024 was received.

This letter confirms that you have been granted Recertification Approval for a period of one year from the date of this letter. This approval is based strictly on the research protocol submitted and approved in 2021.

Any alterations to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study must be reviewed and approved through the amendment/modification prior to its implementation. Please quote the above reference number for all queries relating to this study.

PLEASE NOTE: Research data should be securely stored in the school/department for a period of 5 years

Incidents of adverse events and serious adverse events (AEs and SAEs) should be reported in writing to HSSREC, the study sponsors, and any regulatory authority (where appropriate), within 7 working days of the occurrence for local sites and 14 days for all other South African sites.

This approval is valid for one year: 09 September 2025.

To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

HSSREC is registered with the South African National Research Ethics Council (REC-040414-040).

Yours sincerely,



Professor Dipane Hlalele (Chair) /nng

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Appendix 2 Delphi Questionnaire One

Water Equity Questionnaire

Introduction

Equality and equity in water resources management

In water resources management, equality is linked to equity and the two terms are often used interchangeably (UN-Water, 2015). Equality, in the water sector, typically adopts a human rights-based approach. The 2010 United Nations (UN) General Assembly formally recognised the human right to water and sanitation, acknowledging that clean drinking water and sanitation are essential to the realisation of all human rights (De Albuquerque, 2014a).

The UN offer a definition in this regard; “*The legally binding obligation for ensure that everyone can enjoy her or his rights equally*” (De Albuquerque, 2014b: 19). Whereas they define equity as “*The moral imperative to dismantle unjust differences based on the principle of fairness and justice*” (De Albuquerque, 2014b; 19). Another, yet simple distinction between the two terms, is that while the human rights-based approach is associated with equality (De Albuquerque, 2014b), equity is primarily about social justice (Peña, 2011).

While the human rights-based approach is well covered in the literature and in practice, equity (or the social justice approach) in water resources management has received little attention. Water equity is a procedural and a distributive concept (Mirza and Mustafa, 2016). Equity in water management and allocation also implies that water for basic needs must be prioritised (Mirza and Mustafa, 2016). Ecological integrity underpins basics rights and therefore must be upheld and respected (Kallhoff, 2014). Furthermore, water equity is anchored in the local situation (or context).

This questionnaire explores these, and other elements of water equity, with the intention of disentangling the concept. It is envisaged that once disentangled, these elements can be converted into water equity criteria and indicators that will aid in the implementation, progress and monitoring of equity in water resources management. Thank you for your time and expertise in helping reach this goal.

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Water Equity Questionnaire

Equity criteria

- This is a list of elements, derived from the literature, that could potentially be used to generate human rights and social justice (equity) criteria.

Element	Rank in order of importance where 1 = most important, leave cell blank to omit	Comments
Human rights (basic human / ecological / species needs, cultural elements and future generations)		
Procedural equity (equal say in water management decision-making and water allocation)		
Distributional equity (equity in the distribution of water e.g. access to water for basic needs, for productive purposes, and benefits and burdens sharing)		
Context (in relation to local cultural, socioeconomic, and political elements)		
Other: would you include other elements here? If so, please specify and justify your answer		
Other		
Other		

Self rating	Please rank: 1 = not competent 2 = slightly competent 3 = moderately competent 4 = competent 5 = extremely competent	Explain / justify your answer
Please rate your perceived competence to answer the above questions i.e. are you confident that these questions are within your area or expertise?		

Area of expertise	Please mark with an X (you can choose more than one)	Explain / justify your answer
Please select from the list below your area of expertise:		
Environmental justice		
Human rights law		
Integrated Water Resources Management		
Water policy / law		
Philosophy		
Social justice		
Social psychological		
Water ethics		
Water governance		
Water justice		
Other (please specify)...		

End		
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Water Equity Questionnaire

Human rights elements

- This is a list of elements, derived from the literature, that could potentially be used to generate human rights and social justice (equity) indicators.

Element	Rank in order of importance where 1 = most important, leave cell blank to omit	Comments
1 BASIC NEEDS		
SDG 6.1 Achieve safe and affordable drinking water (by 2030, achieve universal and equitable access to safe and affordable drinking water for all)		
SDG 6.2 Achieve access to sanitation and hygiene and end open defecation ("by 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations")		
Availability. Water for personal and domestic uses, and sanitation facilities		
Accessibility. Physically accessible and secure water and sanitation infrastructure in the immediate vicinity		
Acceptability. Basic services must meet local social or cultural standards		
Affordability. Ability to pay for water and sanitation services		
Quality. Safe for human consumption and protection of health and safety during use of facilities		
Disparity in access to services between worst-off and better-off population groups; rate of progress towards 100% access		
Monitoring of water resources management plans and the implementation thereof		
Time, distance, and accessibility for those who face physical barriers, within and outside the home		
Level of use of water and sanitation services e.g. Access in public spaces, at schools, at public health facilities		
Income levels in relation to access to water and sanitation costs		
Achievement and communication of water quality and sanitation standards		
Monitoring of budgets, water resources management plans, accessibility, quality and affordability		
2 OTHER HUMAN RIGHTS		
Water for indigenous peoples. Please specify who you understand 'indigenous peoples' to be.		
Water for food production at a household or community level		
Water for livelihoods		
Water for cultural and religious purposes		
Water for customary uses e.g. fishing, bathing, cattle grazing, hunting		
Water for production at a level of community/national economy e.g. water for food security and productive purposes		
The elimination of discrimination against women and other vulnerable groups in access to water and water management at all levels e.g. household level, decision-making level		

2 ECOLOGICAL NEEDS		
SDG 6.3 Improve water quality, wastewater and safe reuse ("by 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally")		
Indicator 6.3.1: Proportion of wastewater safely treated		
Indicator 6.3.2: Proportion of bodies of water with good ambient water quality		
Target 6.4: Increase water-use efficiency and ensure freshwater supplies		
Indicator 6.4.1: Change in water-use efficiency over time		
Indicator 6.4.2: Level of water stress: freshwater withdrawal as a proportion of available freshwater resources		
SDG 6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes (Protect and restore water-related ecosystems)		
Indicator 6.6.1: Change in the extent of water-related ecosystems over time		
Ecological integrity: Water management to support a healthy human environment e.g. environmental water demand, measures of discharge, water quality, habitat integrity and biotic integrity		
Water for the environment: for biodiversity as well as livelihoods based on environmental resources		
Water for the needs of nonhumans, including plants, animals, places, and habitats		
Water for the needs of future generations		
The impact of socio-environmental processes such as climate change on water for basic needs, ecological integrity and future needs (as these processes impact on water quality, quantity, and future generations)		
4 OTHER		
Other.....		
Other.....		
Other.....		

Self rating	Please rank: 1 = not competent 2 = slightly competent 3 = moderately competent 4 = competent 5 = extremely competent	Explain / justify your answer
Please rate your perceived competence to answer the above questions i.e. are you confident that these questions are within your area of expertise?		
End		

Water Equity Questionnaire

Procedural equity elements

- This is a list of elements, derived from the literature, that could potentially be used to generate human rights and social justice (equity) indicators.

Element	Rank in order of importance where 1 = most important, leave cell blank to omit	Comments
1 PROCEDURAL EQUITY		
SDG6b. Support and strengthen the participation of local communities in improving water and sanitation management (Support stakeholder participation)		
Institutional systems: Institutional systems that promote equity		
Institutional systems: Training in Institutional systems to level the playing field		
Institutional systems: Institutional systems that regulate access to benefits from water management		
Communication: Must be clear and uncomplicated to encourage participation		
Communication: Accessible and diverse to reach all those affected (multi-media and language)		
Communication: Technical and specialised knowledge provided in a manner that is accessible to all (training may be necessary for some)		
Accuracy: Information must be accurate (correct and considered legitimate by all parties)		
Participation: Must be open to broad participation of all affected parties, including through such mechanisms as networks, voluntary associations, and public/private partnerships		
Participation: Ability to participate, express opinions and raise issues (all have the same opportunity to participate)		
Participation: Activities that are easy to participate in		
Participation: Capacity building to overcome knowledge asymmetries		
Representativeness: Representativeness of all affected persons / parties (road and inclusive participation of stakeholders including all affected parties across the entire spectrum of water users and across scales)		
Representativeness: Representativeness in collective agency (to overcome power inequities)		
Representativeness: Women and other vulnerable groups enabled to participate		
Voice: Being heard and having influence (traditional knowledge, local knowledge and technical knowledge must be considered and respected)		
Voice: All treated with dignity and respect		
Non-discrimination: Recognition of women (and other vulnerable groups e.g. persons with disabilities)		
Impartiality: Impartial and creditable authorities/decision-makers (to prevent bias, which would be inequitable)		
Consistency: Consensus on, and consistent upholding of the rules		
Ethicality: Anti-corruption and transparency (an openness in procedures, information, potential sources of conflict)		
Error correctability: Appeal mechanisms		
Conflict: Mechanisms for conflict management		

2 INTERACTIVE JUSTICE		
Interactive judgment: People treated appropriately		
Trust: Trust between the authorities and other participants)		
Dignity: People treated with dignity		
Respect: People must be treated with respect, including respect for cultural differences		
3 SOCIAL LEARNING		
Knowledge-sharing and learning: Mechanisms in place for knowledge sharing and learning		
Continuous learning: Mechanisms in place for continuous learning and improvement		
4 OTHER		
Other.....		
Other.....		
Other.....		

Self rating	Please rank: 1 = not competent 2 = slightly competent 3 = moderately competent 4 = competent 5 = extremely competent	Explain / justify your answer
Please rate your perceived competence to answer the above questions i.e. are you confident that these questions are within your area of expertise?		
End		

Water Equity Questionnaire

Distributive equity elements

- This is a list of elements, derived from the literature, that could potentially be used to generate human rights and social justice (equity) indicators.

Element	Rank in order of importance where 1 = most important, leave cell blank to omit	Comments
1 WATER USES AND USERS / BENEFITS (VALUE) AND BENEFICIARIES		
DIRECT (benefit directly from water use)		
Achieve a full understanding the full array (social and economic) of direct water users and uses (quantitatively and qualitatively e.g. quantity per sector, per capita, intensity of use):		
Productive purposes: water used for productive purposes and beneficiaries thereof e.g. irrigation, industry, hydroelectric energy, mining, tourism		
Public goods: Universal access e.g. Recreation, ecosystem services, transport		
Social benefits: Water contribution to society e.g. water for food security		
Social benefits: Cultural, symbolic and religious uses		
Social benefits: The aesthetic of water / natural beauty		
Social goals: Water's contribution to social goals e.g. SDGs		
Benefit from externalities: Those that benefit from impacts of externalities in water resource management e.g. users of return flows generated from irrigation		
State services: Drinking water and sanitation e.g. at a household level		
State services: Services that are funded by resources obtained from water-related economic activity e.g. water taxes used to fund water for basic needs		
Other: e.g. educational, scientific		
INDIRECT		
Achieve a full understanding OF the full array of indirect water users and uses (quantitatively and qualitatively e.g. per sector, per capita, intensity of use):		
Productive purposes: Participation in water related productive process (employment, payments, productive chains with other sectors)		
Environmental benefits: e.g. biodiversity sustained by water		
Future use: Water allocated for future needs or projects		
Future use: Water allocated for future generations		
2 BURDENS / COSTS		
Achieve a full understanding OF the full array of burdens, costs and risks that result from water use:		
All affected by the impacts of water use e.g. return flows, pollution		
Cost sharing: Distribution of the cost of making water available to users, and the amount the users pay (the cost of water infrastructure, its operation and maintenance, and how users are charged based on for example quantity used, or quality requirements		
Financing in water management e.g. polluter's pay, ability to pay		
Broader issues that impact on water management e.g. climate change, population growth		

3 RESPONSIBILITIES		
Responsibilities: The distribution of responsibilities in water management e.g. responsibility for water infrastructure and for water management at different management levels and among different water management agencies		
Accountability: Mechanisms to ensure that public and private actors fulfil their duties and responsibilities		
4 OTHER		
Water rights: Individuals and entities who have legal rights to access water, often linked to property rights		
Water impacts many different levels: Local, regional, national, or even international. It is important to consider the issue of benefit and cost distribution within geographic space (e.g. upstream-downstream distribution of benefits and costs)		
Gender and other vulnerable groups: The issues of gender equity and the role of women in water management, and other vulnerable groups must be considered		
Distribution history: Assessing equity in the distribution of socio-economic impacts involves both positive and negative effects of water allocation and use, and encompasses both tangible and intangible aspects, either in the short or long run.		
Justice philosophies used in the determination of water allocation e.g. virtue theory, prior rights, property rights, etc.		
Mechanisms to overcome competing uses		
4 OTHER		
Other.....		
Other.....		
Other.....		

Self rating	Please rank: 1 = not competent 2 = slightly competent 3 = moderately competent 4 = competent 5 = extremely competent	Explain / justify your answer
Please rate your perceived competence to answer the above questions i.e. are you confident that these questions are within your area of expertise?		
End		

Water Equity Questionnaire

Context (cultural, socioeconomic, and political elements) elements

- This is a list of elements, derived from the literature, that could potentially be used to generate human rights and social justice (equity) indicators.

Element	Rank in order of importance where 1 = most important, leave cell blank to omit	Comments
1 CULTURAL		
The symbolic, religious, and lifestyle uses and meanings of water (recognition of these uses)		
Customary uses of water. Please explain what you understand 'customary uses' of water to be.		
Customary governance of water		
2 TIME		
Historical: Historical processes, negative impacts and effects, past pledges and past inequities		
Future: Preservation of future access to water and future water management decisions must not be hindered by present day management		
3 SOCIAL		
Values, attitudes and perceptions among users (particularly in relation to equity and fairness)		
The role of gender in water management, ethnicity and economic status or class		
4 ECONOMIC		
Free basic allowance: The groups of people that benefit, means of access and the quantity of water		
Water (and sanitation) charges / tariffs: How persons and institutions are charged for water, cost as a proportion of household expenditure		
Water taxes, subsidies, etc: How persons and institutions are taxed, and how (and where) those taxes are distributed		
Water costs: Who bears the cost of providing water and water services; infrastructure investment, operation maintenance, maintaining water quality, etc		
Efficient (and transparent) use of financial resources		
Mechanisms to overcome economic power imbalances		

5 POLITICAL/GOVERNANCE		
Water policies, political goals and legal frameworks (past and present) that support and progress equity goals and outcomes		
Policy that guarantees procedural equity		
Basic human, ecological and customary water prioritised in water policy		
Environmental concerns integrated into water legislation		
Recognition of, and respect for customary law in water management		
Non-discrimination promoted in water policy e.g. women and other vulnerable groups		
Mechanisms to overcome political power imbalances		
Regulation of benefits and burdens of available water resources		
Other, water related policies and institutions examined for their impact on equity goals e.g. economic and social regulation		
Transparent, competitive and accessible acquisition and use of services providers (public and private)		
4 OTHER		
Other.....		
Other.....		
Other.....		

Self rating	Please rank: 1 = not competent 2 = slightly competent 3 = moderately competent 4 = competent 5 = extremely competent	Explain / justify your answer
Please rate your perceived competence to answer the above questions i.e. are you confident that these questions are within your area of expertise?		
End		

Appendix 3 Delphi Questionnaire Two

The pillars of water equity

Round 1 of the Delphi process found that this expert panel agree that these are the pillars of equality and equity (i.e., the human rights based and social justice approaches) in water resource management:

- Human rights (basic human and ecological needs)
- Procedural equity (equal say in water management decision-making)
- Distributional equity (equity in the distribution of water)
- Context (cultural, socioeconomic, and political elements)

Do you agree?

* must provide value

Yes

No

reset

If not, please explain

Our review of the literature found that, in practice, the human rights-based, and social justice approaches have been considered, implemented and monitored independently in water resource management.

Should they continue to be operationalised independently?

Or are they intrinsically interlinked and should they be operationalised in a single cohesive framework?

* must provide value

The human rights-based and social justice approaches should be operationalised independently

The human rights-based and social justice approaches are they intrinsically interlinked and should be operationalised in a single cohesive framework?

reset

Comment (only if you wish to comment)

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Save & Return Later

Human Rights Elements

- Below is a list of elements, selected by this expert panel (previous questionnaire), that could potentially be used to generate human rights indicators.
- Please choose 'yes' if you agree and 'no' if you do not agree that each element should be included or excluded.
- Please note that at this point in the process (round 2), we are only interested in elements that you think should be used to develop indicators (which will be developed in subsequent rounds).

Human Rights Elements [water for basic human needs]

	Yes	No	
SDG 6.1 Achieve safe and affordable drinking water (by 2030, achieve universal and equitable access to safe and affordable drinking water for all) * must provide value	☐	☐	
SDG 6.2 Achieve access to sanitation and hygiene and end open defecation (by 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations) * must provide value	☐	☐	reset
Availability. Water for personal and domestic uses, and sanitation facilities * must provide value	☐	☐	reset
Accessibility. Physically accessible and secure water and sanitation infrastructure in the immediate vicinity (includes time, distance, and accessibility for those who face physical barriers, within and outside the home) * must provide value	☐	☐	reset
Quality. Safe for human consumption and protection of health and safety during use of facilities * must provide value	☐	☐	reset

Human Rights Elements [other]

	Yes	No	
Water for livelihoods and customary uses e.g. fishing, bathing, cattle grazing, hunting * must provide value	☐	☐	reset
Water for cultural and religious purposes * must provide value	☐	☐	reset
The elimination of discrimination against women and other vulnerable groups in access to water and water management at all levels e.g. household level, decision-making level * must provide value	☐	☐	reset
Comment (only if you wish to comment)			Expand

Below is a list of elements, that this expert panel, agree should be excluded.

Please choose 'exclude' ONLY if you agree the element should be excluded.

	Exclude	
Monitoring of water resources management plans and the implementation thereof	☐	reset
Level of use of water and sanitation services e.g. Access in public spaces, at schools, at public health facilities	☐	reset

Below is a list of elements presented in the first round, should you wish to reconsider these for elements inclusion. Please choose 'include' ONLY if you have reconsidered and feel that that element should be included.

	Include	
Acceptability. Basic services must meet local social or cultural standards	☐	reset
Affordability. Ability to pay for water and sanitation services and income levels in relation to access to water and sanitation costs	☐	reset
Disparity in access to services between worst-off and better-off population groups; rate of progress towards 1% access	☐	reset
Achievement and communication of water quality and sanitation standards	☐	reset
Monitoring of budgets, water resources management plans, accessibility, quality and affordability	☐	reset
Water for indigenous peoples	☐	reset
Water for food production at a household or community level	☐	reset

Comment (only if you wish to comment)

Expand

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Human Rights Elements [ecological integrity]

- Below is a list of elements, selected by this expert panel (previous questionnaire), that could potentially be used to generate human rights indicators.
- Please choose 'yes' if you agree and 'no' if you do not agree that each element should be included or excluded.
- Please note that at this point in the process (round 2), we are only interested in elements that you think should be used to develop indicators (which will be developed in subsequent rounds).

	Yes	No	
SDG Indicator 6.4.1: Change in water-use efficiency over time * must provide value	☐	☐	reset
SDG 6.6 By 2030, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes (Protect and restore water-related ecosystems) * must provide value	☐	☐	reset
Ecological integrity: Water management to support a healthy human environment e.g. environmental water demand, measures of discharge, water quality, habitat integrity and biotic integrity * must provide value	☐	☐	reset
Water for the environment: for biodiversity including plants, animals, places, and habitats and livelihoods based on environmental resources * must provide value	☐	☐	reset
The impact of socio-environmental processes such as climate change on water for basic needs, ecological integrity and future needs and generations (as these processes impact on water quality, quantity, and future generations) * must provide value	☐	☐	reset

Below is a list of elements, that this expert panel, agree should be excluded.
Please choose 'exclude' ONLY if you agree the element should be excluded.

	Exclude	
SDG Indicator 6.4.2: Level of water stress: freshwater withdrawal as a proportion of available freshwater resources	☐	reset
SDG Indicator 6.6.1: Change in the extent of water-related ecosystems over time	☐	reset
Comment (only if you wish to comment)	Expand	

Below is a list of elements presented in the first round, should you wish to reconsider these for elements inclusion.
Please choose 'include' ONLY if you have reconsidered and feel that that element should be included.

	Include	
SDG 6.3 Improve water quality, wastewater and safe reuse (by 23, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally)	☐	reset
SDG Indicator 6.3.1: Proportion of wastewater safely treated	☐	reset
SDG Indicator 6.3.2: Proportion of bodies of water with good ambient water quality	☐	reset
SDG 6.4: Increase water-use efficiency and ensure freshwater supplies	☐	reset
Comment (only if you wish to comment)	Expand	

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Procedural Equity Elements

- Below is a list of elements, selected by this expert panel (previous questionnaire), that could potentially be used to generate procedural equity indicators.
- Please choose 'yes' if you agree and 'no' if you do not agree that each element should be included or excluded.
- Please note that at this point in the process (round 2), we are only interested in elements that you think should be used to develop indicators (which will be developed in subsequent rounds).

	Yes	No	
SDG6b. Support and strengthen the participation of local communities in improving water and sanitation management (Support stakeholder participation) * must provide value	☐	☐	reset
Institutional systems: Institutional systems that promote equity * must provide value	☐	☐	reset
Participation: Must be open to broad participation of all affected parties, including through such mechanisms as networks, voluntary associations, and public/private partnerships * must provide value	☐	☐	reset
Representativeness: Representativeness of all affected persons / parties (road and inclusive participation of stakeholders including all affected parties across the entire spectrum of water users and across scales) * must provide value	☐	☐	reset
Non-discrimination: Recognition of women (and other vulnerable groups e.g. persons with disabilities and minority groups) * must provide value	☐	☐	reset
Ethicality: Anti-corruption and transparency (an openness in procedures, information, potential sources of conflict) * must provide value	☐	☐	reset
Trust: Trust between the authorities and other participants * must provide value	☐	☐	reset
Knowledge-sharing and learning: Mechanisms in place for knowledge sharing and learning * must provide value	☐	☐	reset

Below is a list of elements, that this expert panel, agree should be excluded.
Please choose 'exclude' ONLY if you agree the element should be excluded.

	Exclude	
Error correctability: Appeal mechanisms	☐	reset
Participation: Activities that are easy to participate in	☐	reset
Impartiality: Impartial and creditable authorities/decision-makers (to prevent bias, which would be inequitable)	☐	reset
Comment (only if you wish to comment)		Expand

Below is a list of elements presented in the first round, should you wish to reconsider these for elements inclusion. Please choose 'include' ONLY if you have reconsidered and feel that that element should be included.

	Include	
Institutional systems: Training in Institutional systems to level the playing field	☐	reset
Institutional systems: Institutional systems that regulate access to benefits from water management	☐	reset
Communication: Must be clear and uncomplicated to encourage participation	☐	reset
Communication: Accessible and diverse to reach all those affected (multi-media and language)	☐	reset
Communication: Technical and specialised knowledge provided in a manner that is accessible to all (training may be necessary for some)	☐	reset
Accuracy: Information must be accurate (correct and considered legitimate by all parties)	☐	reset
Participation: Ability to participate, express opinions and raise issues (all have the same opportunity to participate)	☐	reset
Participation: Capacity building to overcome knowledge asymmetrie	☐	reset
Representativeness: Representativeness in collective agency (to overcome power inequities)	☐	reset
Representativeness: Women and other vulnerable groups enabled to participate	☐	reset

Voice: Being heard and having influence (traditional knowledge, local knowledge and technical knowledge must be considered an respected)	☐	reset
Voice: All treated with dignity and respect	☐	reset
Consistency: Consensus on, and consistent upholding of the rules	☐	reset
Interactive judgment: People treated appropriately	☐	reset
Dignity: People treated with dignity	☐	reset
Respect: People must be treated with respect, including respect for cultural differences	☐	reset
Continuous learning: Mechanisms in place for continuous learning and improvement	☐	reset
Conflict: Mechanisms for conflict management	☐	reset
Comment (only if you wish to comment)	Expand	

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Distributive Equity Elements

- Below is a list of elements, selected by this expert panel (previous questionnaire), that could potentially be used to generate distributive equity indicators.
- Please choose 'yes' if you agree and 'no' if you do not agree that each element should be included or excluded.
- Please note that at this point in the process (round 2), we are only interested in elements that you think should be used to develop indicators (which will be developed in subsequent rounds).

Achieve a full understanding the full array (social and economic) of direct water users and uses for:

	Yes	No	
Productive purposes: water used for productive purposes and beneficiaries thereof e.g. irrigation, industry, hydroelectric energy, mining, tourism * must provide value	☐	☐	reset
Productive purposes: Participation in water related productive process (employment, payments, productive chains with other sectors) * must provide value	☐	☐	reset
Social benefits: Water contribution to society e.g. water for food security * must provide value	☐	☐	reset
Environmental benefits: e.g. biodiversity sustained by water * must provide value	☐	☐	reset
Future use: Water allocated for future generations * must provide value	☐	☐	reset

Achieve a full understanding of the full array of burdens, costs and risks that result from water use:

	Yes	No	
Financing in water management e.g. polluter's pay, ability-to-pay * must provide value	☐	☐	reset

IESEL

Expand

Below is a list of elements, that this expert panel, agree should be excluded.
Please choose 'exclude' ONLY if you agree the element should be excluded.

Achieve a full understanding the full array (social and economic) of direct water users and uses for:

	Exclude	
Social benefits: The aesthetic of water / natural beauty	☐	reset
Benefit from externalities: Those that benefit from impacts of externalities in water resource management e.g. users of return flows generated from irrigation	☐	reset

Below is a list of elements presented in the first round, should you wish to reconsider these for elements inclusion.
Please choose 'include' ONLY if you have reconsidered and feel that that element should be included.

Achieve a full understanding the full array (social and economic) of direct water users and uses (quantitatively and qualitatively e.g. quantity per sector, per capita, intensity of use) for:

	Include	
Public goods: Universal access e.g. Recreation, ecosystem services, transport	☐	reset
State services: Services that are funded by resources obtained from water-related economic activity e.g. water taxes used to fund water for basic needs	☐	reset
Future use: Water allocated for future needs or projects	☐	reset
Other: e.g. educational, scientific	☐	reset

Achieve a full understanding of the full array of burdens, costs and risks that result from water use for:

	Include	
All affected by the impacts of water use e.g. return flows, pollution	☐	reset
Cost sharing: Distribution of the cost of making water available to users, and the amount the users pay (the cost of water infrastructure, its operation and maintenance, and how users are charged based on for example quantity used, or quality requirements)	☐	reset
Broader issues that impact on water management e.g. climate change, population growth	☐	reset

Other distributive equity elements

Include

Water rights: Individuals and entities who have legal rightS to access water, often linked to property rights

☐

reset

Water impacts many different levels: Local, regional, national, or even international. It is important to consider the issue of benefit and cost distribution within geographic space (e.g. upstream-downstream distribution of benefits and costs)

☐

reset

Mechanisms to overcome competing uses

☐

reset

Comment (only if you wish to comment)

Expand

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Context

Round 1 of the Delphi process found that this expert panel agree that these are the major elements of the context pillar:

- Culture
- Time (historical and future)
- Social Economic
- Political

Do you agree?

* must provide value

Yes

No

reset

Why/why not?

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Save & Return Later

Context Elements		
- Below is a list of elements, selected by this expert panel (previous questionnaire), that could potentially be used to generate context indicators. - Please choose 'yes' if you agree and 'no' if you do not agree that each element should be included or excluded. - Please note that at this point in the process (round 2), we are only interested in elements that you think should be used to develop indicators (which will be developed in subsequent rounds).		
	Yes	No
Cultural: The symbolic, religious, and lifestyle uses and meanings of water (recognition of these uses) * must provide value	☐	☐
		reset
Time: Historical processes, negative impacts and effects, past pledges and past inequities * must provide value	☐	☐
		reset
Time: Preservation of future access to water and future water management decisions must not be hindered by present day management * must provide value	☐	☐
		reset
Social: Values, attitudes and perceptions among users (particularly in relation to equity and fairness) * must provide value	☐	☐
		reset
Social: The role of gender in water management, ethnicity and economic status or class * must provide value	☐	☐
		reset
Economic: Water (and sanitation) charges / tariffs: How persons and institutions are charged for water, cost as a proportion of household expenditure * must provide value	☐	☐
		reset
Economic: Efficient (and transparent) use of financial resources * must provide value	☐	☐
		reset
Economic: Mechanisms to overcome economic power imbalances * must provide value	☐	☐
		reset

Political: Water policies, political goals and legal frameworks (past and present) that support and progress equity goals and outcomes * must provide value	☐	☐	reset
Political: Environmental concerns integrated into water legislation * must provide value	☐	☐	reset
Political: Non-discrimination promoted in water policy e.g. women and other vulnerable groups * must provide value	☐	☐	reset
Political: Mechanisms to overcome political power imbalances * must provide value	☐	☐	reset
Comment (only if you wish to comment)			
		Expand	

Below is a list of elements presented in the first round, should you wish to reconsider these for elements inclusion. Please choose 'include' ONLY if you have reconsidered and feel that that element should be included.

	Include	
Cultural: Customary uses of water	☐	reset
Cultural: Customary governance of water	☐	reset
Economic: Free basic allowance: The groups of people that benefit, means of access and the quantity of water	☐	reset
Economic: Water taxes, subsidies, etc: How persons and intuitions are taxed, and how (and where) those taxes are distributed	☐	reset
Economic: Water costs: Who bears the cost of providing water and water services; infrastructure investment, operation maintenance, maintaining water quality, etc	☐	reset
Political: Policy that guarantees procedural equity	☐	reset
Political: Basic human, ecological and customary water prioritised in water policy	☐	reset
Political: Recognition of, and respect for customary law in water management	☐	reset
Political: Regulation of benefits and burdens of available water resources	☐	reset
Political: Other, water related policies and institutions examined for their impact on equity goals e.g. economic and social regulation	☐	reset
Political: Transparent, competitive and accessible acquisition and use of services providers (public and private)	☐	reset

Comment (only if you wish to comment)

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Appendix 4 Water Equity Indicators Included in the Case Study Questionnaire

Indicator #1 Quality of drinking water and the condition of sanitation services and programmes

Indicator	Inequitable	Ineffectual	Equitable	Equitable	
	(negative impact on equity)	(no impact on equity)	(positive impact on equity)	Inclusion of women and other vulnerable groups	Consideration of the needs of future generations
Drinking water quality	Drinking water from a municipal water source is perceived as being of poor quality and/or unsafe to drink OR Drinking water is derived directly from an alternate water source (untreated water), e.g., springs, wells, dams, pools or from rivers and streams	Drinking water is from a municipal water source and is perceived as being of an adequate quality and safe to drink	Drinking water is from a municipal water source and is perceived as being of a high quality and safe to drink	Menstrual hygiene facilities are hygienic, and menstrual products are disposed of safely by the responsible authority	The responsible authority ensures environmental protection through effective and efficient solid waste management e.g., the safe disposal of excreta and good maintenance of sanitation facilities to prevent discharge into the environment
State of sanitation facilities	Sanitation facilities are unhygienic, and there are no handwashing facilities	Sanitation facilities are either unhygienic OR There are no hand washing facilities	Sanitation facilities are hygienic and there are hand washing facilities		

Indicator #2 Interruptions to water services and reliability of sanitation services

Indicator	Inequitable	Ineffectual	Equitable	Equitable	
	(negative impact on equity)	(no impact on equity)	(positive impact on equity)	Inclusion of women and other vulnerable groups	Consideration of the needs of future generations
Frequency and length of interruption to water services	Frequent interruptions, water is not provided within 24 hours and service is returned after more than 7 days	Infrequent interruptions, water is provided within 24 hours of interruptions and service is returned within 7 days	No interruption, or service is returned within 24 hours	Menstrual hygiene facilities are reliable*	Where water and sanitation services are shared and/or unreliable, the responsible authority is rectifying and expanding these services
Reliability of free basic sanitation	Sanitation facility (community facility) is shared and unreliable*	Sanitation facility in the yard, that is unreliable*	Sanitation facility in the yard, that is reliable*		

* Sanitation facilities must be functional at all times, with prompt repair services

Indicator #3 Physical accessibility of drinking water and sanitation facility

Indicator	Inequitable	Ineffectual	Equitable	Equitable	
	(negative impact on equity)	(no impact on equity)	(positive impact on equity)	Inclusion of women and other vulnerable groups	Consideration of the needs of future generations
Proximity of water source to the household	Water is obtained from a communal water source more than 200 m from the household	Water source is located less than 200 m from the household	Water source is in or at the boundary of the household yard	Women and other vulnerable persons can safely (physical and personal safety) access sanitation facilities	At schools, the water source and sanitation facilities are within 200 m of the building, are accessible by all and there is no risk of physical harm
Proximity of sanitation facility to the household	Sanitation facility is more than 200 m from the household, and access to the facility potentially puts one at risk of physical harm	Sanitation is shared and within 200 m of the household and there is no risk of physical harm	Sanitation facility is located within the household yard, and is safe and private		

Indicators #4 & 5 Water for, and protection of, the Ecological Reserve

Indicator	Inequitable	Ineffectual	Equitable	Equitable	
	(negative impact on equity)	(no impact on equity)	(positive impact on equity)	Inclusion of women and other vulnerable groups	Consideration of the needs of future generations
The Ecological Reserve has been determined for the water resource	The Ecological Reserve has not been, or is not in the process of being determined	The Ecological Reserve has been, or is being determined but has not been gazetted	The Ecological Reserve has been gazetted, is monitored, and is enforced	Water for the Reserve is given the highest priority in the allocation of water, and sufficient water has been allocated for the Ecological Reserve	An Ecological Category of C or higher is being maintained or improved
Resource quality objectives (RQOs)	RQOs have not been determined OR RQOs have been determined and are not being met and/or the resource class is deteriorating	RQOs are being met AND the resource class is being maintained (where the Ecological Category is at least C)	RQOs are being met and/or the resources class is improving (where the resource class is at least C)		

Indicator # 6 Stakeholder participation

Indicator	Inequitable	Ineffectual	Equitable	Equitable	
	(negative impact on equity)	(no impact on equity)	(positive impact on equity)	Inclusion of women and other vulnerable groups	Consideration of the needs of future generations
Broad and inclusive stakeholder participation*	Limited number of stakeholders and/or the dominance of certain stakeholders or stakeholder groups	An intermediate number of stakeholders have participated in decision making, including marginalised groups	A broad range of stakeholders and stakeholder groups have participated in decision making	Women and other vulnerable groups have participated in decision making	Youth have participated in decision making

* Degree of inclusiveness and diversity of a broad range of institutional (formal and informal) and individual stakeholders

Indicator #7 Stakeholder representativeness

Indicator	Inequitable	Ineffectual	Equitable	Equitable	
	(negative impact on equity)	(no impact on equity)	(positive impact on equity)	Inclusion of women and other vulnerable groups	Consideration of the needs of future generations
Representation in participation*	Limited number of poor and marginalised groups are represented	Some poor and marginalised groups represented	Poor and marginalised groups are represented	Women are represented	Youth are represented

* Representation by poor and marginalised groups and women in water institutions, both formal and informal and recognition of their concerns in water management decision making

Indicator #8 Ethicality

Indicator	Inequitable	Ineffectual	Equitable	Equitable	
	(negative impact on equity)	(no impact on equity)	(positive impact on equity)	Inclusion of women and other vulnerable groups	Consideration of the needs of future generations
Transparency in procedures* (information about the engagement process)	No transparency in procedures	Some transparency in procedures	Procedures are transparent, and are followed	Women play an equal role in procedures, and identifying where procedures are / are not transparent	Where procedures are not transparent, there is evidence of the responsible authority rectifying these issues

* The degree of corruption, and transparency in procedures including, water decision making, water resources planning and management and water governance

Indicator #9 Water for cultural, spiritual and customary practices

Indicator	Inequitable	Ineffectual	Equitable	Equitable	
	(negative impact on equity)	(no impact on equity)	(positive impact on equity)	Inclusion of women and other vulnerable groups	Consideration of the needs of future generations
Water quality impacts on cultural, spiritual and customary water uses	Poor water quality hinders cultural, spiritual and customary water uses, and has resulted in the loss of ecosystems, fauna and flora that are essential to these practices	Water quality impacts on cultural, spiritual and customary water uses and there is some loss of ecosystems, fauna and flora that are essential to these practices	Water quality does not affect cultural, spiritual and customary water use nor the ecosystems, fauna and flora that are essential to these practices	Water quality does not affect women's cultural, spiritual and customary uses of water	Where water quality does negatively affect cultural, spiritual and customary water uses, there is evidence of the responsible authority improving water quality and availability

Indicator #10 Water for subsistence food production

Indicator	Inequitable	Ineffectual	Equitable	Equitable	
	(negative impact on equity)	(no impact on equity)	(positive impact on equity)	Inclusion of women and other vulnerable groups	Consideration of the needs of future generations
Provision of water for food production	Household relies on subsistence farming for food or to supplement food, and does not have adequate water for subsistence farming	Household does not rely on subsistence farming for food, or to supplement food	Household relies on subsistence farming for food, or to supplement food, and has adequate water for subsistence farming	Women-headed households that rely on subsistence farming for food, or to supplement food, have adequate water for subsistence farming	Where water for subsistence farming is not adequate, there is evidence of the responsible authority rectifying and expanding water for subsistence farming

Indicator #11 Water for commercial and economic uses

Indicator	Inequitable	Ineffectual	Equitable	Equitable	
	(negative impact on equity)	(no impact on equity)	(positive impact on equity)	Inclusion of women and other vulnerable groups	Consideration of the needs of future generations
Allocation of water for commercial and economic uses	Water for economic and commercial use is disproportionately allocated to White-owned farms and businesses	Water allocation continues the status quo, without addressing past imbalances	Black African farmers are allocated a fair share of water for economic and commercial use	Black African women are prioritised and receive a fair share of water for economic and commercial use	Where water for economic and commercial use has a significant negative impact on water quality (e.g., water pollution), there is evidence of the responsible authority rectifying the situation
Distribution of the impact of the use of water for commercial and economic uses	Water used for commercial and economic purposes has a significant negative impact on local water resources e.g., water is heavily polluted	Water used for commercial and economic purposes has a negative impact on local water resources e.g., water is polluted	Water used for commercial and economic purposes does not impact on local water resources e.g., water is not polluted		

Appendix 5 Case Study Questionnaire

Water equity questionnaire

Thank you for taking the time to participate in this research. This questionnaire is designed to gather your valuable insights on water equity within your Catchment Management Agency. The primary objective is to assess the practical applicability of proposed indicators as a tool for monitoring and evaluating water equity in your CMA.

Your participation involves three key steps:

Step 1: Reviewing the chosen indicators in detail (attached)

Step 2: Assessing water equity in your CMA using the indicator

Step 3: Evaluating the indicator's effectiveness, strengths, weaknesses, and potential improvements.

This should take longer than 20 minutes, depending on the level of detail you choose to contribute.

Your input will play a key role in refining these tools to ensure they are both practical and impactful. We greatly appreciate your time and thoughtful contributions to this important research.

STEP 1 Review the selected indicator in isolation

1. Carefully consider the full description of the indicators attached
2. Take note of the specific aspects the indicator aims to measure
3. Consider the relevance of the indicator to your CMA's context
4. Identify any terms or concepts within the indicator description that may need clarification

STEP 2 Assess water equity using the indicator

1. Reflect on the current state of water equity in your CMA as it relates to the selected indicator
2. Rate the state of equity in your CMA

Indicator #: Indicator name

[Q1.1] Indicator #: Indicator name

☐ Inequitable

☐ Ineffectual

☐ Equitable

[Q1.2] Inclusion of women and other vulnerable groups

☐ Equitable

[Q1.3] Consideration of the needs of future generations

☐ Equitable

STEP 3 Evaluate the indicator

Based on your understanding and analysis from previous steps, provide a response based on your evaluation of the indicator

[Q2.1] The indicator is clear and understandable

Please indicate your level of agreement with this statement by selecting one option

☐ Strongly disagree

☐ Disagree

☐ Neither agree nor disagree

☐ Agree

☐ Strongly agree

[Q2.2] This indicator effectively assesses whether the situation it is designed to measure is equitable or inequitable

Please indicate your level of agreement with this statement by selecting one option

☐ Strongly disagree

☐ Disagree

☐ Neither agree nor disagree

- ☐ Agree
- ☐ Strongly agree

[Q2.3] It will be easy to collect the data required for this indicator

Please indicate your level of agreement with this statement by selecting one option

- ☐ Strongly disagree
- ☐ Disagree
- ☐ Neither agree nor disagree
- ☐ Agree
- ☐ Strongly agree

[Q2.4] How does this indicator compare to existing measures you currently use?

[Q2.5] Are there any improvements that you would suggest for this indicator?

[Q2.6] Do you have any other feedback on the practicality or applicability of the indicators being used?