Exploring water security perspectives and priorities in Addis Ababa, Ethiopia.

A systems approach for understanding diverse problem perceptions of water security across governance levels.

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Abstract

Analysis of water security in Addis Ababa, Ethiopia demonstrates it to be a complex, dynamic, interconnected water management paradigm defined by: physical water insecurity; social and political practices, processes, and values; and connections to human security and justice.

To address this complexity, a systems approach has been developed that draws upon three system concepts: open systems, boundary judgements, and methodological pluralism. In adopting these, the systems approach triangulates a variety of qualitative data to understand water security in Addis Ababa, critically examining and comparing the various water securities among actors as products of interconnected elements between water governance, use, and value.

The research demonstrates water security to be a heterogeneous environmental and social product across stakeholders in the city, with multiple perceived drivers and impacts. Furthermore, it shows how a systems approach can benefit exploring complex socioenvironmental issues, demonstrating this in both practice and analysis. Additionally, the work highlights how varied social and geographical management scales and unclear responsibilities are systemic barriers to the adoption of water security as a water resources management paradigm.

Importantly, a systems approach has demonstrated how water security requires several interconnected human-water relationships to be fulfilled beyond consideration of water supply alone. Conservation of environmental water security, protection and safety from water-related risks, and preservation of water-dependent livelihoods, for example, were found to be key determinants of the degree of water (in)security. A siloed, linear, approach would not identify these or provide the critical consideration for improving the understanding of water security more broadly.

Addis Ababa is a rapidly urbanising city with various unique issues; however, many other cities around the world are experiencing similar socioenvironmental pressures for water resources management. The systems approach can therefore be applied, accounting for local specificities, to other cities that face similar interconnecting challenges.

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List of common abbreviations

AAWSA	Addis Ababa Water and Sewerage Authority
BHC	Basin High Council
CLD	Causal Loop Diagram
ETB	Ethiopian Birr (national currency of Ethiopia)
FCDO	Foreign, Commonwealth, and Development Office (UK)
FDRE	The Federal Democratic Republic of Ethiopia
GDP	Gross Domestic Product
GST	General Systems Theory
IWMI	International Water Management Institute
IWRM	Integrated Water Resources Management
KI	Key informant
MoW(I)E	Ministry of Water, (Irrigation), and Energy
NGO	Non-governmental organisation
NRW	Non-revenue Water
OSZ	Oromia Special Zone (Finefinnee)
OWEB	The Oromia Water and Energy Resource Development Bureau
RBA	River Basin Authority
RBO	River Basin Organisation
SD	System Dynamics
SSM	Soft systems methodology
ST	Systems thinking
UN	United Nations
WASH	Water, Sanitation, and Hygiene

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Introduction

Chapter 1. Introduction

The water security paradigm is deep and broad in content, with contemporary framings being highly diverse and including a variety of themes and disciplines (Cook & Bakker, 2012). The increased uptake of this paradigm over the past two decades can be attributed to its attempt at understanding water resources management issues as interconnected, interdependent, and interdisciplinary across a variety of supply and demand factors. Additionally, water security has come to encompass uses of water from multiple sources with different quality, reliability, and access rights profiles, for multiple purposes, all of which vary in time and space, according to wider livelihood priorities and pressures (Dessalegn et al., 2013). Hence, the meaning of water security has become complex and dynamic, making it increasingly difficult to understand and operationalise. For some, the complexity and breadth of water security has therefore made it a thin and unrealistic water resources management paradigm, being an intractable problem for defining clear policy (Sultana & Loftus, 2013, p.102).

This research investigates water security in Addis Ababa, the capital city of Ethiopia, examining the contextual factors at individual, regional, and national level that could contribute to its use in water resources management. Firstly, it unpacks the wider origins and development of the water security paradigm over time. Secondly, it investigates contextual water security as a state of being among individuals, and as a sectoral goal for utilities. And, thirdly, it seeks to understand the challenges of adopting water security in national policy by examining existing Ethiopian water management and socioeconomic development agendas. Through this investigation, it is demonstrated that consideration of contextual water security is fundamental to its operationalisation; water security being more aptly water *securities* with diverse origins, indicators, interventions, and understandings related to water insecurity. For water resources management, this means water security must be reflective of local practices to effectively deal with risks to security. For national policy, this presents a variety of challenges in the adoption of water security as a water resources management paradigm.

As you read this thesis, you will realise that a definition of water security is neither sought nor reinvented. It was the intention of this work to explore water security rather than arrive at a singular binary answer for what water security is or includes (sometimes the best solution is to explore a problem, not to solve it (Fraser, 2008, p.78)). This choice was made to be open to the complexity and diversity of water security. An explorative approach is therefore adopted to navigate this research landscape, being based on a systems approach that allows for a critical understanding of the interconnectedness of contextual complex processes that characterise water security in Addis Ababa. Utilising systems thinking additionally adheres to suggested guidance from the Ethiopian Ministry of Water and Energy for developing and managing water resources[1]. The systems approach draws upon three fundamentals; methodological pluralism, boundary judgements, and open systems. Whilst the details of the approaches differ, these three fundamentals remain central to the analysis and interpretation of interconnected perspectives and priorities of water security in Addis Ababa.

[1] Guiding principle 12 in the 2020 Draft National Water Policy and Strategy specifically states that water resources should be developed and managed on the principles of: the polluters pay principle; the users pay principle; the precautionary principle; the good governance principles; and the principle of **holistic systems thinking** (MoWIE, 2020, p.13).

1.1 Research rationale

Ethiopia's hydrological climate has always been temporally and spatially variable. New and forecasted impacts as a result of global climate change, however, have the potential to impact Ethiopia severely. Due to its geographic location, the economic and social dependence of the population on climate-sensitive sectors, and widespread environmental degradation in parts of the country (UNDP, 2015), climate change is both a major concern and a major consideration for addressing water security in Ethiopia (Calow et al., 2013). An estimated 10% of GDP is already annually lost in Ethiopia due to increasing natural disasters, loss of water resources, forests and biodiversity, and population displacement (United Nations in Ethiopia, 2020). Developing and securing water resources remains a challenge for Ethiopia, especially under potential future climate impacts, and acts as a barrier to Ethiopia's goal of becoming a low-middle income country by 2025, especially for the country's poorest (van der Heijden et al., 2017).

These concerns have made the pursuit of water security increasingly urgent for Ethiopia, being observed to appear in some recent national documents where broader ideas of food, health, and social security are being discussed. The 2018 One Wash National Programme, for example, specifically mentions water security as part of its short to medium term actions around advocacy[2] for WASH, with the longer-term goal of 'fully established advocacy procedures for water security, sanitation, and hygiene' (FDRE, 2018b). Additionally, the 2020 10-Years Development Plan discusses the role of water in 'food security systems' as well as clean water being a core part of 'basic economic and social services' to provide a broader social security (PDCE, 2020). Another example is the 2022 National Health Equity Strategic Plan that highlights the role of water in both food and health security (Ministry of Health, 2020). Lastly, a recently released Ministry of Water and Energy bulletin specifically refers to water security. Whilst this is in relation to the hydropolitics surrounding the recent Grand Ethiopian Renaissance Dam, it specifically addresses the desire for Ethiopia to create an 'alternative vision or agenda for water security discourse' (MoWE, 2023b).

[2] Advocacy defined as 'Activities undertaken to persuade and mobilize people/decision makers to take action' in FDRE (2018).

This evidence contributes to the likelihood that Ethiopia could develop a specific water security policy in coming years. Adding to this likelihood is also the prevalence of water security in recent international multilateral agendas of institutions that Ethiopia has historically integrated into its own planning and policy frameworks, especially with regards to water management. Ethiopia has previously, for example: integrated the UN Development Goals (2000) into national development planning and policy frameworks (UNDP, 2015; Verhoeven, 2021a; MoWIE, 2015b); been a signatory to the UN Human Right to Water and Sanitation (2010); embedded the UN Sustainable Development Goals (2015) into their 10-year development plan (UN Ethiopia, 2020); and adopted Integrated Water Resources Management (IWRM) into its policy environment through policy, legislation, strategy, and development with the help of external development partners (Jembere, 2009).

Water security has also become a prevalent issue in visions for Africa as a continent. For example, the African Ministers Council on Water highlighted the urgent need to invest in water security in Africa (AMCOW, 2012), developing a specific framework for Water, Water Security, and Climate Resilient Development (2012) that promotes water security and climate resilient development to reinforce ‘actions that reflect the overarching messages and objectives of the Durban COP17 and Rio+20 meetings’ (AMCOW, 2012). Additionally, the African Union’s 2022-2032 strategy and action plan promotes ‘integrating water security issues into development plans’ as a key innovation area (AUC, 2022, p.53). More recently, water security is now one of the Priority Areas in Africa’s Agenda 2063 (AUC, 2015). Ethiopia has, again, historically played an active role in these institutions in terms of integrating their goals and visions into its own planning and policy.

For these reasons, it doesn’t seem unlikely that an Ethiopian water security policy is on the horizon; as demonstrated, understanding contextual water security for Ethiopia is highly interrelated with the socioeconomic development of the country under an uncertain climate future. There is therefore a case for the understanding of what water security means for Ethiopia; contextual priorities and perspectives being needed to guide a policy approach. In order to meet water demand requirements for all, water security must therefore be understood among a diverse set of actors. This

is essential in nurturing coordination and thus developing effective water security policies and investments (van der Heijden et al., 2017).

1.2 Scope of research

Ethiopia is a traditionally agrarian society, with around 20% of the population living in urban centres (UNDP, 2018, 2015). Recently, however, the country has observed an urbanisation trend, where the annual population growth rate in urban areas has been projected at 4.1% between 2012 and 2030, based on rising rural–urban migration, continued high fertility rates, and general population growth (UNDP, 2015). Addis Ababa is the capital city of Ethiopia and of the 20% of the population living in urban centres, most live in Addis Ababa (UNDP, 2018, 2015) along with 37% of the countries manufacturing industries (UNDP, 2018). It is also one of the fastest growing cities in Africa (Adane, Ameha, et al., 2021). As a result, the city experiences a large gap between water supply and demand, and water shortages are frequently observed within the city. Understanding water security in Addis Ababa is therefore critical for sustaining the urban growth of the city. Additionally, it offers an opportunity to understand the various water resources pressures of urban areas in Ethiopia, which are predicted to increase over the coming years.

1.2.1 Aims and objectives

The scope of this research is to understand the contextual factors that contribute to water (in)security in Addis Ababa, and therefore what challenges may be faced if a broad water security policy was to be created at national level. As a means to investigate these contextual factors, a systems approach is taken to explore the various problem perceptions, interconnectedness, and complexity of water security at different water resources management levels. At local level, water security priorities and perspectives of different communities in Addis Ababa are collected, compared, and discussed. At regional level, water security as a sectoral goal for the local water utility is explored, as well as compared with the neighbouring water utility. At national level, document analysis of policies, plans, and laws, provides the institutional context of water security as a possible water resources management paradigm for Ethiopia. The time period considered for document analysis is from 1995 (The Constitution of the Federal Democratic Republic of Ethiopia) to 2022.

A few existing studies explore water security in Addis Ababa (Table 8) or the wider Akaki watershed (Table 9), in which Addis Ababa resides. Few, however, account for

water security as multidimensional and complex; comparisons of water security between different stakeholders within the city, water security outside of a relationship with physical water, and interconnections with other types of security are therefore not well considered in the existing research. Additionally, findings are rarely related back to the wider context of national water resources management policy.

The aim of the research is therefore to assess the contextual factors that contribute to different problem perceptions of water (in)security in Addis Ababa and the homo/heterogeneity between these. Additionally, to relate these findings back to the broader institutional context of water resources management in Ethiopia, identifying challenges for operationalising water security in broader water resources management policy. This investigation is centred around a systems approach that has been developed to be able to structure water security perspectives and analyse the outcomes. Furthermore, this research also aims to investigate how systems approaches more generally, can facilitate a better understanding of water resources management issues for water resources research.

This research aim has therefore been divided into the following objectives:

- Identify key discourses that have contributed to water security and understand how these frame water security for this research (Chapter 2)
- Understand the fundamentals and variety of systems approaches (Chapters 3 and 4), how these are currently used in water resources research (Chapter 4), and therefore which may be suitable for structuring an investigation of water security
- Identify what data is needed to support and evidence a systems approach to investigating water security (Chapter 5)
- Understand the historical context of water resources development in Addis Ababa (Chapter 6)
- Understand community perceptions and priorities of water security and how these may vary in different areas of Addis Ababa e.g., location in the city (urbanisation levels) and position in the wider catchment (upstream/downstream) (Chapter 7)
- Understand water security from the perspective of the local utility, including the range of factors that are perceived to contribute to water insecurity in Addis Ababa (Chapter 8)
- Explore the institutional context of water security through analysing relevant and appropriate documents related to national water resources management (Chapter 9)

- Present an understanding of water security in Addis Ababa as a product of various contextual factors, unique to the area (Chapter 10)
- Demonstrate the various challenges that may arise at a national level for water security if adopted as a water resources management paradigm for Ethiopia (Chapter 10)
- Reflect on taking a systems approach for investigating water security and the methods used to inform this research (Chapter 11)

1.3 Organisation and structure of Work

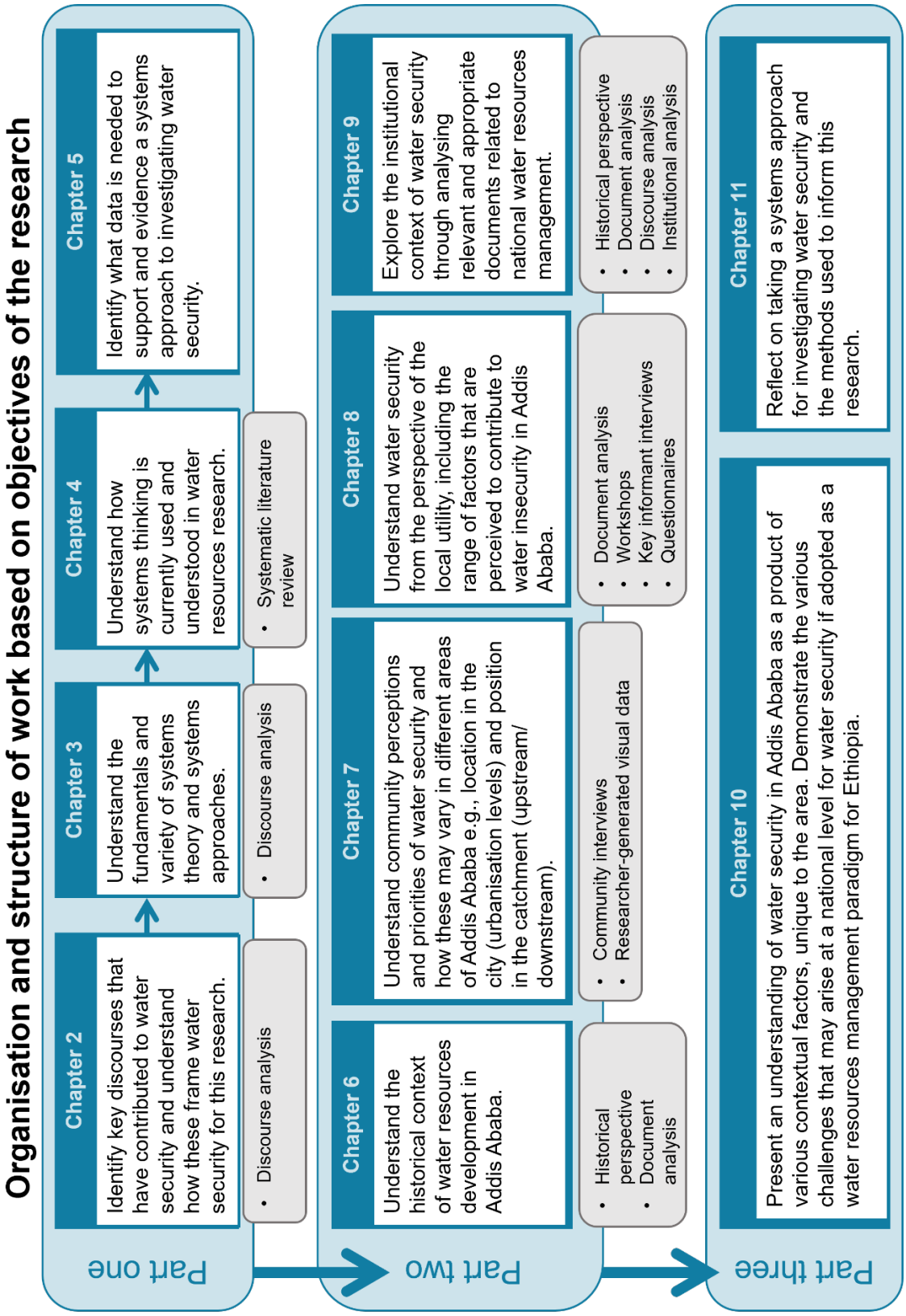
This thesis is divided into three parts (see Figure 1): (1) The problem domain; (2) Water security across territories and actors in Addis Ababa, Ethiopia; (3) Discussion, reflections, and conclusions**.**

Part 1 is an exploration of water security and systems thinking. It lays out the origins, developments, and understandings of water security and therefore provides a broad background for subsequent, more specific, research. In this section, the theoretical framing of systems thinking is also discussed and the systems approach that runs as a core through the research is presented. Furthermore, a broader systematic literature review on the use of systems approaches in water resources research is conducted. Part 1 concludes with an outline of the methods used to investigate and navigate the research landscape.

Part 2 applies this knowledge in the context of Addis Ababa; narrowing the broad framing of water security and systems thinking from Part 1 down to the specific interactions in Addis Ababa, Ethiopia. Beginning with an introduction to the study area, Part 2 then presents the investigation of water security at community and utility level. This is done using a systems approach supported by qualitative empirical data and document analysis. It finalises with an analysis of water resources management policy and discourse at national level. A purposeful choice has been made in Part 2 to present the research in a bottom-up format, beginning with water security at community level, then regional, and then national.

Part 3 revisits the objectives set out by this research, summarises the key findings from Part 2, and discusses the wider implications of these. The section concludes with reflections of the research and methods as well as a discussion of remaining gaps and future recommendations for this research area.

Figure 1. Organisation and structure of work based on the objectives of this research



1.3.1 Notes for the reader

There are some considerations that are useful for reading and understanding this research. Firstly, a number of direct quotes are used in this research, where this is the case, words or sentences in square brackets may be added for clarity. Square brackets represent additions for clarity and are not present in the original interview or transcript. Secondly, the Gregorian calendar system is not used in Ethiopia; the Ethiopian (Ge'ez) calendar has different months, a different number of days in each month, and a different number of total months compared to the Gregorian calendar. Consequentially, the current year in the Ge'ez calendar is roughly seven years behind the Gregorian calendar system. Therefore, when referring to time in this thesis it is made clear whether this is referring to the Gregorian calendar (G.C) or Ethiopian calendar (E.C). Moreover, when translating discussions on months or seasons, the Amharic wording is used followed by the equivalent transliteration and equivalent time in the G.C system. The three distinct seasons are:

- በጋ (*Bega* – the dry season between the equivalent of September and January/February – often referred to as 'summer')
- በልግ (*Belg* – the small rainy period between the equivalent of February/March and May)
- ክረምት (*Kiremt* – the rainy season between the equivalent of June and September – often referred to as 'winter')

Lastly, Appendix G contains an essay on 'Regional water security perspectives and priorities: the Awash River Basin Organisations'. This was originally intended to be part of the main body of research. It was later found, however, that the water security perspectives and priorities of the Awash River Basin Organisations (RBOs) were closely related to those at national level (which are covered in Chapter 9), and that the influence of the Awash RBOs on Addis Ababa is not significant enough for analysis in this research. It is still included in the appendices, however, as a consideration for some of the water resources management dynamics in Addis Ababa and the surrounding area, as well as some reflections of water security priorities and perspectives at national level.

Part one

The problem domain

Chapter 2. Global perspectives on water security

The term *water security* began its popular uptake among the water resources community at the start of the 21st century (Varady et al., 2021). Since this point, it has become increasingly adopted by, and in some cases now dominates, many water management discourses – water security has become a prevalent term in policy, development, and academic debates (Cook & Bakker, 2012; Lautze & Manthrithilake, 2012). Additionally, it is popular among global and regional organisations across the multilateral, governmental, and NGO spectrum due to its attractive framing (Staddon & Scott, 2018). It therefore appears likely that this paradigm could endure within water resources discourse (Varady et al., 2021).

A re-definition of water security is therefore not sought here; definitions of water security and the fleshing out of this paradigm have been explored numerous times across a range of literature. Popular definitions (e.g., UN Water, 2013; World Economic Forum, 2011; Global Water Partnership, 2000) share common themes of water resource protection in the balance between ecosystems nourishment and socioeconomic prosperity and development. Some definitions also allude to the complexity of water security created through its linkages with other dependencies of health, education, and water quality, for example.

Despite these relatively consistent themes, what it means to achieve water security has an extremely high variation across contexts and disciplines. Cook & Bakker (2012) hypothesise this variation as an issue of differing framings across multiple paradigm tangents as the term water security developed from water resource safeguarding – linked to human and military security – to encompassing other interdependencies such as affordability, public health, risk and hazards, and food security. The discourse and interpretation analysis of water security conducted by Varady et al., (2021) and Bakker et al., (2013), respectively, additionally demonstrates that inclusions for water security reflect the same pluralities and paradoxes that the definitions of the paradigm allude to: a battle of ideas, multiple societal-biophysical links, interconnectedness between elements, and diversity amongst actors and framings.

Beginning with a global overview, this chapter sets the broader scene for the subsequent chapters that explore water security in Ethiopia, examining the water security paradigm through its evolution and connections to existing resource management paradigms. An understanding of the meaning and framing of water security is presented, as well as what is included and excluded in this paradigm at various stages and why. This investigation of the discourse consequently informs three conclusive statements for water security that are essential in the framing of the research for this thesis.

2.1 The origins of water security

An initial dissection of water security can be found in an analysis of language, the choice of the word *security* in particular. The importance of the choice of language in environmental discourse is explored by Hajer & Versteeg (2005), their analysis points out that language for environmental issues has the power to create and dissolve barriers for activism, policy options, and problem conceptualisation. This will be further explored in subsequent chapters but, for now, it is important to recognise that the active choice to label what is understood as interventions for diverse and complex water resource issues as water *security* is scientifically, institutionally, and culturally significant. Water security as the representative conceptualisation for identifying areas of action or analysis as priority is therefore immersed in an evolution of what is considered as being secure.

2.1.1 A brief philosophy of security

The concept of security encompasses a broad range of political and social interpretations with a main function being to achieve an ideal of stability that both individuals and communities have historically aspired to. With this diversity, it inherits complex societal values that deviate between individuals, issue areas, societal conventions, and changing historical conditions and circumstances (Mabe, 2008). These variations prompt a philosophical discussion as to what is meant by security. An in-depth dialogue of this is outside the remit of this research; however, there are some fundamental philosophical characteristics of security that become relevant to this thesis' analysis of water security which will be explored.

The development of thinking on security largely follows philosophical theories that emerge over the 20th and 21st centuries. Notable theories form a family of security framings that include conventional realism and neo-realism, post-modernism, (social) constructivism, and post-structuralism, amongst others. A classical realist view of security is that of military and state defence, developing into a neo-realist perspective that aligns more with economic power and diplomatic ownership of resources (Ahsan, 2018). Both present a materialistic view of security (including resource grabbing) that neglects variation in scales of human security, potentially leading to insecurities among different social categories through political-material effects

(Marhia, 2013). Additionally, suggesting that the idea of security is guaranteed to citizens by the state, being the dominant actor in the system and defining security as a product of self-interest (Wendt, 1992). A (social) constructivist view of security, however, is intersubjective and therefore a social rather than individual or state phenomenon based on shared knowledge, material resources, and practices (Wendt, 1995). In this sense, security is a social structure composed of intersubjective understandings; crucially being an aspect that is open to deconstruction and reconstruction (Pettman, 2005).

Post-structuralist security takes the perspective that security and the response to security are performative of particular configurations of political identity (Butler, 2004). Furthermore, one feminist view of security is a gendered concept within human security, where security is sought in direct relation to who the referent is (Stern, 2006). Another critical feminist perspective understands security as ‘not just a public good, but an institutional field of power, in the reproduction of structuralist inequalities, violences, and insecurities’ (Marhia, 2013). Security’s intersections with gender and identity therefore meaning that the concept incorporates repression and inequality carried out in multiple manifestations of security (and responses to security) among diverse referents. The security narrative in this sense once more cannot be separated from the narrative of political of identity as they are interwoven (Wibben, 2011).

The fundamental takeaway between these philosophical concepts to bring through into the discourse of water security, is the social-political nature of placing water issues under the specific phrasing of water *security*. Additionally, the recognition that the manifestation and realisation of a is entirely dependent on the referent.

2.1.2 Emergence of resource security

Preceding the discourse around water security were, more generally, ideas and discussions around resource security. The traditional meaning of security is rooted forms of protection – safety from danger and threats. As is globally and historically experienced, danger and threats can take many forms from natural hazards to war, moreover safety becomes variable across scales of individuals, communities, and states, as well as safety also being a personal feeling. These threats and dangers,

however, have changed overtime to create evolutions the meaning of *security* with reference to water, or more generally resources and the environment. The concept of resource security appeared in policy literature in the 1940s and was dominated by narratives of military and state defence as well as re-establishment of political boundaries of former colonial empires (Garrick & Hall, 2014). By the 1960s this had transformed into resource ownership security defined by economic power and diplomatic capability (Ahsan, 2018).

In the early 1980s, resource security was still associated with national security and conflict. Ideas around environmental security were especially influenced by international environmental issues and the aftermath of the Cold War (Gleick, 1993). Security, in this sense, was viewed as being provided by the nation-state and hence was the state's responsibility. The 1982 report on Common Security[3] demonstrates this stating that 'a secure nation is one that is free from both the fact and the threat of military attack and occupation, that preserves the health and safety of its citizens, and generally advances their economic well-being' (Independent Commission on Disarmament and Security, 1982). This places the framing of security in the interest of the state and not the individual. This report also mentions that, amongst other drivers, the access and distribution of natural resources plays a role in the manifestation of conflict situations. This prompted the beginning of the widening of the security concept at this time (Brauch, 2008); creating an association between environmental events or resources and conflict or political and economic instability, with resource insecurity being correlated with the potential of armed conflict or civil unrest (Fischhendler, 2015; Gerlak & Mukhtarov, 2015).

This was the specific argument made by Myers in 1984 for the inclusion of environmental security in the 1987 Brundtland Report (Myers, 1993). In this report, *security* is mentioned prolifically – many times with reference to national security, political unrest, and international tension – notably moving away from violent conflict to political negotiation as the link between armed conflict and water disputes was contested (by Gleick (1993), for example). Resource security therefore evolved to include environmental security as an extension of political and military security,

[3] This was a report of the Independent Commission on Disarmament and Security (also known as the Palme Commission), a body set up by Olof Palme, published during the midst of the Cold War.

responding to threats from ‘the growing impacts of environmental stress - locally, nationally, regionally, and globally’ (Brundtland & The World Commission on Environment and Development, 1987).

A few years later, in 1992, The Dublin Statement on Water and Sustainable Development presented four guiding principles on water, specifically addressing water scarcity, that explicitly use the term *threats* when outlining concerns for water management. This connects with the previously mentioned traditional meaning of security that is rooted in forms of protection – safety from danger and threats. Most importantly, this report not only recognises water as having a duality as both a finite resource and an economic good (ICWE, 1992), but also recognises access to water as a human right. These two fundamentals of The Dublin Statement created another intellectual shift in addressing the approaching global water crisis (Wutich et al., 2022a) whereby water resources are observed as connected with agendas outside water’s physicality.

This discourse change in the 1990s, that placed contributions to resource security outside of the purely physical, is referred to by many as a paradigm shift that moved security from (nation-)state focus to the individual (Marhia, 2013). A shift that ran in parallel to developments in welfare economics at the time, particularly the introduction of the countering capabilities approach by Amartya Sen[4] and Martha Nussbaum that critiqued and provided an alternative to welfare economics. This brought individual well-being and social justice into the discourse of human security (Sen, 1995); contributing to human security are dimensions of health security, environmental security, community security, and global political security. Here, it appears that ideas of resource security ultimately break away from the link with military security by enforcing that human security comes from development and not ‘in arms’ (UNDP, 1994). This seems to also be reflected in the water security discourse at the time, at this point becoming united with human security and the securitization of environmental issues (Cook & Bakker, 2012; Staddon & Scott, 2018).

[4] See Inequality Re-examined (1995) and Development as Freedom (1999) by Amartya Sen.

2.1.3 The water security (r)evolution

Following the rising discourse in the 1990s on human security, and its links with water, the start of the 21st century saw a huge increase in water security literature and initiatives. The Second World Water Forum in 2000, following the UN Millennium Summit, paved the way for many of these. Participants of The Second World Water Forum pledged themselves to a common goal of providing water security (Barnaby, 2000) with the resulting document of this forum (The Ministerial Declaration of The Hague on Water Security in the 21st Century, also known as The Hague Declaration) stating 'together we have one common goal: to provide water security in the 21st Century'. Other important water security documents were also presented at this forum, such as The World Water Council's *World Water Vision*, The Global Water Partnership's *Towards Water Security*, and Water Supply and Sanitation Collaborative Council's *A Shared Vision for Hygiene, Sanitation, and Water Supply* (Lundqvist, 2000).

Within these various documents, a meaning of water security emerged that was more than just an interest in avoiding the outcome of water scarcity based on purely physical factors (perhaps a consideration based on similar evolutions of resource security as mentioned previously). For example, impairments to security expanded to include threats to: drinking water supply systems, economic growth and human livelihoods, water-related hazards, water-related ecosystem services, and increased hydrological variability in the context of climate change (Bakker, 2012).

Consequentially, the phenomenon of water insecurity at this time shifts to being placed on water resources management and not water availability. This is demonstrated by the World Water Council's *World Water Vision* directions for action such as: integrated water resource management replacing fragmented management; participatory institutional mechanisms; and political will and behavioural change (World Water Council, 2000). A narrative of tackling water security through water management at different actor levels also appears in various water security targets, such as those in The Global Water Partnership's *Towards Water Security*, that reflect water's role in sustainable development, suggesting that these set a baseline for governments to create their own water security targets, indicators, and monitoring. Throughout the documents presented at the World Water Forum in 2000, there are

consistent recounts of the balance between protecting water as a resource whilst fulfilling social needs and economic development, with human action notably influencing an aspect of environmental security (water security) that underlies wider social and economic security (GWP, 2000; WSSCC, 2000).

An ultimate reflection of the proceedings of Second World Water Forum is the solidification of the role of water management in achieving water security, although it is additionally recognised that achieving water security is also a form of management power struggle between the sexes, communities, local governments, localities and national governments and national regimes (Barnaby, 2000). This links back to critical philosophical ideas of security being ‘not just a public good, but an institutional field of power, in the reproduction of structuralist inequalities, violences, and insecurities’ (Marhia, 2013).

2.1.3.1 Rapid uptake

The 2000 UN Millennium Summit further snowballed discourse around water security and, post-2000, rapid uptake of water security began and permeated across policy, academia, and development, engulfing multiple disciplines and dominating a variety of debates. Running in parallel to the growing water security discourse, was also the continuous development of elements of human security, as previously mentioned, that began to include water issues. For example, the launching of the 2001 UN Commission on Human Security included many aspects of water issues (e.g., water shortages, clean water supply and sanitation, and access and equity of water resources) as direct the threats to human security (Commission on Human Security, 2003).

The following 2003 World Water Forum in Kyoto stuck with the water security narrative. Exploring this discourse in terms of financial flows and management, reduction in poverty, and again major water resources management reform. Following this, the 2006 World Water Forum in Mexico discussed developing a threshold that countries must acquire to achieve water security which was scoped to include: investment in water infrastructure; strengthening of democratic institutions; and involvement of indigenous groups and marginalised communities (World Water Council, 2006). Other consequential institutional documents and reports that followed also adopted this particular framing of the water security paradigm (e.g., UN World

Water Development Reports from 2003 onwards; The GWP 2009-2013 Water Strategy; 2009 OECD Water Security and Pro-Poor Growth; and the 2013 UN Water Security and the Global Water Agenda Report).

The steady stream of this water security discourse throughout the early 2000s – largely directed by multilateral organisations – encouraged academic literature to follow suit. Arguments around the inclusion of virtual water and nexus dynamics in the water security discourse were presented (see Allan, 2003; Kumar & Singh, 2005) as a means of understanding the broader externalities of water security. Related to this was the development of links between other forms of security recognising that 'water is not just a technical issue but in fact a key component of both society and the life support system' (Falkenmark, 2001). Water security became entangled with other sectoral securities such as food security, national security, and development, as well as energy security, climate security, community security, economic security, and ecological/environmental security (Zeitoun, 2011; Bakker et al., 2013; GWSP, 2018; Xia et al., 2007; Falkenmark, 2001).

Adding to the water security discourse at this time was also the increasing concern of the combined effects of climate change with other various global changes (increasing population, urbanisation, resource degradation, and economic development) as these presented a severe threat to water security at various levels (Alaerts & Dickinson, 2008, p.42-55, pp.212). Climate change concerns included impacts on the hydrological cycle leading to flooding, drought, and rainfall variability causing critical pressures and challenges for water security (GWP, 2009; Pandey, 2010; OECD, 2011) therefore making climate change strategies and policies for water security imperative (World Water Council, 2018).

The 2008 IPCC report *Climate Change and Water* stressed the likely increase of water security problems over the next 20-years linked to both hydrological **and** water management factors related to these concerns (IPCC, 2008). Additionally, the 2008 OECD *Natural Resources and Pro-Poor Growth: The Economics and Politics* report also observed the potential unequal global distribution of climate change impacts on water security. With areas that were challenged by water insecurity caused by climate seasonality, variability and/or rainfall extremes without the capacity, institutions, and infrastructure to manage and mitigate these, being the most

hindered (by climate change vis-à-vis water insecurity) in terms of sustained socioeconomic development (OECD, 2009). Both of these IPCC and OECD reports complemented the earlier 2006 UN Human Development Report *Beyond scarcity: Power, poverty and the global water crisis*, agreeing that water (in)security was rooted in power, poverty and inequality, not in physical availability (UNDP, 2006, pp.2).

At this point, the paradigm of water security begins to represent a multidimensional 'interconnectivity challenge' whereby considering the links between various securities and the relevant actions and policies become as crucial to human security and development (WBCSD, 2006) as elements of water security themselves[5]. However, it also becomes recognised that these newly established relationships between water security and other securities were not always complementary. The values and priorities within various notions of security were not necessarily compatible, and tension from trade-offs was created; pursuing one form of security often undermined another and this incompatibility became the real challenge of water security (Dimitrov, 2002; Bakker, 2012).

2.1.3.2 The top of the international agenda

By the end of the first decade of the 21st Century, there was a high diversity of water security literature, and arguably water security by this point had gained a large amount of its breadth and depth. Aided by growing Malthusian worries (Allan et al., 2012), this paradigm had worked its way to the top of the international resource management agenda. However, despite this international and institutional recognition, it was still being referred to as an emerging paradigm (see Cook & Bakker, 2012). There was no universally accepted definition of water security, apart from the general reflection of a country's ability to function productively in the face of water vulnerability (UNESCO World Water Assessment Programme, 2012). Multiple definitions of water security existed, creating a divergence amongst those that used it for water-related issue framings (e.g., scholars, policy makers, international organisations) and hence disparities in analytical approaches and recommendations (Cook & Bakker, 2012) were common.

[5] This is a similar theme in the SDGs, for example, where the links between goals and sub-goals are just as important as the goals themselves.

In 2012, the United Nations Conference on Sustainable Development (Rio+20) took place in Rio. Acting as another catalyst in the global solidification of water security, this conference launched the 2015 Sustainable Development Goals (SDGs). Consequently, the 2013 UN *Water Security and the Global Water Agenda* report was produced, providing possibly the most universally used working definition of water security: ‘the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socioeconomic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability’ (UN-Water, 2013). This report explored water security in several dimensions, demonstrating its complex, interconnected nature as well as an being an umbrella term for framing a number of water-related issues. By attempting to engage with the complexity of water security, previous thinking around resource and human security were integrated into water security; namely that many water security dimensions lay outside the water realm and therefore addressing water security required interdisciplinary collaboration across sectors, communities, and political borders (UN-Water, 2013).

This definition of water security was produced in preparation for the 2015 SDGs, particularly for the SDG related to water (UN-Water, 2013). This became SDG6 ‘Ensure availability and sustainable management of water and sanitation for all’ which does not directly mention water security in its targets and sub-goals; however, the later released UNESCO *Water Security and the Sustainable Development Goals* describes the meeting of the SDG6 targets as part of the water security process (UNESCO, 2019). To maintain this process, The Global Water Security Partnership (GWSP) was launched in 2017 as 5-year international partnership to support countries in meeting SDG6 targets (GWSP, 2018).

2.1.3.3 A not-so-neutral paradigm

After the 2015 SDGs, water security initiatives and research appeared to be somewhat split between a risks and hazards-based approach and a hydrosocial approach in academia and policy (or perhaps, put more aptly, reductionist versus integrative approaches as demonstrated by Zeitoun et al., (2016)). With the latter, the water security discourse brought in elements of hydrosocial cycles, capabilities, and

political economy and ecology perspectives in an effort to disrupt the main criticisms of water security at the time. These were namely the apolitical[6], environmentally deterministic aspects of the water security discourse (Loftus, 2015), leading to the paradigm's role in constituting prevailing social power relations (Hidalgo et al., 2017).

These criticisms point to water security not only being associated with water management and environmental pressures, but also with power relations and competition between political and socioeconomic interests (Bakker & Morinville, 2013). Within this, it becomes apparent that the adoption of water security is not neutral, and reflections for whose security was being sought through what agendas and power dynamics became more considered. The apolitical nature of existing water security discourse was therefore rejected by some, and water security was described as a socio-political tool (Radonic & Jacob, 2021) that failed to represent local context, masked variations in local disparities (OECD, 2013; Vörösmarty et al., 2010), and did not account for the role of politics and power in reproducing water inequalities (Loftus, 2015). Additionally, the environmentally deterministic side of water security was exposed for promoting territorial agendas through the association between state stability and more capability to store water (i.e., increased storage is equal to increased wealth, and vice versa). In this sense, some argued that the water security paradigm was being used to solidify the nation-state and fuel geopolitical circumspection between communities under water grabbing initiatives (Loftus, 2015).

Water security was seen by some as a vessel for maintaining regional power positions and controlling access to water in multiple ways through investments in land and water resources (Allan et al., 2012). This was reflected in the dominance of global market conditions and, largely western, economic stakeholders, and global processes (such as trade, food security, policy, and foreign direct investment in land) (Allan et al., 2012) in the water security discourse. Additionally, global aggregated water security indicators and mainstream water security discourses were, in some cases, rejected on the premise of the misrepresentation of local context and unaccounted inequalities. Water security was therefore observed as being an

[6] Whilst the political nature of water security that was initially mentioned in the proceedings of Second World Water Forum, this dimension failed to come through in the consequential solidification of the term.

important force constituting prevailing social power relations and a paradigm existing in a socio-political arena whose (insecurity) outcomes were felt hardest by the socioeconomically and politically less powerful (Hidalgo et al., 2017).

As a response to these criticisms, the context specific significance of water security initiatives was emphasised. The importance of incorporating community context in the understanding and employment of water security was imperative for emphasising the diversity in types of social relations, worldviews, ontologies, traditions, and gender relations for water security (Gerlak et al., 2018; Jepson et al., 2017). This can be seen in the political economy framing of water security, bringing in ideas for producing sustainable environments that require an integrated approach for water between health and sanitation policy, ecological considerations, socioeconomic processes, planning and governance systems, and other sustainability-related processes (Swyngedouw et al., 2002). Additionally, the addition of hydrosocial frameworks offered more potential to unite actors under a common umbrella of water security than with physical-risk-hazard based approach by including human values and perceptions, problem framing, and the challenges of governance, power, and policy in a context of high future uncertainty (Wheater & Gober, 2015).

2.1.3.4 The institutionalised securitisation of water

Towards the end of the second decade of the 21st Century, the academic field of water security seemed to be less about utilitarian physical water availability and more about the nature of water-society relations (see Jepson et al., 2017). However, the main narrators of global water security still appeared to be international and multilateral organisations with specific interests in development and nation-state building – shaping the discourse up to this time as a sectoral concept of human security governed by international initiatives – hence solidifying water security in the institutional arena. This arena was largely dominated by global western agro-food corporate powers within the European Union and United States (Allan et al., 2012), perhaps the reason why water security has been referred to as an idea, or ideal, of universal water security from global north high-income countries preserved by global development reports (Radonic & Jacob, 2021).

In addition to this, Staddon & Scott (2018) observed that water security was being enshrined by cooperations whose interests extended beyond water trade (e.g., goods

companies such as Coca Cola, Nestlé, and water services such as Veolia). Reflecting that commercial interest in water security was being created from the link between cooperate risk associated with wider societal insecurities (Bakker et al., 2013, Ch. 14). This institutionalised securitisation of water had an observable impact on decision making and water security was being used as a hoax for more powerful actors to influence water management in their favour (Fischhendler, 2015).

In many cases, however, the water security discourse at this time still largely referred to older themes created by large multilateral organisations, such as: targets of an adequate, acceptable, or basic level of security. This, as pointed out by Beck and Villarroel Walker (2013), then raised questions of a water security: acceptable to who; according to which socioeconomic contexts; and, arrived at through what socially legitimate process? Even with the observed split in reductionist and integrative water security, as aforementioned, the question of whose security was being sought and who was the subject of water security was still a mainstream debate (Loftus, 2015).

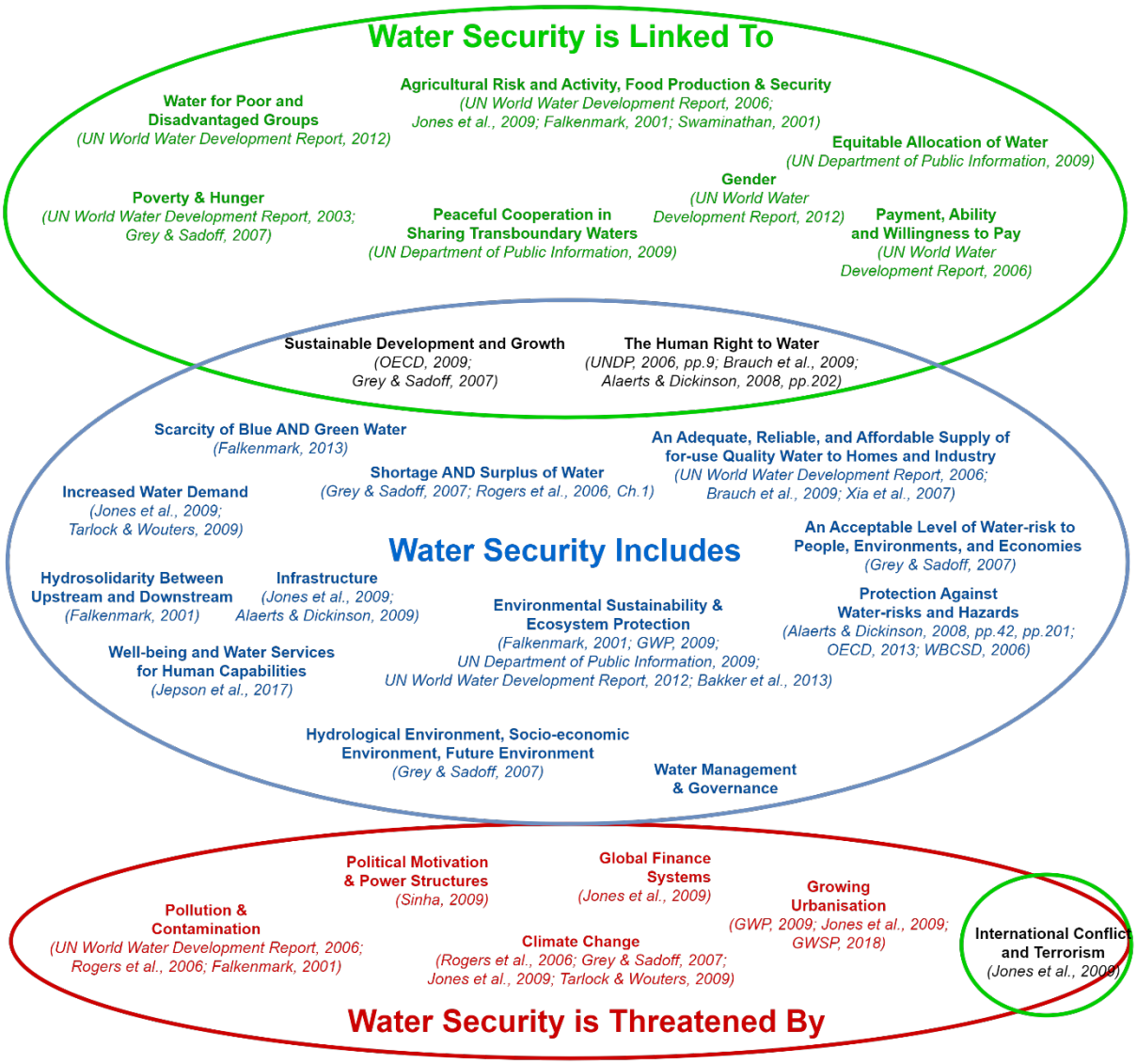
2.2 The current global water security interpretation

As demonstrated, the globalization of politics and environmental issues have caused recognisable ideology shifts in resource security over time which are also reflected in the parallel water security discourse, pushing the water security paradigm outside of purely physical descriptions of supply and demand. Observably, a large part of these shifts in the ideology of water security came from the shifts between subjects and referents, moving from the nation-state to other referents over time; with both the state and civil society being key actors in environmental management (Staddon & Scott, 2018). With this shift, water security appears to be accepted as a heterogenous phenomenon based on relationality and justice rather than a state-oriented focus on economic and political securitisation (Wutich et al., 2022b). Even though the environmental deterministic aspect of water security can still be seen in current policy (Zeitoun, 2011) in the priority of investment solely in water storage to ensure future water security (e.g., GWSP, 2020, pp.3; Dopico et al., 2022).

The inclusion of relationality and justice to current water security discourse brings in socio-political relations and social value to the achievement of water security, or perhaps better phrased as the phenomenon of water insecurity. To tackle water security as a socio-political framing, further understandings of water security's heterogeneity and contextual diversity amongst local stakeholders is required to be acknowledged through intersectional research, and recognition that water security is both a historical reflection and a product of prevailing social power relations (Hidalgo et al., 2017; Radonic & Jacob, 2021). Part of this also includes the empowerment and recognition of different communities at all levels, strengthening the link between the achievement of water security with water justice (see Wade, 2018).

Examining the current discourse around water security appears to conclude with a water resources management paradigm owning multiple dimensions and interpretations. Additionally, possessing characteristics of nestedness across multiple extents; direct-indirect, macro-micro, technical-political, and peace-conflict (as described in Varis et al., 2017). As a result, water security has become almost uncontainable as a concept, having formed links with many other dimensions and disciplines (demonstrated in Figure 2).

Figure 2. Water security interpretations and dimensions across literature[7]



[7] See additional references (UNESCO World Water Assessment Programme, 2006, 2003; Jones et al., 2009; Tarlock & Wouters, 2009; Swaminathan, 2001; Sinha, 2009; Falkenmark, 2013; Rogers et al., 2006)

2.3 The framing of water security for this thesis

As mentioned in the introduction of this chapter, a re-definition of water security is not sought here. Many singular definitions of water security already exist in literature and none seem to fully include or represent all the multidimensional, intersectional, and interconnected aspects of water security as demonstrated by this review of the discourse. It is the opinion of the author that the reductionist nature of a singular definition would not remain true to the complex, systemic nature of water security. This could be detrimental to the pursuit of water security and, indeed, the effectiveness of the water security paradigm in water resources initiatives is largely a direct result of which of its many definitions is considered and by who (Varady et al., 2021).

Considering the variety of water security dimensions and interpretations collected in the previous sections, as well as a reflection on how the paradigm has evolved over time, the broadest interpretation of water security can be viewed as an intersectional, multidimensional, complex state – governed by power, ontology, world views, and institutional history. The approach to problem solving for water security must therefore establish and explore relationships, chains of events, organisations, and structures, to map solutions rather than chasing a singular binary answer. To expand on this perspective, the following three key statements explain the fundamental framing of water security taken by this research. Moving forward, these statements guide the consequential research, the framing running throughout the thesis as core to observation, analysis, and reflection.

2.3.1 Statement 1: water security as defined by physical water insecurity

Water security can be defined by the relation to its supplement[8]; the threshold of water security being known through the experience of physical water insecurity. This is a largely physical and material relationship with water where water security is sought through the obtaining and securing of water as a material object (Jepson et al., 2017). This extends to elements of the hydrological cycle (water in the ocean,

[8] As described by Edkins' the logic of the supplement; water security therefore contains within itself a duplicity of meaning which incorporates opposites; 'an inessential extra added to something complete in itself, but added in order to complete, to compensate for lack of what was supposed to be complete in itself … [therefore] it is both inessential and essential' (Edkins, 1999, pp.70).

land surfaces, water bodies, and atmosphere at a variety of geographical scales), water flows through landscapes and infrastructure, patterns of allocation (from water resources utilisation and development), physical manipulation through infrastructure, environmental science objectives and outputs, and physical policy design (Budds & Loftus, 2014; Budds, 2009). Additionally, elements of economic processes where water, as a material object, can be transformed into a commodity; the transformation of water (as H_2O) into profits and capital accumulation by institutions to achieve economic objectives (Swyngedouw, 2005).

This can be demonstrated through water insecurity resulting from global processes such as climate change, growing populations, and increased domestic and industrial demand. Additionally, escalating energy consumption, mining, urbanization, deforestation, migration of people (Singh, 2017), and political mandates that govern distribution and water management. These physical characteristics are spatially and temporally variable and are influenced other processes such as social, economic, political, and environmental cycles.

2.3.2 Statement 2: water security as a social and political practice, process, and value

Water security is inherently social; the threshold between security and insecurity being an expression of embedded social relations within the environment, as well as multiple forms of value in water (use value, exchange value etc.) (Budds, 2009; Loftus, 2007). Additionally, water security is central to socioenvironmental functions at various levels, e.g., for livelihood, recreation, ecosystem services, environmental security, and joy of life (Spring, 2020) as well as being a state of being. The pursuit of water security therefore includes those that are securing water as H_2O, but also those that are pursuing other forms of water security through socio-nature, socio-hydrological, and socio-political relationships (Budds, 2009; Loftus, 2007; Jepson et al., 2017). With this perspective, water security cannot be uniform due to it being a product of the relationship between context and individual/societal value systems; it is determined by the relationship between a referent and water under a range of possible futures. Therefore, it is not a principle that can be homogeneously achieved on a global scale; there is not one holistic water security due to it being an account of a particular type of entity.

Water security is also inherently political; governance structures help actors pursue their water security. Actors that interact with water governance systems can create (or block) the ability to pursue water security priorities. Governance systems also reflect who is involved in, and responsible for, pursuing water security and how the structure for this is created through natural resources management. The bureaucracy surrounding the pursuing of water security can also be seen as an instrument of social power amongst actors (Budds, 2009). In this sense, water security is a political practice that is determined by subjective definition and legitimisation of dangers to security dimensions and is responded to with legitimatised action in a similar vein. Water security agendas are therefore entwined with power dynamics[9]; security, in many aspects, being driven by an egotistical desire for being secure in power or wealth. At the higher level, attracting national and international interest.

2.3.3 Statement 3: water security as indivisible from human security and justice.

Water security is intrinsically linked to human security, water justice (see Wade, 2018), empowerment, and global development (Ait-Kadi, 2016; Garrick & Hall, 2014, pp.616). It is a cross-sectoral security concern for all people in all aspects of their lives; health, education, hunger, malnutrition, environmental hazards, social vices or even lack of political spaces (Woldetsadik, 2015). As a result, the failure to achieve water security will disproportionately impact marginalised groups, as those who are less able to pursue their water security and claim water justice. The link between water security, water justice, and human security highlights the crucial role and need for achieving water security within comprehensive developmental frameworks that endeavour to address specific water security challenges in society (Woldetsadik, 2015). Water security initiatives must therefore move away from current narrow and instrumentalist framings adopted in water security programmes, and towards a more ‘relational and processual framing of empowerment that engages with structural and social change’ (Leder et al., 2017).

[9] Where there are multiple entities, the diverse instances of what it means to be water secure may sometimes compete. In competition, more powerful can assert themselves in the decision-making arena to steer the security agenda in their favour.

Water insecurity also hinders the capabilities of individuals and communities. The ideas of capabilities and functionings were brought into the water security discourse by academics such as Jepson, Wutich, Harris, and Budds to incorporate a broader understanding of hydrosocial relations opposed to simply water access and environmental and economic services (Jepson et al., 2019). Jepson et al., (2017) suggested that water security needed to be thought about 'in its broadest sense: securing the ability to engage with and benefit from the sustained hydrosocial processes that support water flows, water quality, and water services in support of human capabilities and wellbeing'. Therefore, water security is more than a product of socio-physical interactions – it is fundamentally linked to well-being, agency, human security, justice, and corresponding freedoms.[10] (Sen, 1985; Jepson et al., 2017; Clark, 2005; Robeyns, 2015). As capabilities are a set of accessible or achievable *doings* and *beings* required to meet aims, objectives, allegiances, obligations, and moral directions deemed important – and the freedom to choose amongst these (Sen, 1985; Fia & Sacconi, 2019) – there is individuality of what is regarded as important by different actors.

[10] Well-being freedom is defined by Sen as the capability of a person to have 'various functioning vectors (a set of ways in which a person functions through various *doings* and *beings*) and to enjoy the corresponding well-being achievements' and agency-freedom as 'what the person is free to do and achieve in pursuit of whatever goals or values he or she regards as important' (Sen, 1985 - brackets added by the author).

Chapter 3. Understanding systems thinking: a review of the spectrum of approaches and fundamental concepts

"…we have been compelled to investigate 'parts' and to discover what things are parts of the substance, and what are not."

(Aristotle, Metaphysics. VIII, 8, 1042a, 350 B.C.E)

"We can't control systems or figure them out. But we can dance with them!"

(Meadows, 2001)

This thesis attempts to contribute to the fields of both systems thinking (used interchangeably with systems approach) and water security; using systems concepts to understand how to better represent, interpret, and understand water security for water resources governance. To investigate the specific water security interactions amongst actors in Addis Ababa, a systems approach is used that draws on different elements and interactions of water issues, seeing how these interrelate and function to create the phenomenon of water (in)security. This chapter therefore puts systems thinking into a theoretical perspective; providing the theoretical base for the systems approach used in this research.

A system can be interpreted in several ways: a group of at least two things (elements) that are interconnected, hierarchically organised, and interrelated; interactions between elements that create a complex whole and produce dynamic behaviour and outputs; a set of connected elements that respond to inputs and external forces, and are themselves a sub-system of a larger system; and, an aggregation of things, interactions, and behavior that exist in the context of an environment (Oxford English Dictionary, 2023; Steeg, 2000; Meadows, 2008; Arnold & Wade, 2015; Cano, 2003, chap.1; Ackoff, 1971). Systems thinking could therefore be simply understood as using this perspective as a tool to approach a problem where phenomena are explained through the complex behaviour of interrelated parts. Systems thinking is, however, more than this.

The fundamental aspects of systems thinking are often contested due to various interpretations not only among different disciplines, but also for different individuals, organisations, and goal-seeking approaches. These variations are largely a result of

differences in philosophical research paradigms. Some key philosophical foundations, largely themed around trying the understand the ‘whole’, underpin many systems thinking understandings and define the various fields of systems approaches. The formation of the various research paradigms associated with systems thinking are presented in this chapter in order to demonstrate key systems thinkers and movements that contribute to the use of systems in this research.

3.1 A (quick) systems philosophy

Systems philosophy is not the focus of this thesis, but it is worth covering a few brief movements and theorists that have had a large impact on the evolution of systems thinking. Foundational systems ideas stem from observations of living systems and philosophies of metaphysics[11], largely beginning with Greek natural philosophy. Aristotle discusses parts of substance and what causes unity between these parts to form a whole. It is observed that the whole is something beside the parts; the whole is not only a sum of parts, but also that the parts both have meaning and give meaning to the whole (Metaphysics VIII, 350 B.C.E). Democritus' atomism, although criticised by Aristotle (Taylor, 1999, pp.157–234), also saw living things as aggregates of independent material parts (Van de Vijver et al., 2003). Sometime in the future, Descartes and Leibniz used systems as logic to explain how elements interact with their surroundings, largely through spatiotemporal and causal relations, and as sub-systems within systems (Buroker, 2006, p.8; Gaukroger, 2002, chap.4; Guyer & Wood, 2021; Rutherford, 1995, chaps2, 8, 9). These systems perspectives are considered rationalist.

Empiricists, like Hume and Berkeley, criticised the rationalist perspective and rejected the idea of unobservable entities and causal necessity, they relied on observation of these systems in order to be scientifically proven (Mingers, 2000). Hence, causal relationships between inner actions and outer objects were explored but facilitated with the positivist position that systems could only be known through experience, experimentation, and observable phenomena, and crucially that the observation of one event following another did not prove an underlying causal mechanism (Radcliffe, 2022; Oliga, 1988; Mingers, 2006, chap.2).

The proposal that the social and natural world were the same was one of the main criticisms of empiricism, the other being the lack of the *why* in science i.e., neglecting the dependence of scientific theory on human perception (Mingers, 2000) and what science was for. Kant, a critic of both empiricism and rationalism, suggested that causality, observed as reality, is an imposed upon phenomena by human thought; what we perceive as reality is created and organised by the nature of the mind

[11] The philosophy of the study of reality and being.

(Mingers, 2000; Brocklesby & Cummings, 1996; Jackson, 2019, sec.1.2). Hence, scientific theory was part of human perception. Taking this further, inspired by Kantian ideas, were pragmatists – such as Dewey and James – who developed this opposition to empiricism in defining knowledge and truth as outcomes that solve problems; science should always aim to produce useful knowledge rather than understanding (Mingers, 2006, chap.2). This extended to identifying how to best use scientific concepts (such as systems thinking) to create order in a world of chaos (Jackson, 2019, sec.1.5). By this logic, systems could only be considered science if they resolved a problem, and systems approaches would be focused on acquiring knowledge rather than understanding.

Hegel drew on many of Kant's insights, including the idea that our minds impose order on the world (Brocklesby & Cummings, 1996). Hegel's idealist view was that the understanding of the whole system[12] (of reality) would be achieved through the systemic unfolding of partial truths, using a higher abstract holistic perspective that could consider phenomena outside of isolation (Jackson, 2019, p.9; Caulfield & Maj, 2001). However, Hegel criticised Kantian views for failing to account for historical conditioning of human action through customs and institutions (Jackson, 2019, p.9).

This critique of Kant by Hegel, the role of historical conditioning, fed into consequential thinking by philosophers such as Marx, Nietzsche, Weber, and Heidegger. Although, Nietzsche and Heidegger disputed Hegel's view that the systematic unfolding of history and uncovering of partial truths would lead humanity to a better place (Brocklesby & Cummings, 1996). Among these thinkers came the ideas that: (1) the existence of a system is not just a product of the current state, but also the effective history; (2) order does not exist independently of actors in the system and actors must therefore be considered alongside the natural system; and (3) the understanding and interpretation of the system is influenced (or created) by the observer (Oliga, 1988).

A shift in systems thinking took place away from positivist and functionalist orientation (with empiricist methodologies being dominant) as a response to wanting

[12] Referring to the state of Absolute Knowledge, perceived by Hegel as a pre-ordained state where humans can grasp order and control their world, instead of being controlled by external forces (Brocklesby & Cummings, 1996; Jackson, 2019, sec.1.3).

to handle more human and social aspects of systemic problem analysis (Jackson, 2001; Mingers, 2000). The major critiques of empiricism had created a rift between positivists and interpretivists that was reflected in the systems world and birthed soft systems thinking (Mingers, 2000). This drew on the works of theorists such as Derrida, Foucault, and Habermas, in the conditioning effect of governing structures on the way we think and how this gives rise to multiple meanings (Jackson, 2019, sec.4.5). Derrida and Foucault both theorised that different discourses had different constructs and rules of reality, leading to the possibility of an infinite number of relational systems and subjective realities (Jackson, 2019, sec.4.5). Related to this was the role of language and power on the formation and development of knowledges (and systems), power being linked to knowledge in all aspects of social life (Brocklesby & Cummings, 1996; Jackson, 2019, sec.4.5). Furthermore, how some dominant systems representations and interpretations can purposefully exclude, lose, and suppress some knowledges.

These various philosophies and theories have shaped the forming of knowledge and perceptions of interactions, which can be directly related to the forming of systems; systems being an interpretation of reality governed by the philosophies associated with research paradigms, goal-seeking objectives, and disciplines. This has a significant impact on the creation of a systems framing – how we interpret and create a system, how we use this to shape understanding, and how we respond with interventions. The existence of a spectrum of systems thinking is a demonstration of how the philosophies of research paradigms have shaped systems science. Whereby some view the world to be systemic, and others make the process of inquiry into the world systemic; the word systems being ontological or epistemological in providing a means of making sense of the world (Checkland, 2011, chap.4).

3.2 The spectrum of systems thinking

According to Flood & Jackson (1991), four main strands of systems thinking exist based on the philosophical debate between modernism and post-modernism: hard, soft, cybernetics, and critical systems thinking. Hard and cybernetics systems thinking being of modernist orientation; concerned with the role of rationality in a logical and orderly world, where history is unilinear and the future is susceptible to forecast (Jackson, 1991, p.283). Soft and critical systems thinking instead being based on hermeneutic, post-modernist methodologies (Oliga, 1988; Mingers, 2006, chap.2), rejecting ideas of objective truths, universal consensus, and rationality (Flood & Jackson, 1991, chap.14). These strands of systems thinking should be considered on a spectrum, rather than running in parallel and being mutually exclusive.

3.2.1 Hard systems thinking

Hard systems thinking reflects the main features of systemic modernism. It is therefore associated with with positivist (classical operations research, systems engineering, systems dynamics, (RAND) systems analysis) and structuralist (organisational cybernetics, general systems theory, socio-technical systems, modern contingency theory) philosophies. Notable examples of hard systems thinking include general systems theory (GST) and first-order cybernetics, being fundamental in the rise of systems thinking popularity in the 20th century (Jackson, 2019), as well as systems dynamics. These approaches are associated with a problem approach where the end is specified, known, and defined, the system that contains the problem is quantitively modelled, and the systems function is centred around maximising efficiency and performance (Jackson, 1991, pp.283–284).

3.2.1.1 General Systems Theory

GST was first formulised by the biologist Ludwig von Bertalanffy (1901 – 1972) in the 1930s (Mingers, 2006, chap.2; Wilson, 1991) largely as a response to his issues with the mechanistic positivist reductionism present in biology, physics, and psychology at the time (Ramage & Shipp, 2020, p.56; Hammond, 2002).

As part of his studies on organismic biology, Bertalanffy firstly observed that an organism's constituent physiological and physicochemical processes did not explain

complexity and it was ‘necessary to study not only parts and processes in isolation, but also to solve the decisive problems found in the organisation and order unifying them, resulting from dynamic interaction of parts, and making the behaviour of parts different when studied in isolation or within the whole’ (von Bertalanffy, 1968, p.31). From this, he formed ideas of systems centred around wholeness, organisation, regulation, hierarchy, boundaries, and sub-systems that were applicable to a range of disciplines such as biology, economics, chemistry, physics, psychology, and social sciences (Gilbert & Pratt-Adams, 2022, chap.1; von Bertalanffy, 1968).

These observations, recognising commonalities across different disciplines, created general systems principles irrespective of particular kinds of elements, or whether systems were of physical, biological or sociological nature (von Bertalanffy, 1968, p.32). Lastly, and perhaps most notably, Bertalanffy pioneered the concept of an open system (Hammond, 2002; Ramage & Shipp, 2020, p.55) being a system that maintains and regulates itself to attain a steady state through exchanges with its environment, inputs and outputs, and the building-up and breaking-down of constituent components (von Bertalanffy, 1968, p.141).

Other key actors in the development of GST were Kenneth Boulding (1910 – 1993), Geoffrey Vickers (1894 – 1982), and Howard Odum (1924 – 2002). Boulding and Bertalanffy worked together in founding the Society for General Systems Research, Boulding being the only founder not trained in biology, he was instead an economist interested in ideas of emergence at different levels of systems organisation (creating the levels of systems in Table 1) as well as the nature of social systems and the role of perception and values in decision making (Hammond, 2002). Consequently, he contributed to the development of GST through the concept of hierarchies amongst sub-systems, the addition of a phenomenological perspective, and work on integrating the social sciences (Ramage & Shipp, 2020, p.65). Boulding also began to suggest the existence of a systems thinking spectrum in what he termed *special general systems theory* (based on mathematical modelling) and *general general systems theory* (based on philosophical and ethical considerations) (Hammond, 2002).

Table 1. Boulding's Levels of Systems (Mingers, 2000, sec.4.7; von Bertalanffy, 1968, table 1.2; Boulding, 1991)

Level	System Type	Characteristics
1: self-referring	Static structures	Static relations of topology
2: self-influencing	Simple dynamic / clockworks	Dynamic relations of order with pre-determined, necessary, motions
3: self-regulating	Control mechanisms	Feedback relations, transmission, and interpretation are essential parts of the system
4: self-producing	Open systems (cells, flames, rivers)	Relations of self-production and self-maintaining
5: self-recognising	Lower organisms (plants)	Relations of structural coupling between components
6: self-replicating	Animals	Self-awareness, teleological behaviour, increased mobility
7: self-cognising	Man	Self-consciousness
8: self-conscious	Socio-cultural systems	A set of roles tied together with channels of communication; the content and meaning of messages, the nature and dimensions of value systems, the transcription of images into a historical record, the subtle symbolizations of art, music, and poetry, and the complex gamut of human emotion.
9: transcendental	Symbolic systems	Unknowables that also exhibit systematic structure and relationships

Boulding's work on the phenomenology of systems and how mental images were developed within individual and groups across a range of fields had a large impact on Geoffrey Vickers (Ramage & Shipp, 2020, chap.7). Through Boulding, Vickers developed systems methods that focused on the nature of human systems and decision-making at managerial, political, and societal levels. These can be seen through three important contributions: the importance of relationships between people as a way of understanding systems; systems as tools of understanding rather than a precise description of reality; and the concept of the appreciative system (Ramage & Shipp, 2020, chap.8).

The last of these, the appreciative system, is arguably Vickers' most notable contribution to systems thinking. He describes a conceptual system where humans represent, interpret, value, and create the world in which they live; each individual system (be it individual, group, or societal) being unique and containing multiple possibilities for mediating change that have no counterpart in other creatures or organic processes – the mediator of change is 'appreciation' (Vickers, 1968). *Appreciation* is an explanation for the cultural mechanism that maintains desired relationships and eludes undesired ones, creating a system that is a continuous cycle of thought and action 'carved out by our interests, structured by our expectations and

evaluated by our standards of judgement' (Vickers (1972) quoted in Checkland, 2005).

This concept changed GST and later paved the way for the development of soft systems methods by Peter Checkland[13]. Using the appreciative system, there were now three ways of mediating systems change: transfers and transformations; responsiveness; and appreciation. Additionally, the idea of system boundaries being assumed to exist independently of the observer, being one of the main criticisms of GST (Mingers, 2006, pp.73, 86), was now partly addressed using appreciative systems; there was now a need to continually question and review judgements on systems boundaries and during any systems intervention (Reynolds & Holwell, 2010, p.302).

The last significant influence on GST was Howard Odum who, by introducing GST to the field of ecology, popularised the systems idea of an ecosystem. Ideas around ecosystems were developed by Odum in the 1950s as an effort to understand complex behaviour through networks of interaction. He used many existing GST concepts as well as von Bertalanffy's theory of open systems (Jackson, 2019, p.37) in what he called the *macroscopic* approach; 'whereas men used to search among the parts to find mechanistic explanations, the *macroscopic view* is the reverse. Men, already having a clear view of the parts in their fantastically complex detail, must somehow get away, rise above, step back, group parts, simplify concepts, interpose frosted glass, and thus somehow see the big patterns' (H. Odum (1971) quoted in Ramage & Shipp, 2020, p.87: authors italics). In Odum's view, the transfer and transformation of energy in a system was largely responsible for the dynamic behaviour of ecosystems and therefore the best way to view the system (Jackson, 2019, p.37; Ramage & Shipp, 2012).

3.2.1.2 Systems dynamics

The fundamentals of modern systems dynamics (SD) were developed by Jay Forrester in the 1950s; a means of using large-scale simulation to study how feedback loops and time delays affect system behaviour in a non-linear way

[13] Vickers' ideas massively influenced Checkland's SSM, being its major theoretical underpinning and using Vickers' epistemology as an appropriate description of the process of inquiry embodied in SSM (Brocklesby, 2007).

(Reynolds & Holwell, 2010, chap.2). Taking this perspective, it sought to simulate the dynamic behaviours of physical and social processes, using the technology of computers and quantified data, to uncover the various structural relationships that govern systems behaviour: material and immaterial stocks and flows, causal feedback relations, the information and decisions that link them (Mingers, 2006, p.224; Jackson, 2019, p.167).

According to Forrester, four hierarchies of structure were required to create a systems dynamic model: a closed boundary around the system; feedback loops as the basic structural elements within the boundary; level variables representing accumulations within the feedback loops; and rate variables representing activity within the feedback loops (Forrester, 1968). This later developed from *four hierarchies* to *four foundations* of: the theory of information feedback systems; a knowledge of decision-making processes; the experimental model approach to complex systems; and the digital computer as a means to simulate realistic mathematical models (Richardson, 2011). This change in the four fundamentals of SD is thought to be a result of Forrester emphasising an experimental approach to understanding the dynamics of social organisations (Richardson, 2011).

Forrester's SD became particularly popular in systems thinking through the Club of Rome's report *Limits to Growth* (Ulrich, 1988). The report drew on the work of a team of MIT[14] researchers' SD model (based on Forrester's work) of the global system. This model was used to study the future implications of worldwide growth through interrelated components of population growth, agricultural production, food production, non-renewable resource depletion, industrialisation, and pollution generation (Meadows et al., 1972; Jackson, 2019, pp.229–230). The report concluded with several alternatives of future world system behaviour that all ended in 'exponential growth of population and capital, followed by collapse' (Meadows et al., 1972, pp.122–142). The main criticisms of this SD model were insufficient consideration of scientific and technological advances, high sensitivity to initial conditions, and the exclusion of social factors because they were too complex to model (Jackson, 2019, pp.230–231).

[14] The Massachusetts Institute of Technology (MIT) researchers were commissioned by the Club of Rome think tank, funded by the Volkswagen Foundation (Jackson, 2019, p.229).

Donella Meadows became particularly renowned for her role in *Limits to Growth*. She, however, presented some cautions for relying on computer simulated SD models. The first caution was that the use of computers and equations could hide many assumptions and perspectives (Meadows, 2008, pp.3, 172). The second was that the SD model did not provide an answer for prediction and control (Meadows, 2001). The third, was that SD could potentially be more useful to policymakers if it was separated from computers and equations (Jackson, 2019, p.242). She states that 'there is much to be learned about systems without using a computer' and:

> *"You don't have to put forth your mental model with diagrams and equations, although doing so is a good practice. You can do it with words or lists or pictures or arrows showing what you think is connected to what. The more you do that, in any form, the clearer your thinking will become, the faster you will admit your uncertainties and correct your mistakes, and the more flexible you will learn to be."*
>
> (Meadows, 2008, p.172)

The inadequacy of SD modelling being able to deal with complex social problems and dynamics is often a main criticism (Ulrich, 1988; Ramage & Shipp, 2020, p.101), largely a result of the dependence on quantitative computer modelling (e.g., in Forrester's SD model of a city in *Urban Dynamics* (Forrester, 1969)). Forrester points to the limitation of using qualitative data to represent social phenomenon in SD models, saying that in the social sciences 'the numerical information is an extremely small part of all the information that is available… [and] the written database is far more informative about how society operates than the numerically recorded information' (Forrester, 2009, p.12). However, despite the misrepresentation of social phenomenon in computer simulated SD models, overtime Forrester developed SD modelling to be much more participatory (Jackson, 2019, p.239). Forrester demonstrated the importance of stakeholder engagement in model construction so models could contribute to learning and hence increase the chances of bringing about improvement (Jackson, 2019, p.233). Additionally, the use of SD models to model different perceptions and beliefs about events has contributed to the process of group learning and decision making alongside other – softer – approaches (Mingers, 2006, p.237).

3.2.1.3 First-order cybernetics

The term cybernetics came from the Greek word *kybernetes* (steersman), used by Plato in The Republic (360 B.C.E). Whilst Plato used this term to provide an analogy for the steering of the state, his thinking implied regulation and control and hence the term was adopted by the early cybernetics groups (Jackson, 2019, p.3). Plato's *kybernetes* observations have also since been developed to more broadly mean the studying of governance, specifically control, information transmission processes, and self-organisation in different systems (Novikov, 2016).

First-order cybernetics was focused on regulatory issues and systems rationalisation within a modernist evolutionary paradigm, emphasising self-regulation and self-organisation (Ulrich, 1988; Flood & Jackson, 1991, chap.14). The term became popularised amongst systems thinkers in the c.1950s by a group of military-funded mathematicians, engineers, and neuroscientists founded by Norbert Wiener (Gilbert & Pratt-Adams, 2022, p.6). Cybernetics built on Bertalanffy's GST[15], but was further developed (largely by Ashby, Bateson, Beer, and Wiener) to recognise the importance of feedback and communications process on systems (Mingers, 2000, chap.2). Radical constructivism later had a large impact on cybernetics, splitting cybernetics into hard and soft approaches as first-order and second-order cybernetics, respectively (Jackson, 2019, sec.1.6). This section will cover first-order cybernetics, second-order cybernetics is covered in Section 3.2.3.3.

Norbert Wiener and William Ross Ashby are considered to have provided the grounding work for the field of first-order cybernetics with their books *Cybernetics (1948)* and *An Introduction to Cybernetics (1956)*, respectively (Jackson, 2019, chap.6). Wiener, in particular, is considered the founder of cybernetics; drawing on his discipline of applied mathematics, Wiener observed patterns of control and communication in animals, machines, and society, which he later applied to create the fundamentals of cybernetics (Ramage & Shipp, 2020, chap.2). At this foundational stage, cybernetics sought to create an 'interdisciplinary framework that would allow humans, animals, and machines to be constituted through the common

[15] Bertalanffy was, however, keen to differentiate GST, arguing that cybernetics did not account for social change, he further rejected the idea of negative feedback (Ramage & Shipp, 2020, p.56).

denominators of feedback loops, signal transmission, and goal-seeking behavior' (Hayles, 1994).

Cybernetics created two fundamental systems concepts that contributed to the design, operation, and understanding of complex systems: negative feedback and the black box (Jackson, 2019, chap.6). The idea of negative feedback is the continuous feedback of information about the output of a closed-loop system. This allows for continuous reiterative adjustment of the system design which the system can 'use' in order come closer to realising a goal, maintaining stability, and 'correcting its own action' (Wiener, 1950). This system phenomenon is described by Wiener as existing in both animal and machine (Wiener, 1950). For a negative feedback system to maintain control, communication and rapid, continuous operation between four main elements are required: a desired goal, a sensor, a comparator, and an activator (Jackson, 2019, chap.6).

The black box concept originates from electrical engineering but was brought into cybernetics by Ashby who argued that black boxes were a pervasive feature of all disciplines (Jackson, 2019, p.98). The black box was a solution to the existence of complex systems that couldn't be precisely analysed, as their elements and process were hard to observe and define, but they still needed to be controlled. Early cyberneticians used the electrical engineering concept where the behaviour of the black box can be understood by manipulating its inputs and recording the corresponding outputs without knowing the exact nature of a systems causal links (Jackson, 2019, p.90). The black box acted as a solution for complicated internal systems structures and mechanisms, but this only worked when these were very complicated, unknown or negligible within the framework of a given problem (Novikov, 2016, pp.29, 93).

Ashby also introduced the idea of *requisite variety*, a measure of complexity as the number of distinguishable states a system can exhibit (Jackson, 2019, p.99). From observing processes of regulation in biology, Ashby observed that given a set of elements, its variety is the number of elements that can be distinguished, and the higher the variety, the more resilient the system as it can respond more readily to its environment (Ashby, 1991). Additionally, the variety of control mechanisms must be

equal to or greater than the variety of the system to be controlled, so that the system can match the variety imposed on it by its environment (Jackson, 2019, pp.99, 207).

Cybernetics was later applied to the management of organisations by Stafford Beer[16], taking ideas from both GST and Ashby's *law of requisite variety* (Ulrich, 1988). Beer developed the viable systems model (VSM), a diagnostic tool for the operational effectiveness of organisation design; a viable system being one that has the ability to resist, respond, keep an independent existence, and meet demands, under unforeseen environmental changes (Flood & Jackson, 1991, pp.284–285; Reynolds & Holwell, 2010, chap.1). Some classify VSM as a hard systems approach within first-order cybernetics whilst others see it as more interpretivist, suggesting that the concept can be used as a heuristic in conversations between participants in a problem situation or as a way to undermine more powerful actors within a coercive or organisational context (Mingers, 2006, p.237; Reynolds & Holwell, 2010, p.12).

3.2.3 Soft Systems Thinking

Soft systems thinking is largely the group of systems work associated with Russell Ackoff, Peter Checkland, and Charles West Churchman. Soft systems thinking emphasises how to cope with disorganised, messy systems, without reducing them for mathematical or cybernetical models (Flood & Jackson, 1991, chap.14). The difference between a soft and hard system being the difficulty in identifying a limited number of components within a system; soft systems having more variables, relationships, and causal factors (Gilbert & Pratt-Adams, 2022, chap.1).

Soft systems thinking introduced the importance of gaining an increased understanding of theory and its relationship to practice in systems research; hard systems thinking being based on functionalist methodologies, but soft systems thinking being based on phenomenological/hermeneutic methodologies (Jackson, 1982). Soft systems thinking mainly rejected hard systems ideas of assumed objectivity, rationalism, and reality in systems. Notable systems thinking practices include soft systems methodology, critical systems thinking, and second-order cybernetics.

[16] Beer effectively founded management/organisation cybernetics (Reynolds & Holwell, 2010, chap.1).

3.2.3.1 Soft Systems Methodology (SSM)

Peter Checkland pioneered the soft systems methodology (SSM), drawing from Bertalanffy's GST, Beer's VSM, Wiener's cybernetics, and Ackoff's social systems science (Gilbert & Pratt-Adams, 2022, chap.1). Additionally, Vicker's concept of appreciative systems had a considerable influence on Checkland and became a theoretical support in the interpretive SSM (Ramage & Shipp, 2020, p.76; Jackson, 1982).

SSM is an action research methodology used to identify problem situations in project management, organisational development, and information systems development – building on the foundational concepts of emergence and hierarchy, and communication and control (Gilbert & Pratt-Adams, 2022, chap.1). Importantly, in SSM, Checkland differentiates between the 'real world' and the 'systems world' which leads two main critiques of his work: (1) the dislocation between the social and natural sciences; (2) distinguishing situations that require hard systems thinking versus SSM (Gilbert & Pratt-Adams, 2022, chap.1).

Checkland observed that there were wicked, messy, human-activity, problems that were complex, dynamic, and near impossible to control and predict; comprising multiple components and sub-systems, these could only be resolved through holistic treatment (Gilbert & Pratt-Adams, 2022, chap.1). Checkland reflected that these problems required a systems methodology that explicitly faced problems of soft, unstructured problem situations where there were multiple, conflicting values and objectives; an approach that declared the systems observer's worldview and helped them to organise a complex confusing world by engaging with it in a learning system (Checkland, 2011, chap.4; Mingers, 1980). In this sense, SSM is more concerned with exploring a problem, not defining it, using the systems model as an intellectual device to express a situation considered (by some) to be problematical (Checkland, 2011, chap.4). This can be seen in the learning cycle of SSM (Table 2) where the use of the conceptual systems model is significant in structuring debates and taking action.

Table 2. The Soft Systems Methodology learning cycle (Reynolds & Holwell, 2010, chap.5; Mingers, 1980; Gilbert & Pratt-Adams, 2022, chap.1)

The learning cycle of soft systems methodology	
Finding out Initial identification of the problem situation and the characteristics of the intervention to improve it (the issues, the prevailing culture and the disposition of power within the overall situation)	• Consider and recognise the observer's role (the *Weltanschauung*/worldview) • Conduct a, neutral as possible, initial analysis of the problem-content system which will identify a number of human-activity systems and *Weltanschauungs* • For each human-activity system and *Weltanschauung*, produce a root definition[17]
Modelling Expressing different worldviews and transformations through activity models	• Create a conceptual model for each root definition
Using models to structure debate Using the models as a source of questions to ask of the real-world situation	• Compare the conceptual models with each other and with the initial description • Use the comparisons to structure a debate between actors within the situation • Consider different changes and how the new system would be monitored and controlled
Action Using results to improve the situation	• Continuously bring together the results from finding out and ideas for change to find changes that are both desirable and feasible • Social and political analysis should both be considered • Consider that taking action to improve the problem situation changes the situation and restarts the SSM learning cycle

3.2.3.2 Critical systems thinking

Critical systems thinking (CST) came from merging the complementary strengths of social theory and the critical heuristics systems approach (Jackson, 2019, chap.19; Midgley & Rajagopalan, 2021). CST shares the same epistemological shift as SSM but attempts to address the inadequate consideration of power relations (Reynolds & Holwell, 2010, p.10).

CST largely began with the ethical systems work of Charles West Churchman. Churchman found flaws in the rational planning of hard systems thinking which failed to recognise the distinctive purposeful, self-defining, reflexive, character of its human elements and hence had little concern for values and ethics (Ramage & Shipp, 2020, chap.13; Jackson, 1982). Drawing from Kantian ideas, Churchman understood that a system was just a perception governed by a worldview that creates the boundaries of

[17] A concise and comprehensive description of the system and the viewpoint it expresses.

what is inside and outside the system (Ramage & Shipp, 2020, chap.13). This revolutionised systems thinking by arguing that the boundaries of systems were not fixed by reality, but by the knowledge and values of observers; drawn boundaries had the power to exclude people from the system and to shape, define, and govern it (Jackson, 2019, p.558). It is this concept that later formed Ulrich's 'boundary judgments', the fundamental of critical systems heuristics (Reynolds & Holwell, 2010, p.20).

Churchman's ideas on systems boundaries transformed some existing systems approaches to be more focused on stakeholder participation and qualitative dialogue for collaborative learning, but these participative methodologies still did not account for power relationships within interventions (Midgley & Rajagopalan, 2021). An approach to enable planners and participants, using systems thinking, to challenge the unjust political and economic relationships in the environment of the system was needed. This required empowering participants and changing systems to be more socially relevant and societal – these were the basic starting points of critical systems heuristics (CSH) (Ulrich, 1996).

CSH, developed by Werner Ulrich, was the first systematic attempt at providing a philosophical foundation and a practical framework for critical systems thinking (Reynolds & Holwell, 2010, p.20). Its goal was to provide heuristic support to practice practical reason in systems thinking, exposing the normative implications of systems designs and problem definitions, and demonstrating how knowledge depended on value judgements and vice versa (Ulrich, 1987, 1996). This involved: providing systems thinkers with a clear understanding of the meaning, the unavoidability, and the critical significance of system boundaries; providing a conceptual framework that enabled the systematic identification of effective boundaries of argumentation in concrete designs and to trace their normative content; offering a practicable model of rational discourse on disputed validity claims of such boundaries (Ulrich, 1987). The CSH conceptual framework consists of a set of twelve basic types of boundary judgements and questions (see Ulrich, 1996).

CST ultimately set out how a variety of systems methods could be used in combination to create better solutions for complex organisational and societal problems, whilst challenging the explicit and implicit philosophies and theories

underlying systems methodologies (Jackson, 2019, pp.149, 512) as well as value-driven boundary judgements. The fundamental commitments of CST are therefore:

- **Critical awareness** – examining and re-examining taken-for-granted assumptions, along with the conditions that give rise to them
- **Human emancipation** – ensuring that research is focused on improvement, defined temporarily and locally, taking issues of power into account
- **Methodological pluralism** – using a variety of research methods in a theoretically coherent manner, becoming aware of their strengths and weaknesses, to address a corresponding variety of issues

(Midgley, 1996)

- **Social awareness** – recognising that certain systems theories, methodologies, and interventions are made popular and acceptable through social rules and practices by organisational and societal pressures, and that these have consequences
- **Theoretical complementarity** – the complementary and informed development of all varieties of systems approach and recognition that there are limitations to any one framework of ideas

(Flood & Jackson, 1991, chap.14; Flood, 2010, p.279)

3.2.3.3 Second-order Cybernetics

Heinz von Foerster introduced the term *second-order cybernetics* to describe approaches that included the observer as a subject of the cybernetic system under study alongside concepts of autonomy, dialogue, self-organisation, language[18], reflexivity, and subtle intervention (Ramage & Shipp, 2020, pp.14, 18, 22). Foerster drew on the phenomenological aspects of autopoietic theory[19], radical constructivism, and distinctions to shift the attention to the observers and the distinctions they make to bring forth their reality (Jackson, 2019, p.310).

[18] Humberto Maturana introduced the idea of the influence of language in social systems. For Maturana, language was at the core of individuals becoming aware of themselves as observers and observing, interacting in, and making sense of the world through communication of human experience (Jackson, 2019, sec.6.4; Ramage & Shipp, 2020, chap.20).

[19] Maturana introduced the concept of *autopoiesis* which referred to the phenomenon that living systems organised themselves in such a way that their processes are self-producing; they produce the very components necessary for the continuance of these processes hence an autopoietic system is one that maintains itself solely through its own activities (Ramage & Shipp, 2020, chap.20).

Second-order cybernetics built on the idea of 'the cybernetics of cybernetics' – that the practice should engage in self-reflection and use its own methods on itself, extending the idea of feedback to the relationship between the observing system and the observed system (Jackson, 2019, sec.6.4). As a result, second-order cybernetics reinstated the role and influence of the observer (researchers, analysts, agents, and practitioners) on systems thinking and objects of their activity (Mingers, 2006, pp.86, 257). The focus on the observer is fundamental to second-order cybernetics; being aware of the observer and identifying them as part of the system transfers the focus of the system from the object being observed to the combination of object plus observer (Ramage & Shipp, 2020, p.20). As put by von Foerster:

> *"…the cybernetician, by entering his own domain, has to account for his or her own activity. Cybernetics then becomes cybernetics of cybernetics, or second-order cybernetics. Ladies and Gentlemen, this perception represents a fundamental change, not only in the way we conduct science, but also how we perceive teaching, learning, the therapeutic process, organizational management, and so on and so forth; and I would say, of how we perceive relationships in our daily life. One may see this fundamental epistemological change if one first considers oneself to be an independent observer who watches the world go by; as opposed to a person who considers oneself to be a participant actor in the drama of mutual interaction of the give and take in the circularity of human relations."*
>
> (von Foerster, 2003)

3.3 Core systems components

Drawing on the key systems thinking ideas in the previous sections, as well as foundational philosophies, it is obvious that the practice of systems thinking is highly variable depending on the research paradigm(s) adopted. Regardless of this, however, it is possible to deduce some core systems components.

At a basic level we can define a system according to Meadows (2008) and Ackoff (1971); a set of at least two interrelated elements that are organised in a structure that produces a characteristic set of behaviours, the systems elements are interconnected to every other element, directly or indirectly, so no subset of elements is unrelated to any other subset. The idea of interconnected/interrelated organised elements appears to be relatively consistent across the spectrum of systems thinking, being able to be traced back to Aristotle's ideas of related parts and wholes (Metaphysics. VIII, 8, 1042a).

The basic systems concept of elements, interconnections, and behaviour appears to be relatively consistent from Aristotle through to modern system practice. Across the spectrum of systems thinking we consistently encounter elements, interconnections/interrelationships, and behaviour: Bertalanffy's GST describes parts, processes, and behaviour (von Bertalanffy, 1968, p.31); Forrester's systems dynamics describes basic structural elements and behaviour (as feedback loops) (Forrester, 1968); first-order cybernetics observes negative feedback behaviour and resilience in the variety in the number of elements that can be distinguished (Wiener, 1950; Ashby, 1991); Checkland observed that, even in messy problems, there were complex, dynamic behaviours and multiple components and sub-systems (Gilbert & Pratt-Adams, 2022, chap.1); lastly, CST and second-order cybernetics draw on the perspectives of systems behaviours and inclusion/exclusion of elements as a demonstration of different worldviews and expression of values (Jackson, 2019, secs6.4, 20.2.4).

Whilst behaviour is an agreed fundamental of systems[20], what the behaviour of a system is becomes diverse among different systems practice. Bertalanffy, for example, observed that the behaviour of parts was different when studied in isolation compared to within the whole (von Bertalanffy, 1968, p.31). In his perspective of systems behaviour, he created the concept of an open system to explain the self-maintenance and self-regulation that systems undergo to attain a steady state (von Bertalanffy, 1968, p.141). Boulding also observed, in his levels of systems (Table 1), that not only was there self-maintenance and self-regulation, but also feedback and communication; each new system hierarchy demonstrated a more complex form of behaviour compared to the last – a concept called emergence. Ideas of self-regulation and self-organisation behaviour in systems are shared between first-order cybernetics and systems dynamics, as well as behaviours of feedback, control, and communication.

This framing of systems behaviour (self-regulation and maintenance, feedback, control and communication, and emergence and hierarchy) are largely adopted by hard systems thinking methodologies. Although, the causes behind these behaviours were disputed within hard systems approaches. Odum's GST view explained dynamic behaviour by the transfer and transformation of energy, for example (Jackson, 2019, p.37; Ramage & Shipp, 2012). On the other hand, SD perspectives, such as Forrester's, considered dynamic behaviour to be a product of stocks and flows, causal feedback, and information and decisions between these (Mingers, 2006, p.224; Jackson, 2019, p.167).

In soft systems thinking, the idea of systems behaviour is different. Even though some systems thinking approaches, such as SSM, build on the behaviours of emergence and hierarchy, and communication and control (Gilbert & Pratt-Adams, 2022, chap.1), the consideration of the social alters the preconceptions of what systems behaviour looks like. The social world is seen to be full of soft, unstructured problem situations where there are multiple, conflicting values and objectives, the behaviour of the system is therefore an observer's worldview and not an objective

[20] The behavior of systems is agreed in the sense that systems exhibit behaviour. Across systems thinking approaches there is also agreement in behaviour being the nature of the system, differing between complicated, complex, and chaotic systems (see Van de Vijver et al., 2003).

reality. This is in line with some philosophical ideas that put forward the idea that our minds impose order on the world e.g., Kant and Hegel (Brocklesby & Cummings, 1996). For these reasons, behaviour is a subjective product of the observer that requires critical reflection and not an objective output of the system (as is the case in hard systems approaches). The behaviour of a system therefore reflects the views that either the world is ordered, logical, and rational or messy, unstructured, and irrational.

The next commonly disputed system fundamental is environment and boundaries, which are related in their defining of the context of the system; in order for a system to be recognisable it must be bounded in some way (Cilliers, 2001). The first dispute of this is between the open and closed system model. Bertalanffy pioneered the open system model, one that can maintain and regulate itself through exchanges with its environment. Whereas closed systems, used in systems dynamics for example[21], are separate from their environment and its influences – often related to more positivist thinking – where conditionals on hypotheses are known and controllable (Barton et al., 2009). In both representations of systems we also find primary and secondary boundaries. The former being the boundary that is most obvious or traditional, and the latter being the boundary that allows recognition of the significance and effect elements outside the system being defined (Midgley, 1992).

The most notable dispute on environment and boundaries, however, come from soft systems methods that critique the drawing of a boundary (boundary judgements) in how it defines what is included and excluded in the system (Midgley, 1992). This is a central concept in both SSM and CSH. Ulrich's boundary critique in CSH stresses the importance of 'reflective practice and the need to address issues of power implied though our boundary judgements' and how the choice between different boundary judgements is also a choice between different ethical concerns (Reynolds & Holwell, 2010, p.18; Midgley, 1992). Ulrich argues that the facts we observe and values we judge depend on our reference system and reflect our boundary judgements, this can also happen in reverse where the changing of system boundaries can change our facts and values (Ulrich, 2000).

[21] Forrester included a closed boundary around the system as one of the four hierarchies of structure required to create a systems dynamic model (Forrester, 1968).

Lastly, is the relationship between the observer and the system – another fundamental of systems but, again, heavily contested. This is partly linked to the idea of Ulrich's boundary judgments in that the observer of the system is the creator of the system, imposing their own structure on reality. In this sense, order does not exist independently of actors in the system and actors must therefore be considered alongside the natural system (Oliga, 1988). The role of the observer, again, becomes particularly important in soft systems thinking: SSM declares the observer's worldview; CST explores how the boundaries of systems are fixed by the knowledge and values of observers; and second-order cybernetics includes the observer as part of the system. The common thread through all of these is that each observer interprets the system differently, giving shape to the system that means it cannot possibly be an objective reality. Although, even this idea can be traced back to some of the very beginning of systems thinking:

> *"The truth probably is that "part" has several meanings…"*
>
> (Aristotle, Metaphysics. VII, 7, 1043b, 350 B.C.E)

The fundamentals of systems are therefore not simply elements, interconnections, and behaviour. But also, subjective behaviour, boundaries, and perspectives. What is considered inside and outside the system, by boundary judgements, can be dependent on many factors that must be explored in the interpretation and understanding of systems. Pragmatically, therefore, the *right* system is arguably not one that holds objective truth, but one that is fit for purpose considering the many theoretical, cultural, and subjective ingredients that go into its conception.

3.4 Exploring water security using a systems approach

Chapter 2 presented three statements on water security: (1) water security as defined by physical water insecurity; (2) water security as a social and political practice, process, and value; (3) water security as indivisible from human security and justice. Among these three statements water security not only exists as a physical and social phenomenon, but also a phenomenon of injustice, disempowerment, and wider systemic inequalities. A systems approach for understanding water security therefore appears appropriate for exploring water security in its ability to consider its interconnected and complex nature.

In order to refine how this research will *take* a systems approach, suitable systems fundamentals will be drawn from the discussion in the previous sections of this chapter. The systems fundamentals taken from the review are; open systems, boundary judgements, and methodological pluralism. The reflections and justification behind each of these are discussed in the following sections.

3.4.1 The open system

As previously mentioned, open systems are those that interact with their environment and self-regulate and self-maintain through exchanges with it – a system does this to try and attain a steady state. The reason that this is argued as being an essential systems component to investigate water security, is that the open system model not only allows for these exchanges and interactions with the system's environment, but also allows for consideration of the influence of other systems' boundaries as well as the wider social environment (Ulrich, 1988). This has made, for example, the model of an open system one of the core fundamentals in the socio-ecological systems[22] (SES) approach (Barton & Haslett, 2007); the open system model is integrated with theory and practice (where practice involves important human societal and organisational concerns) to understand socio-ecological phenomena by

[22] The Tavistock Institute developed the use of open systems to understand the processes behind the influence of agents on the environment. This was originally conceived as *social ecology* by Fred Emery (Barton et al., 2009) but was developed by Emery and Eric Trist into the field of socio-ecological systems (SES) (Barton & Haslett, 2007).

demonstrating how agents both learn from and influence the environment[23] (Emery, 2000; Barton et al., 2009).

The open system model allows for the transaction between system and environment through four foundational parameters: all components are governed by known laws; the system acts on the environment through planning; the environment acts on the system and is known through the process of learning; the laws that govern the system and the environment are implicitly learnt about through understanding the SES (Emery, 2000). For understanding water security, the use of an open system model can inherit the same concepts associated with its use in SES. Specifically, the considerations of: the bidirectional exchanges between internal system actors and the external environment; the environment being both physical and social; asnd that systems change also happens inside an environment that is itself changing towards complexity (as observed by Emery & Trist (1965)). It should be considered, however, that the open system model does not provide an objective system. Issues of power, inequality, exclusion, and control still pervade in the open system model, even having the potential to increase the rationality of more powerful actors through expanding their control over the environmental, societal determinants of systems behaviour, without regard for the impacts such control may impose upon third parties (Ulrich, 1988).

3.4.2 Boundary judgements

The open system cannot be separated from the boundaries drawn between the internal and external, which is an application of boundary judgements. An introduction to boundary judgements was presented in Section 3.2.3.2 and further described in Section 3.3 – drawing on two key thinkers, Geoffrey Vickers and Werner Ulrich, as well as the idea of critical awareness in CST.

Vickers observed that systems allow us to extract meaning from experiences based on our *appreciative setting* formed by three sets of judgements: reality judgements,

[23] In SES, the environment means a social environment ‘consisting of the changing values, expectations, and ideals of the human systems within it’ (Emery, 2000; Ulrich, 1988).

value judgements, and instrumental judgements[24], all of which create a predisposition for the observer to see problem situations in particular ways (Brocklesby, 2007; Burt & van der Heijden, 2008). The *appreciative setting* influences the contribution of meaning that feeds into general ideas about phenomenon, this then forms the standards that carry forward to further cycles of the appreciative system and form the basis of action (Brocklesby, 2007). Within Vickers' appreciative system, thought and action are 'carved out by our interests, structured by our expectations and evaluated by our standards of judgement' (Vickers (1972) quoted in Checkland, 2005).

Vickers' perspective makes the argument for an obligation of the observer to take responsibility for decisions and actions made in the name of their 'truths' and 'facts' (Brocklesby, 2007). Furthermore, that the interpretation and understanding of a situation (as a system) is a framing unique to the individual, group, or organisation. This leads to a familiar conclusion that the systems we use to provide meaning from experience are not objective (being based on our appreciative setting, for example). Additionally, that there is a possibility for multiple systems interpretations for the same phenomenon (e.g., water security) based on different experiences, interests, and expectations.

In addition to Vickers' ideas there is Ulrich's boundary judgements. The concept of boundary judgements is not too big of a leap from Vickers' ideas around the influence of the observer on the system[25]. Boundary judgements say that 'the meaning of a proposition depends on how we bound the relevant reference system, that is, the context that matters when it comes to assessing the merits and defects of the proposition. As a rule, our assessment of the merits and defects of a proposition depends on both observations of fact and judgements of value' (Ulrich, 2000). For Ulrich, these boundary judgements should be assessed critically…

[24] Reality judgements are those that make sense of the situation through understanding the state of the system. Value judgements are those that that determine whether reality is good or bad, giving meaning to the reality judgments. Instrumental judgments are what might be considered strategic action to improve the situation (Burt & van der Heijden, 2008; Brocklesby, 2007).

[25] In terms of Ulrich's *reference system* being similar to Vickers *appreciative setting* and both being centred around the observation of facts and value judgements.

> *"We do not need the systems concept at all if we are not interested in handling systems boundaries critically."*
>
> (Ulrich, 1996)

…through boundary questioning[26] based on twelve boundary categories. This is linked to critical awareness in CST, one of the fundamental commitments that exposes and questions assumptions and values inherent in systems design, as well as the exploration of the systems methodologies, associated methods, and techniques themselves (Flood, 2010). In these evaluations, the conditions that give rise to assumptions are also examined and re-examined (Midgley, 1996). Similarly to Vickers, this critiques the observers' influence on the conceptualisation and understanding of a system through critical reflection.

Boundary judgements and critical awareness allow the understanding and critique of objective and subjective systems. And, similarly to Vickers, a rejection of reality – systems are not real, objective entities but mental constructs with multiple views of reality and values (Flood & Jackson, 1991, chap.14). For water security, this critical perspective allows the water security system to be understood as a reflection of facts and values based on an individuals' system boundary and reference system. With this perspective, it is also possible to reflect on the power associated with system boundaries, where drawn boundaries have the power to exclude people from the system and to shape, define, and govern it (Jackson, 2019, p.558).

3.4.3 Methodological pluralism and complementarity

Another fundamental commitment of CST is theoretical and methodological pluralism/complementarity. This means: the recognition that there are limitations to any one systems framework; the complementary and informed development of all varieties of systems approach; and the recognition of the need for different sets of methodological principles for concerns about human emancipation (Flood, 2010). Methodological and theoretical complementarity sit alongside the explorative approach to understanding systems that embraces methodological pluralism (Midgley, 1996). This is a characteristic of SSM, where the goal is exploring a

[26] Types of boundary questioning as well as a checklist of critically heuristic boundary questions can be found in Ulrich (2000) Tables 1 and 2, respectively.

problem, not defining it, using the systems model as an intellectual device to express a situation considered (by some) to be problematical (Checkland, 2011, chap.4).

For water security, this means that with each framework of ideas that brings a methodological principle for action with it, CST recognises the need for all these different sets of methodological principles (Flood, 2010). The scope of issues around water security cannot be addressed with one systems approach due to its multidisciplinarity. Hence, theoretical and methodological complementarity is beneficial in structuring a more interdisciplinary approach.

3.5 Conclusion

This chapter has demonstrated the vast quantity and diversity of systems approaches that germinate from simple ideas of parts and wholes. Whilst many systems concepts exist, it is argued that not all are suited to exploring water security; a water resources paradigm with multiple socio-physical influences, disciplinary diversity, and embedded socio-political values. Therefore, in crafting a systems approach for exploring water security, three fundamental systems concepts are adopted that consider boundaries, environment, and interconnectedness whilst nurturing an explorative, interdisciplinary, critical research approach.

By implementing the systems concepts of open systems, boundary judgements, and methodological pluralism in the exploration of water security, an attempt can be made to understand water security as a system bigger than simply elements, interconnections, and behaviours. The open system model can structure analysis of interactions and exchanges with the wider social and physical environment and the influence of other processes on water security; water resources management actors and governance, hydrological processes, land-use change, urbanisation, and political and cultural dimensions of water security, for example. Boundary judgements can provide a means of critiquing different water security priorities between actors, demonstrating judgements of value, interests, and perceptions of reality related to a subjective water security. Lastly, methodological pluralism can be adopted to nurture an explorative and multidisciplinary approach, one that is required to understand and communicate water security, debate contextual solutions focused on improvement, and take issues of power into account.

All of these system fundamentals enable a deeper understanding of water security priorities and perspectives between actors. This can be used to structure debates on solutions and interventions and give voice and recognition to less powerful actors based on their water security priorities. Before discussing the specific methods used to execute the systems approach for exploring water security in this research (Chapter 5), Chapter 4 provides a systematic review of systems thinking in water resources research to understand characteristics, research gaps, and systems approaches, that currently exist in the broader academic field.

Chapter 4. Water systems and systems for water: a review of systems thinking in water resources research

Systems interpretations of water resource issues are numerous, and the phrase *water system* is commonly thrown around between different disciplines as well as across academic, non-academic, and policy literature. The popularity of systems approaches in understanding water resource issues could reflect the complex nature of water itself; a technical issue, a key component of both society and the life support system, an environmental necessity, and an economic good (Falkenmark, 2001; ICWE, 1992). Water issues therefore have multiple layers of complexity and characteristics such as interconnectedness, nestedness, and responses to external forces, all of which are characteristics shared with systems. This complexity and dynamism are added to when the influence of human actions are considered, making systems approaches to water issues a suitable response for analysing the complex water related interactions between natural and human components and their feedbacks (Zeng et al., 2020).

On the other hand, the characteristics that make systems approaches so well suited to the understanding of complex water issues also act as a hinderance in assessing the literature in this area. Namely that the field becomes extremely broad and diverse due to water issues crossing a range of disciplines and system approaches being interpreted in multiple ways; a *water system* ranging from physical distribution and treatment infrastructure to holistic indicators of ecosystem and social services. Additionally, the implicit use of system approaches in research produce a range of terminologies that describe systems thinking (ST) approaches for water resource issues.

To attempt to understand this research field more, this review uses a combination of systematic literature review and content analysis methods to analyse the subject matter publications as well as facilitate an understanding of critical themes and key insights. The systematic literature review method allows a course high level overview of sources through data analysis, whilst the content analysis method provides a more in-depth qualitative analysis of textual data (Khirfan et al., 2020). The methodology for this is adapted from Khirfan et al., (2020) and follows the main steps of: (1)

research questions; (2) literature search; (3) extraction, and organisation; and (4) combination and identification. Although, the research questions in step (1) split this review into two parts based on the questions: How are water systems currently interpreted and represented across a range of disciplines? and What is the extent and characteristics of literature applying systems thinking concepts to assessing problems in water resources research?

For the first part of the review, water systems are investigated across disciplines. This is done through an initial database search plus consequential screening criteria. For the second part of the review, a system test is developed to identify systems thinking in water resources research that can exclude studies that use the phrase ‘water system’ but do not adopt a systems approach. In this part, content analysis of the sources provides a more detailed understanding of the use of systems in water resources research.

Both of parts of the review required searching the literature (step 2), which meant choosing an academic database. The Elsevier Scopus academic database was chosen over the other main competing database, Web of Science (WoS), as Scopus has a much larger catalogue – 20% more coverage than WoS (Chadegani et al., 2013). It is worth noting, however, that Scopus has a smaller representation of the social sciences compared to WoS, but a higher representation of humanities, and both have a weighted bias towards the physical sciences (Martín-Martín et al., 2018).

Step (3), extraction and organisation, used Microsoft Excel to record source’s manifest data (title, abstract, year, keywords, doi, etc.) for both parts of this review. These were then processed in multiple ways (e.g., in VOS viewer). Additionally, a content analysis document was created for part 2 of this review to summarise the approach of systems thinking, any specific tools or methods, the area and scale of case study (if applicable), and any diagrammatic aids.

These results were combined in step (4), by using the results from part 1 to improve the literature search in part 2. The water systems themes and sub-themes were used to create the Boolean strings for the database search in part 2. Additionally, results between both parts of this review were compared to understand the differences

between *water systems* and *systems for water*; providing an insight as to how systems thinking is used and interpreted in water resources research.

4.1 Part 1: Water systems

For systems thinking to exist, a system must exist. For water, however, the interpretation of a system varies massively among disciplines and research scope. Figure 3, for example, demonstrates the use of the phrase ‘water system’ across a variety of disciplines[27]. When this is narrowed down to include those that not only refer to a water system, but also use a systems approach[28], there is an 84% drop in the total number of sources. This demonstrates how the phrase ‘water system’ does not necessarily imply a systems approach has been used. In both cases, the physical sciences dominate the literature, although social science appears more popular in use of systems approaches over water systems (see Figure 3). Figure 4 and Figure 5 further demonstrate the comparisons and characteristics between these two searches.

[27] This initial search was performed within the Elsevier Scopus database for the presence of ‘water system’ in title AND abstract within the time frame of 2015-2022. Additionally, the documents must include ‘water’ in the title AND abstract AND keywords. This left a total of 1,584 sources.

[28] ‘system’ AND ‘approach’ were added to the search requirements above. They needed to be present in the abstract of the literature. This left 259 sources remaining.

Figure 3. Percentage composition based on subject area between water system research vs. water system approaches documents (2015-2022)

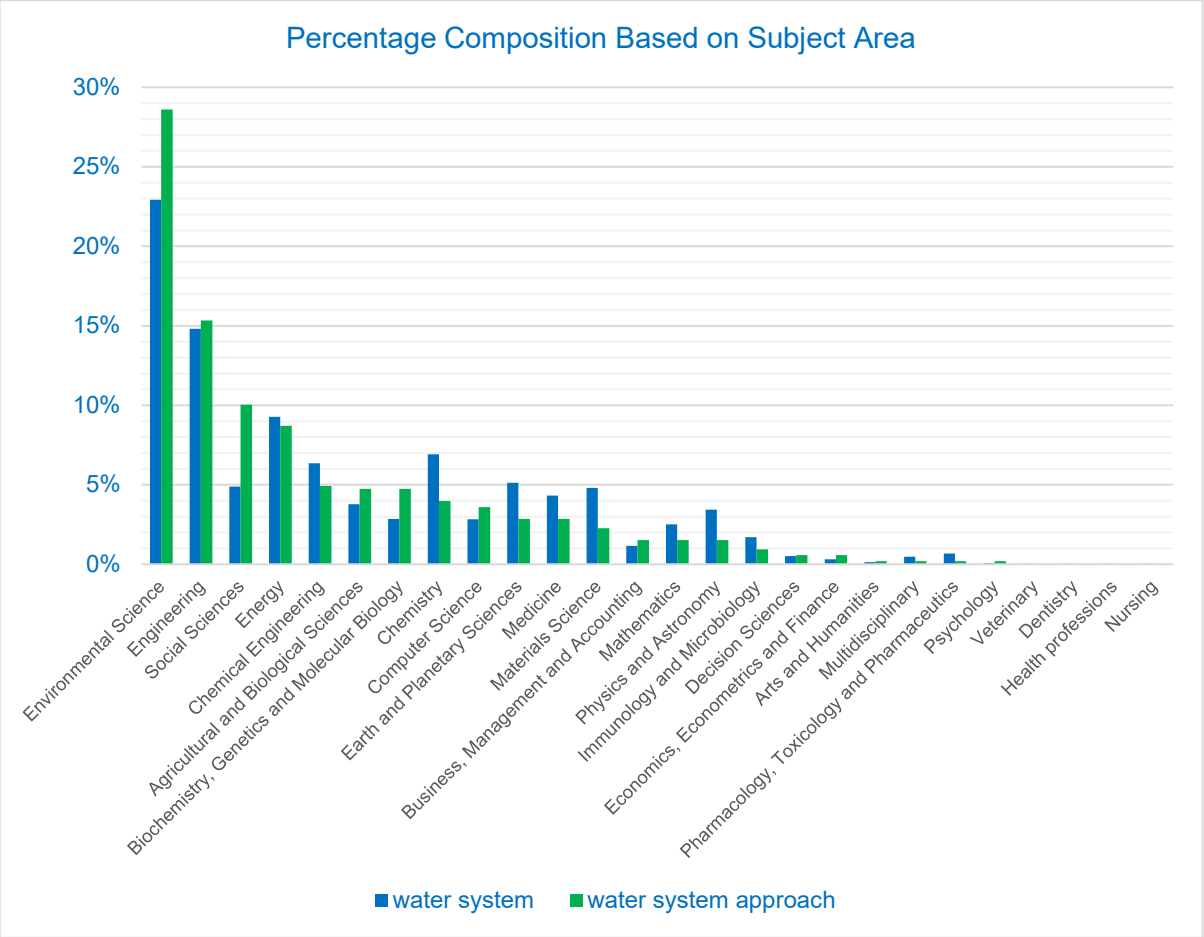


Figure 4. Percentage of total published sources for water system vs. water system approach by year (2015-2022)

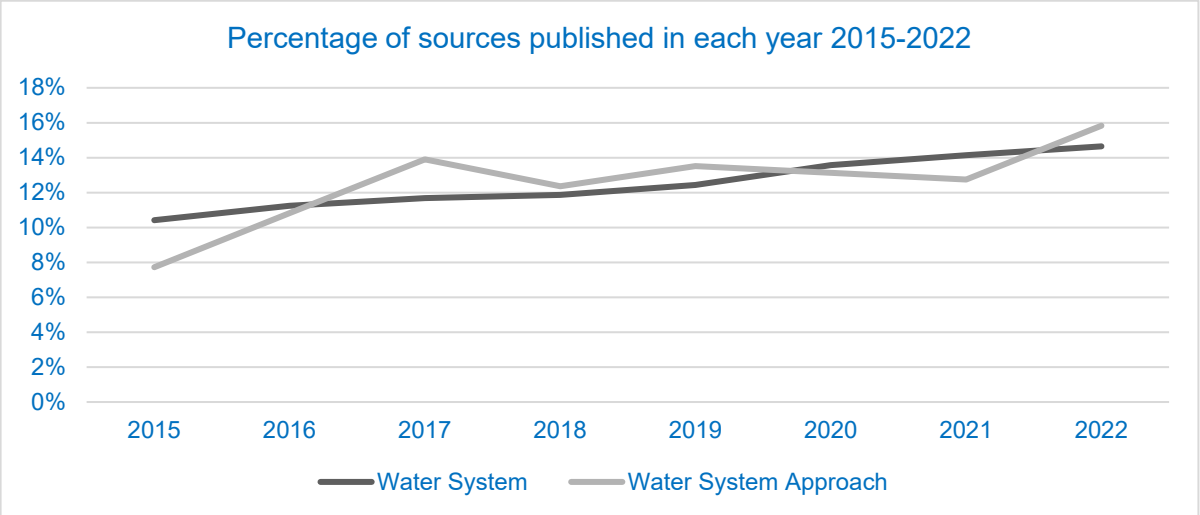
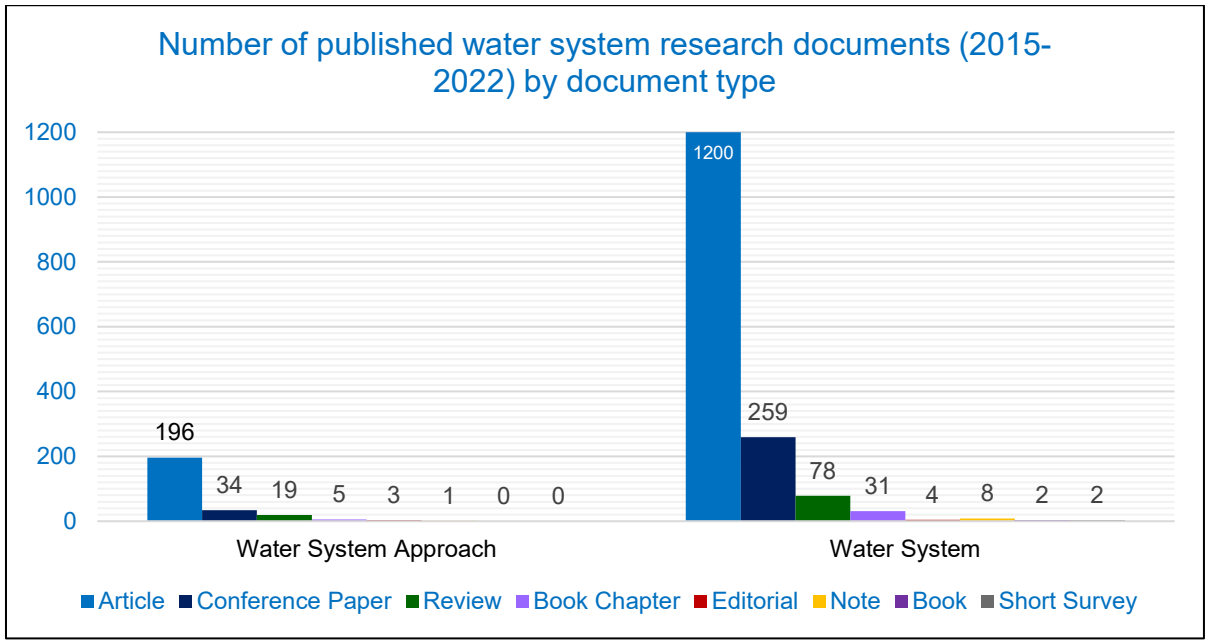


Figure 5. Number of published water system vs. water system approach research documents (2015-2022) by document type



Whilst these broad observations demonstrate some characteristics of systems thinking in water resources research, they do not demonstrate the characteristics of approaches between subject areas. To get a better understanding of the representation of the water system from these 259 sources, eleven broad categories (see Table 3) were defined to categorise the water system representations. The creation of these broad categories were decided through combination of literature (particularly Schenk et al., (2009)) and an expert panel discussion on water system components involving twenty senior academics from eight international universities (described in Appendix A).

These eleven categories were added as constraints to the existing search string[29] as required to be present in the abstract of sources, the full list of results are available on request. The abstracts of all 259 sources were also placed in VOS viewer (van Eck & Waltman, 2009) to understand the occurrence and connectivity between terms. The results can be seen in Figure 6. As categories were not mutually exclusive, there was overlap between these. These overlaps (see Table 4 and 5)

[29] 'water system' in title AND abstract within the time frame of 2015-2022. Additionally, the documents must include 'water' in the title AND abstract AND keywords. For Economic, Hydrology, and Political the strings "economic" OR "economy", "hydrology" OR "hydrological", and "political OR politics" were used to ccount for small variations that may still be relevant to these categories.

were also of interest, demonstrating the broadest subject areas as well as those with the most in common.

Table 3. Number of hits per category of water system

Category	N. Total Hits
Management	88
Energy	57
Urban	57
Economic	50
Infrastructure	37
Social	28
Environment	27
Health	22
Hydrology	17
Political	11
Agriculture	4

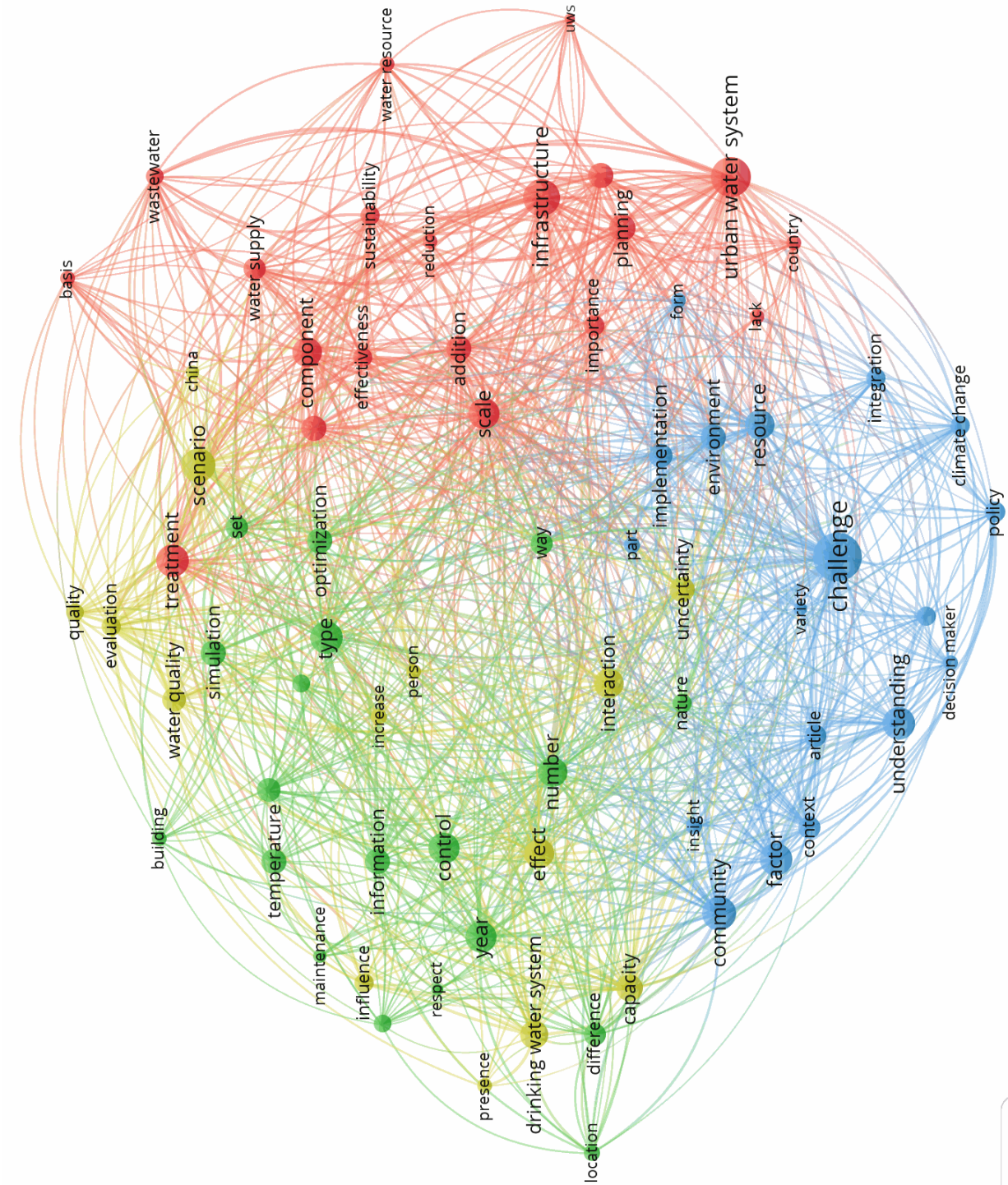
Table 4. Number of total overlapping cases per category

Category	N. Total overlapping cases
Management	152
Urban	107
Economic	105
Infrastructure	82
Social	77
Energy	67
Environment	50
Hydrology	38
Health	32
Political	26
Agriculture	6

Table 5. Percentage of overlap between water system categories

%. Of Overlap	Management	Energy	Urban	Economic	Infrastructure	Social	Environment	Health	Hydrology	Political	Agriculture
Management		13%	20%	15%	16%	17%	11%	9%	10%	7%	2%
Energy			13%	11%	11%	5%	4%	1%	1%	3%	0%
Urban				14%	21%	13%	8%	5%	4%	4%	0%
Economic					14%	19%	12%	8%	12%	8%	4%
Infrastructure						9%	11%	5%	4%	4%	0%
Social							7%	4%	20%	13%	3%
Environment								12%	2%	0%	0%
Health									0%	0%	0%
Hydrology										7%	5%
Political											0%

Figure 6. Occurrence (minimum occurrence = 10) and links between terms across abstracts of all 259 sources. Larger circles/font demonstrate a higher occurrence, colours of circles and links represent communities of occurrence terms.



4.1.1 Water management systems

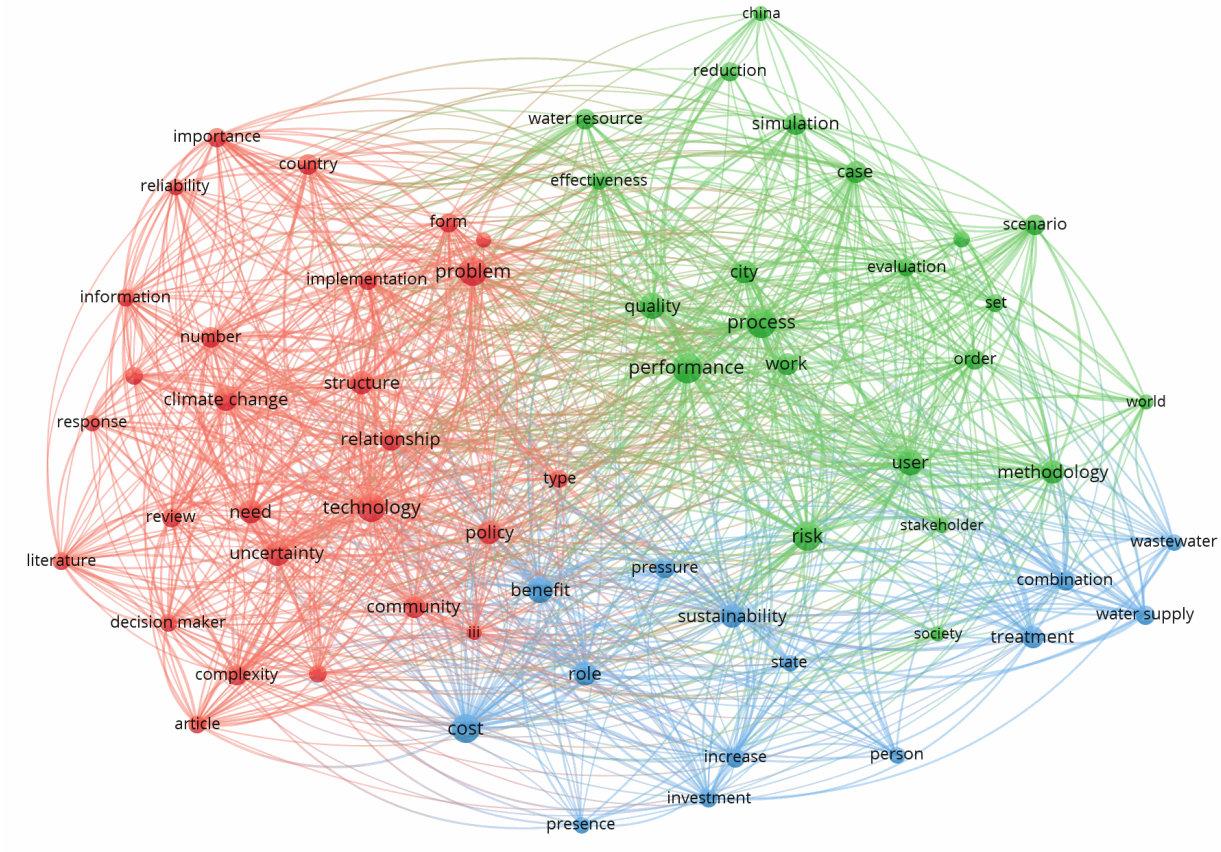
The water management category does not only appear to be the most common use of water systems, but it also has the most overlap with other water system areas (Table 3 and Table 4). It overlaps the most with urban water systems, followed by social, economic, and infrastructure water systems (Table 4), with some of these interlinkages being visible in Figure 6. Water management systems therefore appear to cover a range of topics from water policy, to storage and release systems, to the improvement of specific water systems infrastructure (e.g., cooling systems, distributions systems, drinking water systems, water distribution networks). As a result, many types of water management are referred to by the literature. For example, community-based water management systems (Chen & Bilton, 2022; Thomson, 2021), heritage water management systems (More et al., 2022), participatory water management systems (Almazán-Casali et al., 2021), integrated urban water management systems (Nieuwenhuis et al., 2021), and cooperation management systems (Ebert et al., 2019).

The literature additionally demonstrates several strong arguments for including social, economic, and institutional factors in water resource management systems to better understand vulnerability and barriers to change (Boruff et al., 2018; Nieuwenhuis et al., 2021). Water management systems, in this sense, being the point in which human and water systems intersect and therefore requiring an understanding of various factors driving systems change (such as policy, administration, ecological characteristics, institutional and political factors, upstream/downstream relationships, and behaviour change) (Essenfelder et al., 2018; Konar et al., 2019; Chang et al., 2022). As part of this, much of the literature considers how other interfering systems impact the management of water systems. For example, socioeconomic, political, cultural, urban, land use, institutional, ecological, resource, and financial systems (Chen & Bilton, 2022; Iyer et al., 2022; Hughes, 2022; Evers et al., 2017). In another particular example, Höllermann & Evers (2020) split water systems management into operational management and risk management, both governed by political factors.

Furthermore, governance is observed to be particularly important in water management systems; the connected nature of the water system meaning that

management actions on any component will influence the others in a cascading effect to create many economic and environmental outcomes (Garcia et al., 2016). This perspective is largely explored in literature through evaluating different water system configurations under different management/governance decisions and policy choices. This also includes integrated water resources management (IWRM), which is viewed by some as a systems-level approach that can account for both human and ecological needs (Jensen & Khalis, 2020). This approach to using systems allows an understanding of 'the costs and benefits of alternative management strategies following agronomic, hydrologic, or economic criteria, or a combination thereof' (Essenfelder et al., 2018).

Figure 7. Occurrence (min = 5) and linkages between terms in the abstracts of all management cases



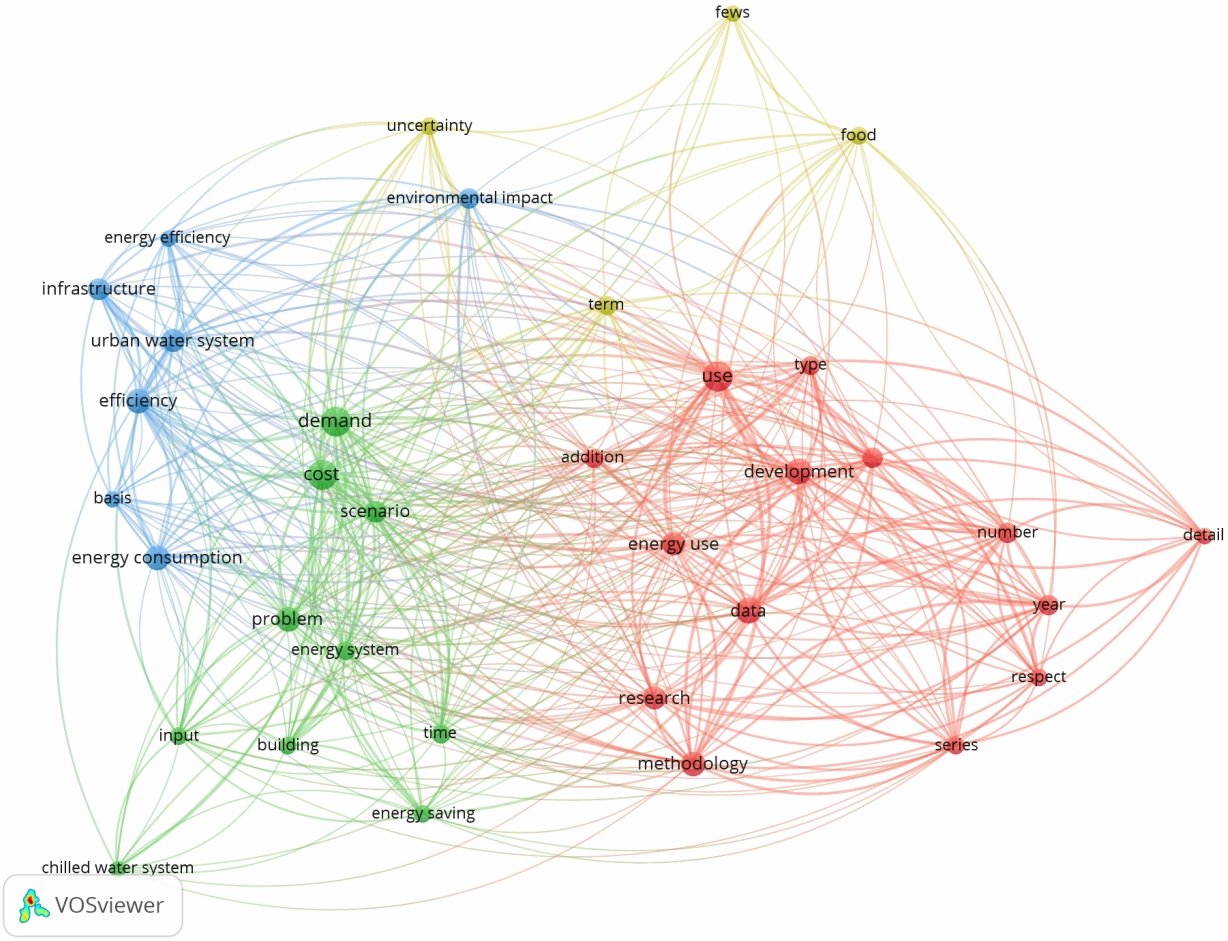
4.1.2 Energy-water systems

Energy-water systems appear to consistently be an integration between energy systems and water systems. The energy system is sometimes referred to as a background system that processes intermediate resources to the foreground systems of water supply systems (Stanchev & Ribarova, 2016; Todorovic et al., 2016). On the other hand, this integration is sometimes described as the interactions between water for energy (e.g., hydropower, cooling of power plants, extraction of fossil fuels, renewable energy, emission control) and energy for water (water supply system, water purification system, distribution, drainage, urban river system, pumping) (Ahmad et al., 2020). Across these integrations, different scales of energy water systems are observed to exist from small infrastructure (e.g., cooling water systems, solar hot water systems, chilled water systems) to household to city to state. The energy water system therefore appears to be comprised of many elements that are integrated with the water system that take into account energy sources and sinks (such as mining, electricity generation infrastructure, transmission and distribution), local energy demands (including food, water, urban systems), stocks of water sources, treatment plants, end users, flows of energy (energy carriers such as coal, diesel, electricity) and water uses (Leung Pah Hang et al., 2017; Arora et al., 2020; H. M. Ramos et al., 2020).

In energy for water systems, there are many studies concerning embodied energy, energy use and consumption, energy savings, energy efficiency, energy recovery, energy loss, and energy optimisation. These are largely concerned with the processing, treatment and distribution of water supply driven by the energy system (Oh et al., 2021). Water for energy, on the other hand, is largely concerned with the power production form various renewable and non-renewable fuels and the water demands associated with the electric power demands (Oh et al., 2021). Both are, however, voiced to be crucial for studies into emissions (Oh et al., 2021); integrated energy-water systems being used for planning and decision making for resources sustainability where ‘integrated analysis of water and energy allows more reliable, flexible, and sustainable eco-design projects, reaching better resilience systems through new concepts’ (H. M. Ramos et al., 2020).

Systems approaches for energy-water systems appear to be largely nexus dynamics, life cycle, and climate, land, energy, water (CLEW) approaches. Literature on nexus dynamics between energy and other systems (e.g., food-energy-water (as can be seen in Figure 8 as ‘fews’), water-energy-greenhouse gas, energy-water-carbon, water-energy nexus) provide an integrated approach to understanding risk, uncertainty, and interdependence between sectors. Whereas life cycle energy of water systems includes the direct and indirect energy consumption in water systems over their full life span. This includes fabrication, installation, and operation (water transmission, pumping, treatment, distribution, wastewater treatment and collection) (Beygi et al., 2021). Moreover, CLEW systems interactions examine how energy sources (e.g., gasoline, diesel, natural gas, hydropower, wind, solar) feed into climate, land, energy, and water processes, such as: greenhouse gas emissions; water for irrigation, energy for power plants (that require water cooling systems) to grid; and to water users and sectors (Ramos et al., 2022). Lastly, among this literature on energy-water systems is the concept of emergy; the idea of energy flow between components to create a process, in this case the water system. This perspective is used to assess the sustainability and quality of water systems through their products and services based on the available energy required to create these for water users within a corresponding socioeconomic system (Fonseca et al., 2017).

Figure 8. Occurrence (min = 5) and linkages between terms in the abstracts of all energy cases



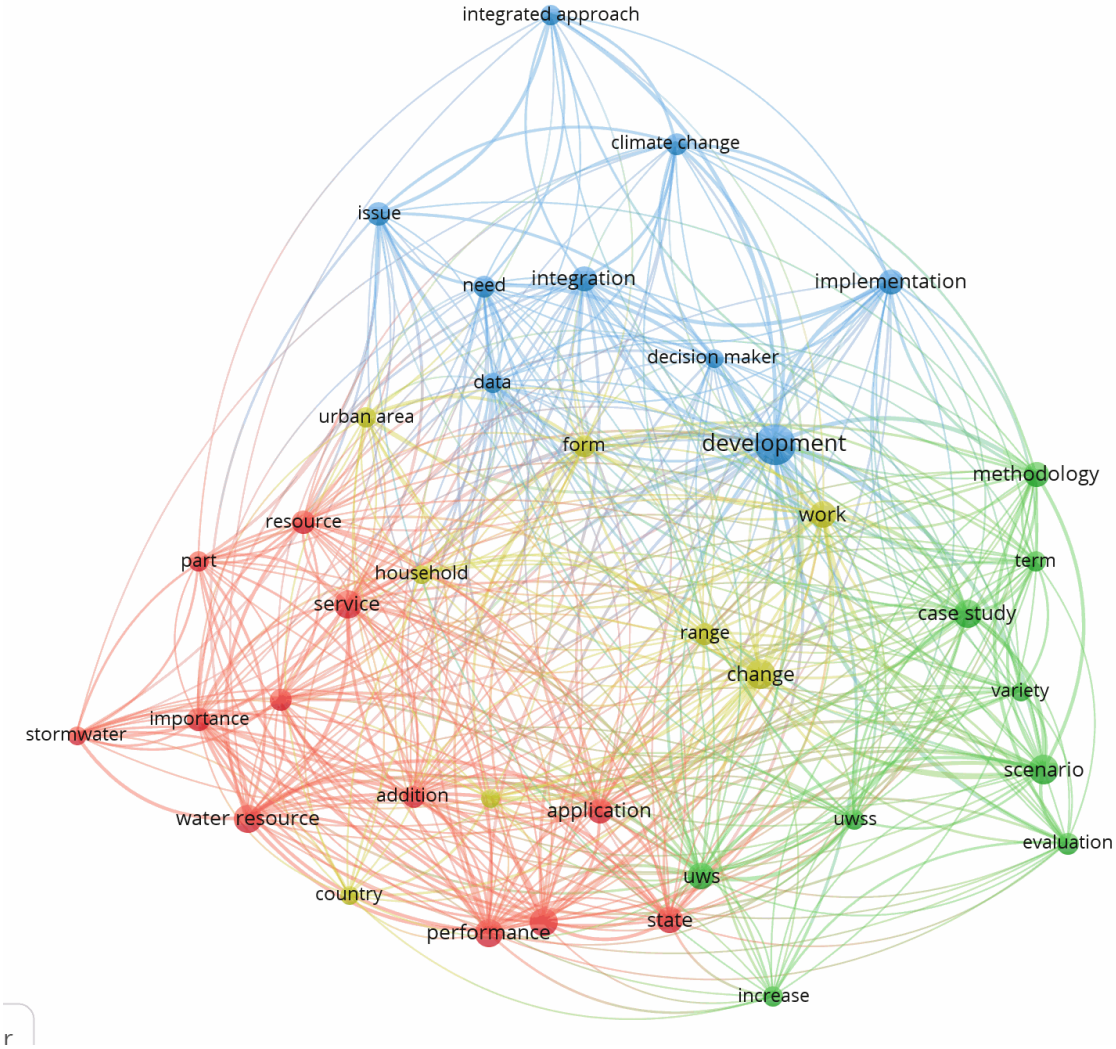
4.1.3 Urban water systems

Urban water systems are the second highest category with the most hits and number of overlapping cases (Table 3 and Table 4). Within urban water systems there are common themes such as cities, households, urbanisation, decentralisation vs centralisation, and scenario modelling. Generally, urban water systems appear to largely refer to the technical and environmental parts of the water cycle in urban areas including water sources, freshwater ecosystems, water abstraction and storage, water treatment, supply and distribution networks, water use, wastewater collection and treatment, and disposal (Garcia et al., 2016; Negi & Chandel, 2022; Grigg, 2022). These elements appear to be so commonly agreed that, in some instances, the phrase ‘urban water system’ comes without any explanation of system elements.

The focus of literature studying urban water systems seems to largely revolve around issues associated with energy use, water quality, water scarcity, wastewater contamination, extreme events, urbanisation. This is perhaps why many urban water system studies centre around human health protection, reliable and safe water supply, and flood management, and drinking water (Sharma & Gray, 2021; Stanchev & Ribarova, 2016). Moreover, why the boundaries in which the urban system operates in vary from administrative to sectoral (e.g., water industry) to beginning and ending processes such as construction and operation.

Urban water systems are also observed to be used as a planning tool, assessed to guarantee water supply, ensure adequate capability of treatment facilities, and understand urban energy-water interactions for infrastructure development (e.g., de Oliveira et al., 2022). In these cases, urban water systems are seen as completely interconnected with the cities they service and cannot be solved in isolation of the city or its planning (Kenway & Lant, 2015). Sometimes this is demonstrated through integration between urban water systems and other urban systems (e.g., energy, socio-technical, environmental) to improve resilience and respond to future challenges through innovations with other urban disciplines (e.g., Nieuwenhuis et al., 2022). Also, through understanding trade-offs and synergies between urban and other systems.

Figure 9. Occurrence (min = 5) and linkages between terms in the abstracts of all urban cases



4.1.4 Economic-water systems

Economic-water systems have the third highest overlapping cases (Table 3), sharing the most with social water systems (Table 4). This is perhaps due to the indirect benefits from water systems to both the economic development and society (Grigg, 2022; Hughes, 2022). However, Figure 10 suggests that management, energy, and (urban) infrastructure, are more prevalent (and interlinked) terms within the economic water systems literature.

The economic-water system appears to be less of a system in its own right, but more of a consideration for other water systems to improve or optimise water systems processes (largely engineered water systems). For example, to reduce costs of upgrading, operating, or maintaining infrastructure. In other cases, the consideration

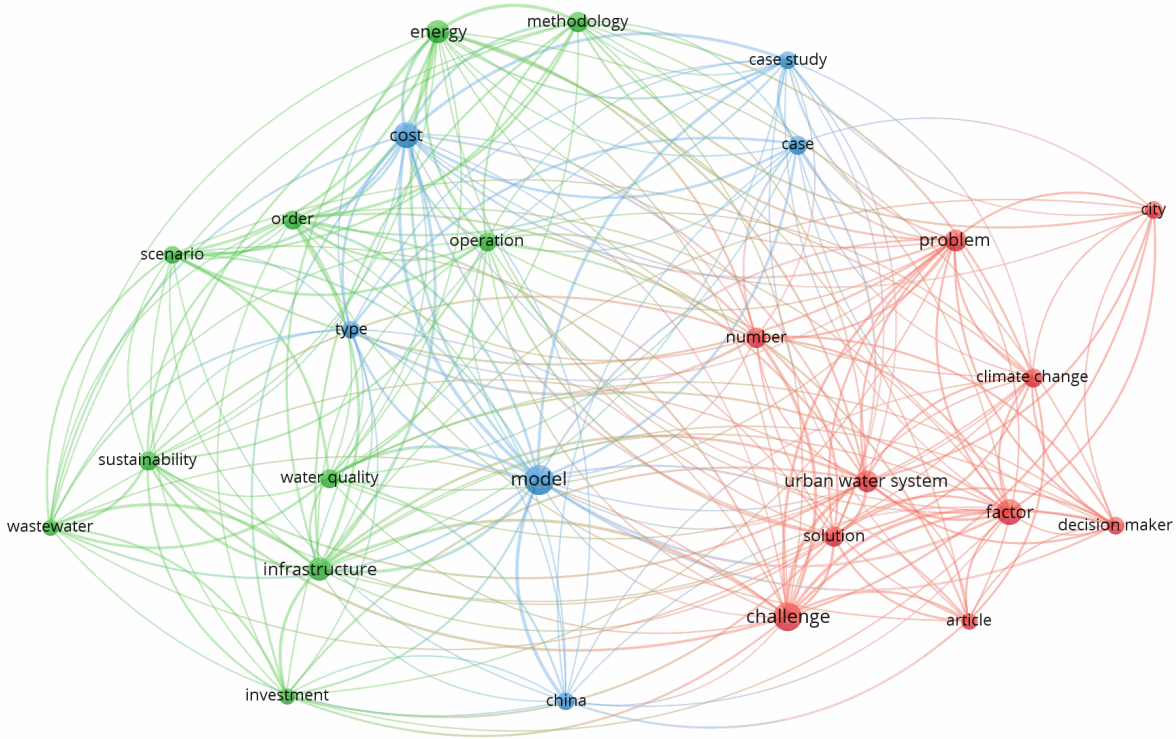
of the economic-water system is used to: explain local inequalities and underperformances in technical, managerial, and financial capacities; as an assessment indicator for water management systems; as a constraint in decision making; as a demonstration of the economic benefits of systems change.

In cases where the economic-water system is described it appears to include: water supply and demand for the public and private goods provided; direct and indirect benefits and costs; linkages and impacts due to interdependencies with other sectors; the organisation of system management to facilitate collective action; and social issues stemming from interactions with system customers and other stakeholders (Grigg, 2022). Among these are economic systems linkages with water such as the links between national wealth, water-related productivity, losses from water-related hazards (Konar et al., 2019), and between infrastructure and the environment (Breen, 2018). As one example, Todorovic et al., (2016) considers economic systems linkages such as: value added to the system's final products due to water use and the adopted management practices; the flows of water, products and other materials that permit the estimation of the costs and incomes generated by the system and quantify the interactions among the actors.

It is apparent that the economic-water system rarely stands as its own system and is often integrated with other factors to represent a more socioeconomic system. There are therefore several arguments made for including socioeconomics in water system studies, for example:

- The role of socioeconomics in the representation of a water system which define the characteristics of the local study (E. P. Ramos et al., 2020)
- The role of socioeconomics in successful water systems management and the creation of barriers to this (Brelsford et al., 2020)
- The importance of socioeconomic factors in determining systems vulnerability and resilience (Ahmed et al., 2019; Romero-Lankao & Norton, 2018; Breen, 2018)

Figure 10. Occurrence (min = 5) and linkages between terms in the abstracts of all economic cases



4.1.5 Water infrastructure systems

Water infrastructure systems appear to largely consist of connected engineering elements that are often described as key components of another water system e.g., water supply, water treatment, water governance, climate resilience, the socioeconomic, and the biophysical system. This requires both context and scale, of which the dominant context appears to be urban water infrastructure systems, which is concurrent with the findings in Table 4 and Figure 11. Where stated, the water infrastructure system is commonly comprised of water abstraction, water treatment and pumping, water network distribution, wastewater collection and treatment, and construction and operation (Negi & Chandel, 2022).

In some cases, water infrastructure systems are integrated with other systems. Those that provide multi-utility, such as green infrastructure (More et al., 2022), as well as those that integrate with other systems to create both benefits and negative impacts (Almazán-Casali et al., 2021; Thomson, 2021), or those that model long-term

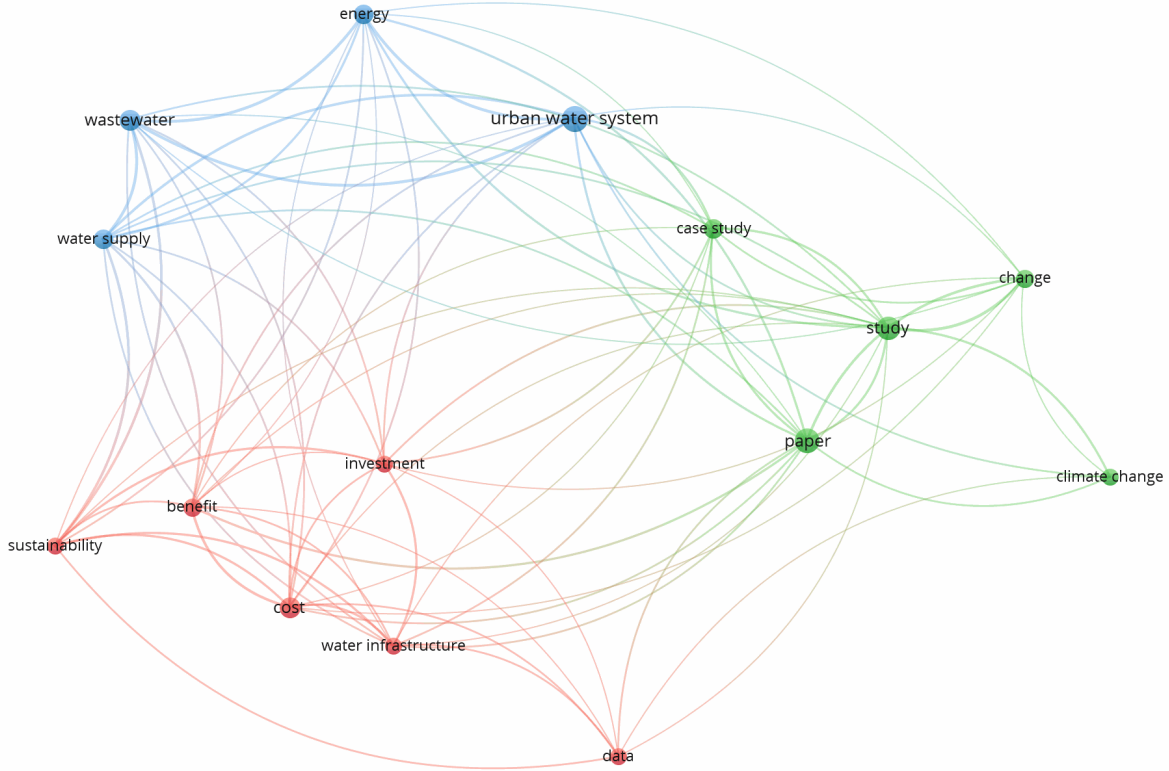
transitions through the consideration interactions between water infrastructure, development, and societal systems (Rauch et al., 2017), for example.

Additionally, resilience is a common theme for water infrastructure systems in the literature. Where a resilient water infrastructure system should be able ‘to sustain its water provisioning, water quality regulation, and waste- and storm-water management services under both low frequency changes and trends in precipitation regimes as well as extreme flooding or drought events’ (Brown et al., 2020). Therefore, a water systems’ resilience is often linked with infrastructure systems through the relationship between infrastructure and governance (Breen, 2018), where interdependencies between actions, institutions, and water infrastructure systems can create the conditions for vulnerability (Romero-Lankao & Norton, 2018).

Another common theme is drinking water systems. Drinking water systems being the infrastructural resource systems that provide water to users that together with others engage in the governance of the system (Hasan et al., 2020). The infrastructural resources systems therefore define the drinking water system capacity by ensuring the water is safe to drink (Worden & Deaton, 2017). The infrastructure in these systems is described as needing to be functional, reliable, and resilient, as well as governed efficiently and equitably, hence these characteristics are often the focus of drinking water systems studies.

Lastly, it is observed that, in the majority of cases for water system infrastructure, the phrase ‘water system’ is often used without explanation or diagrammatical representation. This creates an assumption of the processes under assessment. For example, the use of the phrase ‘drinking water system’ often lacks a description as it assumes agreed parameters amongst academia as the inclusion of resource, treatment, and distribution of water. The same is for wastewater systems, water treatment systems, and water supply systems (centralised and decentralised) – these cases often lack description of components or processes, assuming that the reader already understands the fundamental components.

Figure 11. Occurrence (min = 5) and linkages between terms in the abstracts of all infrastructure cases



4.1.6 Social-water systems

Social-water systems appear to combine physical and social processes in studying the relationships between ecohydrological and water-related social-economic systems. This often produces coupled systems understandings such as: socio-hydrology, socio-technical systems, human-water systems, integrated water system modelling, and waterscapes, as some examples.

The integration of the social and the hydrological in these studies vary. Coupled systems understandings range in their inclusions of the social with the physical; sometimes this is captured simply and sometimes it is more complex. Simpler examples consider social factors as quantitative system element such as human demands vs. available supply or placing social elements into indicators. More complicated coupled understandings, however, involve the hydrological cycle combined with human activities, sociocultural values, social administrative and institutional characteristics, and economics between sources and users (e.g., Chang et al., 2022; Thompson et al., 2021; Polonenko et al., 2020).

Overall, the integration of social dynamics into water systems appears to branch into five main lines of enquiry. The first of these seems to be the study of systems change as a response to social and institutional changes e.g., the physical linkage of infrastructure with the various actors involved and the institutions that direct their perceptions and actions (e.g., Nieuwenhuis et al., 2021). The second is the study of system resilience as a result of social resilience to hydrological change, hydrological resilience to social (human) perturbations, and socio-hydrological resilience dealing with bidirectional feedback between human and water systems in the face of disturbance and adversity (e.g., Xu et al., 2021). Thirdly, the systems approach appears to be used to investigate the social barriers that impact water systems e.g., social factors (Nelson-Nuñez et al., 2022; Hughes, 2022), organisational culture, transparency, legislation, consumer awareness (Schmack et al., 2019), and technical, institutional, and financial capacity (Minnes & Vodden, 2017). Penultimately, interpretations of social-water systems also appear to be used to aid decision making and asses water management based on physical and social processes and their combined benefits, risks, and vulnerabilities (e.g., multi-functional, multiple-benefit systems, nature-based solutions, ecosystems services) where multi-benefit solutions are commonly sought for improving local hydrology and ‘preserving the natural water balance whilst enhancing local climate resilience and delivering ecological, social and community services’ (e.g., Sitzenfrei et al., 2020). Lastly, the impact of engineered water systems on human health seems to be a common focus of social-water systems e.g., the provision of clean drinking water, and improvements in health through a combination of ‘both water, sanitation, and hygiene as well as food security, nutrition, and safety’ (Oerther et al., 2019).

4.1.7 Environment-water systems

Environment-water systems include system impacts on the environment and system responses to environmental changes. In the case of the latter, there is a large amount of literature that discusses various water system responses, impacts, and vulnerabilities to environmental shocks, challenges, conditions, factors, variables, and pressures. In terms of the impacts of the water system on the environment, these appear to be largely concerned with environmental health and protection, with pollution being a consistent theme. Studies on environmental health and protection

often refer to the impact of human (engineered) water systems on the environment, here there is often a distinction between natural and engineered water systems. Natural water systems being various environmental sources and their associated biophysical processes (e.g., rivers, lakes, groundwaters, and seawaters) whereas engineered water systems being the process of water being taken from natural sources and supplied to users via treatment and distribution systems (Huang et al., 2021).

Social-environmental/socio-ecological systems appear to distinguish themselves as a distinct field in environmental-water systems focussing on the integrated influences of the environment on society and vice versa. These systems are largely agreed to include interactions between natural resources and ecosystems with infrastructure, water use, governance, and economic activities (Jensen & Khalis, 2020; Novo, 2017; Garcia et al., 2016). Under socio-environmental systems, there is also the use of systems approaches for improving integration between the engineered water systems and the environment, the demonstration of the role of the environment in society, and environmental benefits from multi-benefit systems solutions.

In some cases, the environment is important insofar that it is the setting in which other systems exist (e.g., urban environment, natural environment, aquatic environment, geological environment, collaborative environment), but in these cases the study of the water system is more relevant to another overlapping subject area rather than the environment system in its own right. There was no literature identified in this search that appeared to study the environmental water system as a singular system.

4.1.8 Health-water systems

Health-water systems seem to mainly focus on water supply and public health. In this instance, the water system seems to simply describe the flow of water through engineered components and processes for water supply, distribution, treatment, and the pathogen health hazards and risks associated with these. For health, the water system often consists of system design, phases, and operation carried out along the entire water supply chain; resource, infrastructure, local economics, maintenance, distribution, and adaptability (Mirochnick & Russo, 2016; Serio et al., 2021). Hughes

(2022) also explicitly adds that water supply systems are underpinned by social, financial, and physical systems that, when poorly functioning, impact public health. There are a few exceptions to this health system perspective purely being engineering processes. For example, exploring and understanding links between human health and food-water systems (Oerther et al., 2019). Or, exploring health in terms of ecosystem health; for example, Novo (2017) studies the impacts of pollution on ecosystem health and sustainability in terms of ecosystems degradation and services.

4.1.9 Hydrology water systems

Hydrology, being concerned with the more physical scientific concepts over other categories, presents literature mainly categorised by factors of climate and water. Sometimes this brings in other related areas of geology, geochemistry, and hydrogeology. Within these, a large proportion of studies investigate the interactions between hydrological and biogeochemical processes namely the hydrological cycle, ecological processes, water management/use/demand, and water quality (e.g., Zhang et al., 2016). In this sense, the water system usually refers to specific configurations of hydrological features that create a closed system in which water processes exist. For example, Jones et al., (2017) describe the water system under investigation as the interactions between the rivers, the sea, climatic conditions, weather events, and aquatic ecology. Additionally, Marques et al., (2019) describes the water system in terms of subsurface geology, location of potential recharge areas, underground flow paths, main water–rock interactions occurring at depth, and discharge sites.

On the other hand, there are several instances that pair ecohydrological processes and socioeconomic systems (e.g., Zeng et al., 2020). In these examples, hydrology is understood as being influenced by human factors (e.g., decision making, uses, impacts, economics) (Essenfelder et al., 2018). These studies use a variety of terminologies to describe this water system perspective; the human-water system, a coupled system, and an integrated water system model. These are all largely focused around improving water management and, in some cases, use systems approaches to create a shared language between social and physical science to encourage this (e.g., Brelsford et al., 2020). In other cases, this water system

perspective is used to create a systematic understanding of resilience or vulnerability where the resilience of socio-hydrological systems is derived from human and water interactions (e.g., Xu et al., 2021; Ahmed et al., 2019). In these instances, the water system is more conceptual and abstract than in the purely physical use of water system in hydrology, and has main components of physical hydrological processes, water related human activities, and ecological processes.

4.1.10 Political-water systems

Bringing the political into water systems appears to integrate social and governance dimensions into the physical elements of water systems as a means for more human-water focused analysis. The water system is viewed largely as feedback system between physical water and water use, bounded by physical and social processes. At a high-level this appears to be a means of analysing interactions between large systems of climate, land, energy, and water in combination with sectoral activities to aid policy design (e.g., E. P. Ramos et al., 2020). At a smaller scale, this is used to marry local hydrological findings with local scenarios and priorities for strategic long-term planning (e.g., Schütze et al., 2019; Romero-Lankao & Norton, 2018). Another smaller-scale example is the use of water systems to measure the resilience of societies through combination of hydrological, socioeconomic, and infrastructural interactions (Purdue & Berger, 2015). The introduction of the political side to water systems, however, does not appear to necessarily imply any critical reflections on the power dynamics or inequities caused by existing hydrosocial systems dynamics. Instead, it draws the focus of the water system into the decision-making arena, with the outcomes being contributions to policy and strategy, with less of a consideration for the social structures that create (or dismantle) these spaces.

4.1.11 Agriculture water systems

The representation of agricultural water systems is small compared to the other fields. It appears to include the analysis of physical interaction mechanisms between water and land alongside cooperation between water users. There are studies concerned with understanding specific hydrological and biochemical processes (see Carpenter et al., 2019; Zhang et al., 2017) as well as specific configurations of funding, management, supply, and use components (e.g., ‘single use water system’

and ‘multiple use water system’ in Raut et al., (2021)) for a specific purpose (e.g., drinking water, irrigation, sanitation). This approach integrates social aspects of water (e.g., use, reuse, needs, access) with better water management. This sometimes sees the water system considering both the hydrological and economic components of the water system (e.g., in Denaro et al., (2018)).

4.2 Part 2: Systems for water

The second part of this review draws on one of the key findings from the previous section on water systems; the presence of the phrase *water system* does not necessarily imply a systems approach has been used. The conundrum raised by this finding is how to separate systems thinking from systems descriptions, and how to identify systems approaches in water resources research when they are implicit. This then provides answers to the question: *What is the extent and characteristics of literature applying systems thinking concepts to assessing problems in water resources research?*

In Chapter 3, core characteristics of systems thinking were identified as complexity, behaviour (in response to external forces, changes in relationships, changes in inputs), relationships and interactions of components, and levels of hierarchy (sub-systems). In this section, these characteristics of systems thinking are used in combination with the identification of water systems (Section 4.1) to create a systems test for identifying systems thinking applications to the water resource field. The creation of a systems tests follows an approach similar to Arnold & Wade (2015). This approach creates a set of common elements to form criteria that the literature must fulfil to be considered as a systems approach. The common elements come from the fundamental characteristics of systems thinking from Chapter 3 and are broken down into components that relate to research: purpose, tools/methods, and observations/conclusions. Under each of these headings a set of considerations form a testing structure (Figure 12).

To identify sources for screening using this systems test, a literature search method was developed using Boolean strings based on the water systems categories and findings in Section 4.1, but this time making these specific to the field of water resources research, and water resources categories described by Schenk et al., (2009) and Miranda et al., (2011) (Figure 13). The Boolean strings (Table 6) were applied to a literature search in Elsevier Scopus for presence in title, abstract, or key words. A maximum of 400 documents were reviewed per search, sorted A-Z by first author and limited to 2015-2020. The systems test was applied at title, abstract and content level.

Figure 12. A systems test based on core systems components (Chapter 3, Section 3.3)

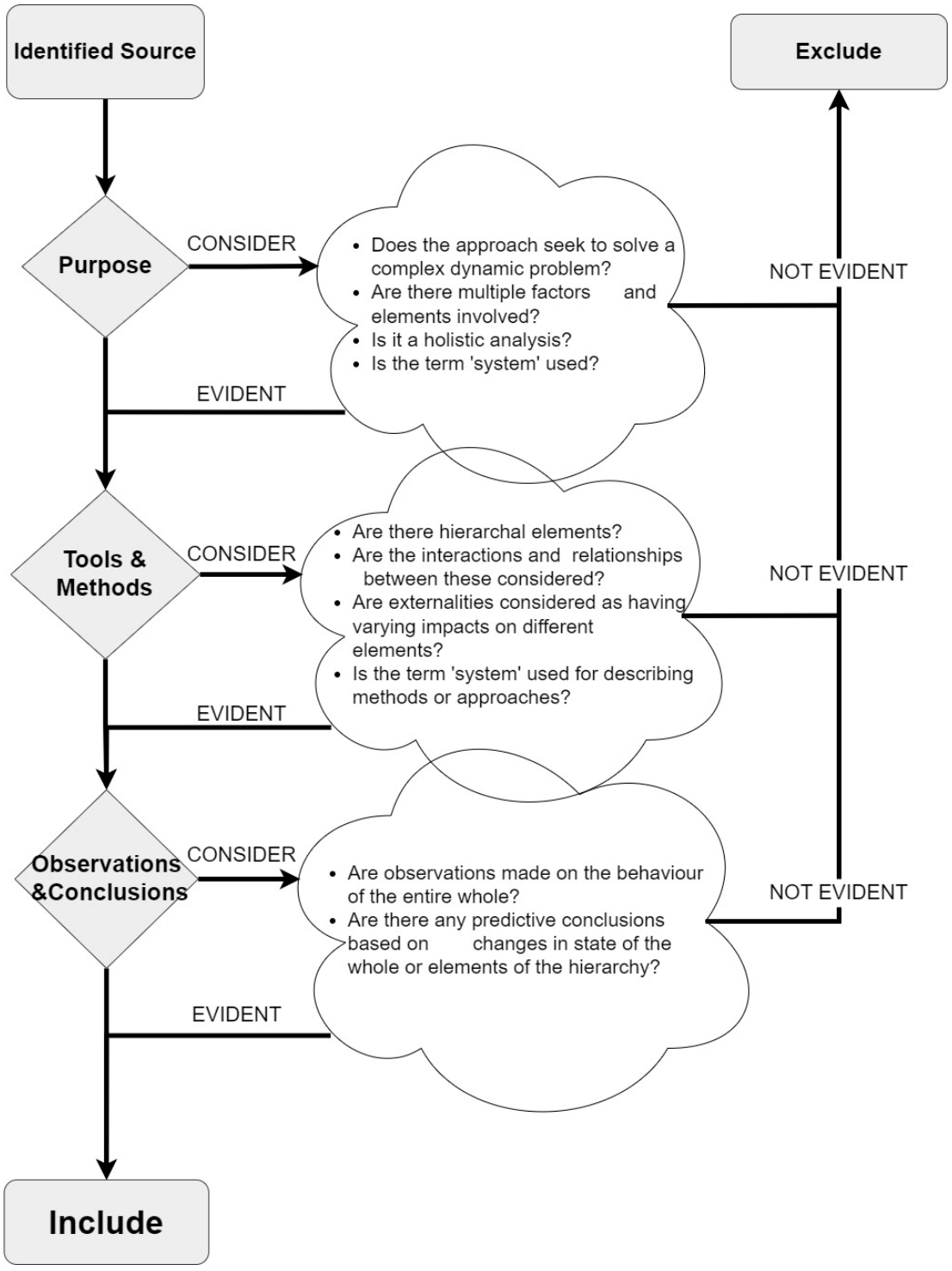


Figure 13. Literature search word strings for water resource dimensions based on the water systems categories and findings in Section 4.1, but this time making these specific to the field of water resources research, and water resources categories described by Schenk et al., (2009) and Miranda et al., (2011)

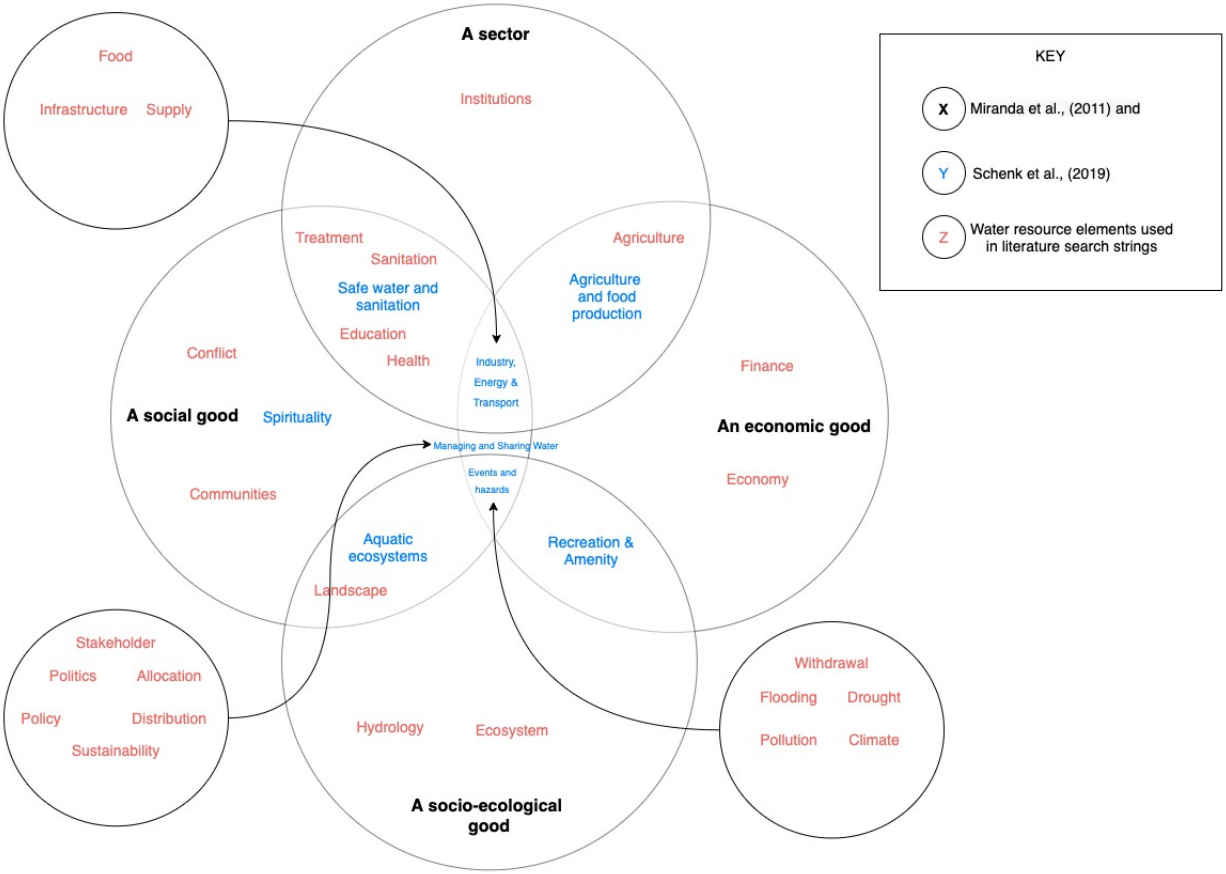


Table 6. Boolean search strings used for searching the literature

Topic	Component	Word Strings
Resources	Withdrawal, sustainability, hydrology, treatment, sanitation, climate, economy,	“water resources” / + “withdrawal” / + “sustainability” / + “hydrology” / + “treatment” / + “sanitation” / + “climate” / + “economy”
Management	Distribution, allocation, policy, finance, stakeholder, infrastructure	“water management” / + “distribution” /+ “allocation” / + “policy” / + “finance” / + “stakeholder” / + “infrastructure”
Social	Communities, politics, institutions, education, health, supply, conflict	“water resources” / + “communities” / + “politics” / + “institutions” / + “education” / + “health” /+ “conflict”
Environment	Pollution, ecosystem, landscape, agriculture, food, flooding, drought	“water” + “environment” / + “pollution” /+ “ecosystem” / + “landscape” /+ “agriculture” /+ “food” / + “flooding” / + “drought”

4.2.1 Reflections and findings

This search and screening method identified 62 sources that passed the systems test under the used search strings: 20 for water resources, 17 for water management, 9 for social, and 8 for environment. The full list of these is available on request. As well as this, an additional category (encompassing) was added, terms were placed here if they were interdisciplinary and so could not be confined to a single category, there were 8 in this category. Of these sources, 35% were identified as tools and 22% as frameworks[30].

A qualitative content analysis (an example of this is shown in Figure 14) was conducted across the sources that passed the systems test. This summarises the systems approach, any specific tools or methods, the area and scale of case study (if applicable), and any diagrammatic aids. This method of qualitative analysis identifies the specifics and trends within these systems approaches. Among the screened sources, it was observed that place-based research was dominated by Asia (largely China) and North America (USA) (Figure 15). Of the studies that were place-based, and not global, the majority were conducted in global south contexts (Figure 16). Additionally, the most popular systems scale was the hydrological basin unit, closely followed by social units such as cities and regions (Figure 17). It was observed that studies relating to physical water favoured environmental scales e.g., basin scale. Whereas those relating to the socioeconomic impacts of water tended towards social scale e.g., city and region.

[30] Being categorised if it was explicitly stated at abstract level as tool or framework.

Figure 14. Qualitative content analysis example

Literature Reference	"Evaluating water resource sustainability from the perspective of water resource carrying capacity, a case study of the Yongding River watershed in Beijing-Tianjin-Hebei region, China" (Dai et al., 2020)
Keywords	Water resource carrying capacity . System dynamic model . Water crisis . Yonding River
Systems Thinking Summary	Water resource carrying capacity (WRCC) A coupled human-water system model based on system dynamics and cellular automaton. Used to test four future scenarios: existing development, water saving, industrial restructuring, and integrated development schemes. The WRCC integrates natural and socio-economic components, such as precipitation, evapotranspiration, land use/cover change, population, economy, technology, policy. Sub-systems of the coupled human-water system include natural water resource production, water supply, water demand, and socio-economy, as well as their interactions with each other.
Specific Tools	WRCC, system dynamics, cellular automaton, coupled human-water system
Case Study	
Area	China
Scale	Basin

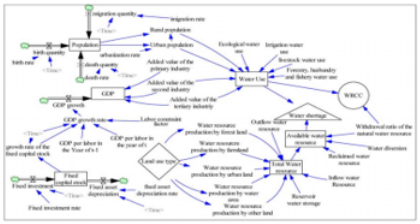


Fig. 2 The major flowchart of the SD model

Literature Reference	"Moving beyond water centricity? Conceptualizing integrated water resources management for implementing sustainable development goals." (Benson et al., 2019)
Keywords	Integrated water resources management · Sustainable development goals · Goal 6 · Target 6.5 · Indicators
Systems Thinking Summary	Integrated Water Resource Management Aiming to help shift IWRM beyond SDG6, towards integration with other goals; ending poverty, providing clean and afordable energy, achieving gender equality, protecting terrestrial ecosystems, promoting sustainable cities, combatting hunger and climate change, and strengthening the Global Partnership for Sustainable Development. Draws on pre-existing conceptualizations of IWRM to identify seven core dimensions: integration; scale; institutions; participation; economic valuation; equity; and, environmental/ecological.
Specific Tools	IWRM
Case Study	
Area	N/A
Scale	Basin

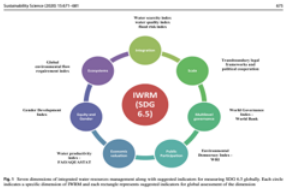


Figure 15. Geographical spread of screened sources for systems approaches in water resources research

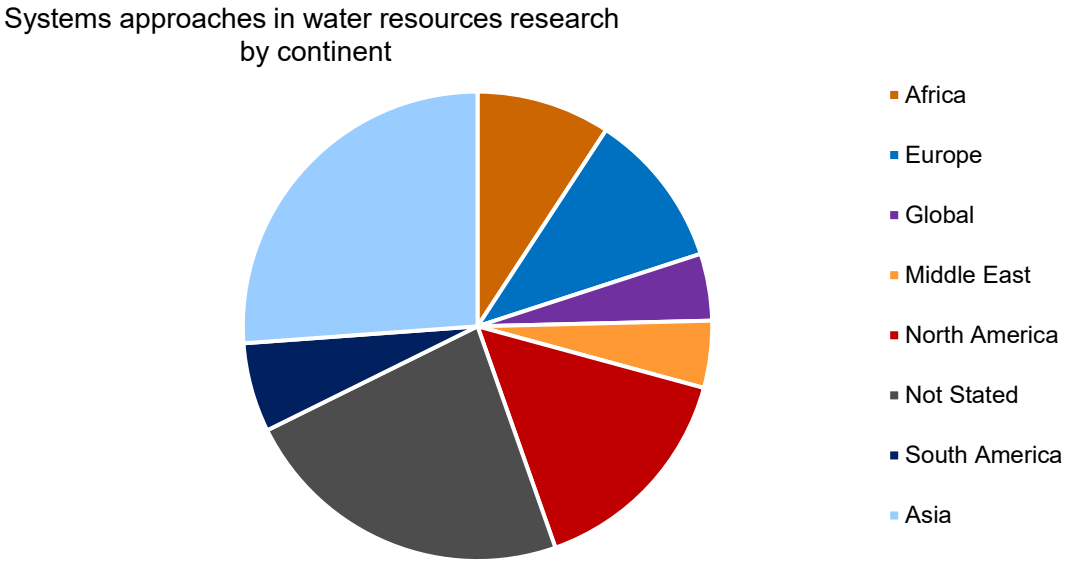


Figure 16. Global North/South spread of screened sources for systems approaches in water resources research

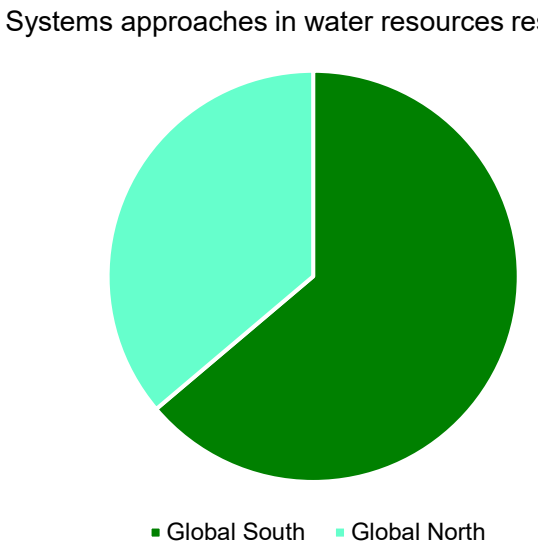
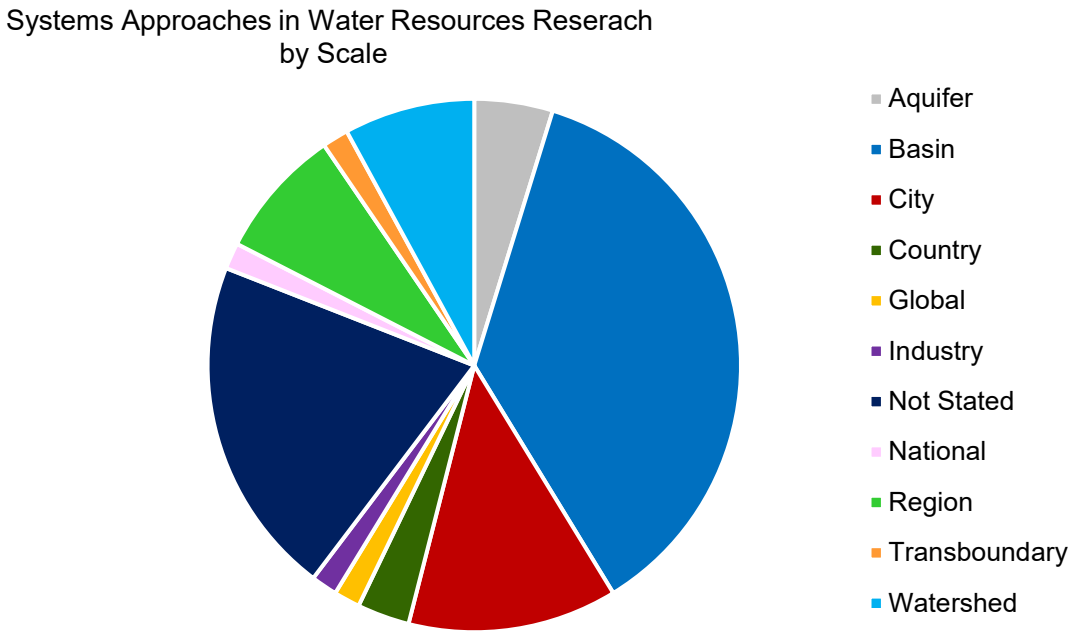


Figure 17. Scales used in screened sources for systems approaches in water resources research



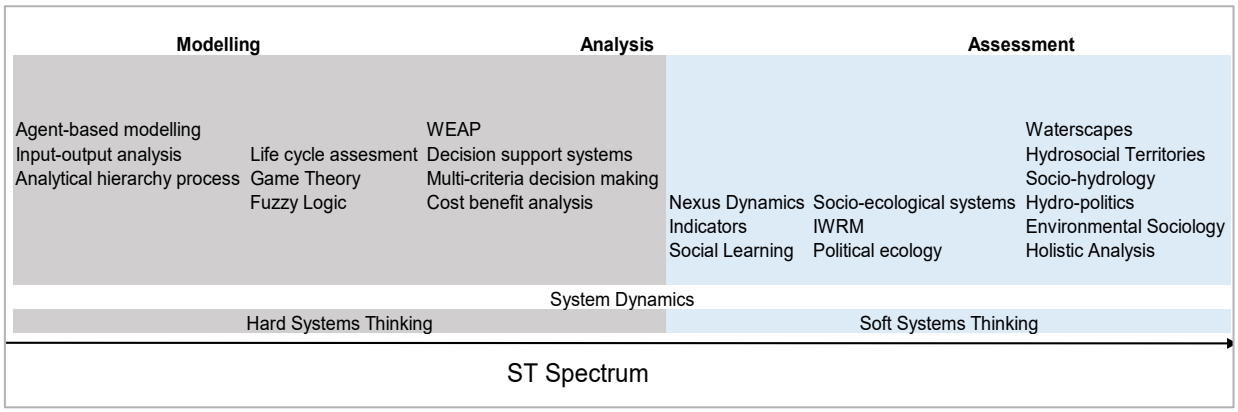
A wide range of tools and frameworks were observed as supporting systems approaches among these sources (see Table 7), the most popular being indicators, coupled human-water systems, and nexus approaches. The diversity amongst these tools and frameworks reflected the spectrum of systems thinking, with various approaches being observed to range from hard to soft (Figure 18). Harder approaches leaning towards quantitative modelling with refined tools, middle-spectrum approaches having more capability to combine both quantitative and qualitative analysis and assessment and, at the other end of the spectrum, soft system approaches being more concerned with social dynamics related to water issues, such as water politics, socio-hydrology, and water anthropology. These softer approaches naturally offer a more social perspective and are more critical and qualitative in nature.

Table 7. Identified supporting systems tools and frameworks for systems approaches in water resources research

Area	Supporting tools and frameworks for systems thinking in water resources research
Water Resources	Indicators (Water poverty - Water Poverty Index [WPI])
	Indicators (Water use)
	Indicators (Water sustainability Index [WSI])
	Indicators (Hydro-socioeconomic [HSEI])
	Indicators (Urban water)
	Water resource carrying capacity (WRCC)
	Integrated Water Resource Management (IWRM)
	Game Theory (cooperative and noncooperative) (water management) (optimisation)
	Life cycle assessment (Water Use)
	Life cycle assessment (Water Supply)
	Input-output analysis
	Water Prism
	Integrated Assessment Model (IAMs)
	Hydro-economic modelling
	Water-economy modelling (WEM)
	Water vulnerability assessment (VWR)
	Cost-benefit analysis
	Hydro-system analysis
	Water-economy nexus (WEI)
	Resource Nexus
Water Management	Integrated Water Resource Management (IWRM)
	Fuzzy logic
	(Integrated) River Basin Management (IRBM)
	Integrated Watershed Management
	Water Rights Allocation

	(Integrated) Metabolism Approach
	Water connectivity
	Optimisation Framework
	Multicriteria Decision Making/Analysis (MCDM/A)
	Water diplomacy
	River Basin Management
	Vensim
	Systematic water governance assessment (City Blueprint Approach)
	Nexus Governance
	Hydro-governance
	WEAP (water evaluation and planning system)
Socio-hydrology	Socio-Hydrological/Hydrosocial Systems
	Econometric Analysis
	Watershed Management
	Socio-ecological systems (SES)
	Political Sociology (water)
	Water Anthropology
	Waterscapes
	Human-natural systems
	SWAP (social water assessment protocol - mining)
Ecology/Environment	Flow-ecology
	Eco-hydrology
	Watershed health
	Hydro-environmental management (fuzzy logic)
	Ecosystem nexus (game theory)
	Political Ecology
	Hydrosocial territories
	Ecological Carrying Capacity (fuzzy comparision & AHP)
Encompassing	Holistic Analysis
	Systematic Approach Framework (SAF)
	Systems Dynamics
	(Coupled) Human-water systems (CHWS)
	Pluralistic Water Research (PWR)
	Nexus (Water-energy-food [WEF])
	Water security/sustainability/connectivity/resilience/vulnerability

Figure 18. Tools and frameworks in systems approaches in water resources research across the systems thinking spectrum



In addition to the tools and frameworks used in these examples are the many systems representations. These are observed to largely fall into categories of process-orientated (Figure 19), behaviour-orientated (Figure 20), relation-orientated (Figure 21), and various combinations of these. Of course, all these systems representations have similarities of systems elements, interconnections, and functions. But their goal-seeking ultimately defines the way that systems thinking is manipulated, and how the water system is represented.

Process-orientated systems (Figure 19) representations were observed to be those that were mainly concerned with how inputs change into outputs in a water system. This usually requires the identification of a specific water system that contains multiple processes along the course of input to output. These examples are less concerned with the overall behaviour of the system, or other interacting systems, and are more concerned with how changing the inputs impact the outputs (of interest). As a result, the systems description is often less interdisciplinary. The process-orientated system is a popular representation for hard quantitative water systems modelling due to its focus on process and a high resolution of internal systems components (e.g., Cheng et al., 2016; Chen & Chang, 2010).

Figure 19. Process-orientated water systems

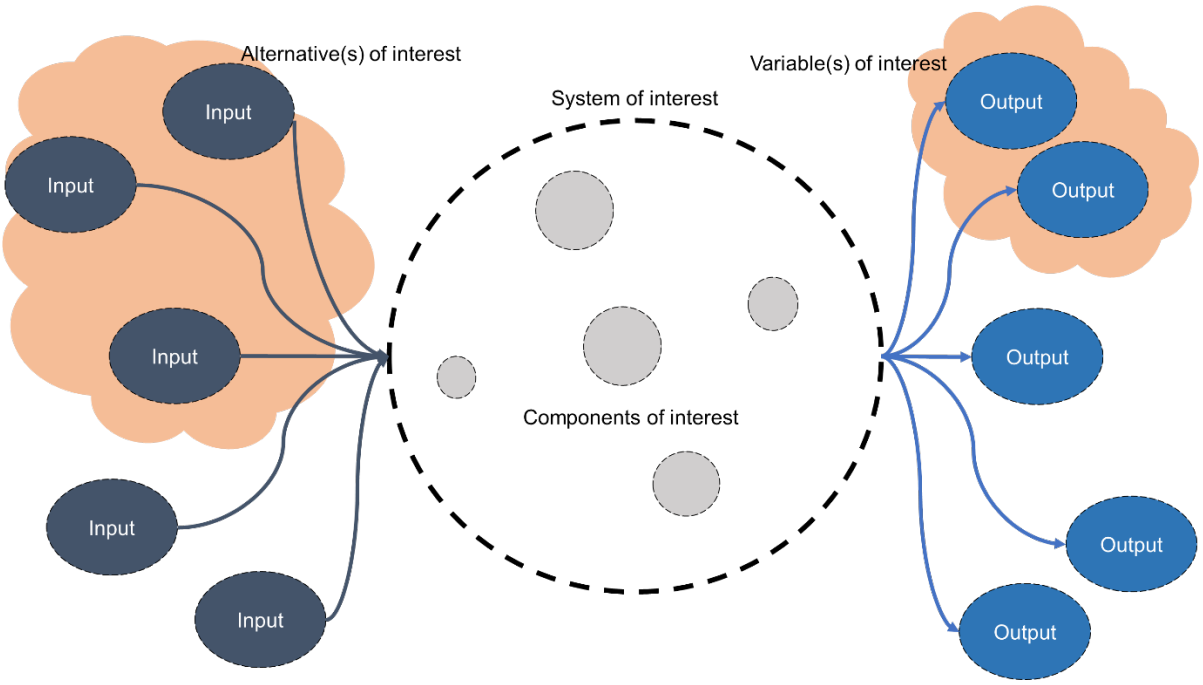


Figure 20. Behaviour-orientated systems representation

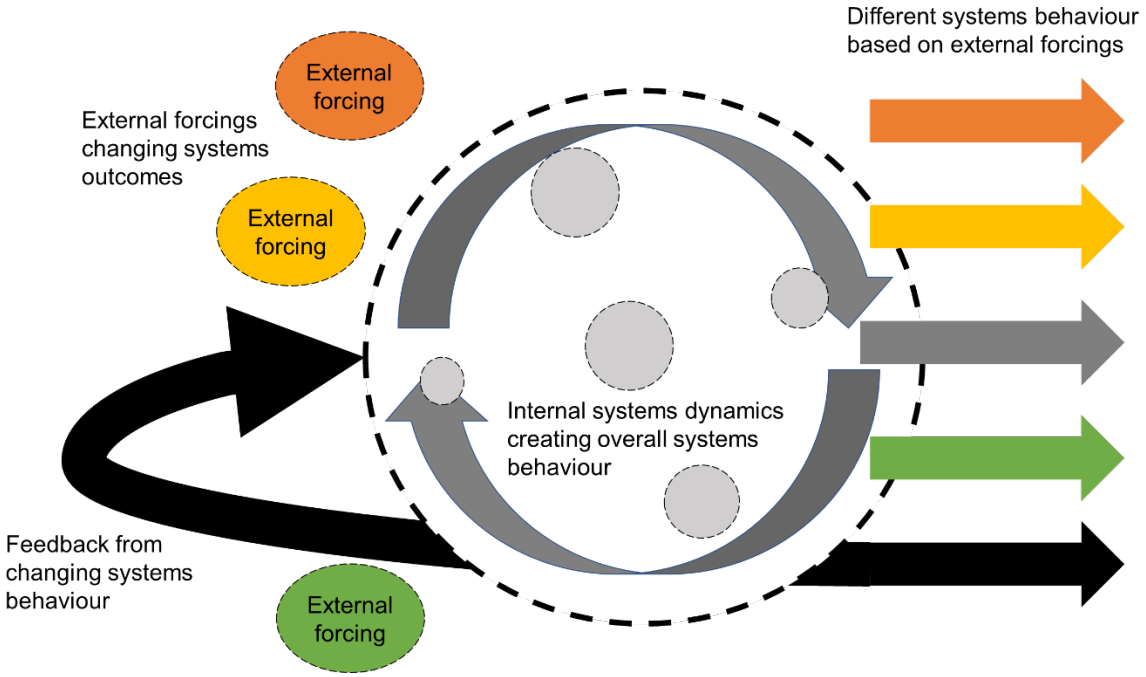
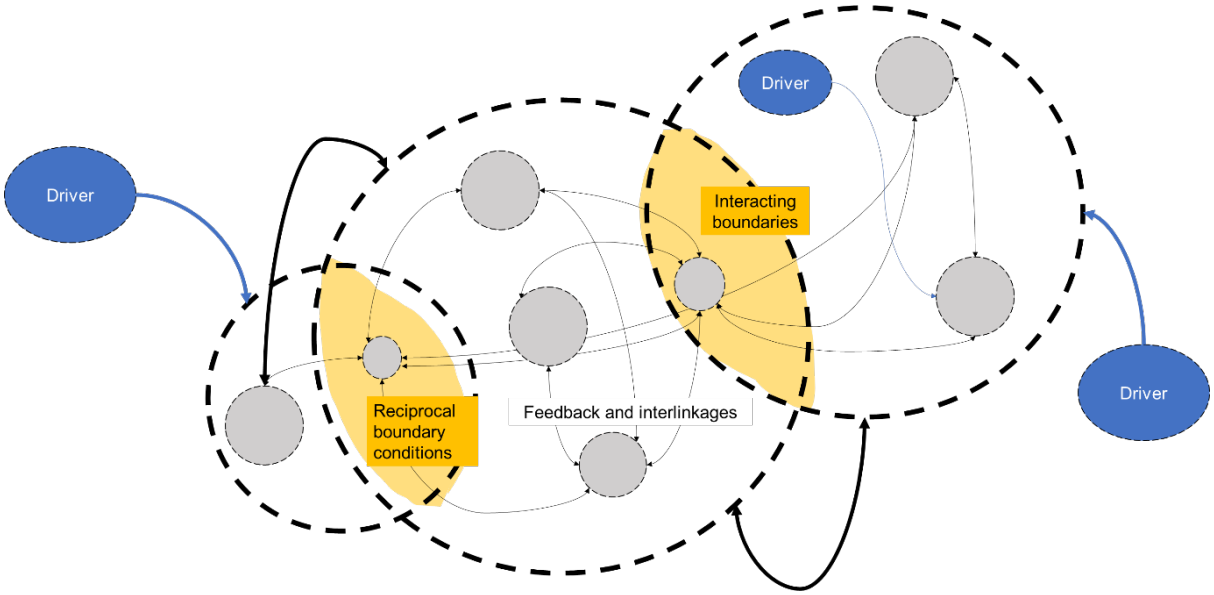


Figure 21. Relation-orientated systems representation



Behaviour-orientated systems (Figure 20) representations were observed to be those that investigated the behaviour of the system, the internal systems dynamics that create this, and how this evolves and changes under difference external influences. Specific internal components appeared to be of a lower resolution than process-orientated systems, but there was more consideration of sub-systems, feedback, and external factors (such as forcings and influence of other systems' interactions) that impact these internal components and the system as a whole. The behaviour of the system appears to be validated with quantitative data (e.g., Abadi et al., 2015), those involved in the system (stakeholder input), or a combination of both (e.g., Różyński et al., 2019).

Relation-orientated systems (Figure 21) representations appeared to be those concerned mainly with interconnections; how internal components relate to one another and how the bigger system interacts and influences other systems. This often included more interdisciplinary studies due to multiple systems being considered. There were multiple scales for relation-orientated systems representations from specific internal components to general systems and sub-systems interactions. Some focused on the interacting system zones to target leverage areas (e.g., Mader et al., 2015), some focused on the interactions between different environments and components (and vice versa) (e.g., Chiluwe & Claassen,

2020), and some explored the coexistence and combination of other systems with the water system among different disciplines (e.g., Evers et al., 2017).

4.3 Conclusions

The combination of these two literature searches (Part 1 and Part 2) firstly demonstrate the breadth and diversity of systems approaches in water resources research, making it a difficult field to define and characterise. Not only are there many definitions of what a water system is, but there are a multitude of systems tools and frameworks to support systems thinking in water resources research. On top of this, despite the clear dominance of physical and natural sciences, there are many disciplines contributing to both the systems approach taken and the interpretation of the water system. Overall, making it extremely difficult to draw the line at what is considered a systems approach.

Part 1 of this review answers the question of how water systems are interpreted and represented across a range of disciplines. Whilst there is an obvious dominance of the physical and natural sciences in the use of water systems, there does seem to be a consensus that human systems (e.g., governance, management, urban environments, agricultural activities etc.) impact water systems (e.g., hydrological cycle, water supply and distribution, water treatment etc.). Additionally, there are consistencies in that the water system is not simply governed by physical factors, that there are elements of the environmental and the social that must also be considered. The representation of the ‘human’ side of the system is, however, considerably variable in representation of elements, interconnections, and function.

The VOS viewer depictions across disciplines in Part 1 (Figures 7-11) show little similarity (in terms of frequently occurring themes) amongst sources in categories of politics, social, hydrology, health, environment, infrastructure, and agriculture – compared to management, economic, energy, urban studies. This could simply be a product of having fewer total hits, and hence a narrower research field. However, interestingly, infrastructure has more overlapping cases than social, energy, and environment (Table 4), but significantly less commonality within its own category (Figure 11). This suggests that, for this case, infrastructure water systems are more of a sub-system of other systems than a system within their own right. This VOS viewer analysis also perhaps indicates that among management, economic, energy, and urban water systems, the understating of a water system is more consistently agreed.

In Part 1, it also became apparent that the presence of the term *water system* does not necessarily mean that a systems approach has been used. Part 2 of this review therefore attempted to understand the extent and characteristics of literature applying systems thinking in water resources research, requiring a process to exclude those sources that refer to water system but do not mention a systems approach. Again, the amount of literature is vast, covering a range of qualitative and quantitative approaches. It seems that systems approaches used to study water resources are largely determined by the qualitative or quantitative nature of the study; the former trending towards softer systems approaches and the latter trending towards harder systems approaches. Consequentially, process-orientated systems interpretations (Figure 19) seem to be more popular amongst quantitative studies, and relation-oriented (Figure 21) interpretations amongst qualitative studies. Behaviour-orientated systems interpretations therefore often being a mixture of the two (Figure 20).

Combining findings from both parts of this review, it is clear that the resolution of systems elements is highly variable and inconsistent amongst water resources research; influenced by study scale, objectives, and disciplinary research paradigms. This is not a surprising finding, knowing that the perspective of a system is largely dependent on the observer and the objective of system creation (as discussed in Chapter 3). Additionally, there is often little on the process of how the water system of interest was created or is validated. In some cases, engineering water systems are justified by processes, hydrological water systems verified by historical data, and social systems verified by consulting actors in this system. However, in many cases, the process of systems creation is not the focus of the water system, and it is automatically assumed as being a true representation. In extreme cases, a visual depiction is not even needed due to idea of a water system being consistently agreed amongst disciplines (e.g., in water infrastructure systems).

Moving forward, there appear to be no specific (or generic) recommended systems approaches for water resources research. Each systems approach appears unique and shaped by the positionality of the researcher and the aims of the study. A key reflection is therefore that the the best systems approach is one that suits the research objectives. Additionally, that this can be evidenced with qualitative or quantitative data, or a mixture of the two. It is further observed that there are no

standard elements of water resource systems, again, each system appearing unique and constructed based on insights of interest. Another key reflection is therefore that the construction of the system is a reflection of those involved in the systems approach. Building on these key reflections, the following chapter details the methods used to take a systems approach for exploring water security in Addis Ababa, Ethiopia. This draws on the knowledge of water security and systems thinking, as discussed in Chapters 2 and 3, respectively. Additionally, it addresses the conclusions of this chapter in building a systems approach that suits the research objectives and considers the evidence behind the system as well as those involved in its construction.

Chapter 5. Methods and research considerations

The aims and objectives of a study largely define the methods used for data collection and analysis (Ritchie & Lewis, 2003). In the case of this research, the aims and objectives (Chapter 1) are rooted in exploring the experiences and priorities of water security in Addis Ababa using a systems perspective. Additionally, demonstrating challenges for the institutional and legislative structure of water resources management in Ethiopia for operationalising water security as a water resources management paradigm in the country.

In refining the methods used for data collection and analysis to meet the research aims, several considerations were made based on the findings from the previous chapters. Specifically, reflecting on how to collect data that could represent the multi-dimensional, -disciplinary, and -faceted characteristics of water security through the three statements that frame water security for this research[31] detailed in Chapter 2. Additionally, constructing, conducting, and evidencing an approach that could utilise the system fundamentals of open systems, boundary judgements, and methodological pluralism, as discussed in Chapter 3 as being particularly applicable to water security. Lastly, how this research could reflect on the idea of *taking a systems approach*; meeting the aims of the research as well as contributing to the wider field of systems approaches for water resources research (as discussed in Chapter 4) in its construction of a water security system and how this is evidenced. The following sections therefore discuss: the data collection and analysis approaches taken by this research; how these align with the specific lines of enquiry in the research; and research considerations such as ethical practice, researcher reflexivity, and framing of knowledge and knowing. Figure 1 demonstrates how the methods discussed support the objectives of this research.

[31] (1) water security as defined by physical insecurity; (2) water security as a social and political practice, process, and value; (3) water security as indivisible from human security and justice.

5.1 Existing research approaches for investigating water security in Addis Ababa

Some studies on water security in Addis Ababa do exist. The research area in general, however, appeared understudied. As a demonstration of this, a quick database search[32] for this research area produced a combined total of 65 results. After removal of duplicates and screening for irrelevance to water security research or location (i.e., not Addis Ababa or the Akaki catchment), a total of 12 examples remained. Table 8 and Table 9 demonstrate the methods used in these twelve studies; the minority (two) are quantitative methods, six are qualitative, and four are a mixed approach.

Across the existing research, surveys, interviews, and stakeholder focus groups, appeared to be successful primary methods for exploring water security in this context. Within this, research that specifically focused on experiences and perspectives of water security appeared to use largely similar lines of enquiry across top-level stakeholders and communities. For top-level stakeholders these included: problems with current governance structures; major water resource challenges; priorities of other stakeholders; key sector goals and objectives; existing coordination and management; and existing improvement mechanism(s). For communities these included: water user demographics; water-use categories; community water management and access; relationships amongst different water users; participations in water resources development; and impacts from water shortage/surplus.

What these studies were observed to be lacking, however, was a cross-cutting exploration and comparison of different perspectives and priorities of water security between governance levels. Additionally, an approach that could account for the intersectionality and interconnectedness of water security with other securities as well as, more broadly, the multidimensional characteristics of water security. Lastly, an approach that could account for water security that may exist outside of a relationship with physical water alone. The following sections demonstrate how the

[32]Conducted in January 2023 in Scopus and Web of Science. Search strings were “Addis” AND “water security” in title, keywords, or abstract. Also conducted for “Akaki” and “water security” in title, keywords, or abstract.

methods adopted in this research not only aligned with the specific objectives of this research but also addressed these gaps for water security research in Addis Ababa.

Table 8. Methods used in existing water security research in the Addis Ababa area (QUANT = quantitative methods, QUAL = qualitative methods, QUAL/QUANT= mixed methods)

"Addis" AND "water security"

	Title	Type(s)	Method
1	*Assessing the impact of climate change on water resources of upper Awash River sub-basin, Ethiopia*	• Statistical downscaling model and climate scenario generation	QUANT
2	*The hydrosocial cycle in rapidly urbanizing watersheds*	• Hydrosocial cycle framework and analysis • Data collection methods: field visits, document review, and stakeholder discussions	QUAL
3	*Development of a generic domestic water security index, and its application in Addis Ababa, Ethiopia*	• Domestic water security index based on water supply, sanitation, hygiene • Triangulated with secondary data sources obtained from different Ethiopian governmental offices and national statistics datasets	QUAL
4	*Household Water Security Index: development and application in the Awash Basin of Ethiopia*	• Development of a water security index based on water resource availability, access to available water, purposes and means water used for, capacity of household to manage water, the ecological integrity of water, and organizations and institutions mediating the process of water access and use • Primary data collection: a structured closed-ended interview to collect socioeconomic and biophysical data • Secondary data: from District Offices and Matethara Sugar Factory, and literature review • Triangulation using secondary sources and literature	QUAL
5	*Water security: stakeholders' arena in the Awash River Basin of Ethiopia*	• Stakeholder analyses using key informant interviews, focused group discussions, policy and other secondary documents (water-related policy documents, water resources proclamations and regulations, water resources development strategies, national plans, and programmes)	QUAL
6	*Climate Change Impact on Water Resources in the Awash Basin, Ethiopia*	• The change factor method	QUANT

Table 9. Methods used in existing water security research in the Akaki catchment area (QUANT = quantitative methods, QUAL = qualitative methods, QUAL/QUANT= mixed methods)

"Akaki" AND "water security"

	Title	Method(s)	Type
1	*Impacts of Surface Water Quality in the Awash River Basin, Ethiopia: A Systematic Review*	• Systematic Review	QUAL
2	*Impact of Natural and Anthropogenic Stresses on Surface and Groundwater Supply Sources of the Upper Awash Sub-Basin, Central Ethiopia*	• Surface water (WEAP) and groundwater (MODFLOW) models • Survey to collect water consumption data for different water users • Estimates sourced from published literature and reports • Stakeholder consultation (Basin Development Authority) to estimate demand where no published sources were available	QUAL / QUANT
3	*Evaluation of factors affecting the quality of citizen science rainfall data in Akaki catchment, Addis Ababa, Ethiopia*	• Citizen science for rainfall data and demographic data	QUAL / QUANT
4	*Trace Element Levels in Nails of Residents of Addis Ababa Are Shaped by Social Factors and Geography*	• Comparison based on trace element detection in nail samples • An individual-level questionnaire to collect the demographic and lifestyle characteristics of participants (age, education, body mass index, alcohol consumption, and gender)	QUAL / QUANT
5	*Absence of significant association of trace elements in nails with urinary KIM-1 biomarker among residents of Addis Ababa in Upper Awash Basin, Ethiopia: a cross-sectional study*	• Upstream/downstream community comparison based on nail and urine samples from purposive sampling of one adult from every household • An individual-level questionnaire (occupation, gender, level of education, body mass index, alcohol consumption behaviour and health history)	QUAL / QUANT
6	*A Synthesis of Surface Water Quality in Awash Basin, Ethiopia*	• Systematic Review	QUAL

5.2 Data collection

Several challenges existed for data collection to evidence this research. The first of these being the variety of data types that could support a systems approach (as demonstrated by Chapters 3 and 4) as well as explore water security (partly discussed in Chapter 2, further demonstrated in Table 8 and 9), and therefore deciding what data was best for supporting this research. The second challenge was how perspectives and priorities of water security could be captured across a variety of actors and governance scales, where water security was framed by the three statements of water security outlined in Chapter 2. The challenge therefore being how the data could represent these three statements of water security, and how it could be gathered with potential varying degrees of access as well as under the constraints of limited time.

To address the first of these challenges, it was observed that the study possessed several defining parameters of qualitative research (Ritchie & Lewis, 2003, pp.3–4): the aims of the research being concerned with experiences of water security; emergent categories of water security being expected to materialise as the research was conducted; outputs including detailed descriptions, perspectives, and recounts of water security; and most importantly, the investigation of water security being an explorative approach. The supporting data could therefore be qualitative in nature to support the research aims; taking an explorative approach to water security based on narratives and experiences.

To address the second of these challenges, a solution was the collection of a range of data sets (i.e., not just one qualitative data collection method) that could then be triangulated to provide a complete understanding of water security in Addis Ababa. The collection of multiple data sets could additionally provide: consideration of multiple knowledge viewpoints, perspectives, positions, and disciplines; richer datasets from integration, combination, and various triangulations; and, the reduction of information gaps and bias that could come with using only one data collection and analysis method (Axinn, 2006, p.1; Tzagkarakis & Kritas, 2022; Baran & Jones, 2016; Creswell, 2015, p.60; Mukherjee & Kamarulzaman, 2016). This also adheres to the idea of methodological pluralism, one of the systems fundamentals drawn upon for this research.

The qualitative data collection methods were chosen based on the ability to capture narratives and experiences of water security that could inform water security as defined by three statements: (1) water security as defined by physical insecurity; (2) water security as a social and political practice, process, and value; (3) water security as indivisible from human security and justice. Additionally, methods that could provide evidence for systems interpretations of the interconnectedness of water security in Addis Ababa. Even though the approaches differed, they upheld the fundamentals of being complementary to each other[33], counterbalancing the weaknesses of one method with the strengths of another (Axinn, 2006, pp.11, 25) (as demonstrated in Table 10), and facilitating eventual triangulation[34].

Table 10. Complementary differences between methods including differences in structure and researcher participation between methods (modified from Figure 1.1 in Axinn (2006, p. 10)**)**

			Structure		Researcher	
	Method		**Level of structure**	**Data form(s)**	**Involve-ment**	**Position**
Capturing experience and perspectives	**Interviews**	Semi-structured	Medium/ Low	Text/ audio	Always	Questioning
		Key informant	Medium/ Low	Text/ audio	Always	Questioning
	Workshops	SSM	High	Visual	Usually	Questioning
	Questionnaire	-	High	Text/ numerical	Sometimes	Questioning
Capturing context	**Document analysis**	-	High	Text	-	-
	Visual-spatial data	Researcher-generated visual data	Low	Visual, spatial	Always	Observing

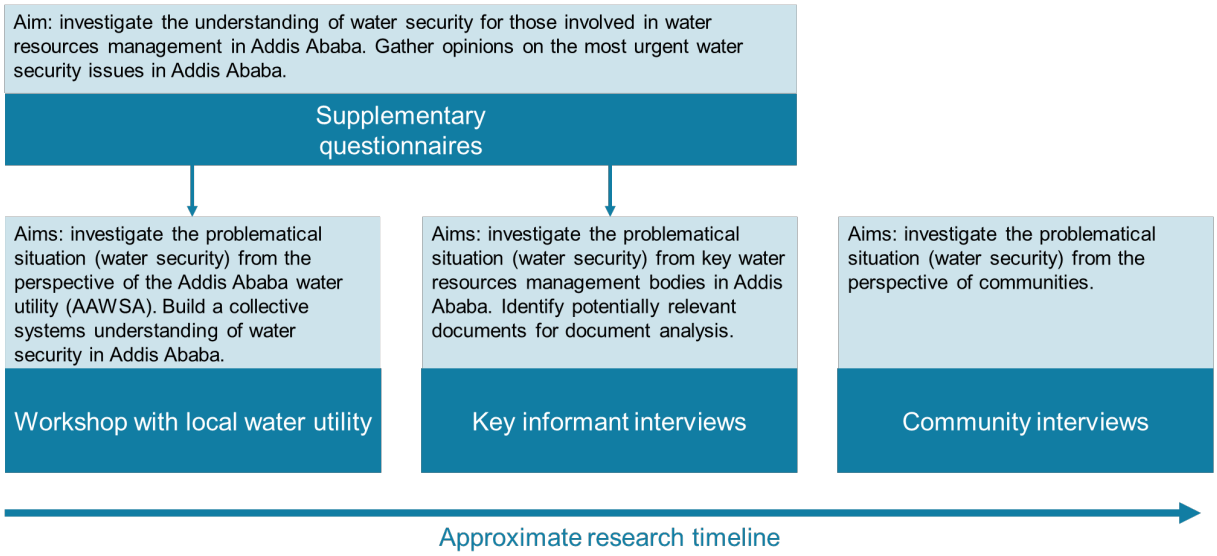
5.2.1 Capturing experience and perspectives

The following sections discuss the details of the data collection methods used in this research (as described in Table 10). This section specifically covers those that were used to capture experience and perspectives of water security in Addis Ababa (Figure 22).

[33] Balancing out differences in the level of structure, researcher involvement (Axinn, 2006, p.10), researcher position, and data form(s) produced, for example.

[34] Triangulation from questionnaires, interviews, and document analysis allows testing of data based on frequencies in themes (Flick, 2009, pp.25, 444), comparison and combination of answers, and participants cross-referenced to each other in analysis (Flick, 2009, p.27).

Figure 22. Overview of data collection methods used to capture experience and perspectives of water security throughout the research



5.2.1.1 Workshops

Workshops can be seen as a form of collaborative research where research is conducted with stakeholders who are invested in the research and its findings; the needs, interests, and questions of stakeholders are therefore taken into account in mutually shared lines of enquiry (Given, 2008). For this research, the term workshop refers to a structured pre-planned knowledge sharing event attended by multiple people. This research used workshops as a qualitative research method in order to: facilitate a space between industry and academia; improve the relevance of the research; collect water security perspectives and priorities from stakeholders in a shorter amount of time; build a collaborative systems interpretation; and to use knowledge sharing as a means to build capacity among involved participants.

Workshops were seen as complementary to the research due to the aforementioned reasons but also due to their adherence to parts of the soft systems methodology (SSM) approach for addressing complex problems. In soft systems methodology (discussed in Chapter 3), the approach follows four key steps: (1) finding out about the problematical situation; (2) model building; (3) using the interpretation of the problem situation as a source of discussion and debate; (4) discussing ideas of change that are both desirable and culturally feasible (Reynolds & Holwell, 2010, chap.5; Checkland & Winter, 2006; Checkland, 2000). Applications of SSM follow these steps with varying interpretations with the approach being described as flexible

(Reynolds & Holwell, 2010, chap.5). Generally, however, Step 1 is focused on gathering different perspectives of the problem situation; representation of the situation being the primary concern (Checkland & Winter, 2006). Step 2 builds a model that can be used as an intellectual device to help 'structure an exploration of the problem situation being addressed' (Checkland, 2000). In the case of this research, the model was built using causal loop diagrams (CLDs) following a process similar to that described in Checkland, (2000, fig.A6) of: describing activities independently; indicating the dependencies between these; and redrawing the system for clarity and adding monitoring and control. Step 3 then uses the models to structure discussion; questioning the real world and debating purposeful action as well as exploring the differences between different model constructions (Reynolds & Holwell, 2010, chap.5; Checkland & Winter, 2006).

The workshop was conducted over two days with the local water and sewerage utility (AAWSA), and was structured around steps (1), (2), and (3) of the SSM approach. The full workshop outline can be found in Appendix B, a broader structure is shown in Table 11.

Table 11. Broad workshop structure (within steps of SSM).

Part 1: Finding out about the problematical situation	
Day 1	• Understanding the perspectives of different types of *water problems* in Addis Ababa and the severity for individual stakeholders. • Sharing and discussing problem perceptions with other stakeholders. • Categorisation of agreed *water problems*.
Day 2	• Explore the idea of boundaries both based on individual stakeholders knowledge/work remits.
Part 2: Model building	
Day 1	• Explore causes and components of each of the agreed *water problems* from Part 1. • Start building causal loop diagrams using connecting arrows and descriptions of relationships (i.e., + or -).
Day 2	• Using the maps from Day 1, begin to explore the boundaries of these processes (both spatially and institutionally).
Part 3: discussing and debating	
Day 1	• Compare and discuss systems interpretations between individuals and groups.
Day 2	• Discuss outputs of Day 1 and 2 and how they can be used within AAWSA's planning, and within individual's activities.

5.2.1.2 Semi-structured interviews

Interviews were used as a data collection method in this research to gather water security experiences and perspectives through narratives across communities and key informants. The type of interview used was the semi-structured interview. Semi-structured interviews are a form of guided conversation whereby a protocol is prepared that covers some general topics but the interview is flexible, with the direction being shaped or changed by the responses of the interviewee (Fife, 2006, p.95). There is no standardised method for semi-structured interviews, and various approaches exist on a spectrum of level of structure, flexibility, and probing (Ritchie & Lewis, 2003, p.111). Semi-structured interviews were complementary to investigating the experience of water security as this type of interviewing is appropriate for storytelling and exploration which are at the core of narrative data. Additionally, as demonstrated in Section 5.1, they appeared to be an existing successful method for investigating some aspects of water security in Addis Ababa.

As previously mentioned, there is no standardised approach to conducting semi-structured interviews. In general, however, semi-structured interviews have an open-ended question format covering several topic areas based around the major research components that allow for a dialogue of the lived experience of the interviewee to emerge (Magaldi & Berler, 2020; Flick, 2009, p.156; Rubin & Rubin, 2005, chap.7). The topic areas of the interviews conducted in this research were therefore the three statements of water security. The specific aims and guiding open-ended questions associated with each of the three statements of water security are demonstrated in Table 12 and the full interview protocol (in both English and Amharic) can be found in Appendix B. As demonstrated by Table 12 and the interview protocol in Appendix B, the community interviews and key informant interviews differed slightly in their lines of enquiry. This is because the key informants could offer more of an insight into organisational and institutional structures, and community interviewees could offer more of an insight into community action and place-based experiences.

As demonstrated by the interview protocol in Appendix B, the interview first began with introductions, obtaining informed consent, and presentation of the research topic to build rapport, which is inherent to any interview process (Magaldi & Berler, 2020; Baumbusch, 2010). The interview questions then followed a bell-curve of intensity;

the first questions being non-personal, broad, factually focused, to later move into a more in-depth, personal questions, and eventually finish again with factual, less emotional questions (Baumbusch, 2010; Magaldi & Berler, 2020). The end of the interview again covered informed consent as well as expressing gratitude to the participant for their time (Baumbusch, 2010).

The semi-structured interviews were conducted face-to-face in one sitting. This approach was chosen as it is personal, builds trust and rapport, has the potential for a better response rate than other survey techniques, and limits the collection of redundant material (Hussein, 2022). Telephone interviewing was considered as it is 'cheaper, quicker, and more practical for generating a random sample of the population' (Hussein, 2022), but it was deemed inappropriate for the context of this research as the interviews required an assistant which would have been difficult to coordinate over a telephone interview.

Table 12. Semi-structured interview topic areas, aims, and main questions

WATER SECURITY AS DEFINED BY PHYCIAL WATER INSECURITY	
Aim(s)	To try to understand the various uses of water (demand) and the various issues with supply (quality, quantity, access etc.). Also, to try and obtain an insight into scales of severity (e.g., how bad something is, how urgent something is, how important something is) as well as a perspective of how/if these things have changed over time.
Guiding questions	• Can you tell me about some of your biggest concerns for water? • Tell me about your water access, how do you obtain water for different purposes, is accessibility consistent? • Tell me about when you feel most and least concerned about water, do the seasons impact these concerns?
Target interviewees	Communities, individuals, and key informants
WATER SECURITY AS A SOCIAL AND POLICITCAL PRACTICE, PROCESS, AND VALUE	
Aim(s)	To try to understand the social experiences of the participant(s) over time in terms of water. This can include changes and memories in the areas they have lived in, uses of water, and experiences of extreme events. The interview should try to remain on the topics of water, changes of the seasons, land-use, water-use, water quality, frequency of flooding/drought, rainfall, urbanisation etc.
Guiding questions	• How long have you lived in this area? • What memories do you have (or have been passed down to you) of water and land use here? • What has changed since you lived here, what has been the biggest change? • Tell me about the way you use water in your day-to-day life.

Target interviewees	Communities and individuals
	Role and knowledge (for key informant interviews)
Aim(s)	To explore the specific role and knowledge of the key informant in relation to water security. This involves their perspective of water security and priorities in relation to their work as well as any specific guidelines/mandates they operate within that they believe is related to water security.
Guiding questions	• What is your perspective of water security? • What water security priorities are there in your work, do you think these differ from your personal life? • Do you work within any frameworks, guidelines, or mandates that specifically focus on water security? If not, then what frameworks do you feel promote water security?
Target interviewees	Key informants

WATER SECURITY AS INSPERABLE FROM HUMAN SECURITY AND JUSTICE	
Aim(s)	Try to understand how various water issues are related to human security and justice. Additionally, whether feelings of injustice have created action such as the forming of groups to give solutions to issues or to raise awareness. Or perhaps there have been other forms of campaigns (e.g., petitions, protests), or maybe there are a select few community individuals who take it upon themselves to try to fix water issues.
Guiding questions	• Do you feel there is equal access to water in this area? What about in Addis? • Do you, as a citizen or community, feel like a priority for water access? • How does your community respond to the main water challenges in this area? • How do you personally respond to water challenges?
Target interviewees	Communities and individuals

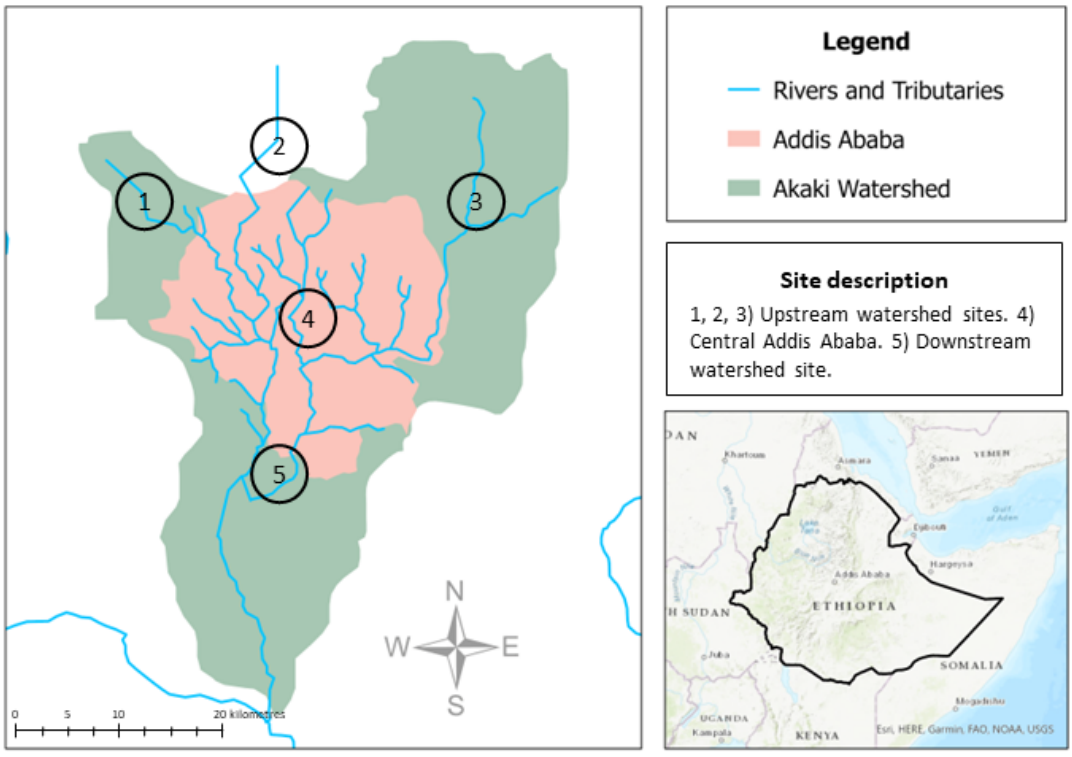
The selection of interviewees undoubtably impacts the research[35], and so was considered carefully. Potential community interviewees were selected based on stratified purposive sampling. This is where members within the sampled population are purposefully chosen because of features or characteristics that represent a location or type in relation to the key criterion, enabling a detailed exploration of the central research themes (Ritchie & Lewis, 2003, p.78). Stratified purposive sampling tries to capture major variations amongst groups, rather than to identify a common core, so that sub-groups can be compared (Palinkas et al., 2015; Ritchie & Lewis,

[35] Influencing the relevancy of findings, the validity of making broader observations for different social groups, and determining whose voices are heard or excluded, for example.

2003, p.78). In the case of this study, location[36] was of particular interest to capture variations in water security priorities in different areas of Addis Ababa, as shown in Figure 23.

Potential key informants, however, were selected based on their area of expertise and their organisation (Table 13). Key informants are seen as experts who can provide required information and insights on a specific issue as a specialist source of information (Akhter, 2022), therefore their expertise can provide direction on situations, events, or people likely to be helpful to the progress of the investigation (Bryman, 2012, p.439). Of course, the idea of an expert is subjective to both the research and the context of the research. For example, the key informant may be determined by playing an important social role, occupying a central structural position in an organisation, or by being situated strategically in a communication network (Ritzer, 2007, p.2457).

Figure 23. Selected sites for interviewee sampling



[36] Based on several factors: urban, peri-urban, rural, as well as, upstream and downstream.

Table 13. Key informant governance organisations

Key informant group	Organisation	Abbreviation
Government	Ministry of Water, Irrigation, and Energy	MoWIE
	Ministry of Health	AAHCC
Local utility	Addis Ababa Water and Sewerage Authority	AAWSA
	Oromia Water Bureau (Oromia Special Zone, Finefine)	OWEB
Environmental management organisations	Addis Ababa Environmental Protection Agency	AAEPA
	Awash Basin Authority	AwRBA
Research organisations	Addis Ababa Universities	-
	Water Resources Institute (Addis Ababa)	WRI

5.2.1.3 Questionnaire

An open-ended self-completion questionnaire was used as a supplementary data collection method with key informants either prior to the semi-structured interview or prior to workshops. This helped to gather additional water security perspectives and priorities in a shorter amount of time[37] as well as obtain a broader knowledge about the issue of the study, and to mutually validate the findings of multi-method approaches through triangulation (Flick, 2009, pp.30, 164). Permission was always obtained to use responses for data collection, as well as permission to contact participants if follow-up was desired or required.

Open-ended questions were chosen so that respondents could answer on their own terms without any fixed choice response options. This allowed the responses to explore new areas, be unpredictable, and reflected respondents' levels of knowledge and understanding of water security (Bryman, 2012, p.246). The open-ended questions within the questionnaire (see Appendix B) were structured around the objectives of:

- Establishing an individual baseline understanding of water security for the key informant

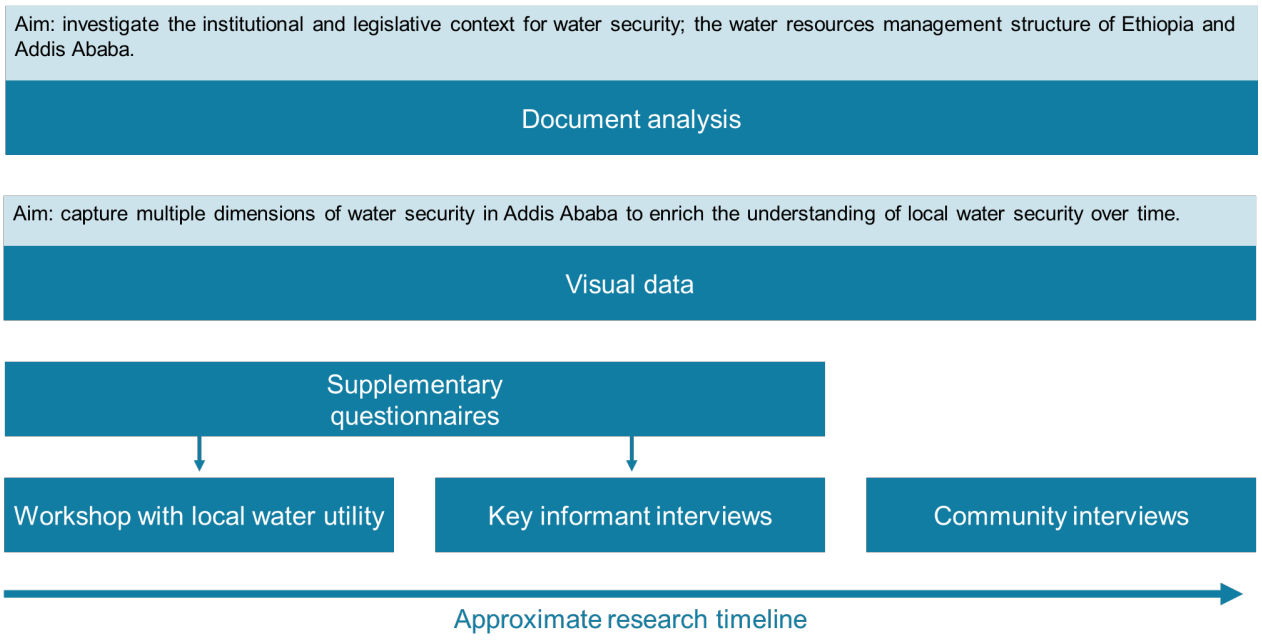
[37] The questionnaire, in some cases, being administered to convenience sample groups as an alternative to probability sampling (which involves a lot of preparation) (Bryman, 2012, p.201).

- Understanding the role, characteristics, and knowledges of those involved in water security decision-making
- Attempting to establish a 'normal' water security position for a certain tier of stakeholder
- To identify which sectors are familiar with, and practice, water security in specific water resources management frameworks
- To gather insights on the most recent concerns and manifestations of water security in Addis Ababa

5.2.2 Capturing context

The following sections discuss the details of the data collection methods used in this research (as detailed in Table 10). This section specifically covers those that were used to capture the context of water security in Addis Ababa (Figure 24).

Figure 24. Overview of data collection methods used to capture the context of water security throughout the research alongside those capturing experience and perspectives from Figure 22



5.2.2.1 Document analysis

Document analysis is frequently used in qualitative research, along with interviews, to collect narratives (Feldman, 2004; Butina, 2015) and build a picture of a certain phenomenon. It is also often used to facilitate triangulation with other methods to seek convergence and corroboration (Bowen, 2009). For this research, the documents of interest were those that could provide institutional and legislative

context for water security as a water resources management paradigm. Proclamations, regulations, local planning and management programmes, government strategies (including those of executive bodies), utility road maps, and national and regional policies, are some examples of documents that were analysed for this research[38]. These documents provided context to this research allowing for assessment of the possible challenges of operationalising water security in policy, as well as an interpretation of water security priorities and perspectives at national level compared to other levels of governance.

As many of these documents fell under grey literature, a traditional database search was not an accurate approach for data collection. A number of other strategies were therefore adopted; document request (asking experts or organisations for relevant documents), citation chaining (using references within one document to find other documents) and hand searching (assessing existing documents page by page to look for other relevant documents). Once located, documents were only considered if they were published by a national or regional Ethiopian government body within or after 1995 (the year that the Federal Democratic Republic of Ethiopia was established). Documents were analysed to provide a historical trajectory of, as well as actors involved in, national water resources management. Documents additionally provided a form of discourse analysis for the specific framing of water resources management by the national government; the interconnection between texts and the different discourse they draw on demonstrating how they contribute to the social and political meaning of water resources management in the country (Phillips & Hardy, 2002, p.5). The document analysis was structured around analysis of:

- Who is involved (departments, organisations, executive bodies, etc)
- How they are involved (organisational structures, specific mandates, powers of enforcement and regulation, etc)
- Priorities for water resources management (sectoral goals, laws, national policies and plans, specific issues raised, etc)
- The rhetoric of the text (e.g., how water resources management issues are structured and organized) (Rapley, 2018, chap.9)

[38] Specific documents are detailed in their respective chapters.

- The authority of water resources management issues (e.g., the arguments/persuasions made to frame the importance of water resources management issues) (Rapley, 2018, chap.9)
- Other referenced water resources management laws, plans, and policies that may also need to be considered

As part of the analysis of national priorities and rhetoric around water resources management, water security perspectives and priorities were also investigated within documents. As only a few recent national documents exist that specifically mention water security, however, water security perspectives and priorities were therefore interpreted based on the three statements of water security (defined in Chapter 2). This was largely based on evidence within the documents for: physical water security priorities and perspectives (water resources development, supply and demand, infrastructure, etc); social and political practice, processes, and values (political goals and structures, laws and mandates, socioeconomic plans for water resources, etc); and the relationship between water security, human security, and justice (legal rights, links to other types of security, links to other sectors and/or work packages, etc).

5.2.2.2 Visual data

The use of visual materials in qualitative research has become more prevalent in recent years but is not a new method in social research (Bryman, 2012, p.455). More specifically, the use of photographs in qualitative research is common in anthropology, ethnography, sociology, psychology (Knowles & Sweetman, 2004; Bryman, 2012, p.455; Margolis & Pauwels, 2011, pt.1), and more. The use of visual images within social research fall under three separate theoretical approaches that describe why they are popular for recording material cultural and human behaviour (Margolis & Pauwels, 2011, pt.1):

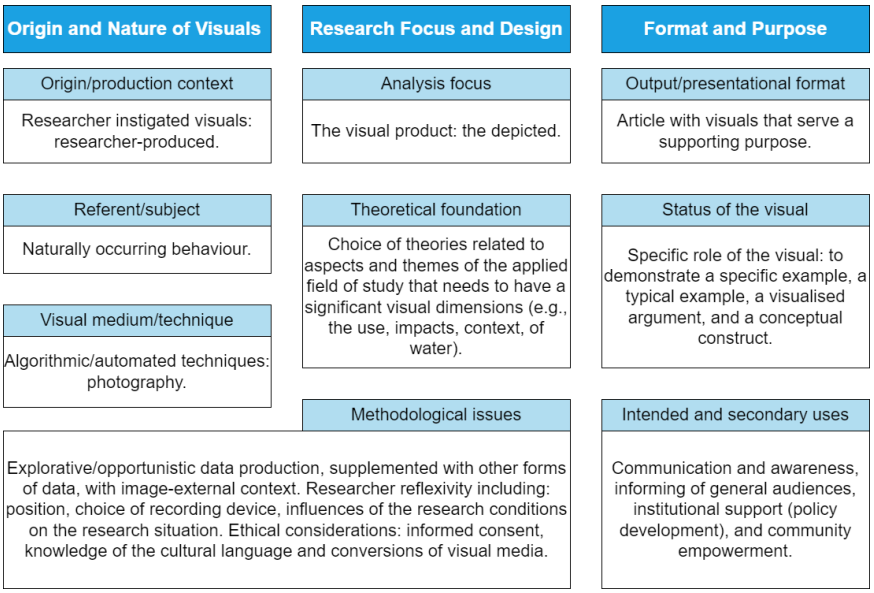
- Images are representations of reality;
- Images help construct reality;
- Existing images are texts that can be read to uncover their wider cultural significance and the ideological and other messages they help to communicate, naturalize, and maintain (Knowles & Sweetman, 2004, pp.5, 6).

In practice, however, the use of photographs in social research can be grouped into three uses: an illustrative tool, a prompt, or as data in their own right (Bryman, 2012, p.547). In this research, photographs were used as the latter, as data alongside other

methods, with the aims to: enrich the understanding of water security; visually demonstrate areas of intersecting water priorities (e.g., between communities and industry); provide an explanation for certain water security phenomenon when compared to waterways, water supply, and sewerage distribution networks; and allow for a visual seasonal comparison between study areas. As the photographs were taken for the research by the researcher, they are researcher-generated visual data whereby the researcher is in control of the selection of events and phenomena to initiate the production of visual data (Kim, 2016, p.31).

Photographs as data for this research were collected using ArcGIS123 survey tool in mobile application form. This meant that spatial data could be collected alongside visual data and directly imported into ArcGIS programmes. The ArcGIS123 app could incorporate photo(s), location, date and time, and notes on the observation in one submission. Additionally, it was convenient as a mobile device was nearly always accessible. Considerations for using photography as visual data were thought about at various stages of the data gathering process; origin and nature of visuals, research focus and design, and format and purpose, for example were important questions for the use of visual data (Margolis & Pauwels, 2011, pt.1). Figure 25 depicts how these were considered for this specific study. Ethical implications of this research technique are discussed more in Section 5.4.3.

Figure 25. Considerations for visual social research. Adapted from Margolis & Pauwels (2011, pt. 1,**Figure 1.1).**



5.3 Data analysis

In analysis, one moves from the micro to the macro (Fife, 2006, p.120). For this research, this meant that the various types of data collected were integrated, combined, and compared in a way that transformed the data into supporting material for interpretation and contributed to the objectives of the research. In this research, the data was largely narrative data which is commonly found in interviews, documents, and observations (Feldman, 2004; Butina, 2015). Unfortunately, there is no set way of analysing narrative data as it is based on the research purpose and questions (Butina, 2015). There are, however, some approaches that can act as a guide. One of these, narrative thematic analysis, is one of the most common narrative analysis approaches (Butina, 2015) and is used to derive participants' stories about a particular phenomenon and examine the cultural logic behind those stories (Schrauf, 2016, p.5). It can also be applied to visual data, incorporating images into narrative analysis alongside written or spoken text (Butina, 2015). Narrative thematic analysis was used as the data analysis approach for this research, being complementary as:

- Narrative analysis allowed for the description of experiences of water security, the understanding of priorities of different actors, the description of systems interconnections in water security experiences between different groups, and the management of water security to be understood as an evolution of discourse.
- Thematic analysis allowed the identification of topics of water security (and comparison of the homo/heterogeneity), the identification of areas and themes of priority, and the grouping of topics into the three statements of water security as defined by this research.

In narrative thematic analysis, the content within the narrative is the main focus, not how a story is told or put together or the dialogic process i.e., what was said rather than how it is said. The main stages of narrative thematic analysis can be ordered as follows (Butina, 2015; Ryan & Bernard, 2003; Kim, 2016, chap.6).

- Step 1: Organisation and preparation of the data
- Step 2: Coding the data
    - Defining categories or (sub-)themes
    - Sorting themes and building hierarchies
- Step 3: Triangulation (comparing thematic results)

- Step 4: Linking themes into theoretical models
- Step 5: Representation of the data
- Step 6: Interpretation of the data

5.3.1 Step 1: organisation and preparation of the data

All data in this research, except for research-generated visual data, derived from interactive discourse. For analysis, this data was continuously transformed throughout the research process. Firstly, it was transformed into representations of discourse (e.g., spreadsheets, transcripts, maps, etc.), and secondly excerpts were then transformed into discussion for publication (Schrauf, 2016, chap.4). This transformation process converted interviews into qualitative data through transcription (Schrauf, 2016, p.66), in the cases of questionnaires and visual data, the transformation had already made the data ready for narrative thematic analysis.

Transcription is the process of transforming audio from interviews into written text or script and is the first initial filtering of data (Schrauf, 2016, p.69) .Transcribing interviews from recordings not only means that a thorough examination of what is said can be conducted, but also that the data is open to public scrutiny and re-use (Bryman, 2012). Transcription is in itself an interpretation of the all information available in the audio file; the level of detail in a transcript serves the needs of the analysis and the readability of the data (Schrauf, 2016, p.69). Interviews from this research were transcribed in Microsoft Word, disfluencies (e.g., hesitations, interruptions, repetitions) or prosodic features (e.g., pitch, speed, volume) were not included in the transcription as this was not a linguistic analysis. Transcriptions were then compiled into one document for each interviewee. For participants to remain anonymous, codes were used to describe the participant (e.g., KI1) and any information that could act as an identifier (e.g., names, occupations, etc.) were removed. As the interviews were conducted in Amharic, a translator was also used in the transcription process (see Section 5.4.2).

5.3.2 Step 2: coding

Coding is an interpretive process with no set rules (Köpsel, 2019, p.86). For this research, the creation of codes was a systematic practice where words or phrases

were identified that showed which concept is being mentioned or referred to within a particular section of the data (Ritchie & Lewis, 2003, p.224). The process of coding followed an iterative process of reading and re-reading the narrative data to identify recurring words, objects, ideas, or patterns (Butina, 2015). NVivo qualitative analysis software was used for this research to code the data from interviews and questionnaires[39]. There is an argument that too many codes risk fragmenting the data and losing the overall narrative (Ritchie & Lewis, 2003, p.211) so codes were considered carefully to concisely reflect the research. Codes were then related and combined to form categories, emerging patterns in categories then forming themes (Kim, 2016, chap.6). Within the narrative data, themes were defined through establishing codes and categories that could be identified by repetitions, indigenous typologies or categories, metaphors and analogies, transitions, similarities and differences, linguistic connectors, missing data, and theory-related material (Ryan & Bernard, 2003).

5.3.3 Step 3: triangulation

In the final stages of narrative thematic analysis, there is the triangulation of data, this is a means of comparing, integrating, and accrediting data and themes. This is often mentioned as one of the main strengths of using multiple data collection methods; triangulation integrates data as it can operate both within and across research strategies (Bryman, 2012, p.392; Tzagkarakis & Kritas, 2022), the process also improves credibility of research findings (Bryman, 2012, p.396).

There are four main types of triangulation: data, investigator, theory, and methodological (Tzagkarakis & Kritas, 2022). As well as three main outcomes: results converge, mutually confirm, and support the same conclusions; results focus different aspects of an issue but are complementary to each other; results are divergent or contradictory (Flick, 2009, p.30). The aims of this research aligned more with data triangulation whereby data has been collected from different people, communities, and groups, and so triangulation was used to gain multiple perspectives and validation (Carter et al., 2014). Triangulation therefore attempted to understand

[39] Nvivo is qualitative data analysis (also known as QDA) software. It can store, organise, analyse, integrate, and visualise different types of qualitative data. Data can be analysed used cross-cutting tools which allow links to be made between data sets and themes to be identified.

similarities and differences between water security perspectives and priorities and explain the diversity and distribution in the discourse, with differences between groups reflecting relations of knowledge, practice, expertise, or authority (Schrauf, 2016, p.15). NVivo qualitative software was largely used for triangulation due to its ability to compare cross-cutting themes and understand similarities and differences between interview responses.

5.4 Research considerations

There were a number of research considerations for the methods used in this research. These broadly fell under: (1) positionality and reflexivity; (2) the interpretation of data; and (3) ethical practice. As the main source of data was narrative qualitative data, the process of data collection was a social interaction, an interaction that can be forgotten through being continuously suppressed in transcription, coding, and analysis (Schrauf, 2016, p.68). The social interaction of data collection unifies the researcher with the research process and therefore becomes influence on both the data that is gathered as well as the conclusions drawn. This is sometimes referred to as the most fundamental criticism of qualitative research; that the process can be biased by the implicit assumptions, interests, worldviews, prejudices, and one-sightedness of the researcher (Diefenbach, 2009). It was therefore important in this research to be aware of, and constantly reflective of, the positionality of the researcher and the research in the context of the interactions that took place throughout the course of gathering empirical data and data analysis.

5.4.1 Positionality and reflexivity

Central to the nature of narrative qualitative research is the interpretation of meanings through analysis of plotlines, thematic structures, and social and cultural referents (Kim, 2016, chap.6). A consequence of this are the subjectivities that are introduced by all involved in the research and at every stage of the research process; the researcher’s presence and background impacting the generation and interpretation of data (Hennink, 2008; Ritchie & Lewis, 2003). It is therefore important whilst conducting research to consider the subjectivity of the researcher and of those being studied as part of the research process in order to be aware of biases and attempt to create objectivity and neutrality (Flick, 2009, p.16; Ritchie & Lewis, 2003, p.20). It was therefore good research practice to continuously reflect on the positionality of the research. This helped to explore the researcher’s status in relation to the research process and outcomes, including their relationship with participants. Additionally, it kept the researcher vigilant and responsive to interferences that could impact data collection, and ensured the researcher did not project their worldviews inappropriately (Magaldi & Berler, 2020).

One dynamic that was particularly present in this research[40], and perhaps required more reflective attention, was the insider-outsider relationship between researcher and participant. The insider-outsider relationship refers to positionality that is characterised by the relative nature of identities and social positions, depending on the specific research context (Kerstetter, 2012). There are advantages and disadvantages of both positions. Being an outsider could mean that nuances from the perspectives of the participant are missed (Brayboy & Deyhle, 2000), but it could also mean that there is a nuanced objectivity and emotional distance which can more easily facilitate relating one set of experiences to another (Bridges, 2001; Kerstetter, 2012). The insider position, however, understands the experiences, culture, or situation of groups in which they are part of better than the outsider (Kerstetter, 2012).

One of the main measures that was taken throughout this research to be proactive in the insider-outsider relationship was developing a thorough understanding of the culture from which data was collected and interpreted. This meant immersing the researcher in the context of the research by spending time in the setting (Irvine et al., 2008). The researcher lived in Addis Ababa for a prolonged period (~9 months) and learnt Amharic, for example. This helped to understand the context of local issues and challenges for water supply, as well as become familiar with language (helping interpretation in interviews) and build rapport and trust with local communities[41].

5.4.2 Translators and transcribers

Language is not only a means of communication but also a distinct marker of culture (Irvine et al., 2008). It enables meanings of the world, through the shaping of individual and communal experiences, to be communicated and interpreted (Hennink, 2008). It is therefore important that articulated expressions, concepts, and descriptions can be accurately represented in a way that remains true to the correspondents (Irvine et al., 2008).

[40] Due to the nature of the data collection methods such as interviews, that involved a direct relationship between researcher and participant.

[41] Time was spent with communities in different areas of Addis Ababa with other researchers before undertaking interviews specific to this research, for example.

Interpreters and translators were critical to this research and, based on the reasons in the previous section, this aspect of the research was carefully considered. The assistance of interpreters and translators adds to the complex process of language and communication as qualitative data becomes generated between researcher and participant as well as between researcher, interpreter, participant, and translator/transcriber, adding an additional layer of subjectivity to the data (Hennink, 2008). Research assistants therefore played a critical role in the research process, beyond simply technical tasks, and shaped the extraction of meaning through transformation of participants' words into an interpretation that is representative of particular sociocultural meanings, inherent values and beliefs, and equivalating these in the language and context of the research team (Hennink, 2008).

Research assistants who were local to the area helped to facilitate the community interviews. All assistants were familiar with both the language and culture of the study population which was important in conveying the underlying cultural meaning of participants' words and expressions to the researchers (Hennink, 2008). Furthermore, all community interviews were conducted in Amharic. Interviews were then translated and transcribed by an assistant in the school of linguistics at Addis Ababa University. It is important to be aware that the translation/transcription into English could have created more distance between the original experiences of the participants and the representation of these experiences in analysis which is problematic (Schrauf, 2016, p.6). Subtle meanings attached to words or phrases could have been misidentified or misinterpreted as they are not translatable outside of the cultural context, for example. To mitigate some of these issues with translation and transcription, both Amharic and English transcriptions were produced so the translations could be checked for credibility by other Amharic-speaking researchers.

5.4.3 Ethical practice

A central aspect of this research is the social experience of water security. This meant that the research involved collecting social data (from people and about people). As part of social research, various ethical principles that come with the involvement of human subjects were considered such as the enhancement of social justice, furtherance of human rights, and respect for cultural norms (Mertens, 2010). Additionally, the welfare of research participants, the protection and maintaining of

participants' rights, the protection of participants from any harm that might emanate from the research process, integrity, beneficence, and justice were also considered in the research (Kim, 2016, p.6; Abul Hossen, 2022). Furthermore, the researcher was reflective of their behavior and respectful in their conduct. It was consistently reflected upon, for example, that participants' involvement was of benefit to the researcher in pursuing understanding and academic development, which was a gift from the participants being at the expense of their commitment. As discussed by Bridges (2001) the reception of a gift in this context required a spirit of gratitude, of humility, of mutuality in the relationship in the cultural context.

In social research, power relations appear in many stages of the research process and the researcher should not only be aware of these but should also attempt to be strategic in resolving and managing them (Abul Hossen, 2022). For example, during social interactions (e.g., interviews) there are certain formalities, role expectations, and power differentials that arise. Consequentially, the researcher accepted that the relations between researcher and participants are hierarchical and sought to become aware of this positionality, aiming to mitigate oppressor/oppressed relationships as well as hierarchies in the knowledge production process (Fife, 2006, p.94; Abul Hossen, 2022). Additionally, the researcher strived to build good mutual relations with their research participants in order to get authentic data and to democratise the research process (e.g., encouraging participants to ask questions, giving participants as much information as possible about the intended project, and the nature of cooperation), hence mitigating disempowerment (Abul Hossen, 2022).

In the broader context of the research the voices that were included or excluded by the data gathered were also considered. Describing clearly who was interviewed and their status, making sure voices weren't excluded or demeaned, ensuring any vested interests were restrained, and ensuring findings and conclusions weren't limited any particular worldviews were some considerations made to reflect on the voices being heard through this research (Diefenbach, 2009). As part of this, it was also important to be sensitive and not politically naïve; undertaking research about people's lives can create many tensions and misunderstandings (Brayboy & Deyhle, 2000) and so the broader context of the research was consistently considered.

These ethical considerations largely came into realisation during the interviews conducted as part of this research; consent, safeguarding and protection, and awareness of power dynamics were important considerations. Consent was grounded in the principles of confidentiality, individual autonomy, and beneficence (Kim, 2016, p.6). Therefore, before recording of the interviews began, the participants were informed of their anonymity, the nature of the research and their involvement, that they were entitled to withdraw at any time, and of any benefits they were to receive from the research (Abul Hossen, 2022). They were also given an opportunity to ask any additional questions about any of the latter. Their informed written consent to proceed and be recorded was then requested by signing a (verbally translated to Amharic) statement of consent[42]. At the beginning of the recorded interview, before questions are asked, the core concepts of anonymity and right to stop the interview at any time were repeated. To further protect the respondent's anonymity and privacy, the research uses code names to identify different transcriptions and interviews and any identifying characteristics are removed. Other additional ethical precautions taken throughout this research included:

- The research obtained ethical approval from the School of Engineering at Newcastle University, from the GCRF Ethics Panel, and from the International Water Management Institute (IWMI).
- Ultimately, ethical practice was grounded in local guidance from academics already working in this field in Addis Ababa (IWMI).
- Verbal consent was always asked where people appear in photographs. The use of visual methods (photographs) in this research poses another layer of ethical consideration. Many of the photos taken do not include people. Where this is not the case, verbal consent was sought. However, in some cases people are in the background, these are made sure to be at a far enough distance that those in the photo are unidentifiable.
- Multiple informal visits to introduce myself and build rapport were done before interviews were conducted.
- There were multiple checks throughout the interview process to ensure the comfort of the interviewee and interviews were conducted in an appropriate and comfortable space. Considerations include: is the place of interview suitable (privacy and safety); is anyone present that may compromise the participant; and,

[42] Statement of consent: "I agree to participate in this interview and to this interview being recorded. The response will be used for Xanthe Polaine's PhD research: their thesis and academic articles. If I have provided any contact details, I understand that they will not be shared without my permissions. I also understand that I remain anonymous and can stop the interview at any time and my responses will be withdrawn from the study."

has the interviewee been given all the information about the objective of the interview and research? (Axinn, 2006, p.42)

- Anonymity was at the forefront of the research data collection, processing, and analysis. Names were not used and identifiers were removed from the transcription.
- Interviewees were always asked if they had any questions and were given the opportunity to add any extra information that wasn't covered in the interview.
- Interviewees were allowed to take my contact details should they want to reach out in the future.
- With their permission, the interviewees contact details were given to be able to let them know about any future research outcomes and the use of their data.

Part two

Water security across territories and actors in Addis Ababa, Ethiopia

Chapter 6. Introducing the study area

Africa and its riparian states are, like the rest of the world, subjects of various water insecurities. The uneven and irregular spatial and temporal hydrological distribution of water between African nations (Isaacman & Musemwa, 2021; Ashton, 2002) in combination with rapid growth in development and population have given rise to multiple stressors – exacerbated by low adaptation and mitigation capacities related to unsustainable finance and investments, and post-colonial institutions – that impact the degree of water security across the continent (AUC, 2022; UNESCO WWAP, 2021).

In addition to this, economic and food security in Africa depend heavily on water security with 95% of the population relying on rain-fed agriculture (UNEP, 2010) – the main economic backbone for most countries in the region (Oluwasanya et al., 2022). Periods of GDP growth are therefore, in many cases, related to reliable rainfall with periods of drought constraining economic growth (van der Heijden et al., 2017). In combination, these stressors and vulnerabilities present new challenges for water security at a time where Africa is simultaneously experiencing a globally unequal heavy climate change burden, due to being a low producer of emissions but acutely vulnerable to climate change impacts (Althor et al., 2016), as well as changing consumption patterns and prevailing social inequality.

As Africa continues to experience rapid development, the concentration of urban populations across the continent is also increasing[43]. This requires construction of infrastructure, adaptive city planning, adequate funds, and reliable freshwater availability, to capture, store, treat, and transport water (UNEP, 2010; Muller, 2016). This heightened pressure to expand water services coverage rather than build strong institutions and increase capacity means a supply and demand gap persists in many places (Pichon, 2019). Furthermore, the increasing urbanisation is causing large depletion of water resources through pollution, environmental degradation, and deforestation (UNESCO WWAP, 2021). The impact to water resources in both quality and quantity has created high competition for freshwater resources between sectors,

[43] Between 2010 and 2050, the number of Africans living in urban areas is predicted to increase from 400 million to 1.3 billion, respectively (Ndikumana, 2015).

regions, and transboundary states in Africa, leading to increasing privatisation and commoditisation of water (Isaacman & Musemwa, 2021). In some cases, this makes the water scarcity faced by around 344 million Africans an economic construct with its root causes in governance, financing, and access, rather than a physical water availability (IWMI, 2007; Calow et al., 2013).

In order to meet demand and increase resilience in a changing climate, water security has become of key importance to the sustainable development of the continent; the African Ministers' Council on Water highlighting the urgent need to invest in water security in Africa, for example (AMCOW, 2012). Furthermore, recognition of the link between gender equality and climate resilience in the pursuit of water security (AUC, 2022). This has prompted water security to become one of the Priority Areas of the first-ten years of Africa's Agenda 2063 (AUC, 2015), as well as 'integrating water security issues into development plans' being a key innovation area in the African Union's 2022-2032 strategy and action plan (AUC, 2022, p.53). Despite this recognition of urgency in obtaining water security for Africa, there has been little progress in national water security of most African states over the past few years (Oluwasanya et al., 2022). This is partly due to financial repercussions; it is estimated that between US$9 billion and US$14 billion would be required per year throughout the continent to achieve water security (OECD, 2021).

Despite these various water security challenges faced by Africa, the continent is not a victim of exogenous transformation when it comes to water security (Verhoeven, 2021b). Africa's many populations have historical success and experience in the management and utilisation of, and dynamic adaptation to (see Filho, 2021), water resources under various extremely difficult circumstances. These successes provide reflective opportunities and insights for socially sustainable water resources development – being essential to the region's social, economic, and environmental security (Damhaug et al., 1996; Isaacman & Musemwa, 2021). Therefore, to understand the water security challenges faced in Africa, and create socially sustainable solutions, imaginaries of water (in)security must be defined by local knowledges; the environmentally deterministic lens of water security must be rejected and reimagined (Isaacman & Musemwa, 2021). Water security must reconsider what

security means in the context of countries within the continent in order to provide meaningful solutions to local water security issues.

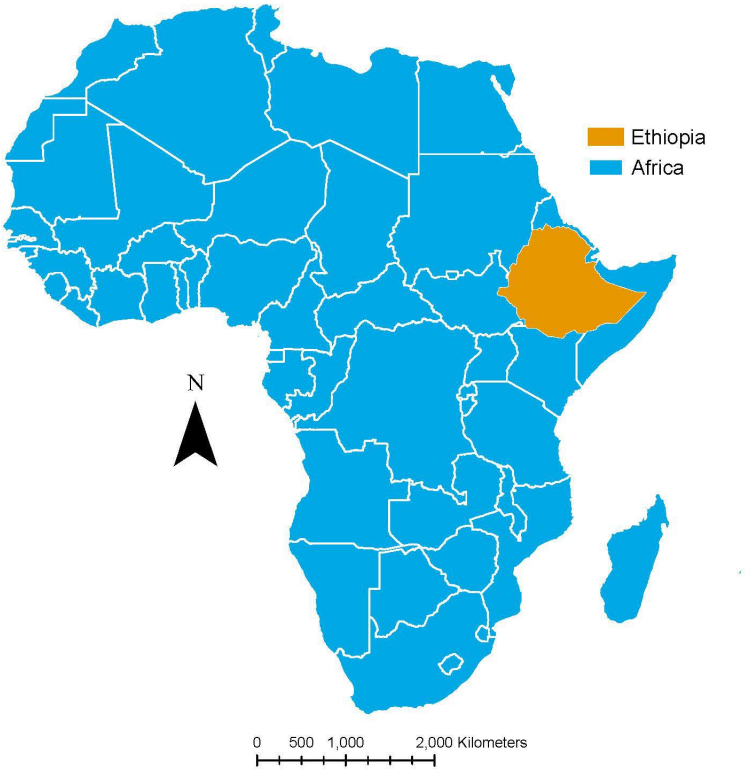
6.1 Ethiopia

Ethiopia is a geopolitically pivotal state within East Africa and beyond (UN Ethiopia, 2020). Located in the Horn of Africa (see Figure 26), Ethiopia is often referred to as the continent's *water tower*. A name given due to the high volume of precipitation that falls in its various highlands, as well as being the source of the Blue Nile; the majority contributor to the river Nile, the longest international river system in the world (Swain, 1997). In addition to this, Ethiopia has a mean total surface water flow of roughly 122 billion m^3 per year and renewable groundwater resources of around 2.6 billion m^3 (Calow et al., 2013). As a result, per capita water availability for Ethiopia is around 1,900m^3 per capita per year, which is above the Falkenmark threshold[44] of absolute water scarcity (Calow et al., 2013).

Despite these connotations of being a water tower and the apparent high availability of water, this resource has not been utilised by Ethiopia (Verhoeven, 2021b) nor is it evenly distributed in all parts of the country (UNDP, 2008). This is thought to be due to spatial and temporal variability and lack of water access from inadequate infrastructure, investment, and institutions (Calow et al., 2013), all of which are intensified by growing water demands, climate change, and watershed degradation in the country (Adane, Swedenborg, et al., 2021). The consequence of being a big water tower with little capacity to utilise this resource is the reoccurring phenomena of water scarcity, drought, and flooding in Ethiopia (Filho, 2021, chap.21).

[44] Falkenmark defines absolute water scarcity as < 1,000m^3 per capita per year (Falkenmark, 1989).

Figure 26. The location of Ethiopia in the Horn of Africa



Additionally, water security in Ethiopia is critically linked to the country's food, livelihood, and economic security due to high dependence on rain-fed agriculture; irrigation is applied to approximately only 5% of total irrigable land (Calow et al., 2013; Moges & Bhat, 2021; Worqlul et al., 2017; Yimere & Assefa, 2022). As a traditionally agrarian society, access to land and water are therefore the most important natural resources as they are not only key for agriculture and pastoral activities, but also livelihood strategies (Allan et al., 2012, pp.461–464). Despite the country's urbanisation trend[45], over 80% of the population is rural. In largely pastoral regions, it is more challenging to deliver basic services (UNDP, 2015) which, coupled with the dependency on water for livelihoods, makes water security a critical challenge for poverty in the rural areas of Ethiopia (FDRE, 2015; Calow et al., 2013; Pichon, 2019).

[45] The annual population growth rate in urban areas in Ethiopia has been projected at 4.1% between 2012 and 2030, based on rising rural–urban migration, continued high fertility rates, and general population growth (UNDP, 2015).

The consequence of this dependency on rain-fed agriculture, both socially and economically, is high vulnerability to drought and rainfall variability at both national level and for smallholder farmers (UNDP, 2022). The occurrence of drought is infamously known in Ethiopia[46] and, as well as loss of lives and livelihoods, periods of drought are also major threats in achieving national economic growth targets (Pichon, 2019) – reducing economic growth by more than one-third and costing Ethiopia around US$92.6 million between 1969-2010 (UNEP, 2010).

Ethiopia's hydrological climate has always been temporally and spatially variable. However, new and forecasted impacts, as a result of global climate change, have the potential to impact Ethiopia severely. Due to its geographic location, the economic and social dependence of the population on climate-sensitive sectors, and widespread environmental degradation in parts of the country (UNDP, 2015), climate change is both a major concern and a major consideration for addressing water security in Ethiopia (Calow et al., 2013). An estimated 10% of GDP is already annually lost due to increasing natural disasters, loss of water resources, forests and biodiversity, and population displacement (UN Ethiopia, 2020). Developing and securing water resources remains a challenge for Ethiopia, especially under potential future climate impacts, and acts as a barrier to Ethiopia's goal of becoming a low-middle income country by 2025, especially for the country's poorest (van der Heijden et al., 2017). In order to meet water demand requirements for all, water security must be understood amongst a diverse set of actors. This is essential in nurturing coordination and thus developing effective water security policies and investments (van der Heijden et al., 2017).

As demonstrated, the case for understanding contextual water security in Ethiopia is high, and furthermore somewhat urgent for the socioeconomic development of the country under an uncertain climatological future. It can also be observed that the types of water security in Ethiopia are very diverse; dimensions of livelihood security, economic security, food security, human security, development security, among others, appearing to be linked with water (in)security in a variety of ways across

[46] The most high-profile drought events being: the 1973 drought that caused the deaths of 100,000 people in Ethiopia (Damhaug et al., 1996); the 1984 drought that killed 300,000 people in Ethiopia (UNEP, 2010); and the 2003 drought that affected approximately 12.6 million people in Ethiopia (UNEP, 2010).

different areas in Ethiopia. The diversity of water security within the country therefore making it difficult to assess water security under a blanket diagnosis for the entirety of Ethiopia. Consequently, this thesis contributes to the understanding of water security in one area of Ethiopia, exploring water security elements and interactions in the capital city of Addis Ababa.

6.1.1 Water governance in Ethiopia

The water resources management structure in Ethiopia largely reflects the federal system of the country[47]. Water governance responsibilities are decentralised through proclamations and regulations and implemented through powers transferred from the Ministry of Water and Energy (an executive arm of the Federal Government) and Regional States (see Figure 27). Other national and international bodies are also involved with water management in Ethiopia with many sectoral institutions having one or more departments for water management issues (Awash Basin Authority, 2018). Some of these other bodies include Federal ministries and authorities (e.g., the Ministry of Water and Energy, the Ministry of Finance[48], the Ministry of Agriculture, the Ministry of Livestock and Fisheries, the Ministry of Irrigation and Lowland Areas, and Environmental Protection Authorities), River Basin Organisations (River Basin High Councils and Authorities), Water Utilities and Bureaus of Regional States, Zonal Administrations, Construction Works Corporations[49], Non-government Organisations (NGOs), and local communities (Tekle, 2019).

The Ministry of Water and Energy (MoWE) is the national water resources executive arm, regulator, and research institute of the Federal Government. The current form of this ministry was established in 2021 under The Definition of Powers and Duties of the Executive Organs Proclamation No. 1263/2021 (FDRE, 2021) that transferred the

[47] Under Proclamation No. 1/1995 Ethiopia became a federal and democratic state with Addis Ababa as its capital city. This proclamation divided Ethiopia into nine member states based on ethnicity (Article 47) and additionally made Addis Ababa a city state that operates in a form of autonomous self-rule (FDRE, 1995b).

[48] The Ministry of Finance and Economic Affairs are responsible for the channelling of multilateral, NGO, and bilateral donor funding towards various water-related development projects (as per Proclamation No.268/2002, Article 5:2) (FDRE, 2002b) .

[49] The Ethiopian Construction Works Corporation is tasked with the construction, upgrading, maintenance, owning, and administration of works relating to dams, irrigations, hydropower generations, water supply systems, sewerage systems, drainage, deep water wells, reclamations, river diversion (Regulation No. 366/2015, Article 5) (Awash Basin Authority, 2018; FDRE, 2015).

rights and obligations of the Water Development Commission, Basin Development Authority, Office of Water Resources Development Fund, and the previous Ministry of Water, Irrigation, and Energy, to MoWE (Proclamation No. 1263/2021 Article 106:12). Formerly, similar powers and duties existed under The Ministry of Water Resources (2000-2018) and The Ministry of Water, Irrigation, and Energy (2018-2021) as the executive 'supervising bodies' of the Federal Government responsible for water resources management.

Several proclamations (e.g., Proclamation No. 1263/2021 and No. 197/2000) detail the powers and responsibilities of MoWE. Under The Ethiopia Water Resources Management Proclamation (No.197/2000) (FDRE, 2000), MoWE is responsible for 'the planning, management, utilisation, and protection of water resources' (Article 8:1). This includes water supply, sanitation, and large and medium scale irrigation, as well as strategy delivery and directive issuing for management of the country's water resources (MoWE, 2023a; Arup, 2021b; Tamrat, 2008). MoWE therefore executes it activities under three pillars: Water Resources, Water and Sanitation, and Energy, with each pillar having further sub-divisions. Water Resources, for example, includes hydrology, IWRM implementation, watershed management, transboundary issues, informatics, etc (Key Informant Interview (MoWE), 2022). Additionally, part of MoWE's powers and duties can be delegated to 'appropriate bodies' (Proclamation No.197/2000, Article 8:2) i.e., another accountable institution or other federal and regional institution (Proclamation No. 1263/2021, Article 9:3). Other powers and duties of MoWE include to:

- Initiate and implement policies, strategies, and laws with respect to water and energy.
- Undertake policy studies, surveys, and research needed for the implementation of IWRM within basins.
- Ensure that projects, activities, and interventions related to water management in basins align with IWRM.
- Cause and implement improvement and expansion of water resource development and management.
- Cause establishment of sustainable and integrated administration system facilitating the equitable utilisation of water resources.
- Determine conditions for optimum and equitable allocation and utilisation among various uses and regional states of trans regional water bodies that crossing or bordering in more than one regional states.

- Issue permits for usage of water.
- Provide the necessary professional and technical support in capacity building of regional water development institutions.

(Proclamation No. 1263/2021, Article 32:1)

- Act as an executive body to resolving disputes between Regional States over shared water resources.

(Proclamation No.197/2000, Article 18:d)

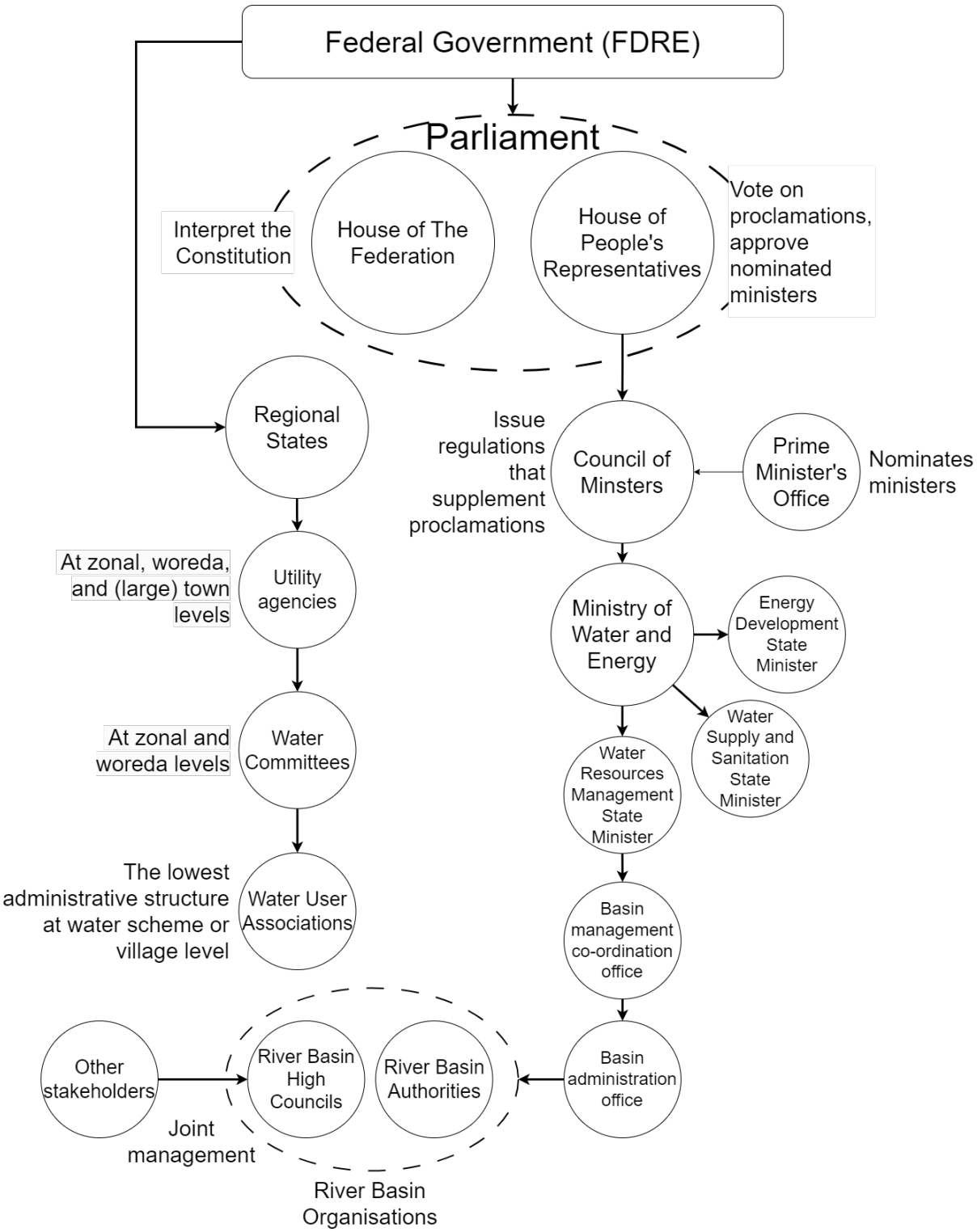
Other Ministries are also important to the water resources management of Ethiopia but play a much smaller role in the shaping of policy, strategy, and law for the country's water resources. For example, Proclamation No. 1263/2021 also gives powers and duties to the Ministry of Agriculture and the Ministry of Irrigation and Lowland Areas in water resources management and development. The Ministry of Agriculture has the powers and duties to utilise and develop surface and ground water and conserve river basins and wet lands (Proclamation No. 1263/2021, Article 20:n,o). The Ministry of Irrigation and Lowland Areas are also given the powers and duties to facilitate the utilisation of ground and surface water resources, administer dams and water infrastructure, and (in collaboration with Ministry of Agriculture and Ministry of Water and Energy) expand water centered basin development activities and irrigation development (Proclamation No. 1263/2021, Article 33:1).

Ethiopia is also involved in several international water resources management conventions, protocols, and agendas. As some examples, Ethiopia has committed to the following conventions and agendas:

- **United Nations Framework Convention on Climate Change (1992)** which agrees to prepare countries for climate change impacts as well as the transboundary impacts of climate change (Proclamation No. 97/1994)
- **The UN Millennium Development Goals (2000)** of which Ethiopia was one of the first countries in Africa to integrate these into national development planning and policy frameworks and establish major progress (UNDP, 2015; Verhoeven, 2021a; MoWIE, 2015b)
- **The Africa Water Vision 2025 (2000)**: the 'equitable and sustainable use and management of water resources for poverty alleviation, socioeconomic development, regional cooperation, and the environment' that calls for strengthening water resources governance and financial bases, improving 'water wisdom', and meeting 'urgent' water needs (UNECA, 2000)

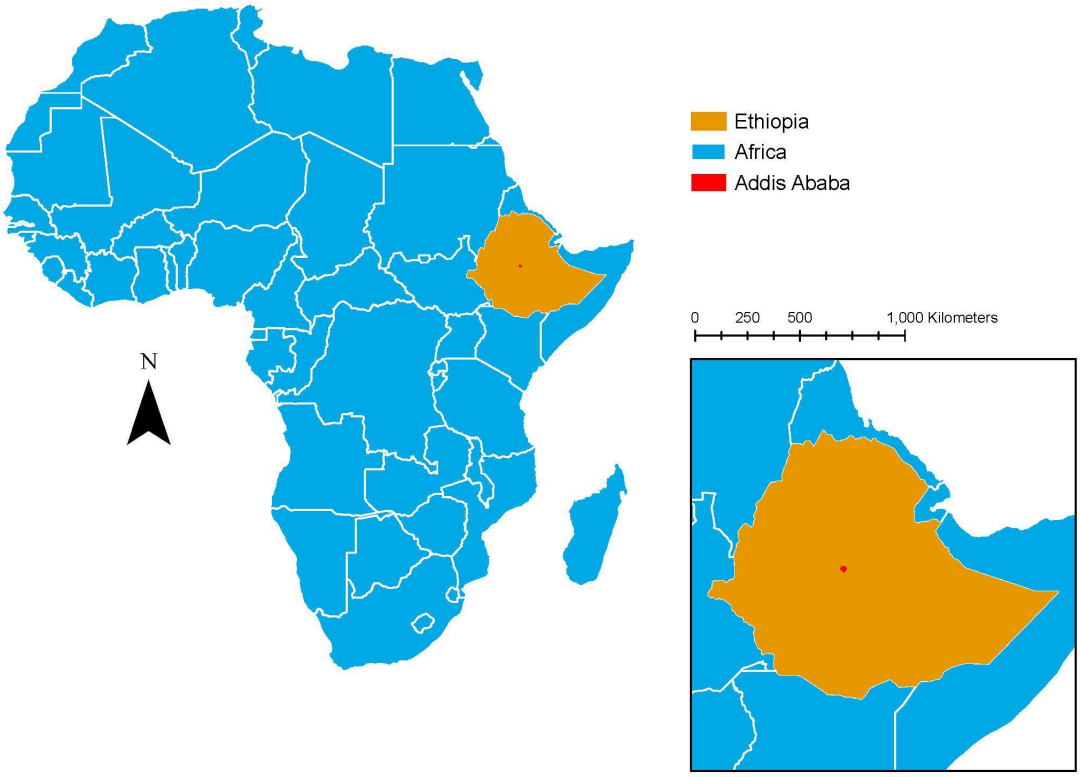
- **The Human Right to Water and Sanitation (2010)** Ethiopia is a signatory to the UN Human Right to Water and Sanitation
- **The African Ministers Council on Water, Water Security, and Climate Resilient Development Framework (2012)** that promotes water security and climate resilient development to reinforce 'actions that reflect the overarching messages and objectives of the Durban COP17 and Rio+20 meetings' (AMCOW, 2012)
- **The UN Sustainable Development Goals (2015)** of which the Government of Ethiopia embedded into their 10-year development plan Ethiopia 2030: The Pathways to Prosperity which outlines the country's ambition to become 'a beacon of prosperity by the deadline of the SDGs' (UN Ethiopia, 2020).
- **The African Union 2063 Agenda (2015)** which includes development goals of: water and sanitation provision, access, and services, and 'equitable and sustainable use and management of water resources for socioeconomic development, regional cooperation, and the environment' (AUC, 2015a).

Figure 27. Delegation of powers and responsibilities for water resources management in Ethiopia



6.2 Water resources development in Addis Ababa

Figure 28. Addis Ababa's location in Ethiopia



Addis Ababa (also referred to as Addis) was established in c.1886 and became the capital of Emperor Menelik II's empire in 1892 (Ejigu, 2014). The establishment of Addis Ababa was on an area in existing Oromo territory called *Finfinnee* – an important cultural site for the Tulama Oromo people (Dulume, 2022; Geleta, 2014; Abate, 2019). In the founding of Addis, Menelik II destroyed the local Oromo government and killed or expelled the existing Oromo peoples, causing mass migration and imperial exploitation of this group, as was common in imperial conquests at the time[50] (Geleta, 2014; Gemeda, 2018; Dulume, 2022).

Menelik's choice of location for Addis was largely based on the available water resources. The original settlement of Addis (in the Entoto mountains to the North of the city's current location) was moved south to the plains surrounding the *Filwoha* hot

[50] Menelik II was seen by some as a colonizer who, in the pursuit of imperial expansion similar to European colonizers, led mass massacres and forceful submission of many different ethnic groups (e.g., Oromo, Keffa, and Wolita) in order to secure the territory that is now Ethiopia (Geleta, 2014; Dulume, 2022).

springs in c.1888, largely through the influence of Menelik's wife (Alemayehu & Stark, 2018, p.5; Pankhurst, 1961; Dulume, 2022). These springs were later utilised and distributed to different parts of the city, water being an abundant resource from these various springs and shallow hand-dug wells (Worku, 2017; Behailu et al., 2015). Despite the abundance of water, the city had a complicated relationship with this resource in its early existence. In c.1906, for example, a number of bridges were required to be constructed due to 'the inconvenience caused by streams and rivers in the rainy season' (Pankhurst, 1961). Opposingly, in 1910, two-thirds of wells that supplied Addis with water dried up, causing the digging of new wells and the construction of reservoirs (Pankhurst, 1961).

6.2.1 The early 1900s

In the early 20th century, Addis Ababa began to undergo large scale modernisation. This saw the reconstruction of traditional administrative and land holding systems, the creation of government ministries, a railway to Djibouti City, paved streets, hospitals, secular schools, and the replacement of hereditary territorial rulers with trained civil servants (Ejigu, 2014; Pankhurst, 1961). Additionally, the first piped water supply system was installed in c.1900, although this mainly served the Imperial Palace of Menelik II and his parliament (Arup, 2021b; Behailu et al., 2015; Adam, 1999). At this time, Addis had a comparatively large population (around 70,000 residents (Geleta, 2014)) for several reasons: being the house of the emperor (drawing nobles, servants, slaves, prisoners of war, soldiers, and other dependents to the city); the migration of people as laborers for the various construction happening in the city; and people coming into the city to sell their produce at a higher market rate (Pankhurst, 1961). The urban expansion at this time, however, lacked formal planning and was centred around securing the surrounding strategic territory; Addis was essentially a military base made up of a conglomeration of camps or quarters, churches, and houses of the elite (Alemayehu & Stark, 2018, chap.1; Pankhurst, 1961). By 1935 the population of Addis Ababa had reached 100,000 (Abdissa & Degefa, 2011) and Ethiopia was under the reign of a new king; Haileselassie was appointed as 'Emperor, King of Kings, and Conquering Lion of Judah' in 1930 (Ejigu, 2014). Under Haileselassie, more Oromo territory surrounding

Addis Ababa was given to associates of the emperor, causing eviction and denial of property rights of Oromo farmers (Geleta, 2014).

There was a five-year Italian occupation of Addis Ababa during the Ethio-Italian war (1936–1941), causing the city to undergo some major transformations. New infrastructure, institutions, and fascist planning were introduced such as the first public projects, the city's first master plan, and the Italians' segregated dual-city approach, all of which created urban layouts and patterns that still characterise the city today (Alemayehu & Stark, 2018, chap.1; Ejigu, 2014). Additionally, new water infrastructure was created. The first water treatment plant was constructed in c.1937 in Entoto to treat water coming from the Kebena and Kidane Mehrete springs (Arup, 2021b; Adam, 1999; Behailu et al., 2015). Furthermore, the Aba Samuel reservoir (43km south of Addis Ababa) was completed in 1939, under the Italian occupation, to supply Addis Ababa with electricity which it continued to do until c.1970 (Arup, 2021b; Kassegne et al., 2019). The end of the Italian occupation saw capitalist development within a primarily feudal system and the rise of autocratic rule in Ethiopia, Addis Ababa became a diplomatic city, with new buildings and institutions being purposed for international consumption (Ejigu, 2014).

In the 1940s, after the Ethio-Italian war, the responsibility of the provision of potable water was transferred to a new water department organised under the municipality of Addis Ababa (Arup, 2021b; AAWSA, 2023). Up until 1940, public water provision was mainly from a variety of ponds and springs (Adam, 1999). In 1944, however, the centralised water network from Gefersa dam (a surface water reservoir ~18km northwest of Addis Ababa in the Oromia state (Berga, 2011)) was established which sought to meet the city's increasing water demands by storing around 1.5 million m^3 of water (Arup, 2021b; Behailu et al., 2015; Adam, 1999). Although, this was only fully operationalised in 1952, with water treatment systems being installed in 1954 and then doubled in 1960 (Adam, 1999).

6.2.2 The late 1900s

By the 1960s, the springs that had previously supplied water for Addis Ababa were taken out of service due to poor water quality (Adam, 1999). At this time, Addis Ababa was also experiencing unregulated building booms and urban expansion,

having a population of nearly half a million (Abdissa & Degefa, 2011) and being described as the 'most populous city on the eastern side of Africa between Cairo and Johannesburg' (Pankhurst, 1961). Additionally, the diplomatic and political importance of Addis was strengthened by becoming the seat of the Economic Commission for Africa (1958), the host for the Headquarters of the African Union (1962) as well as the presence of many other UN and international organisations (Ejigu, 2014). The water requirements of Addis Ababa continued to grow with the city's development. In 1960, the capacity of the Gefersa Dam was increased to store an additional 5 million m^3 of water (Adam, 1999). Furthermore, a 'Stage I Water Supply Project' was created by the newly established *Addis Ababa Water and Sewerage Service Authority*[51] in response to the increasing demand. This included: the rehabilitation of the treatment plant at Gefersa; the construction of an additional dam and treatment plant, the Legedadi, ~33km northeast of Addis Ababa in Oromia (in 1970); and the general upgrading and construction of several pumping stations (AAWSA, 2023; Arup, 2021b; Behailu et al., 2015; Hussen, 2020; Berga, 2011; Bekele, 2020).

It was around this time, the early 1970s, that Addis Ababa's population reached 1 million (Alemayehu & Stark, 2018; World Population Review, 2023; Abdissa & Degefa, 2011) and the urban sprawl of Addis had started to spill into the neighbouring Oromia region. For one thing, two of the city's surface water supply reservoirs (Gefersa and Legedadi) were outside of the city's administrative boundary in Oromia. As a response to this growth and influence of Addis Ababa, the Oromia Special Zone (OSZ) was informally created[52] from the surrounding small towns on the shared administrative boarder of Addis Ababa city state and the Oromia state (Alemayehu & Stark, 2018, chap.1).

In 1974, a socialist military coup saw the overthrow of Haileselassie and the end of the imperial regime in Ethiopia. The new military regime (the Derg) nationalised all

[51] In 1971, under proclamation No. 68/1963, the *Addis Ababa Water and Sewerage Service Authority* was established and would later become the Addis Ababa Water and Sewerage Authority (AAWSA) (AAWSA, 2023; Arup, 2021b).

[52] The OSZ was legally recognised by Oromia Regional State as *The Finfinnee Surrounding Special Zone* council through proclamation 115/2000.

land and rental houses (UN-HABITAT, 2008; Alemayehu & Stark, 2018, chap.1; Ejigu, 2014). This slowed the urban expansion of Addis, but increased inner city density, squatter settlements, and illegal land transactions (Abdissa & Degefa, 2011). The city therefore continued to expand, but without any formal planning[53] (Alemayehu & Stark, 2018, chaps1, 2).

In 1980, the Addis Ababa Water and Sewerage Service Authority introduced Stage II of the Water Supply Project which included extensions of primary and secondary pipeline installations, forming the construction of water transmission mains, reservoirs, and distribution facilities (Bekele, 2020; Hussen, 2020). In 1986, the Legedadi treatment plant was required to be upgraded in order to provide even more water to the city; an additional 100,000 m^3 of water per day was provided (Adam, 1999). The capital city also began to severely suffer from pollution problems in its various waterways. In 1989, for example, Addis Ababa's local rivers were described as not being able to 'satisfy physical, chemical or bacteriological requirements for water supply or even water contact' (EVDSA, 1989). By 1990, the population of Addis Ababa had reached around 1.7 million (EVDSA, 1989; World Population Review, 2023).

In 1991, the military government imploded and was replaced by the new government set up by the Ethiopian People's Revolutionary Democratic Party (EPRDF) (Ejigu, 2014). This marked an end to the Derg regime and a start towards the country's engagement in (ethnic) decentralisation. In 1995, under Proclamation No. 1/1995 (The Constitution), Ethiopia became a federal and democratic state with Addis Ababa as its capital city. This proclamation also divided Ethiopia into nine member states based on ethnicity (Article 47): Tigray, Afar, Amhara, Oromia, Somali, Benshangul-Gumuz, The State of the Southern Nations, Nationalities and Peoples (SNNP), Gambella, and Harari. Among these, Addis Ababa became a city state – granted autonomy in a semi self-rule where it reports directly to the central government instead of the state they are located in i.e., Oromia (UN-HABITAT, 2008). In this proclamation (No. 1/1995), the 'special interest' of Oromia Regional State in

[53] The Derg's 1986 Ethio-Italian master plan, based on a polycentric city with multiple core districts, was never implemented as it took too long to be legalised and so became irrelevant (Alemayehu & Stark, 2018, chaps1, 2).

Finfinnee (Addis Ababa) ‘regarding the provision of social services or the utilisation of natural resources and other similar matters, as well as joint administrative matters’ is stated to be respected under law. However, there is some lack of confidence around the implementation of this to Addis Ababa’s urban expansion into Oromia territory (Abate, 2019).

Addis Ababa’s status as the diplomatic capital of Africa, the capital of Ethiopia, and the seat of the government seemed to be solidified. This institutionally confirmed importance of the city saw neoliberal developments trying to catch up with a ‘delayed’ modernity of Addis Ababa through large infrastructure projects and mass-housing construction (Ejigu, 2014). As part of Addis’ urban growth and development, industries flocked to the city; It is thought that by 1999 65.3% of the total industry in Ethiopia resided in Addis Ababa (Alemayehu, 2001). New infrastructure and housing projects, rises in industrial presence, and an increasing urban population further contributed to Addis Ababa’s water demand and local pollution.

In 1999, another additional reservoir in the Oromia regional state, Dire, was constructed just north of Legedadi, it provided an additional 42,000 m^3 of water per day to the city (Berga, 2011). Additionally, the Addis Ababa Water and Sewerage Authority (AAWSA)[54] planned a Stage III Water Supply Project (1999) that included two more planned reservoirs[55], Siblu (an additional 600,000 m^3 per day) and Gerbi (an additional 73,000 m^3 per day), as well as plans to produce 125,000 m^3 of water for the city from groundwater in the Akaki well fields over multiple phases (Muleta & Abate, 2021; Lulu et al., 2005; Kitessa et al., 2021).

6.2.3 The early 2000s

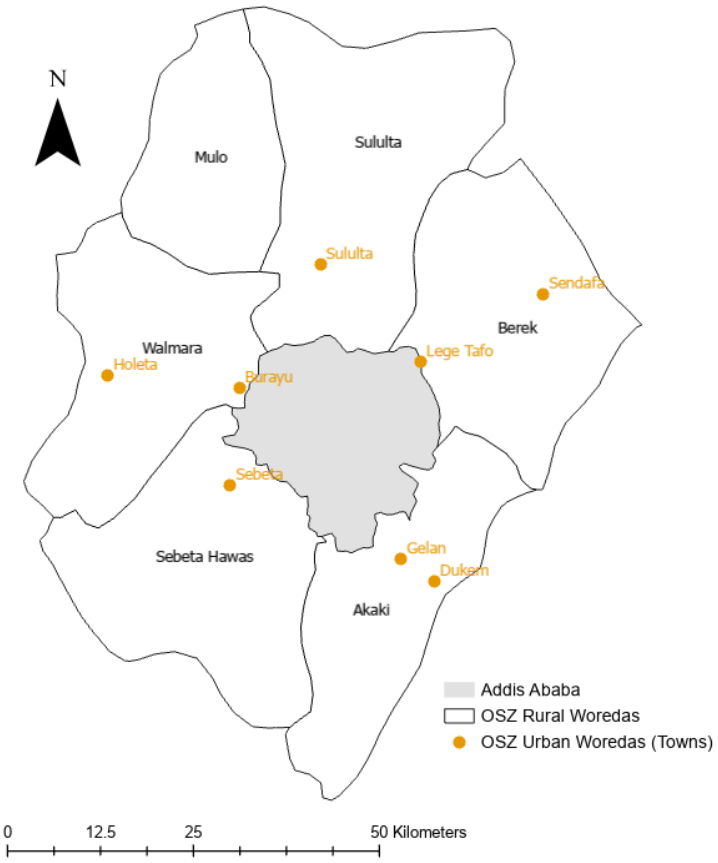
The urban spread and development of the city continued at an accelerated rate, with the population of Addis Ababa rising to around 3 million by 2008 (Van Rooijen & Taddesse, 2009; World Population Review, 2023). In 2000, the OSZ was legally recognised by Oromia Regional State council through proclamation 115/2000 as *The Finfinnee Surrounding Special Zone*. Under this law, the OSZ is comprised of six

[54] The Addis Ababa Water and Sewerage Service Authority was renamed The Addis Ababa Water and Sewerage Authority in 1987 (AAWSA, 2023).

[55] Siblu and Gerbi are still yet to be constructed.

rural Woredas – Welmera, Sebeta Hawas, Akaki, Sululta, Mulo, Berek – and eight urban Woredas – Dukem, Lege-Tafo Lege-Dadi, Sendafa-Beke, Sululta, Holota, Burayu, Sebeta, and Gelan (OPEDC, 2016, 2021a) (Figure 29).

Figure 29. The Oromia Special Zone and relevant Woredas



The 2003-2013 master plan for Addis Ababa aimed to fill expansion areas between settlements along trade routes with housing and other mixed developments (mainly government-sponsored condominium apartments) (Alemayehu & Stark, 2018, chaps1, 2). This master plan saw 131,000 new houses (mostly condominiums) constructed between 2002-2012, with the majority being supplied by the government's Grand Housing Project (2004), which displaced around 80% of inner-city dwellers from public housing into condominium apartments in satellite cities on the Addis Ababa-Oromia boarder (Alemayehu & Stark, 2018, chap.2; Ejigu, 2014; Bekker, 2021, p.158). Needing to meet water demands, Addis continued to draw water from the surrounding Oromia state through various well field and borehole development projects. In c.2000, Akaki phase II groundwater development project

saw water wells drilled in the Oromia Regional State, in Gelan, producing 66,000 m^3 per day (Bekele, 2020; Arup, 2021b). In 2015, drilling commenced in the Legedadi, Legetafo and Ayat areas, 30km from the city in the Berek region of Oromia, withdrawing around 40,800 m^3 per day to supply the new condominiums in Addis (Bekele, 2020).

The impact of the growth and influence of Addis, however, began to reach heightened political levels. More involvement from the federal government was seen[56] as well as more resistance from the Oromo people in response to government plans for the city. The first of these was in 2004, when the EPRDF attempted to move the capital of Oromia from Finfinnee (Addis Ababa) to Adaamaa (Adama), which was met with violent protests and imprisonments (Abate, 2019). The most notable, however, was the resistance to the EPRDF's c.2014 Addis Ababa Master Plan which threatened the 1995 constitutional rights of Oromia over Finfinnee (Addis Ababa).

The c.2014 Addis Ababa Master Plan proposed extending a 40-100km radius around Addis Ababa that would see the engulfment of several rural and urban surrounding territories into the city state to create a 11,000km^2 region; essentially integrating Addis Ababa and the OSZ (Geleta, 2014; Lavers, 2018). The government's position was an argument of development and modernisation, saying that the expansion of Addis would benefit local Oromo people, the Oromo protesters, however, saw this master plan as an attempt to seize more Oromo territory and further marginalise the Oromo people (Záhořík, 2017; Lavers, 2018). Mass protests took place across Oromia, demanding the renunciation of the Master Plan and exercise of the Oromo ownership of Finfinnee – some protests were met with violent opposition from the EPRDF (Abate, 2019; Gemeda, 2018). The c.2014 master plan was eventually terminated (Záhořík, 2017).

6.2.4 Current dynamics

Since Addis Ababa's establishment there has been a constant struggle between the growth of Addis Ababa and the surrounding Oromia Special Zone (OSZ). Addis

[56] In 2003, a revised proclamation (No. 361/2003) gave the federal government the authority to determine the boundary that separates Addis Ababa and Oromia (Article 5), hence involving the federal government in the disputes between the two states (Geleta, 2014).

Ababa's large scale modernisation, rapid urban development, and sprawling spatial expansion, is built on foundations of a complex social and political history with the Oromia Regional State. Historically, this has been in the form of environmental degradation, loss of land, ethnic marginalisation, eviction, and the worsening of livelih(Mohammed & Worku, 2019; Geleta, 2014)med & Worku, 2019; Geleta, 2014). But, in more recent times, the intrusion of Addis Ababa into the surrounding OSZ has been met with fierce resistance, becoming a trigger for rural-urban and ethnic conflicts both within and outside the administrative boundaries of Addis; some Oromo people still seeing the urban planning and expansion of Addis as a tool for dispossessing Oromo land, strengthening marginalisation, and justifying ethnic eviction (Alemayehu & Stark, 2018, chap.1; Lamson-Hall et al., 2019; Abate, 2019).

It is now thought that Addis Ababa has a population of between 4-6 million[57] and is host to around 30% of Ethiopia's urban population (Bekker, 2021, p.111; World Population Review, 2023; Alemayehu & Stark, 2018, p.21; UN-HABITAT, 2008; UNDESA, 2018). The city currently covers an area of around 540km^2 (Abdissa & Degefa, 2011; Worku, 2017) and is said to be one of the fastest growing cities in Africa, with rapid urban expansion being fueled by a mixture of expanding industrial and economic enterprises, a growing urban population[58], and increased migration into the city by people in search of work and life opportunities (Bekker, 2021; UN-HABITAT, 2008). Additionally, its geographic location in the centre of Ethiopia (see Figure 28) combined with its historic role in hosting organisations (such as the African Union and Economic Commission for Africa) as well as the lack of development policies in other urban centres, has made it both a geopolitically pivotal state and economic centre within East Africa (UN-HABITAT, 2008; UN Ethiopia, 2020). Hence, this city in the center of Ethiopia now has many personalities: a political and economic centre for East Africa; the capital city of the Federal Government of Ethiopia (FDRE); the seat of the state of Oromia's government and

[57] A contested figure due to the inaccuracies of census data as well as a large fluxes of migration in and out of the city.

[58] Being predicted somewhere between 2-5% (Bekker, 2021, p.158; World Population Review, 2023; Arup, 2021a). Some sources speculate the population in Addis will be 5.8-12 million by 2024 (UN-HABITAT, 2008; World Population Review, 2023) and others between 4.5-7.5 million by 2030 (UNDESA, 2018; Van Rooijen & Taddesse, 2009).

Oromia's capital city[59]; and a state of self-ruling government with an elected council and city governor accountable to the residents (Geleta, 2014).

The growth of Addis has consequentially meant a growth of resource demands overtime. Article 62 in Proclamation No. 361/2003 states that the relationship with Addis Ababa City Administration with the Oromia Region rests on 'fruitful cooperation'. Although, some argue that this 'fruitful cooperation' is an exploitative arrangement between Addis and the OSZ that allows Addis Ababa's resource needs – from water to other ecosystem provisioning services such as food products and other raw materials – to be met whilst simultaneously polluting the surrounding areas[60] (Geleta, 2014).

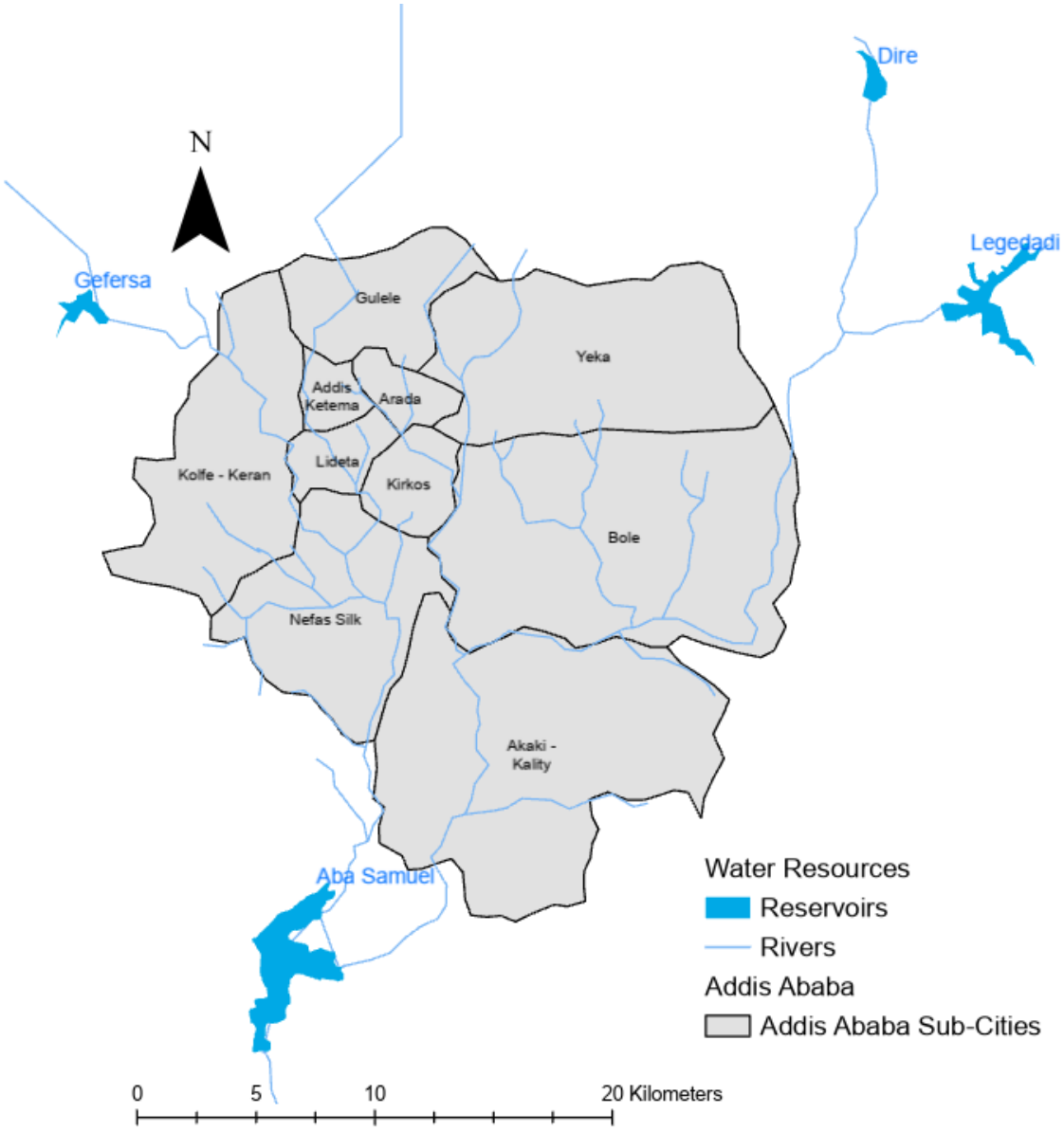
For the most important resource, water, it is currently thought that Addis Ababa requires around 1.1 million m^3 per day of water to feed the city's various demands (Arup, 2021b, 2021a; Woldemariam, 2009). Meeting this has required the combination of both surface water and groundwater supply coming from both outside (i.e., in the OSZ) and inside the city's administrative boundaries. All surface water sources (Gefersa, Dire, and Legedadi reservoirs) are located outside of the city's administrative boundary (see Figure 30), in the OSZ, and supply around 0.225 million m^3 per day (Arup, 2021b; Berga, 2011; Birhanu et al., 2022). Groundwater sources are located in a mixture of both inside Addis and in the OSZ; the various Akaki well fields (~0.25 million m^3 per day), the Legedadi-Legetafo-Ayata well field (~0.04 million m^3 per day), South Ayat-North Fanta (~0.05 million m^3 per day), Koya Feche (~0.03 million m^3 per day), and other pocket boreholes across the city, make up a total contribution of ar(Arup, 2021b; Bekele, 2020; Muleta & Abate, 2021; Birhanu et al., 2022; Kitessa et al., 2021)a(Arup, 2021b; Bekele, 2020; Muleta & Abate, 2021; Birhanu et al., 2022; Kitessa et al., 2021).

[59] The Revised Oromia Constitution sates that Finfinnee is the capital city of Oromia National Regional State (Dulume, 2022).

[60] In addition to the relationship of water demand between Addis Ababa and the OSZ, the pollution that originates in Addis has large impacts on those living in the OSZ (Abate, 2019; Geleta, 2014). It is thought that Addis Ababa is home to 65% of the country's industry, and more than 90% of these industries discharge untreated waste directly into nearby rivers (Arup, 2021a). High industrial presence, informal settlements, and urban agriculture in Addis is related to direct, untreated, wastewater discharges into nearby rivers that exit Addis Ababa into the OSZ (Arup, 2021a).

This adds up to a total water supply that meets between 40-60% of Addis Ababa's water demand (after network losses) which falls significantly short of the city's requirements (Arup, 2021a; Bekele, 2020; Birhanu et al., 2022). One result of this is the government encouraging industries and commercial businesses to establish their own borehole water supply, threatening the sustainability of aquifers as well as community access (Arup, 2021a). Another result is severe water shortages that now occur in many parts of the city, but most notably in the north, west, and south-east of the city, and new areas of development (Bekele, 2020; Birhanu et al., 2022).

Figure 30. The location of the supply reservoirs: Gefersa, Dire, and Legedadi



6.3 Conclusion

It is evident that the current water resources dynamics between Addis Ababa and the OSZ are embedded in historical ethnic tensions between land and resource ownership. As Addis Ababa continues to grow it expands into the surrounding Oromia Regional State which, as historically demonstrated, engulfs not only land in the OSZ but also resources. Furthermore, as Addis Ababa and the surrounding OSZ towns continue on a trend of urbanisation[61], increasing demands are placed on resources, especially water. The implications of this, in combination with potential future climate change impacts to rainfall and temperature (Arsiso et al., 2018), have severe repercussions for water resources management and water security in the area.

Adding to the complexity of water security is the geopolitical significance of Addis Ababa and the underlying conflicting territorial claims and political influence that come with this. For example, there is an apparent bias and 'priority support' towards the development of Addis Ababa from the 'favourable' Federal Government compared to other areas in Ethiopia (AAWSA, 2016). However, there is also a high interest from Oromia Regional State in the development of the OSZ as an area of high production of revenue and high growth of investment (OPEDC, 2016). This, combined with the Regional State's right to develop, manage, control, and administer resources (including Water Resources) within their administrative boundary (OWEB, 2022), means that certain water securities for both Addis Ababa and Oromia rely on utilising water resources in the same hydrological area (the Akaki watershed) and therefore competition.

6.3.1 Exploring water security in Addis Ababa

Understanding the contextual water security in Addis Ababa, whilst taking into consideration the hydrosocial water relationships between the city and the surrounding OSZ, is crucial in understanding the interconnectedness and disconnectedness of water governance priorities at local level. Therefore, providing

[61] Of the eight major towns within the OSZ (Burayu, Dukam, Gelan, Holata, Legetafo, Sebeta, Sendafa, and Sululta), Sululta, Sebeta, and Legetafo are described as 'emerging towns' that have the potential to be 'absorbed' by Addis (Girma, Terefe, & Pauleit, 2019), whereas the others are 'major towns'. Additionally, Sululta, Sebeta, Legetafo, Burayu, and Dukam are observed to have rapid rates of population growth and urbanisation (Girma, Terefe, Pauleit, et al., 2019; Mohamed & Worku, 2019).

important insights for the future planning of water resources through demonstrating that water security must not only be assured in the securing of water as a material resource, but also as a fundamental component of ecosystem services, human security, and wider hydrosocial relationships.

Chapter 2 of this thesis demonstrated the multiple dimensions of water security and how these contribute to a complex water resources management paradigm. It provided three crucial statements on water security: (1) Water security as defined by physical water insecurity; (2) water security as a social and political practice, process, and value; and (3) water security as indivisible from human security and justice. After interpretating water security as defined by these three statements, it is proposed that an appropriate way to assess and understand contextual water security is therefore using a systems understanding.

Therefore, to explore water security priorities and meanings for Addis Ababa, Part 2 of this thesis attempts to employ the systems concepts described in Chapter 3 (Section 3.4) at different levels of water governance: local experiences of water security (Chapter 7); regional water security in Addis Ababa city state administration (Chapter 8); and national water security in law and policy (Chapter 9). These contribute to the conclusions made towards the objectives of this research. The understanding of water security is evidenced by a variety of qualitative data (detailed in Chapter 5), remaining true to methodological pluralism and complementarity described as being essential to exploring water security using a systems approach. Documents (such as legislation, laws, policy, plans, and programmes, etc) are used alongside key informant interviews, workshops, community interviews, and visual material. This not only builds a picture of the contextual water security landscape, but also demonstrates the different water securities between actors, as well as the different agendas for water governance amongst them. It is put forward that this approach to investigating water security will help to better understand the water security dependencies of Addis Ababa and how governance could be better orientated towards these.

Chapter 7. Exploring local experiences of water security in Addis Ababa

As discussed in Chapter 2, a shift in resource security discourse in the 1990s created a paradigm shift that moved security from (nation-)state focus to the individual (Marhia, 2013); with Sen and Nussbaum's capability approach bringing ideas of individual well-being, social justice, and elements of human security into understandings of resource security. This was later realised in water security through approaches such as the political economy of water security, various hydrosocial water security frameworks, and capability approaches to water security. These approaches provide framings of water security issues that include integrated human values, perceptions, and diverse problem framings, as well as address challenges of governance, power, and policy that are embedded in the links between health and sanitation policy, ecological considerations, socioeconomic processes, planning and governance systems, and other water security-related dimensions (Wheater & Gober, 2015; Swyngedouw et al., 2002).

More generally, these approaches reject the idea of an apolitical pursuit of water security; recognising that water security can be a socio-political tool (Radonic & Jacob, 2021) and an important force constituting prevailing social power relations where water insecurity outcomes are felt hardest by the socioeconomically and politically less powerful (Hidalgo et al., 2017). Part of this shift in water (and resource) security discourse places emphasis on the significance of understanding, exploring, and incorporating community context specific factors into analysis and assessment of water security. Additionally, considering the diversity in types of social, worldview, ontological, cultural, and gender relations (Gerlak et al., 2018; Jepson et al., 2017) as well as the link between the achievement of water security with water justice (see Wade, 2018).

Understanding, exploring, and incorporating context specific factors and multiple diverse water-relations at the individual level for analysis and assessment of water security is therefore one of the fundamental systems perspectives sought in this research. Local water security priorities and perspectives are deemed critical

components of all three statements of water security[62]. These statements can be investigated at the local level through individual water security values, perceptions, and problem framings, providing contextual insights to: what is the threshold between water security and insecurity; what are the priorities for water security; what other interrelated human securities are related to water security; and what injustices are being experienced from a lack of water security; and how are experiences of water (in)security homo/heterogenous across communities? Furthermore, local water security priorities and perspectives are also fundamental to the systems approach taken in this research, providing a means to: identify unjust political and economic relationships in the environment(s) of the open system; reorientate systems research to be more socially relevant by focusing on locally defined improvements[63]; and explore and analyse multiple boundary judgements and systems interpretations for the same phenomenon (i.e., water security) based on different experiences, interests, and expectations.

This chapter, therefore, explores local water security within Addis Ababa through individual water security experiences, values, perceptions, and problem framings. This is done through narrative thematic analysis[64] of semi-structured individual interviews carried out across the city between 26th August 2022 and 5th March 2023. A challenge for investigating water security through individual discussions was developing a means to explore diverse aspects of water security without projecting the interviewer's framing of water security onto the interviewee by explaining what is meant by water security; water security can be seen as an academic/policy term which wasn't easily translatable to day-to-day water-related discussions. To address this challenge, the interview protocol (see Appendix B) was based on broad areas of the three statements of water security, purposefully leaving out specific mention of *security* and *water security* to attempt to explore a wider interpretation of water

[62] Water Security as defined by physical water insecurity; water security as a social and political practice, process, and value; water security as indivisible from human security and justice.

[63] This largely draws on critical systems thinking where human emancipation is one of the fundamental commitments of CST and a basic starting point for Critical System Heuristics (Ulrich, 1996; Midgley, 1996).

[64] NVivo qualitative computer software was used to organise and thematically code the interviews, as described in Chapter 5, Section 5.3.

security as a product of more general local water issues, actions, and opinions. This was largely focused around lived experiences related to water and environment.

In total, water security discussions took place with 13 interviewees from 11 individual interviews and one group interview[65] (as shown in Table 14). The transcripts are available in both Amharic and English and can be found in Appendix C. Potential interviewees were selected based on stratified purposive sampling (as detailed in Chapter 5), hence participants were purposefully chosen because of features or characteristics that represent a location or type in relation to the key criterion, enabling a detailed exploration of the central research themes (Ritchie & Lewis, 2003, p.78). In the case of this study, location was of particular interest to capture variations in water security priorities in different areas around Addis Ababa, Figure 31 demonstrates the approximate locations of the interviews. Additionally, over 100 observations (Figure 32) were taken in this area over nine months to capture the seasonal changes in the landscape and environment related to water and water use, a full account of which can be found in Appendix D, some are also presented in this chapter.

Many interviews were in close proximity to the two branches of the Akaki River, the main river that runs through Addis Ababa. The Akaki river's two branches, the ትልቁ (*Tiliku* – meaning 'big') Akaki and ትንሹ (*Tinishu* – meaning 'little') Akaki, originate in the Entoto mountains that bound Addis Ababa in the north and meet at the Aba Samuel reservoir in the OSZ south of Addis. The Big Akaki is located in the eastern part of the city, whereas the Little Akaki exists in the western part of the city. Both branches of the Akaki have significant tributaries that run through the city (Figure 33), although the naming of these is contested. It is generally agreed that the Kebena and Bulbula rivers are the main tributaries to the Big Akaki river, although it is disputed whether the name of the joining tributary (at the Akaki-Kality/Bole sub city boarder) to the Big Akaki is the Bulbula (Bekele et al., 2022; Desalegne, 2018; Asnake et al., 2021) or Kebena (Alemayehu, 2001; Yohannes & Elias, 2017). Tributaries of the Bulbula are Bantyketu and Kurtume (Alemayehu, 2001; Desalegne, 2018). The main tributaries of the Little Akaki are Jemo and Harbu, that join in Nefas Silk sub-city, and

[65] The group interview was intended to be three separate interviews. However, it was the participants' preference to conduct the interview in a group which was respected by the interviewer.

Kolfe that originates in the north (Alemayehu, 2001; Yohannes & Elias, 2017). After the Little and Big Akaki join at the Aba Samuel reservoir, they form one of the main tributaries to the Awash River. Interview 10 was the only interview conducted around the Little Akaki, all others were on the Big Akaki or tributaries of the Big Akaki.

Information on notation can be found in Chapter 1 (Section 1.3.1). Importantly, all interviewees remain anonymous and so are referred to by numbers that correspond with those in Table 14 and Figure 31 (e.g., interviewee 1, interview 5). For the group interview (interview 5), the three participants are referred to as P1, P2, and P3 (e.g., 'interview 5, P1' refers to Participant 1 in interview 5).

Table 14. Community semi-structured interviews: meta data

Interview No.	Interview Location	Interviewee Age[66] and Gender
1	Imperial, Bole Sub-City, Addis Ababa	Young Adult (M)
2	Sululta, Oromia Special Zone	Young Adult (F)
3	Megenanga, Yeka Sub-City, Addis Ababa	Young Adult (M)
4	Bole Arabsa, Bole Sub-City, Addis Ababa	Young Adult (M)
5 (group)	Kality, Akaki Kality Sub-City, Addis Ababa	Adult (M), Adult (M), Older Adult (M)
6	Akaki, Akaki Kality Sub-City, Addis Ababa	Older Adult (F)
7	Akaki, Akaki Kality Sub-City, Addis Ababa	Adult (M)
8	Bole Bulbula, Bole Sub-City, Addis Ababa	Adult (M)
9	Akaki, Akaki Kality Sub-City, Addis Ababa	Young Adult (F)
10	Akaki, Addis Ababa/Oromia Special Zone	Adult (M)
11	Legedadi, Oromia Special Zone	Older Adult (F)

[66] It was not culturally appropriate to ask a person's age. For this reason, the ages have been categorised into Young Adult (18-30), Adult (30-60), Older Adult (60+).

Figure 31. Interview locations around Addis Ababa. Interview number corresponds to the number in Table 14.

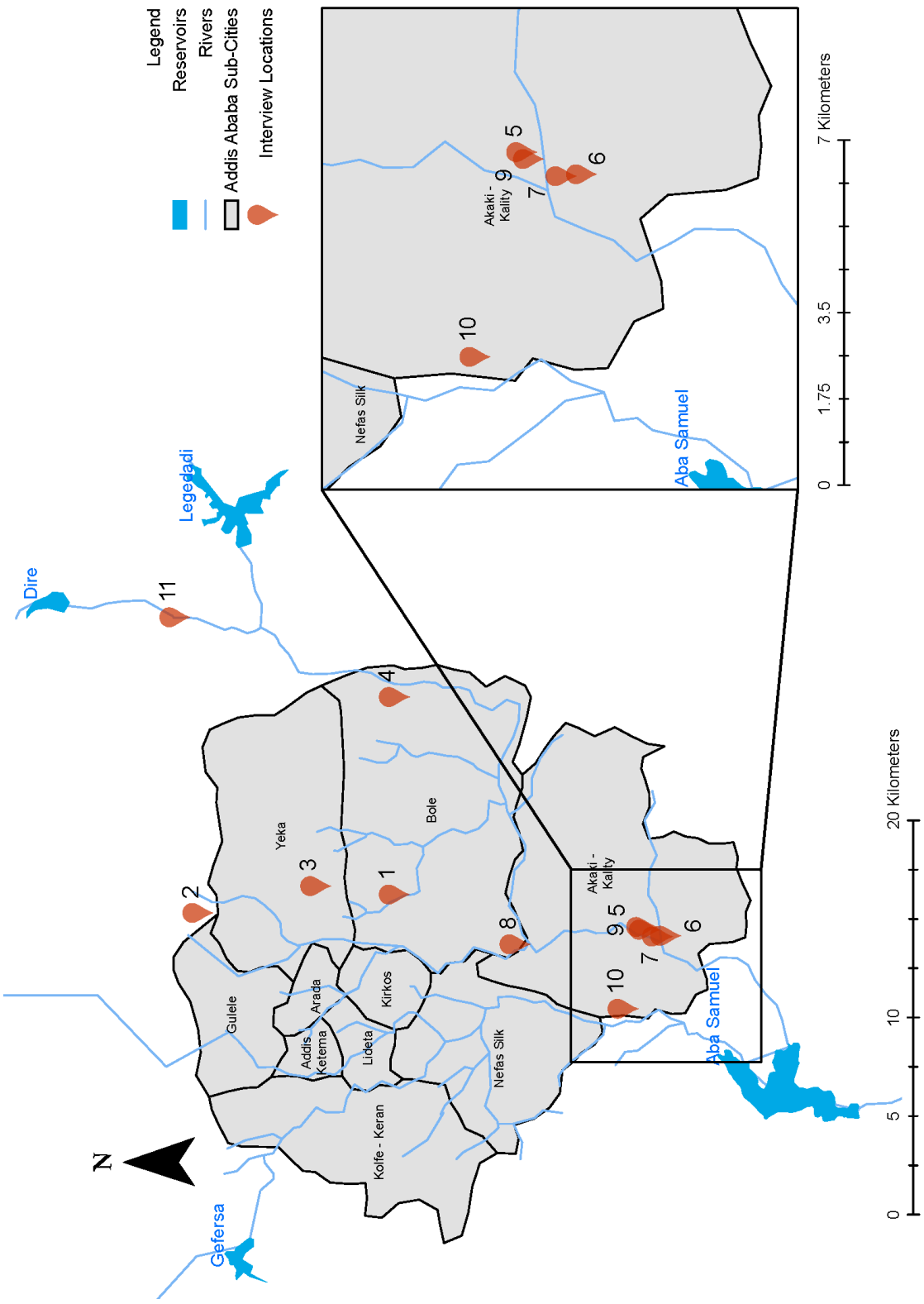


Figure 32. Observation locations and interview locations in and around Addis Ababa

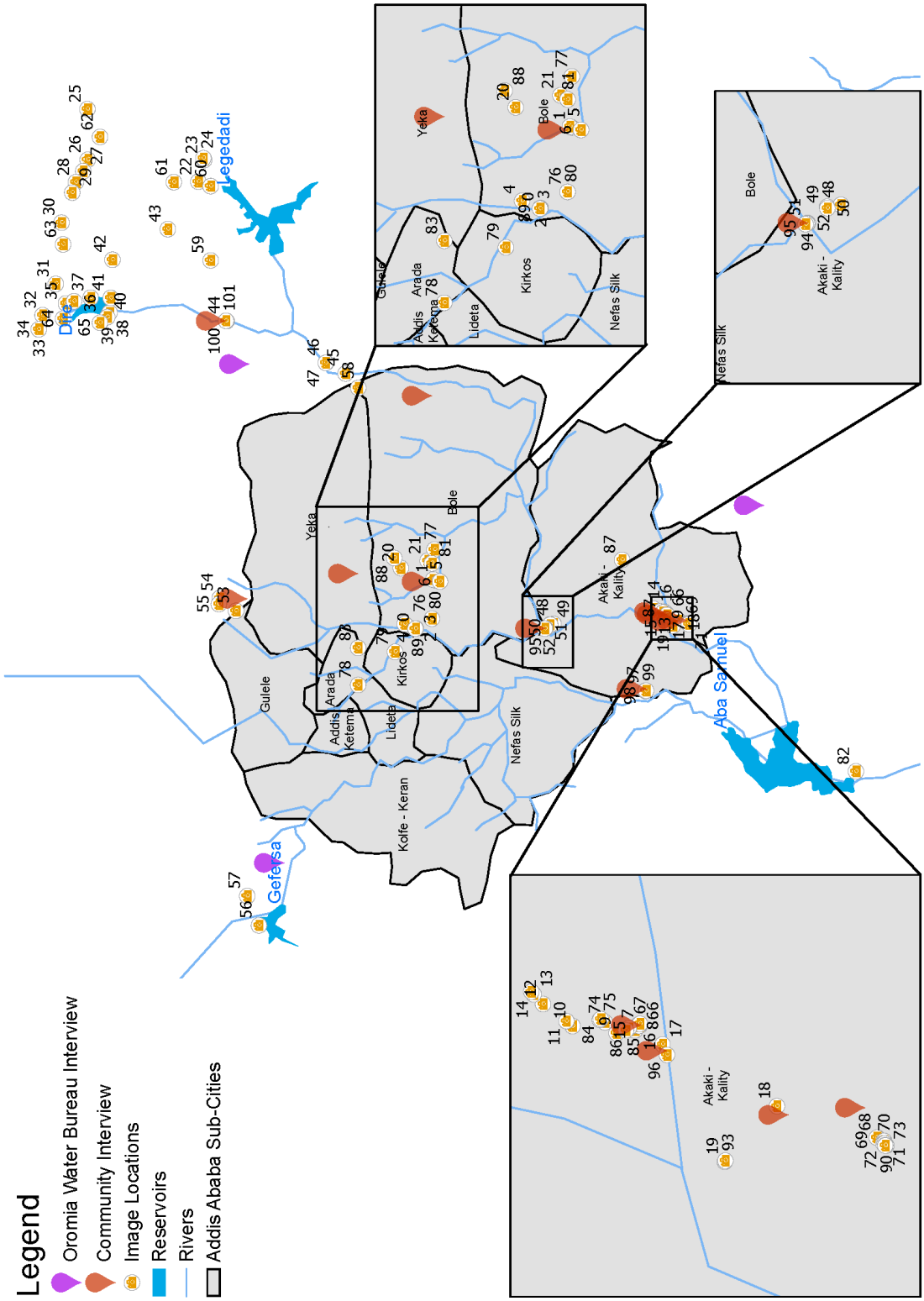
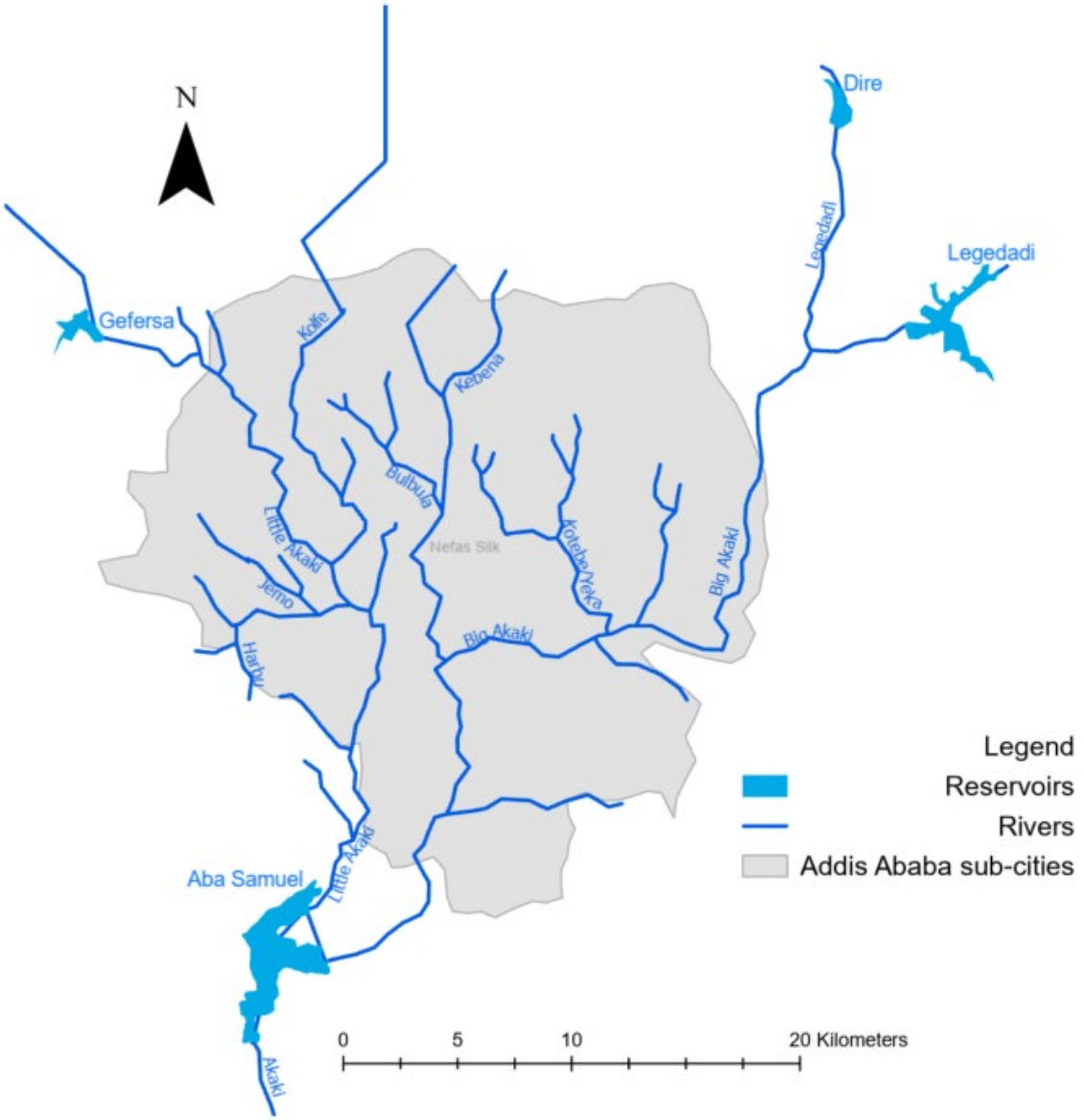


Figure 33. The ትልቁ (*Tiliku* - Big) Akaki and ትንሹ (*Tinishu* - Little) Akaki rivers and their main tributaries



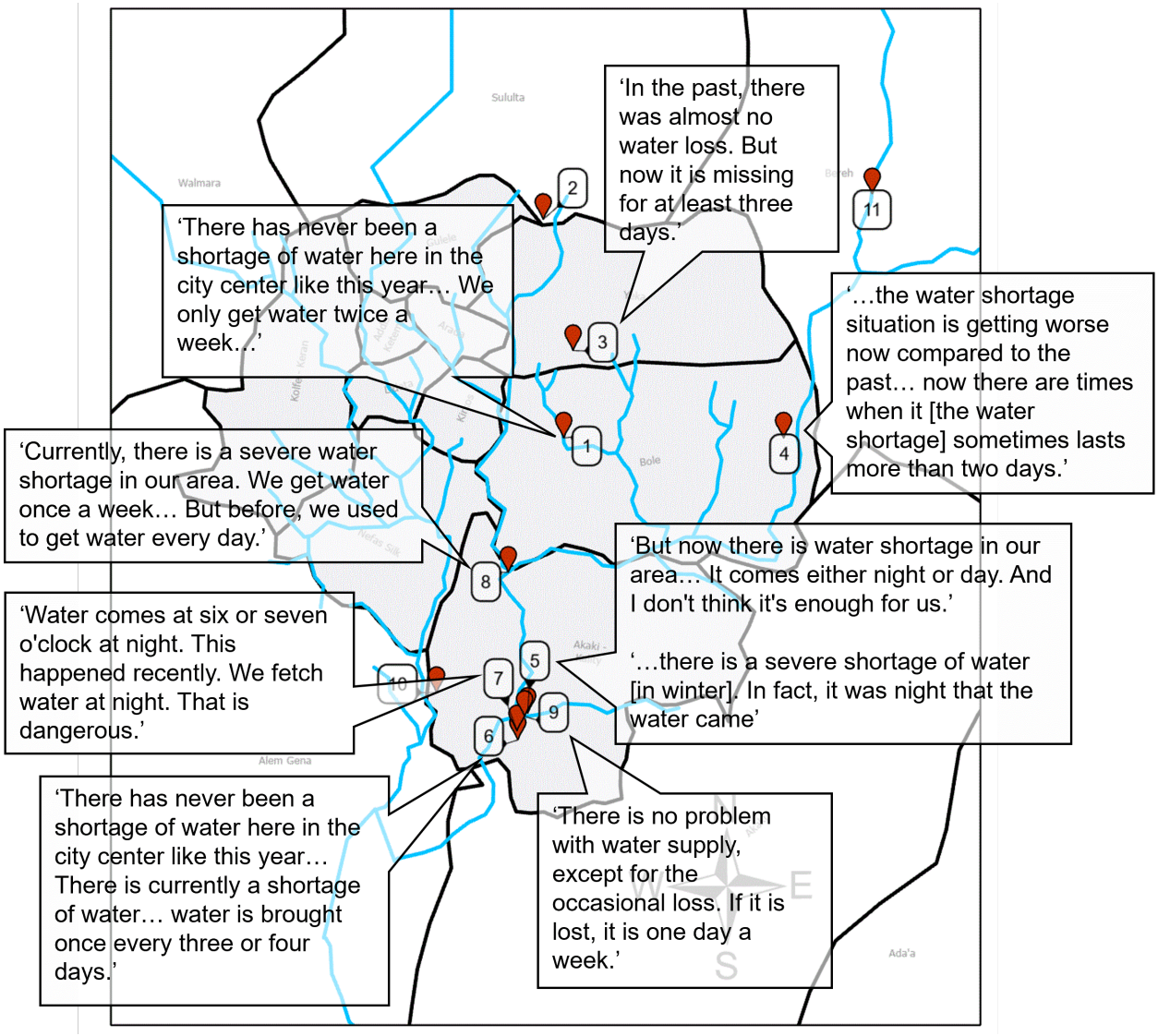
7.1 General water security themes

Several general water security themes appeared across all interviews, the most notable of these were piped water supply, flooding, water quality issues, and rainfall. These largely speak to a more physical water security meaning through material water-relationships such as water-uses, physical water availability and access, and hydrological behaviours. However, flooding and some aspects of water quality also appeared to be strongly linked to water security that protects the individual from harm, does not damage human or environmental health, and enables other human securities.

7.1.1 Piped water supply

Piped water supply was a common theme discussed by all interviewees, in many cases being centered around water supply issues. In some instances, the main issue was simply that piped water supply is not provided (e.g., interviewees 2, 10, 11). But the other notable issue was shortage of piped water supply which was expressed as having gotten worse over time and being especially bad this year (2022/2023 G.C). Piped water supply shortages were described in terms of intermittent supply as well as issues of water pressure (‘power’), for example: ‘Even if the water comes, they will send with less power’ interviewee 3; ‘It [piped water] is very powerful unless we limit its power’ interview 5 P3; ‘The incoming water has no power; it is small.’ interview 5 P1; ‘[the piped water supply is] not very powerful’ interviewee 6. Figure 34 demonstrates some descriptions of water supply issues across discussions with interviewees who had piped water supply.

Figure 34. Interviewee descriptions of piped water supply intermittency N.B. Interviewees 2, 11, 10 do not have piped water supply



7.1.2 Flooding

Flooding was another general theme discussed among interviewees. It was mentioned in all interviews most frequently in response to enquiries and discussions along the lines of memories related to water, concerns about water, and what has changed in terms of water and environment since living in the area[67]. Descriptions of flood events were frequently associated with strong negative feelings of danger, fear, and harm. For example:

[67] Sometimes there was a direct line of enquiry around flood problems or threats in the area. This was often a follow up question to flooding having already been mentioned in the interview, only in three interviews did the interviewer's question of flooding proceed the interviewees mention of flooding.

*'…if the government pays attention to it [the flooding], this river will be dammed. The society will not **harm** year after year. People who work in gardening and urban agriculture around here will not be **harmed**. The **damage** will decrease.'*

Participant 2, interview 5, Kality, Akaki Kality Sub-City, Addis Ababa

*'If the water has changed direction [from a plan to redirect the river], there is a very wide possibility of directly entering the community and school. It means that there was more **harm** than good.'*

Participant 3, interview 5, Kality, Akaki Kality Sub-City, Addis Ababa

*'As soon as we see a cloud in the sky, we become **cautious** [of flooding].'*

Interviewee 6, Akaki, Akaki Kality Sub-City, Addis Ababa

*'A dam has been built around the river, so we are not **afraid** that floods will **harm** us.'*

Interviewee 9, Akaki, Akaki Kality Sub-City, Addis Ababa

*'The farmers are **afraid** of the flood and stop sowing. Floods are especially **dangerous** in መጋቢት [Megabeet – equivalent of around March G.C]. It [flooding] also **threatens** the farmers.'*

Interviewee 10, Akaki, Addis Ababa/Oromia Special Zone

*'When we lived around here, other people tell us that you are in **danger** of flooding.'*

Interviewee 11, Legedadi, Oromia Special Zone

Flooding was not only mentioned by those who are, or have been, directly impacted but also by those who are unaffected yet concerned about flooding elsewhere in the city. For example, interviewee 1 does not directly experience flooding but knows where it occurs in other parts of the city and how to warn others: 'There are no floods in this neighborhood because the land is flat. Elsewhere in Addis Ababa, for example, there may be flooding in Kebena, Saris area… I think that the problem of flooding is specific to each neighbourhood… If there is a river or a flood in this area,

apart from my personal help, I will tell the concerned bodies to know the problem and take the necessary measures'. The interviews in the downstream Akaki-Kality area (interviews 5, 6, 7, 9) mention flooding the most, likely due to the fact that they live in the downstream plains of the Big Akaki river and so are more susceptible to flood events.

7.1.3 Water quality

Water quality issues were a consistent concern across all interviews. Water quality was mentioned as an issue in both piped water supply and local rivers; bad smelling river water, bad tasting tap water, visible litter in the river, and the changing of the colour of piped and river water (often described as black; 'the water we drink sometimes turns **black**' interviewee 3, 'although water is colorless, the [river] water shows something **black**…' interviewee 8) were all mentioned. Additionally, water quality issues were often linked with descriptions of flooding events as well as industry activities and sewerage. For example, the concern that flood events allow water to 'mix up' with sewerage (interviewees 1 and 4) as well as bring 'various wastes, such as wood, plastic, sand' (interviewee 8).

Furthermore, the consensus among downstream users was that upstream 'factories' produce and release pollutants into the rivers. P3 in interview 5 specifically mentioned the Heineken, Walia beer breweries as sources for releasing chemicals. Whereas interviewees 6 and 8 referred to 'factories' more generally. Other mentioned pollutants included 'the discharge of sewage' (interviewee 9), 'medical supplies and wastewater' (interviewee 6), construction activities ('when roads are built, then dirty water enters the water line', interview 5 P1), and upstream tributaries (in Addis Ababa) of the Big Akaki such as Kebena[68] (interview 5 P1). Additionally, visible pollution was mentioned several times: 'It's dirty littered everywhere. There are plastics. There are dropped canteens or bottles' (interview 5 P1 – these can be seen in Figure 35 and Figure 36 which were taken in the area of interview 5); 'We stopped [using the river water] there when there was garbage' (interviewee 11 – see Figure 37 which is the river mentioned by interviewee 11).

[68] **The Kebena tributary joins the Big Akaki around where interview 8 was conducted (see** Figure 33).

Lastly, and similarly to flooding issues, water quality issues were sometimes associated with strong negative feelings such as fear, concern, danger, and harm. This association with negative feelings was more consistent across all interviewees for water quality than flooding. Again, the most extreme examples were amongst the downstream interviews in the Akaki-Kality area with specific mention of health and environmental impacts. Examples of water quality concerns included:

> *'There may be a ruptured pipe when plumbers work; I am **concerned** that this system will allow the water to mix up the flood.'*
>
> Interviewee 1, Imperial, Bole Sub-City, Addis Ababa

> *'I am **concerned** about the quality of the water when it comes in, as it is occasionally contaminated or dirty.'*
>
> Interviewee 2, Sululta, Oromia Special Zone

> *'Drinking water, sometimes when the tank is flushed, nothing but dirty water comes down, I am **afraid**.'*
>
> Interviewee 3, Megenanga, Yeka Sub-City, Addis Ababa

> *'…pollution mainly related to drinking water is a major **concern**.'*
>
> Interviewee 4, Bole Arabsa, Bole Sub-City, Addis Ababa

> *'It [pollution in the river] also brings many **allergens to the body**. That is **allergic to humans**…'. '…there is water pollution. The colour of the water is constantly changing. This **harms** humanity.'*
>
> Participant 2, interview 5, Kality, Akaki Kality Sub-City, Addis Ababa

> *'Perhaps the most **worrying** thing about the vegetables we grow, the chemicals pollute the water.'*
>
> Participant 3, interview 5, Kality, Akaki Kality Sub-City, Addis Ababa

> *'It [pollution] comes with medical supplies and wastewater. That waste causes a lot of **danger**.' 'On the river, it is better if the body concerned does not drain [pollutants] into the river. I want to give this notice. If one citizen is **harmed**, the **harm** is to all Ethiopians.' 'The future **concern** is that as rivers become more polluted…'*

Interviewee 6,

*'The water is contaminated with chemicals. If you touch the water to cross the river, it will **cut** your body…'*

Interviewee 10, Addis Ababa/Oromia Special Zone

Figure 35. The Big Akaki River at Akaki Kality near Beijing General Hospital (looking south). Taken 10/06/2022 G.C (observation No. 15).

Figure 36. The Big Akaki River at Akaki Kality near Beijing General Hospital (looking north). Taken 10/06/2022 G.C (observation No. 8).

Figure 37. The Big Akaki River at Lege Tafo near Interviewee 11. Taken 05/03/2023 G.C (observation No. 100).

7.1.4 Rainfall

The last general theme among interviewees was the importance of rainfall in their water security. This was expressed through seasonal observations made by interviewees when having discussions around memories related to water, noticeable changes in the area they live in over time, concerns about water, and general seasonality. These discussions were related to feelings (such as ‘fear’ in interview 3; ‘I don't think I have anything to fear now rain is good.’), phenomenon such as water scarcity (interviews 1 and 8) and flooding (interview 5), and how long seasonal rainfall has been different (around 4/5 years according to interviewees 3 and 11). A more general trend amongst interviewees, however, was that overall annual rainfall has decreased. More specifically, በጋ (*Bega* – summer/dry season) rain has decreased and the timing of the winter rains (the beginning of ክረምት – *Kiremt* – winter/rainy season) has shifted to earlier in the year. Interviewee 1 describes this

seasonal change as ‘a major threat to water scarcity’. Additional comments on rain included:

> *‘In the past, rains did not start like we do now. It was around ሚያዝያ (Miyaziya – equivalent of around April G.C) that the winter (ክረምት - Kiremt) rains started. But now it's around የካቲት (Yekatit – equivalent of around February G.C). It is different in this regard’.*
>
> Interviewee 10, Akaki, Addis Ababa/Oromia Special Zone

> *‘Now that there is more sun, there is no summer (በጋ - Bega) rain, so the water is decreasing.’*
>
> Interviewee 6, Akaki, Akaki Kality Sub-City, Addis Ababa

> *‘There is a lack of rain. It was raining before. But now it rains only in winter (ክረምት - Kiremt).’*
>
> Interviewee 7, Akaki, Akaki Kality Sub-City, Addis Ababa

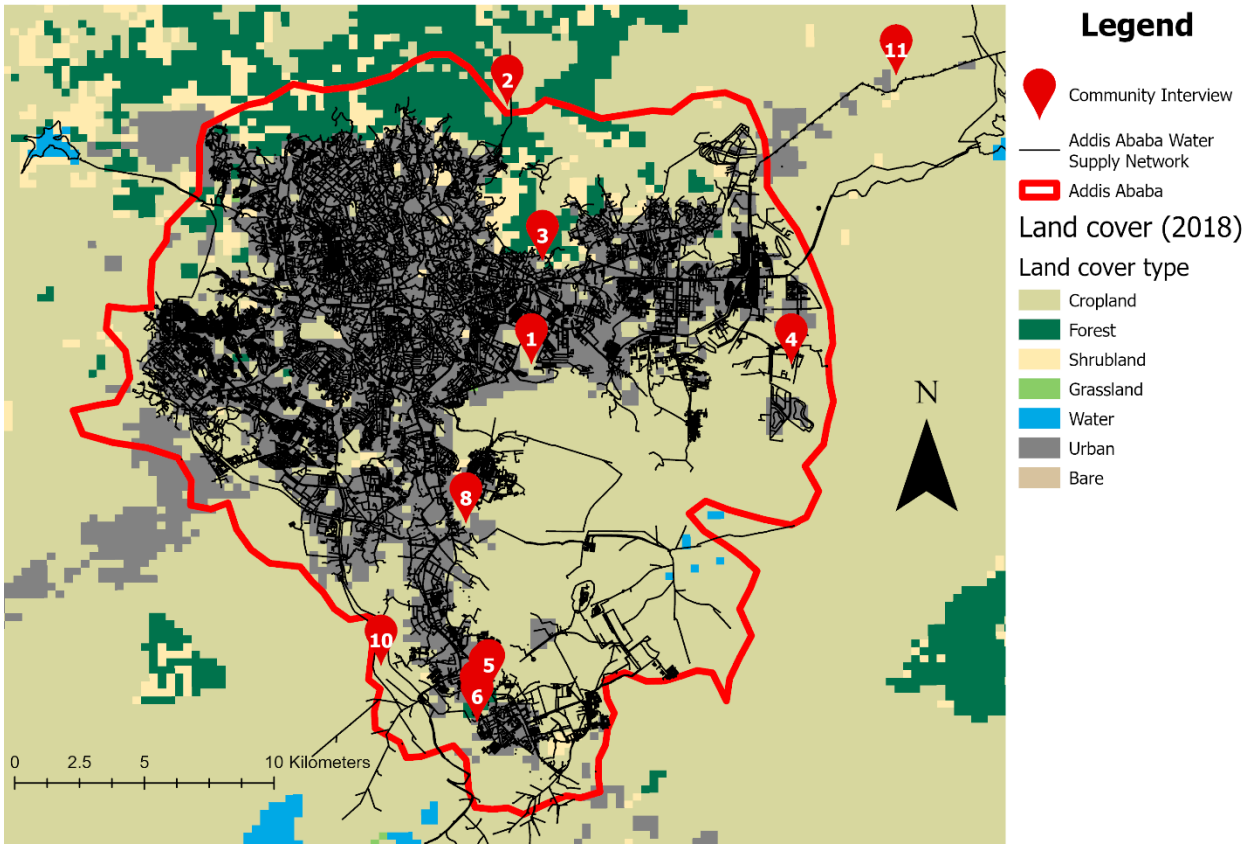
> *‘…water scarcity occurs when the first rains do not fall.’ ‘There is a change in terms of rain. The present and the past have changed.’ ‘…The rain has now subsided. The amount of rain is decreasing every year. The rain is not the same as last year.’*
>
> Interviewee 8, Bole Bulbula, Bole Sub-City, Addis Ababa

7.2 Comparisons of local water securities

The general themes in the previous section demonstrate some homogenous water security themes amongst all interviewees. However, it was also observed that certain interviewee characteristics created heterogenous water security priorities, perspectives, and experiences. The two major characteristics observed as dividing water securities were observed to be between urban/peri-urban areas and upstream/downstream locations.

Water security themes amongst interviewees in peri-urban areas were observed as similar in their priorities, perspectives, and lived experiences. The peri-urban areas around Addis Ababa often sit close to, or within, the OSZ and are characterised by typical peri-urban features such as a relatively low population density (compared to Addis Ababa), scattered settlements, high dependence on transport for commuting, fragmented communities, and lack of spatial governance (Ravetz et al., 2013). Looking at these characteristics (e.g., urban areas, agricultural areas, service connectivity, and general built-up areas in Figure 38) as well as across existing literature (Azagew & Worku, 2020; Woldesemayat & Genovese, 2021; Moisa et al., 2022) appears to separate interviews 1 and 3 (urban) with the other interviews (peri-urban). Whilst it is difficult to make general comparisons between the urban and peri-urban interviewees (due to the limited number of exclusively urban interviewees), some observations and themes can be identified amongst the peri-urban interviews related to livelihood security, water supply access, and disempowerment.

Figure 38. Land cover type (2018), water supply network, and location of community interviews



The other noticeable disparities in water security experiences amongst interviewees were observed between those upstream and downstream in the Akaki catchment. Those upstream included interviews 1-4 and 11, those downstream included interviews 5-10. Defined by the lowest point of major tributary intersection; Kebena/Bulbula tributary into the Big Akaki and the Jemo and Harbu tributaries into the Little Akaki (see Figure 33), this division also separates the Akaki plains to the downstream area of the catchment. The main heterogeneous themes between these areas are that downstream interviewees appear to suffer the most from water insecurities caused by the compounded impacts of flooding and industrial/domestic water quality issues, whereas upstream interviewees have more issues with water insecurity as a result of combined poor water quality (from sediment) and scarcity.

7.2.1 Job and livelihood security

In the downstream areas, the occupations of interviewees (and their families) were found to be mostly rural and therefore more reliant on river water e.g., agriculture,

livestock, and sand mining[69]. Upstream interviewees, however, had occupations associated with more urban professions such as hospitality (interview 2), business (interview 3), and cottage industries (interview 11). As part of this, those whose livelihoods were more dependent on river water had water security perspectives and priorities more significantly linked with the environment and landscape as well as more established links between water security and job, livelihood, and environmental security. The threshold of water insecurity was therefore largely related to water issues that disrupt local occupations, water and land use habits, health, and safety, such as: the destroying of crops from flooding (described in interviews 5 and 10); lack of access to working land from flooding (described in interview 6); destruction of current and historical houses from flooding (described in interview 5 and shown in Figure 39); inadequacy (in water quality) of river water for making products and washing (clothes) (described in interview 11 and 9, respectively); and health impacts associated with poor water quality of river water (described interview 5, 6, and 10).

In these areas, the insecurities caused by flooding, water quality, and water-related environmental change, have driven the adaptation of livelihood practices in order maintain individual economic, job, and health security. For example, agricultural practices seem to be changing from ጤፍ (*Teff*)[70] production to cabbage as the main agricultural product as well as only being able to sow crops once a year instead of twice (due to flooding in ክረምት - *Kiremt* - described as winter). Moreover, sand miners in the area are mentioned to have adapted to the poor water quality of the Big Akaki by covering their skin in Vaseline. This allows them to still enter the water to extract sand but stops the water from touching their skin and causing allergic reactions (as described in interview 5). In addition to this adaptation to the poor water quality, many do not wash their clothes in the (Big Akaki) river, the water is not drunk (although it used to be), products are no longer made (e.g., making ጠላ (*Tela*)[71] in interview 11), and people no longer swim (Big and Little Akaki). Conversely, upstream, interviewee 11 mentions that more people have started washing themselves and their clothes in the river, deteriorating the water quality. Also,

[69] Sand miners manually move sand from the bottom of the river, leave it to dry on the banks, and then sell it in the city for construction purposes. This practice can be seen in Figure 36 and Figure 51.

[70] A local grain used to make flour.
[71] A local fermented beer.

interviewee 7 still swims and uses the river for washing clothes. The quotes below demonstrate the discussions had around these water-related adaptations in the downstream, peri-urban, Akaki-Kailty, area.

'It [the river] was [in the past] used by the community for drinking… They use it [the land] only once during the flood. In the past they can use it [the land] twice. They plant cabbage, vegetables, and various potatoes on top and after they pull it out, they plant something else. But at this time they only use it once.'

Participant 1, interview 5, Kality, Akaki Kality Sub-City, Addis Ababa

'There are children working sand [mining] here in the river. They get Vaseline oil and go into the river water to extract sand. That is to prevent water from getting into them. If they don't use Vaseline, they may be allergic to it [the river water].'

Participant 2, Interview 5, Kality, Akaki Kality Sub-City, Addis Ababa

'Now we use it [river water] to water vegetables, but people don't drink it. They don't wash their clothes.' '…in the days when I was [a child] … Farms were ploughed in ክረምት (Kiremt - winter). Wheat and teff was sown...' 'Those who sow wheat and teff will not be flooded. Vegetables are often grown along the floodplain. They have a different place for teff.'

Participant 3, Interview 5, Kality, Akaki Kality Sub-City, Addis Ababa

'…in ክረምት (Kiremt - winter), we stop working because the area is flooded.'

Interviewee, 6, Akaki, Akaki Kality Sub-City, Addis Ababa

'Although the water is not being used much, urban agriculture is being practiced on vegetables… But now, unlike before, the river water is starting to bring dirt, which is not suitable for the plants. It also shows

burn marks on the vegetables.' 'We still swim. But now the water is dirty, so it's not like it used to be.'

Interviewee 7, Akaki, Akaki Kality Sub-City, Addis Ababa

'At present, the water is dirty, so the community does not use it for washing clothes. But they used it before. No one is using the water now. First, the water smells. Second, it's not clean. '

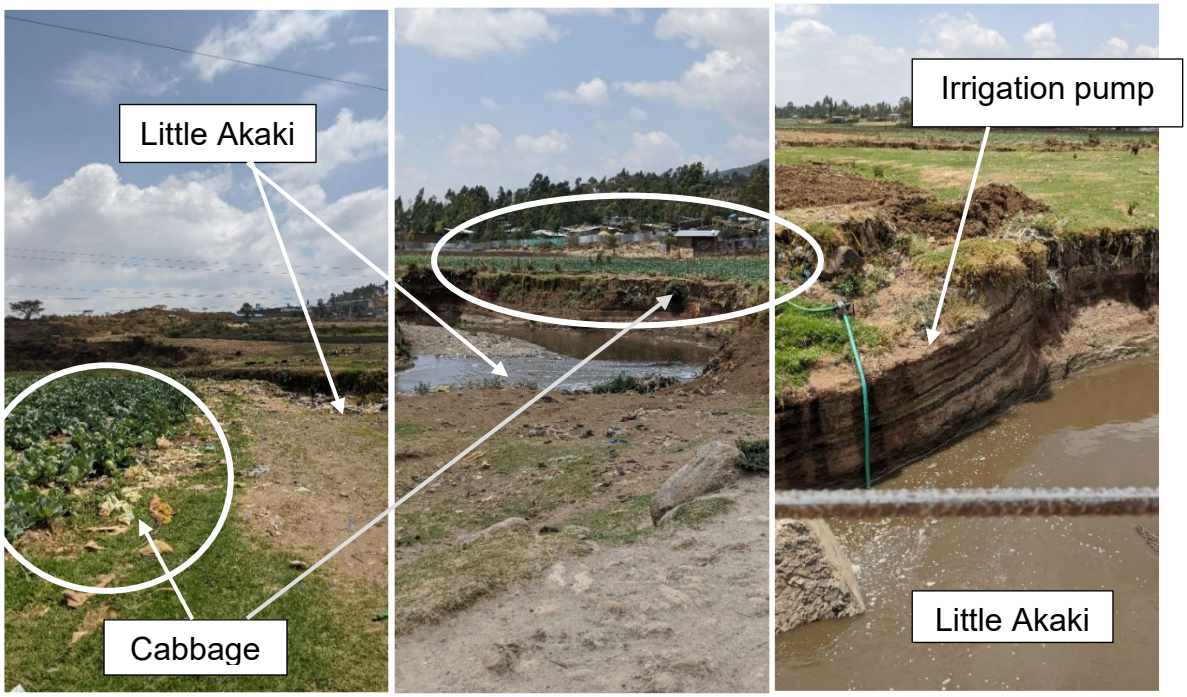
Interviewee 9, Akaki, Akaki Kality Sub-City, Addis Ababa

'They used to sow [Teff] on it [the land]. But now in ክረምት (Kiremt – winter), nothing can be done because the water is overflowing. Cabbage, on the other hand, works twice as well until መጋቢት (Megabeet – equivalent of around March G.C). After that it will be terminated. Because the water will fill up and destroy what they have done...'

Interview 10 (see Figure 40-42), Akaki, Addis Ababa/Oromia Special Zone

Figure 39. Destroyed house near Big Akaki river (observation No. 11). Destroyed in 2018 G.C floods according to local knowledge. Taken 10/06/2022 G.C.

Figure 40, Figure 41, Figure 42. Cabbage planting around the Little Akaki replacing the traditional sowing of ጤፍ (*Teff*) in the area described by interviewee 10 (observations No. 97, 98, 99). Taken 05/03/2023 G.C.



7.2.2 Disempowerment and expressions of injustice

Interviews in peri-urban areas demonstrated various expressions of water injustice or decision-making disempowerment around poor access to water services, environmental impacts, urban expansion (of Addis), and lack of consideration in decision making. Expressions of injustice can be interpreted as a means of trying to obtain water security where it is in some way being denied or blocked. This was noticeably prevalent in the peri-urban interview areas, but particularly those in the bordering area between Addis Ababa and the OSZ (interviewees 2, 10, and 11). It is worth noting that action to pursue water security (as an individual or community) was not always unsuccessful, therefore demonstrating empowerment over disempowerment, this is further discussed in Section 7.3.3.

7.2.2.1 Water security injustices from lack of water supply

One noticeable expressed injustice is the lack of piped water supply, interviewees 2, 10, and 11 did not have access to piped water supply. Interviewee 2 discussed the water supply difficulties in their area with contrast to the situation in Addis Ababa. They hint a tone of being fortunate (in terms of water supply) if you live in the city as

life is not so difficult; ‘Even if you don't want to save water here, you should. But Addis Ababa has no problem because there is tap water… you can use it [water] however you want [in Addis Ababa]. But here it is difficult because you are fetching by donkeys’. This opinion is also supported by the perception of interviewee 3, in the city centre of Addis Ababa, in that there is a noticeable difference in water supply between those in the city and those in peri-urban, bordering areas:

> *‘…if we look outside the city center, for example, there is no water in Yeka Abado [a town on the border of Addis Ababa/Lege Tafo]’.*
>
> Interviewee 3, Megenanga, Yeka Sub-City, Addis Ababa

Interviewee 10 relates the general lack of water supply in their area with a broader sense of neglect of their community, associating absence of water supply with a lack of other social services and false promises. When asked *Do you have any additional thoughts regarding water issues in the area?* the response was: ‘There is no bono[72] or piped potable water in the area. There is no health centre. There is no youth centre. Young people hang out in different places. We asked for bono to make potable water for us. A well is said to be being dug; but it has been too long. It was two years ago’. Lastly, interviewee 11 mentions a different type of injustice in being actively denied water supply based on their social status[73] (which other residents in the area appear to have it based on the interview discussion); ‘when we ask [for water supply], they tell us that you are not a native of this area’.

Obtaining water in these areas (with no piped water supply) therefore comes with a cost for fetching and buying water. One jerry can of water seems to range between two and five ETB (0.037-0.092 US$), plus any additional costs of delivery, transport (as described by interviewees 8, 10, and 11), or access (as described by interviewee 10 who pays the guard ‘employed by the water development bureau’ to have access to a spring in Addis Ababa). Other means of obtaining water in these areas were largely community-based, including river damming and sand filtering (interviewee 11) and inter-community water purchasing between those with water supply and those

[72] ቦኖ (*Bono* – public water taps).

[73] Although, it was not clear who the interviewee was asking or what sort of situation made the interviewee not a ‘native of this area’.

without in close proximity. For example, interviewee 4 does have access to piped water supply (in their condominium), but the neighbouring residents (who do not have piped water supply) buy and take water from those in the condominiums. In the case of interviewee 4, the injustice caused by this arrangement is expressed in the interview. The interviewee observes that they have lived in this area for longer than them, but do not have piped water supply, they want these 'sections of society' to be noticed and given solutions:

> *'There are sections of society in this area that are in need of water. And I want them to be noticed and noticed. Because the area they are in is muddy. If it is not a donkey to carry water, they will have a hard time. And they are buying the water... I would say if there is a solution for them… this area was a farm and it was theirs, they had been living here since before I came here.'*
>
> Interviewee 4, Bole Arabsa, Bole Sub-City, Addis Ababa

7.2.2.2 Water security injustices from urbanisation

The urban expansion and urbanisation happening within and around Addis Ababa was expressed by most interviewees in descriptions of land use or landscape change in the area they live in or in Addis more generally. With the exception of interviewee 3 who, since living in the city (Megenanga) for 20-years, said 'Everything is where it is. And the houses are as they are. Nothing has changed.' Other interviewees, however, mentioned 'new neighbourhoods' on the outskirts of the city (interviewees 1 and 6), changes from rural to urban (interviewees 2 and 4), and the expansion of the city in size and population (interviews 5 and 6). These urbanisation phenomena were occasionally related to water issues and perceptions of distribution injustice in peri-urban areas, specifically related to local water shortage. For example, the 'new neighbourhoods' described by interviewees 1 and 6 were also associated with water shortages due to a perceived inability to distribute water to everyone. Additionally, interviewee 6 linked the general increasing size of Addis Ababa with the local 'water shortage and water crisis'. This is similar to participant 2 in interview 5 who associated the increasing population of Addis Ababa with water shortage issues due to imbalance of 'demand and supply'.

'I think that the problem of water shortage is caused by the fact that water distribution is too much and it is released in turn. There are new neighborhoods outside the city center. When water is distributed to all these settlements, water shortages may occur. So water workers can reduce the water coming into the city center and send it to new neighborhoods on the outskirts of the city; at that time there will be a shortage of water.'

Interviewee 1, Imperial, Bole Sub-City, Addis Ababa

'There is currently a shortage of water. As the size of the city is increasing, water is brought once every three or four days... There are new neighborhoods outside the city center. When water is distributed to all these settlements, water shortages may occur.'

Interviewee 6, Akaki, Akaki Kality Sub-City, Addis Ababa

7.2.2.3 Disempowerment through overlooking and exclusion

There were a few instances in the peri-urban interviews where injustices could be interpreted through the disregard of individual or community voice. The previous example of interviewee 11 asking for piped water and being actively denied[74] is one example of this, specifically related to water supply. Other examples, however, also included lack of regard and involvement for community expertise and knowledge as well as ignoring community water security priorities and concerns. Interviewees 5, 6, and 7 mentioned feeling that their concerns were being ignored through government negligence (interview 5 and 6) and lack of acknowledgement of correspondence (interviewee 7). Those in interview 5, when discussing the flooding situation in their area, expressed frustration and a sense of neglect through the use of short-term solutions, lack of government attention, and general inaction meaning that people are still at risk of harm and displacement.

Interview 5 also mentioned the lack of regard and involvement for community expertise and knowledge in finding solutions for flooding in the area. Voicing that they would prefer if work was 'focused on the local community. Because a community in

[74] '…when we ask [for water supply], they tell us that you are not a native of this area.' (Interviewee 11).

that area knows the area more and better than an expert' (P2). As a result of not consulting the community, the participants discussed how one recently proposed solution[75] will lead to 'displacing and destroying the people and society' (P3) and is a means to 'make the job easier for them' and to 'cut costs' that will result in 'more harm than good'. In interview 5, it appears that there is a clear frustration in the neglect for the water-related (or perhaps, more specifically, river-related) securities of the communities affected by flooding and hence a perception of injustice and disempowerment through overlooking these and excluding the community from decision-making. This is noticeable in the quotations from the discussion in interview 5 (Kality, Akaki Kality Sub-City, Addis Ababa) below.

Participant 1:

> *'…they have come up with a new idea; to divert the river... Their idea is to replace the bridge, to make the job easier for them. It was to cut costs. But we told them that it is not right, it is not appropriate. Because their plan was to divert the river; and we know the flow of the river; we know how much it increases in winter. As it is now, we are struggling to keep the water from going to the community. If the water has changed direction, there is a very wide possibility of directly entering the community and school. It means that there was more harm than good. What knowledge do they have about the area first when doing this work? They should not only divert the river but also consult the community.'*

Participant 3 [in response to participant 1 above]:

> *'Yes, they cut off our land and planned to take the water back on the land. Because of the water, there are displaced people around here. Now the river has changed its direction, which means that this school will be destroyed. At the end, I think it is impossible. They are professionals; but they have no awareness of the environment.'*

[75] To divert the river and replace the local bridge.

7.2.3 Upstream and downstream water security experiences

As previously mentioned, heterogeneous water security themes were observed between those upstream and downstream. These were perceived as:

- Downstream interviewees' water insecurities largely caused by the combined impacts of flooding and industrial/domestic water quality issues;
- Upstream interviewees' water insecurities largely caused by combined poor water quality (from sediment) and water scarcity.

These observations can be partly attributed to the topography of the area; the elevation of Addis Ababa being approximately 2900m around interviewee 2 and 2200m around interviewee 8, for example. Additionally, the Big and Little Akaki (and their tributaries) having to pass through Addis Ababa before reaching the downstream plains, exposing the rivers to a variety of polluting activities along the way. The elevation difference combined with the polluting influence of Addis, creates difficulty in storing water in upstream areas and a water-rich but water hazardous downstream environment. These differences in water securities between upstream and downstream interviewees are best demonstrated by seasonal preferences. Those downstream preferring the dry season (በጋ – *Bega* – described as summer) due to less flooding[76] and more occupational opportunity for sand mining and agriculture (see quotes below). Whereas those upstream appear to prefer the rainy season (ክረምት – *Kiremt* – described as winter) as there is more water availability: '...lack of water is a big problem in our village, especially in summer (*Bega*)' (interview 2); '…the [river] water has decreased a lot. There is no water. In ክረምት (*Kiremt* – winter), this area was covered with water. And the side was covered with water' (interview 11). These seasonal changes between dry and rainy season for land and water use were also witnessed in many research observations around the areas the interviews took place (see Figure 45-57).

> *'In winter, the river fills up. The land around here does not look the same; it covers it all… There is a shortage of water [supply] in ክረምት (Kiremt -winter) …'*

[76] Upstream interviewees that mention flooding either report no flooding (e.g., interviewee 1, 2, and 11) or that they don't happen anymore/usually (e.g., interviewee 3 and 4).

Participant 2, interview 5, Kality, Akaki Kality Sub-City, Addis Ababa

'Flooding is most common in ክረምት (Kiremt -winter) around here and below [further downstream].'

Participant 3, interview 5, Kality, Akaki Kality Sub-City, Addis Ababa

'…in ክረምት (Kiremt -winter), we stop working because the area is flooded… In ክረምት (Kiremt -winter), the water fills up. It is very muddy. The water is useless.'

Interviewee 6, Akaki, Akaki Kality Sub-City, Addis Ababa

'Every time ክረምት (Kiremt -winter) comes, there is a risk of flooding.'

Interviewee 7, Akaki, Akaki Kality Sub-City, Addis Ababa

'The water will decrease It's not like ክረምት (Kiremt -winter). The water level will decrease [in በጋ – Bega – summer].'

Interviewee 8, Bole Bulbula, Bole Sub-City, Addis Ababa

'This is how the farmers work. But the river was not so high. They used to sow Teff on it. But now in ክረምት (Kiremt -winter), nothing can be done because the water is overflowing… Every year during the winter months, the flood erodes the land.'

Interviewee 10, Akaki, Addis Ababa/Oromia Special Zone

'Before there was a change, now the water has decreased a lot. There is no water. In ክረምት (Kiremt -winter), this area was covered with water and the side was clothed with water. There is no water for three or four years now. Water is running low.'

Interviewee 11, Legedadi, Oromia Special Zone

The differences in water (in)securities between upstream and downstream communities from flooding, water quality, and water scarcity can also be attributed to geography of the Akaki catchment. In the upstream areas of the Akaki catchment, the slope of the land and soil type in combination with increasing urbanisation, cultivation, deforestation, and general poor land use management (Tefera et al.,

2023; Hiruy et al., 2022) has caused a high amount of soil erosion. This was observed in this area to also be causing large gully formation (see Figure 43 and Figure 44). Whilst this topography protects upstream communities from flooding (as described by interviewee 2: ‘Even if there is a flood, it will go down because the area is steep. Therefore, there will be no flood in this neighbourhood.’), it contributes to downstream impacts such as flooding and water quality. Specifically, gully formation leading to increased risk of downstream flash flooding and soil erosion creating a high concentration of suspended solids in rivers, especially during periods of heavy rainfall (Hiruy et al., 2022; Veress et al., 2013; Chen et al., 2021). Therefore, when discussing water quality, the upstream interviewees mention dirt (interviewee 2, 3) and muddy water (interview 11, 3) more than other types of pollutants. The increased suspended solids in the rivers between rainy season and dry season can be seen in Figure 45-57 in both upstream and downstream examples. In contrast, the downstream interviewees mention sewage (interviewee 9, 6), medical supplies (interviewee 6), plastics (interview 5 P1), garbage (interview 5 P1), and chemicals (interviews 5, 6, 8, 10), as well as dirt. These different water quality issues are largely a result of the urban and industrial pollution impact of Addis Ababa, meaning that upstream and downstream water insecurity associated with poor water quality is not homogenous.

Figure 43. Soil erosion upstream of Big Akaki around Sululta (reference 53). Taken 15/07/2022 G.C.

Figure 44. Large gully formation upstream of Big Akaki around Sululta (reference 53). Taken 15/07/2022 G.C.

Figure 45. Downstream Big Akaki in *Kiremt* (taken 14/08/2022 G.C), late rainy season. Reference 72.

The above and below images are the same river location (downstream Big Akaki) in two different seasons (*Kiremt* and *Bega/Belg*).

Figure 46. Downstream Big Akaki in *Bega/Belg* (taken 06/02/2023 G.C), late dry season. Reference 90.

Figure 47. Downstream Big Akaki looking towards Aba Samuel reservoir in *Kiremt* (taken 10/07/2022 G.C), mid-rainy season. Reference 19.

The above and below images are the same river location (downstream Big Akaki) in two different seasons (*Kiremt* and *Bega/Belg*).

Figure 48. Downstream Big Akaki looking towards Aba Samuel reservoir in *Bega/Belg* (taken 06/02/2023 G.C), late dry season. Reference 93.

Figure 49. Sand miners on the downstream Akaki River near Beijing hospital. Taken in *Kiremt* (10/07/2022 G.C), rainy season.

The above and below images are the same river location (downstream Big Akaki) a month apart in *Kiremt* (rainy season).

Figure 50. Sand miners on the downstream Akaki River near Beijing hospital. Taken in *Kiremt* (14/08/2022 G.C), rainy season.

Figure 51. Sand miners on the downstream Akaki River near Beijing hospital. Taken in *Bega* (12/12/2022 G.C), dry season. Reference 85.

Figure 52 and Figure 53. Downstream Kebena River (tributary to the Big Akaki) in *Kiremt* (taken 14/07/2022), rainy season. Reference 51 and 52, respectively.

Figures 52/53 and Figures 54/55 are the same river location (downstream Kebena) in two different seasons (*Kiremt* and *Bega/Belg*).

Figure 54 and Figure 55. Downstream Kebena River (tributary to the Big Akaki) in *Belg* (taken 05/03/2023), end of dry season. Reference 94 and 95, respectively.

Figure 56 and Figure 57. Upstream of the Big Akaki (near Legedadi) in *Kiremt* (Figure 56, taken 14/07/2022 G.C) and *Belg* (Figure 57, taken 05/03/2023 G.C). Reference 44 and 100, respectively.

7.2.4 Community and individual action in pursuing water security

All interviewees were asked about what actions are taken when there is a water issue. The responses to this were either based around individual action or community action – reflecting elements of water security as a social practice, process, and value. It appears that the success and prevalence of community and individual action in pursuing water security differed between interviewees, but it is hard to decipher whether this is subject to upstream/downstream or urban/peri-urban variance without more interview data. It was generally observed, however, that group action to pursue water security as a community was more prevalent and successful in the Akaki-Kality area (downstream and peri-urban) over any other interview area. In the Akaki-Kality area there was evidence of community action in flood prevention (early warning

systems and bund flood defence construction), pollution control activism, and resource sharing.

Interviews 5, 6, and 9 all discussed community action for flood defence. Interviews 5 and 9, more specifically, discussed community funded and built earth flood defences; Figure 58 shows the community constructed earth bund built to protect a local school from flooding near the area of interview 5, and Figure 59 shows the community funded and constructed earth bund in the area of interview 9. Interview 5 also discusses how this method of flood defence was shared with the local prison to prevent it from flooding (after it had previously flooded); ‘by looking at ours [earth bund], by throwing soil to prevent it from entering the prison, work was done to prevent it from entering the flood. Those who worked at the prison saw it from us.’ (P1). Interview 10 describes a similar approach to flood defence but based around individual action; ‘Everyone tries to prevent flooding by building a terrace or earth dam around their house. Nothing has been done to protect the remaining land from flooding.’

Figure 58. Community built earth bund (highlighted) to protect from flooding (observation No. 14). Taken 10/07/2022.

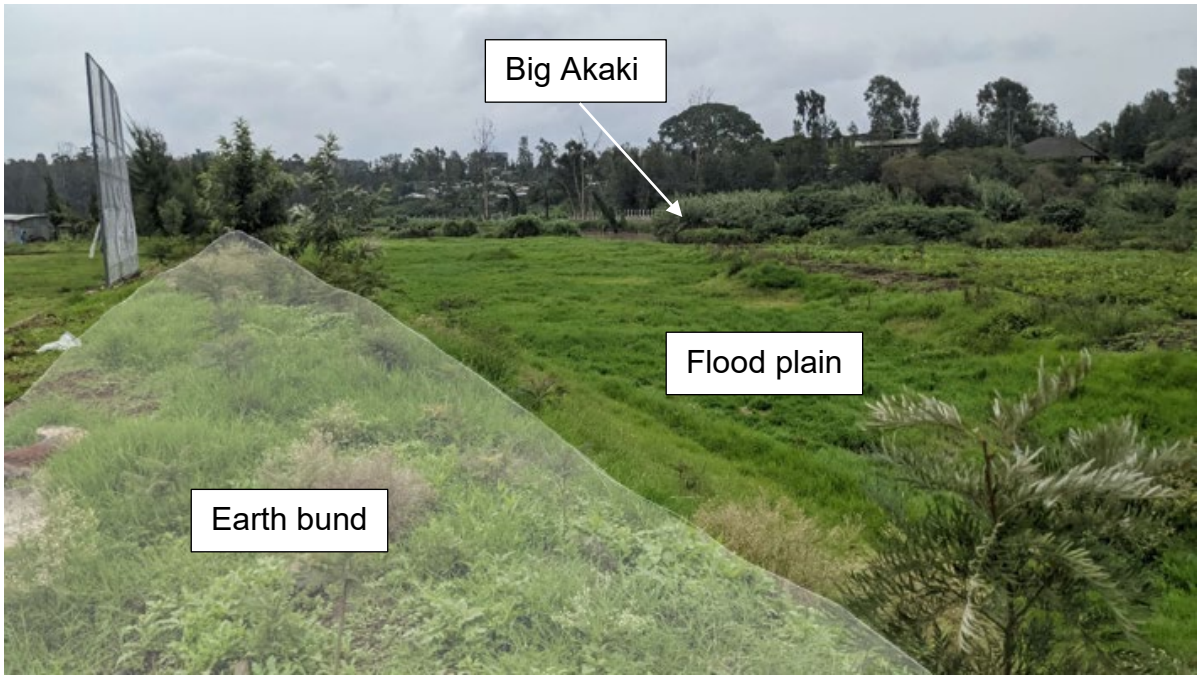
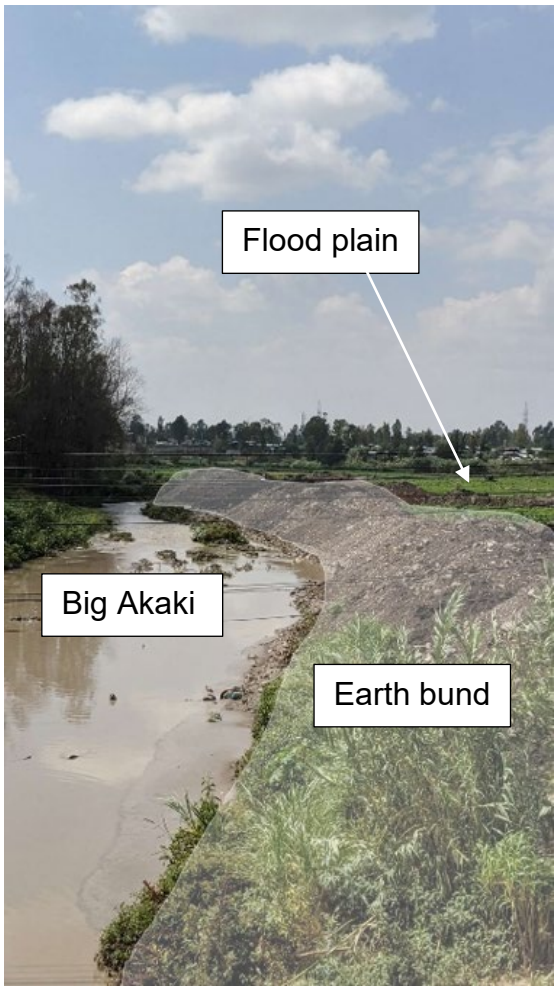


Figure 59. Community built earth bund (highlighted) for flood protection (observation No. 3). Taken 05/03/2023.



As well as these physical flood defences, interviews 5 and 6 mention the early warning systems in place between the downstream (Akaki-Kality) communities and upstream administrative bodies (Legedadi town in the OSZ). The overspill of water from the Dire and Legedadi reservoirs passes into the Big Akaki and causes flooding in the downstream areas (Bekele et al., 2022; interviewee 9). Therefore, the communication between Legedadi, the media, and the downstream communities, can provide crucial warnings and awareness for flood events (see quotes below from interviewee 6 and 7). This information sharing, as an early warning system, is also inter-community. For example, interview 5, 6, and 7 all mention their responsibility in communicating with their own community, and other at risk communities, about flooding. Participant 3 in interview 5 describes ‘an act of exchanging information among the society. When the flood come us, we will inform to the society below [downstream] they will be aware that a flood has come. This is what we convey to the

rural society'. Interviewee 6 describes how 'there is both relief and precaution against floods' amongst people in their community where 'We call each other. We will help each other. We lend them what we have. And we borrow what they have… We are involved in everything together'.

> *'The city of Legedadi warned us [of flooding] in advance. They tell us to be careful not to be found on the river bank from July. They will call the city of Legedadi by phone and inform them through the media.'*
>
> Interviewee 6, Akaki, Akaki Kality Sub-City, Addis Ababa

> *'Three years ago there were no precautions. The city of Legedadi would not tell us [about flooding]. Since we started working with the city three years ago, they have [monitoring] sites all over the place. We will be aware of the time of flood in those places, we will receive the information and we will receive the meteorological information… Mostly, the message is delivered through different media.'*
>
> Interviewee 7, Akaki, Akaki Kality Sub-City, Addis Ababa

The other notable case of community action in the Akaki-Kality area was around pollution. Both interviews 5 and 6 mention how they 'applied' for 'filtering' or 'cleaning control' of the Big Akaki river, sometimes informing 'aggressively at different places', and the result was met with an improvement in the pollution of the river. There was also mention, by interviewee 6, that 'it [pollution] gets less critical in every meeting' implying some form of consultation between or with community members. It is also worth noting, however, that interviewee 6 states that the pollution control has now stopped, and the pollution is again 'loose' in the river.

Aside from the community action in the Akaki-Kality area against flooding and pollution, there was also the theme of action across all interviews in managing water scarcity. In general, it appeared that there was less community action in pursuing group water security for drinking water, with many interviewees discussing how obtaining drinking water security was more of an individual pursuit. The exception to this being interview 11 where the drinking water filtered from the river was available for everyone; 'we make dam and drink potable water in the river. This is the solution we have taken. We do this together. The drinking water is also available for

everyone. The water is filtered through sand'. When there is water shortage, many interviewees aside from 11 were very explicit about the fact that it is individual action that resolves this issue (see quotes below); water was not shared between communities or between individuals within a community, individuals went to 'concerned bodies' or the 'water development office', bought water, or made their own wells. It appears that the existence of ቦኖ (*Bono* – public water taps) used to (or still does, according to interviewee 8) play a significant role in community water use. A few interviewees inferred that, where *Bono* had been taken away, this had contributed to water insecurity in the area (interviews 5, 10, and 11).

'…when there is a shortage of water, personally, I buy water from the store as much as I can and use it.'

Interviewee 1, Imperial, Bole Sub-City, Addis Ababa

'If there is a [water] problem somewhere, they themselves go and dig, take out the dirt and water will come.'

Interviewee 2, Sululta, Oromia Special Zone

'…when the water breaks, as individuals we sometimes go to the concerned bodies.'

Interviewee 3, Megenanga, Yeka Sub-City, Addis Ababa

'…on an individual level, if there is no water in our neighborhood, I would like to call for water development office… as a community, we have never raised a common question about water.'

Interviewee 4, Bole Arabsa, Bole Sub-City, Addis Ababa

'…the community does not share the water it has with others'.

Interviewee 8, Bole Bulbula, Bole Sub-City, Addis Ababa

'ሁሉም ለየራሱ እየቀዳ ነው የሚጠቀመው ::'

('everyone is using and withdrawing [water] for themselves')

Interviewee 10, Akaki, Addis Ababa/Oromia Special Zone

7.3 Local water security systems interpretation and analysis

The previous sections demonstrate some main themes of water security across Addis Ababa, revealing the integrated human values, perceptions, and diverse problem framings of local water security dimensions. Furthermore, showing how water security is uniquely shaped by distinct individual and community interconnections between water, health, livelihoods, environment, and local socioeconomic security. These findings, most importantly, provide the argument for water **securities** over a single water **security**; a singular diagnosis for water security of Addis Ababa not being a suitable representation of the range of priorities, experiences, and concerns for local individuals and communities. This does, however, create a difficulty for a more traditional systems interpretation and analysis of water security. In that, a systems construction based on a set of fixed elements, rigid interconnections, and interrelationships would not reflect the multiple dynamic water securities within Addis Ababa or respect the diversity of water securities found amongst local individuals and communities. It is therefore proposed that, alongside a traditional systems interpretation (Figure 60-64[77]), analysis of local water securities in Addis Ababa should critically consider the systems fundamentals of open systems and boundary judgements as described in Chapter 3[78].

The concept of an open system provides a means to demonstrate how information is exchanged between, processes interact with, and other systems influence the system and its wider social and physical environment. In an open systems analysis, the systems' environment is considered both social and physical and is interpreted through values, expectations, and ideals (Emery, 2000; Ulrich, 1988). The concept of systems boundaries allows an analysis of what is inside and outside of the system; the drawn boundary between these being defined by boundary judgements of value, interests, and perceptions of reality. Individuals' thoughts (perceptions of facts and values), actions (improving a situation), and lived experiences can be argued as key

[77] Figure 61 attempts to interpret a general water security system at individual level for Addis Ababa based on the elements, interconnections, and functions discovered in Chapter 7. Figure 62-65 demonstrate how this was observed to vary across upstream/downstream and urban/peri-urban locations.

[78] Chapter 3 pointed out some fundamentals for using systems thinking in analysing water security; the open system, boundary judgements, and methodological pluralism.

reflections of interests and judgments of value that create the system boundaries. The open system and boundary judgements concepts are therefore both largely centred around water security values, expectations, ideals, and interests. Taking this into consideration, amongst interviewees, we find the three dominant value themes of potable water access, river water quality, and protection from harm – these largely reflect the wider social and physical environments of water security in Addis Ababa and the boundaries drawn between water security processes.

The role of potable water access was a notably influential factor in an individual's water security, the exchanges between an individual and their physical and social environment to obtain potable water are apparent in the development of multiple coping mechanisms in the presence of water shortage as well as the informing of 'concerned bodies' when there is an issue with potable water. In terms of the physical environment, private piped water supply does not automatically appear to grant water security; many participants have private piped water supply and still appear water insecure. A more general access to potable water supply in the wider physical environment appeared to be a bigger determinant of water security than private piped water supply alone[79]. Potable water access in other forms such as river water, ቦኖ (*Bono* – public water taps), and wells/groundwater, were also large contributing factors to the water security provided by access to potable water. The boundary of the social environment for potable water security appears to be largely centered around the individual. Although, this does sometimes extend to community in terms of the responsibility to report piped water issues and the presence of inter-community water markets.

River water quality was another a key determinant of an individual's water security; unpolluted river water being an environmental expectation amongst many interviewees. This is demonstrated to interact with, and influence, many other human security systems such as occupations, health, recreation, and livelihoods, all of which influence the wider social environment of water security. Concern for river water quality also showed a more general reflection of environmental values in not wanting the river to smell bad, look bad (from dirt and garbage), and the ability to enter and

[79] Although, if the private piped water supply was more consistent and of better quality, it could be a bigger determinant.

use (and drink) the river water. This extends the wider social and physical environment to not just good river water quality for health (drinking), but also for the environment and social activities.

Protection from harm was evidently a central aspect of water security; both an expectation (in the protection from flooding and pollution by the government) and an ideal (to use and live near rivers without harm). The idea of harm is therefore defined by the wider social environment associated with the properties and values of the physical environment. Protection from harm appearing to be less of an issue with physical phenomena (e.g., flooding) and more an issue of perceived disempowerment and community neglect (disconnection with the wider social environment) resulting in inappropriate, ineffective, or inexistent action and therefore continual community damage. As a result, there is evidence of attempting to form more exchanges with the wider water security environment through reporting to the ‘authorities’ and community activism in social (early warning systems, pressure groups) and physical (flood defences) action. This demonstrates the pursuit of a common water security goal amongst individuals in the wider social environment and an agreed boundary between what is acceptable and what is not. Despite this, the action to change the system requires recognition, response, and action from higher governance levels. The perceived lack of this felt amongst interviewees demonstrates a blocking of exchanges between the open system of an individual/community water security and the wider socio-physical environment. This disables the ability for individuals/communities to pursue their own water securities and therefore a disempowerment.

To end, the wider social and physical environment crucially includes the city of Addis Ababa. One of the most significant boundaries is the boundary drawn between individuals and the city as an actor in its own right. Addis Ababa is often described as a polluter, a water grabber, and a centre for bureaucratic decisions, creating the image of Addis as the perpetrator of water insecurity and the individual as the victim. This can be demonstrated in the ‘us and them’ rhetoric found amongst interviewees in discussions around potable water supply and pollution. In the downstream areas, for example, it appears to be a perceived as a fact that only pollution from Addis Ababa causes pollution in the rivers. This boundary further separates the individual

from city processes such as urbanisation, industrialisation, and water resources management, perhaps allowing the individual to disassociate from responsibility and accountability in these activities. This boundary, however, is observed to be more likely a reflection of the lack of control felt over an individual's environment and therefore a lack of ability to pursue their water security.

Figure 60. System interpretation of elements and interconnections of general individual water security in Addis Ababa

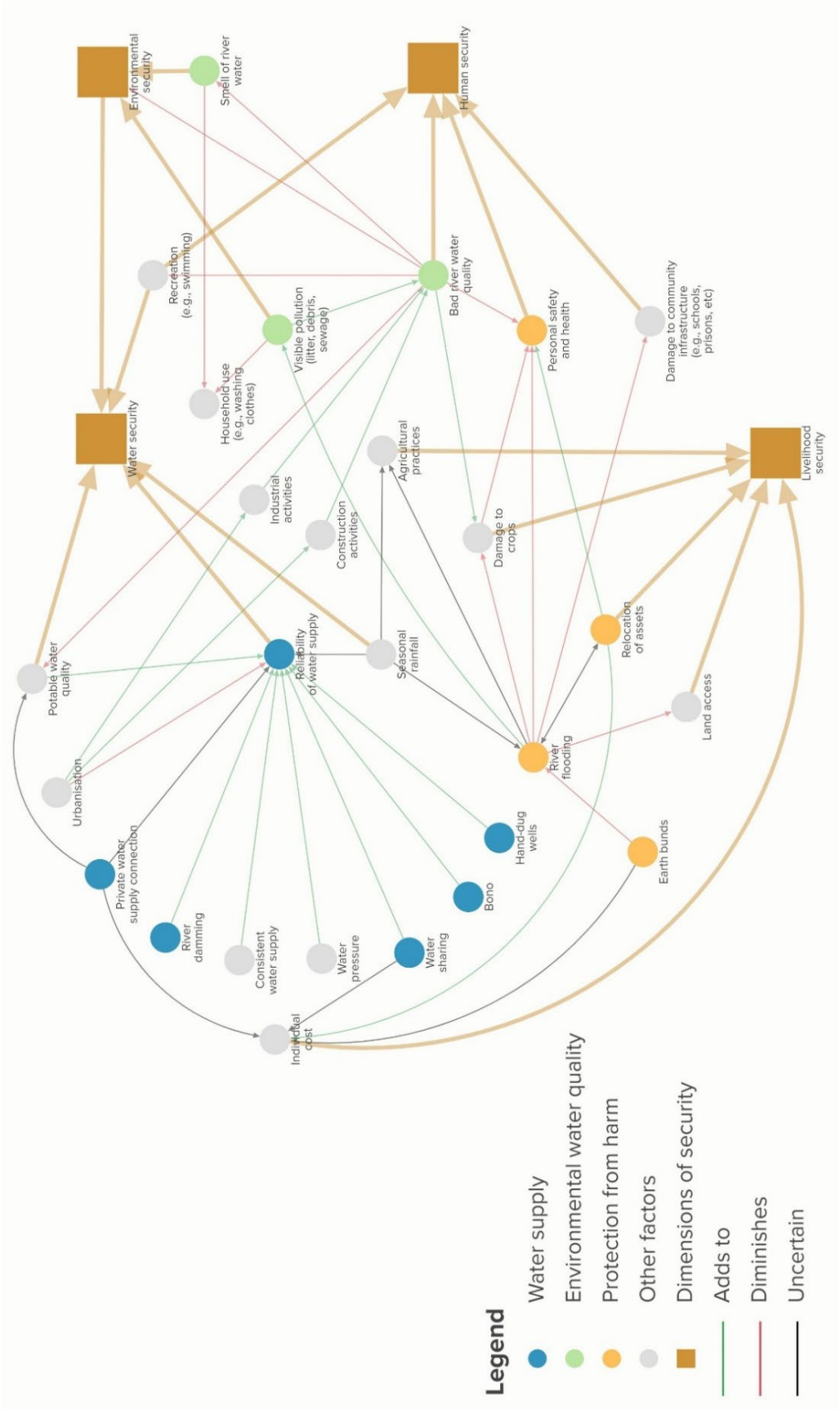


Figure 61. System interpretation of elements and interconnections of upstream water security

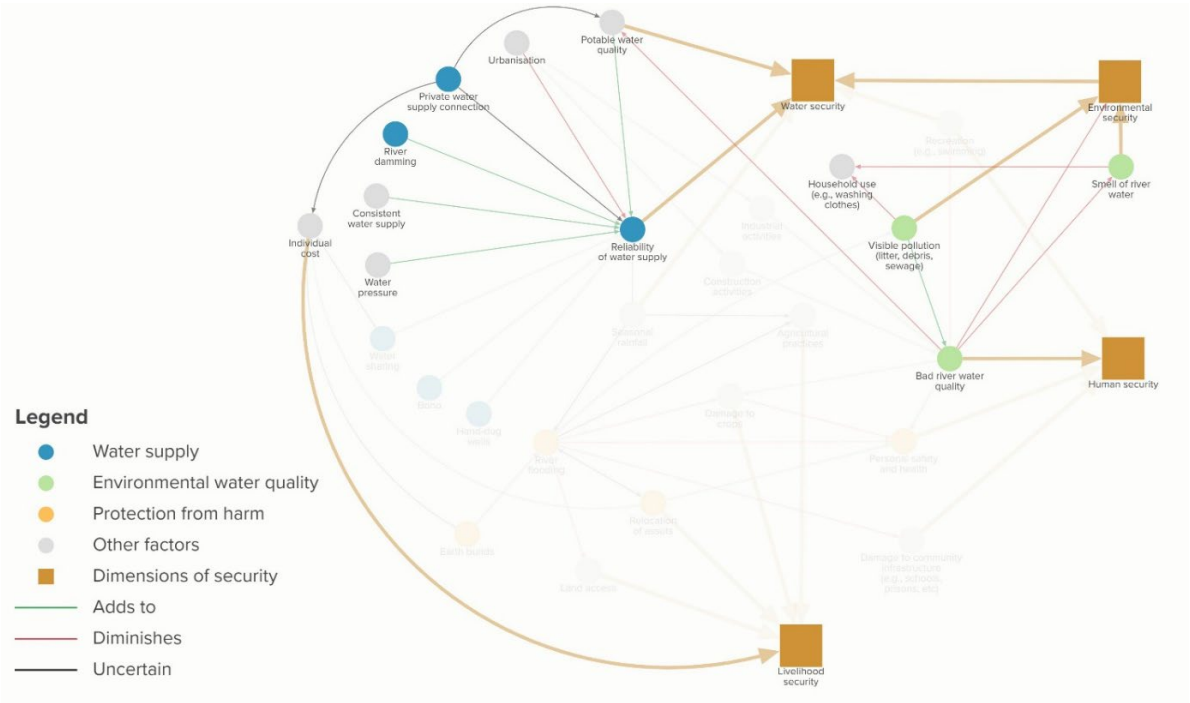


Figure 62. System interpretation of elements and interconnections of downstream water security

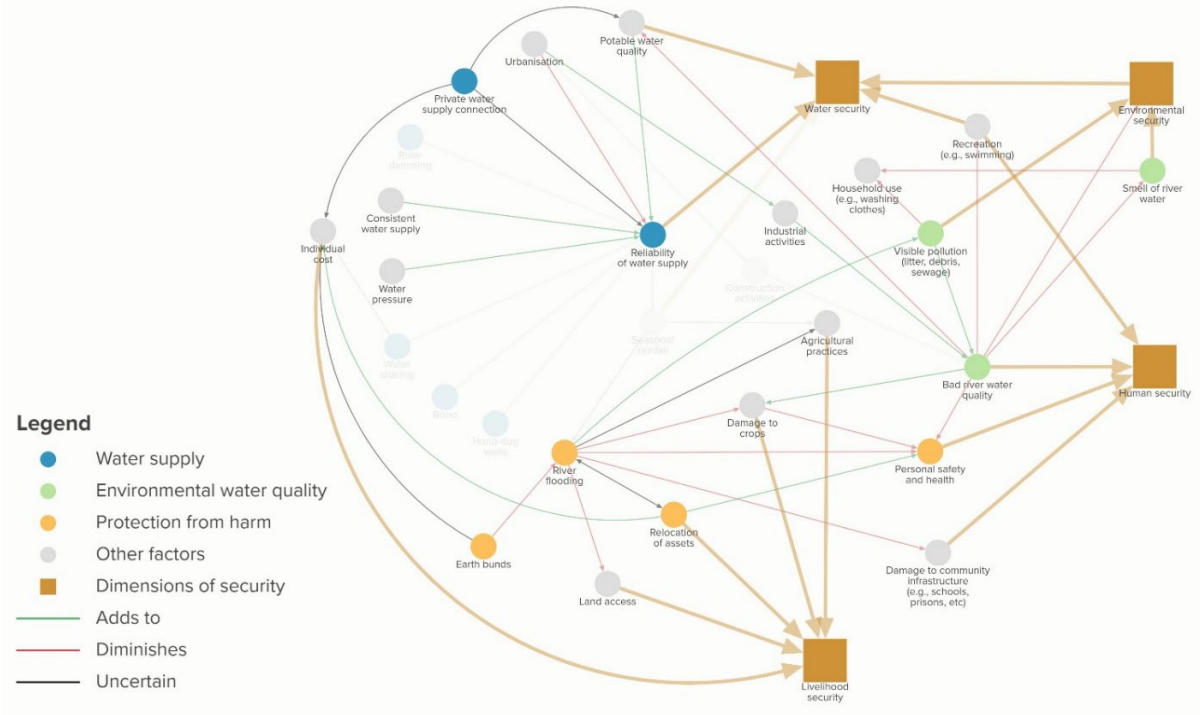


Figure 63. System interpretation of elements and interconnections of urban water security

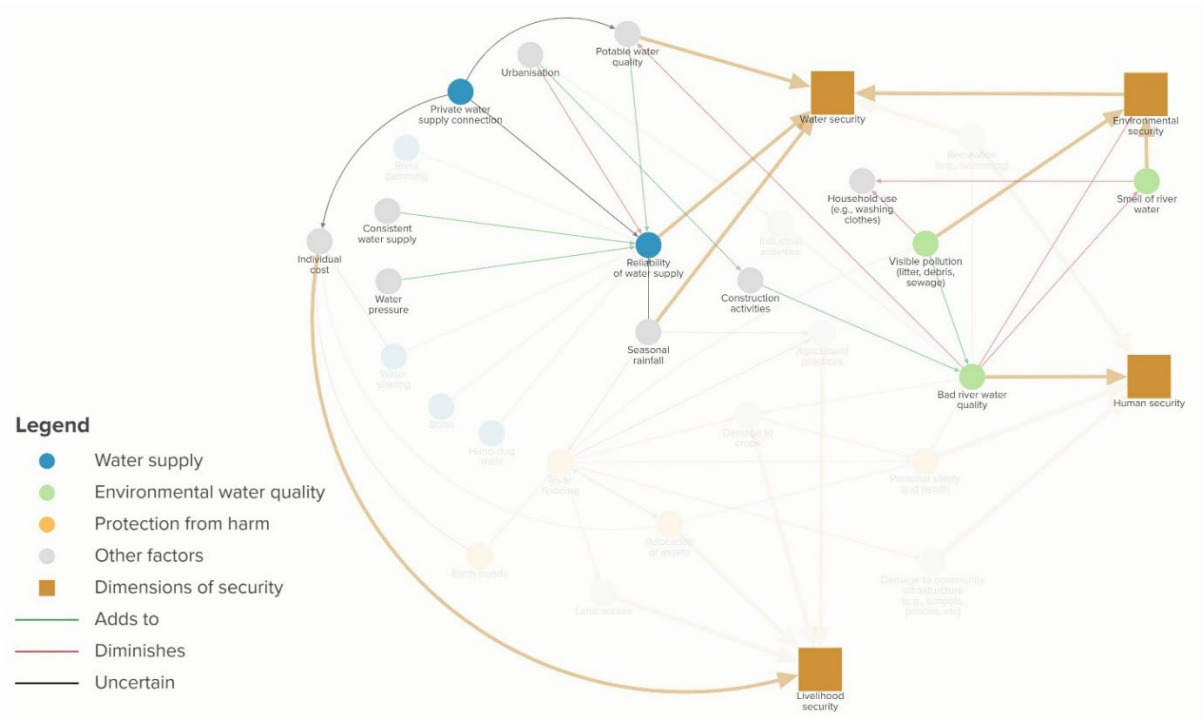
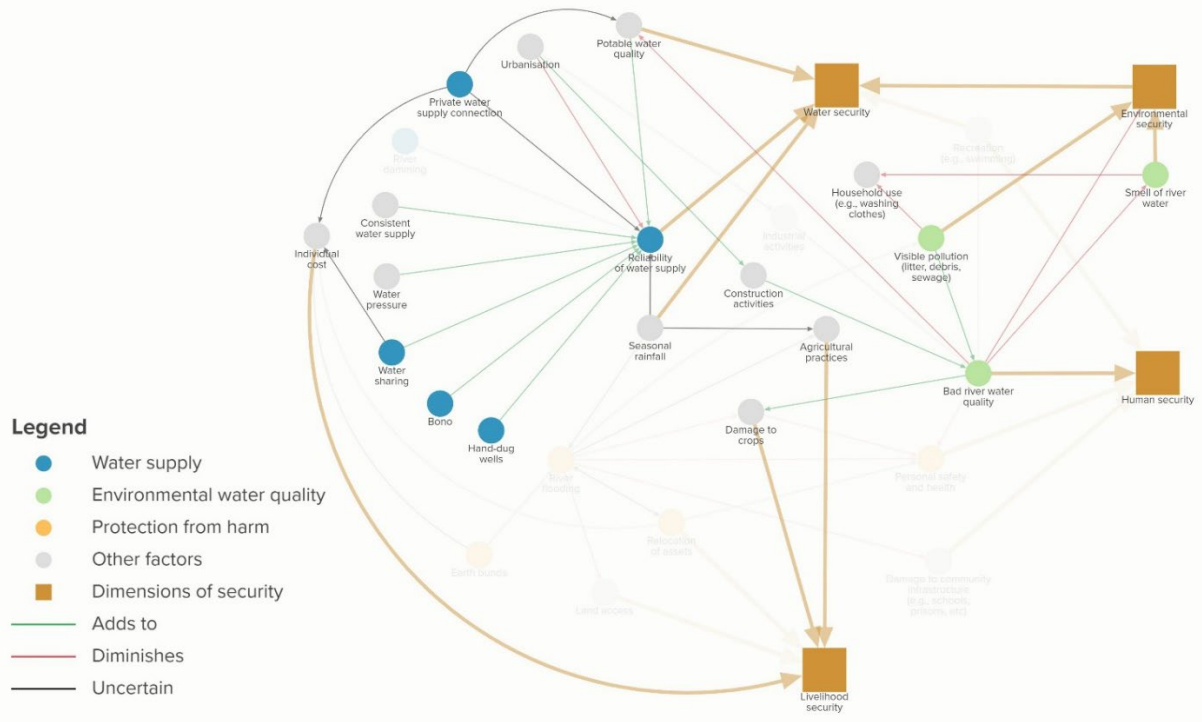


Figure 64. System interpretation of elements and interconnections of peri-urban water security



7.4 Conclusion

This chapter demonstrates that, over the area of Addis Ababa, the diversity in water securities is high. Whilst general themes exist such as piped water supply, water quality, and flooding issues, the difference between priorities significantly varies. It has also been shown that, whilst a baseline for water security appears to be potable water access, the provision of this would not necessarily result in water security. In fact, the interviews particularly demonstrate that water securities are associated with many different types of relationships with water outside of potable water alone. For example, recreational (swimming, playing), occupational, sensory (what the water looks like, smells like), the environment (including impacts of poor water quality as well as land use change), and health and safety (protection from flooding and water quality impacts, and provision of other social services). Furthermore, it has been shown that access to the mechanisms needed for people to improve their water securities is poor, observably a result of disempowerment and exclusion in decision making.

As previously mentioned, it is difficult to generalise water security across Addis Ababa due to the diversity in water securities between individuals. However, it is possible to highlight some key priorities for water securities at the local level using concepts of open systems and boundary judgements. It is believed that these are: (1) potable water securities; (2) environmental water securities; and (3) empowerment to pursue water securities. Potable water securities have been demonstrated to be consistent and equal access to potable water in sufficient quality and quantity. Environmental water securities have been demonstrated to be a sufficient quality of rivers that means that other securities of health, occupation, recreation, and livelihood securities are not impacted. Empowerment to pursue water securities has been demonstrated as a key element of local water insecurity and includes recognition, voice, inclusion in decision-making, and bureaucratic power (e.g., consultation in solutions, power against polluters, ability to identify and report issues to the concerned body).

To conclude, it has been demonstrated that local water security in Addis Ababa is an amalgamation of many water securities based on relationships with water, values of water, and water-related experiences. These largely speak to the dimensions of

water security associated with: water security being defined by physical water insecurity; water security being a social and political practice, process, and value; and Water security being indivisible from human security and justice. To understand the extent to which these local water (in)securities in Addis Ababa are facilitated, the priorities of local water securities must be compared to other water resources management actors.

Chapter 8. Regional water security perspectives and priorities: Addis Ababa Water and Sewerage Authority, Oromia Water Bureau, and other regional actors in Addis Ababa

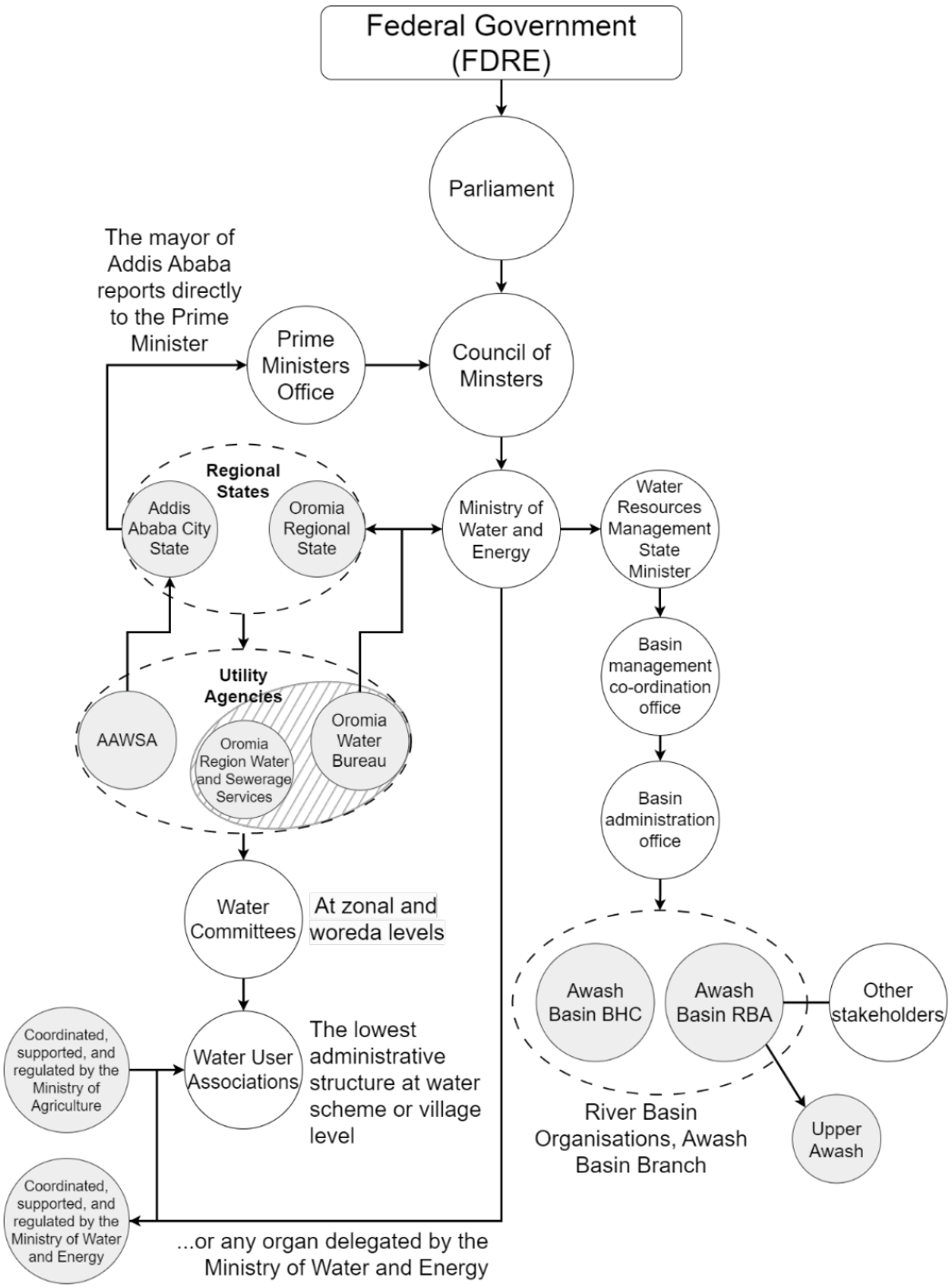
Whilst the Federal Government have the mandate to enact laws regarding the utilisation and conservation of water resources, Regional and City States have the mandate to administer water resources that fall within their regional boundaries in accordance with Federal laws (Proclamation No. 1/1995, Article 52:2d; MoWIE, 2020; Tekle, 2019; Tamrat, 2008). Furthermore, any powers and responsibilities related to water resources management that are not stated in The Constitution of the Federal Democratic Republic of Ethiopia (Proclamation No. 1/1995) are implied to be in the hands of the Regional and City States. Within Regional and City States, powers and duties are further decentralised to respective water bureaus and agencies of Zones, Sub-cities, and Woredas (districts), to enact their mandates (as demonstrated in Figure 65). For these reasons, Regional Water Bureaus and Agencies play a central role in water resources management, being responsible for the planning, study, design, operation and maintenance, and evaluation of rural and urban water supply and sanitation projects in their respective regions (AAWSA, 2016).

Addis Ababa was made a City State under The Constitution of the Federal Democratic Republic of Ethiopia (Proclamation No. 1/1995) (FDRE, 1995) and, as a result, the Addis Ababa City Administration operates in a form of autonomous self-rule where it reports directly to the central government (see Figure 65). The municipal water utility for Addis Ababa is the Addis Ababa Water and Sewerage Authority (AAWSA). AAWSA is institutionally subordinated to the Addis Ababa City Government with the Mayor of the City Government being the Chairman of the board of AAWSA[80]. In the surrounding Oromia Special Zone (OSZ), the Oromia Water and Energy Bureau (OWEB) is the regional water bureau and Potable Water and Sewerage Services operate at a more local level. This chapter investigates water security priorities and perspectives between some of the regional actors that

[80] The board also includes the City Manager of Addis Ababa, representatives from the City Government, other relevant organisations and two representatives of the labour union (AAWSA, 2011).

influence water resources management in and around Addis Ababa, the regional water bureaus and agencies being of particular interest due to their central role in water resources management.

Figure 65. Water resources management structure for Addis Ababa and the surrounding Oromia Special Zone



8.1 The Addis Ababa Water and Sewerage Authority (AAWSA)

The Addis Ababa City Government has the mandate and responsibility to 'identify, determine and organize municipal services[81] to be delivered at the level of the City, Sub-City and Kebele; to provide efficient, effective and equitable services through the use of a variety of service delivery alternatives and the participation of the people and to ensure that a standardized, acceptable system of service delivery is in place' (Proclamation No.361/2003, Article 11:2,f) (FDRE, 2003). The municipal service authority of the Addis Ababa City Government is AAWSA. As part of a decentralisation effort, some of AAWSA's water management activities are further devolved to the eight district branches[82] of Addis Ketema, Akaki Kaliti, Arada, Mekanissa, Megenagna, Gurd Shola, Nefas Silk, and Gulele (Anteneh et al., 2019; Arup, 2021b; AAWSA, 2011). The branch managers of the branch offices are directly accountable to the General Manager of AAWSA and have the responsibilities of distribution and private connections (Arup, 2021b). The eight branches are variable in the number of customers, water supply coverage, and equitable distribution among Woredas (AAWSA, 2016). Additionally, they do not align with the Sub-City administrative boundaries within Addis Ababa and so, in some cases, multiple branches serve the same Sub-City.

8.1.1 AAWSA mandates

The Addis Ababa City Government Proclamation (No.10/1995) gives AAWSA the mandates to supply safe and adequate water and provide wastewater/sludge collection and disposal within the limits of Addis Ababa City (AAWSA, 2011). These mandates fall under three directions within AAWSA's planning, operation, and management activities: Water and Sanitation, Sewerage Disposal Service, and

[81] Under the FDRE Addis Ababa City Government Revised Charter Proclamation No. 361/2003 (FDRE, 2003) a Municipal Service is defined as including a water and sewerage service (Article 2:4).

[82] In AAWSA's Long Term Road Map, there is a suggestion that these would be updated to ten district branches (Addis Ketema, Akaki Kaliti, Arada-Lideta, Kirkos, Kolfe Keraniyo, Megenagna, Gurd Shola, Nefas Silk Latfo, Gulele, and Yeka) to better reflect the ten Sub-Cities within Addis (AAWSA, 2016), but from information on AAWSA's website (e.g., *Contact Us* and *Branches* pages), it does not appear that this has been implemented: https://aawsa.gov.et/?lang=en (Accessed 7th May 2023).

Water Supply and Distribution[83] (Arup, 2021b). Additionally, the Addis Ababa City Government Executive and Municipal Service Organs Re-establishment Proclamation No. 35/2012 (Article 59) defines the specific powers and functions of AAWSA for water supply and sewerage services. Importantly, this includes conducting feasibility studies (for water sources, potable supply, sewerage discharge, and financial viability), construction and maintenance of services, and facilitation of conditions in which the society benefits from these services (The City Government of Addis Ababa, 2012). Additionally, AAWSA's activities are largely influenced by the national water policy that 'provides a number of directives that affect urban water utilities among which full cost recovery and autonomous decentralized management are the most essential ones' (AAWSA, 2011).

8.1.2 AAWSA plans

As part of AAWSA's mandate to prepare and submit short-, medium-, and long-term water supply and sewerage improvement plans (Proclamation No. 35/2012, Article 59:2), the 2011-2020 Business Plan and the 2016 Long Term Road Map are recent documents that lay out current priorities for AAWSA.

The 2011-2020 AAWSA Business Plan lists universal water supply coverage and 50% sewerage coverage for Addis Ababa by 2020 as two of its main goals (AAWSA, 2011). These are in line with its mandates, powers, and functions. The third goal of AAWSA, however, is to position the utility towards a 'more business orientated company' (AAWSA, 2011). In this sense, the ability of AAWSA to function as a business whilst improving water security in Addis Ababa is a considerable dimension of its priorities. This can be demonstrated by the focus on reducing non-revenue water (NRW) in the business plan, planning for this to be reduced from ~40% to 25% by 2020 (AAWSA, 2011), as well as plans to improve organisation, capacity, and financial independence as a business[84]. Ultimately, the 2011-2020 Business Plan demonstrates how AAWSA will need to provide more services to meet the urban and

[83] Only Water and Sanitation is involved in new installations, the other two directions deal with the management and monitoring of existing infrastructure (Arup, 2021b).

[84] Part of which is through collecting water tariffs for water and wastewater services. These are suggested to be based on a progressive yearly-increasing model and a band-system services (AAWSA, 2011).

population expansion of Addis Ababa and, therefore, also meet domestic and non-domestic water demands and waste products.

AAWSA's 2016 Long Term Road Map (LTRM) aims to address 'the long-term supply and demand analysis and mismatch in the sector' and 'to propose strategic solutions that will meet the long-term increasing demands of potable water supply and sanitation coverage of the City' (AAWSA, 2016). Based on the 2011 Business Plan's main goals of universal water supply coverage and 50% sewerage coverage in Addis by 2020 (AAWSA, 2011), the LTRM already demonstrates difficulties in reaching these targets; in 2016 there was a water supply coverage of 76.6%, NRW was estimated at 30.6%, and sewerage coverage was estimated at 12.46% (AAWSA, 2016). Furthermore, as part of the LTRM's analysis, it details 'problems and bottlenecks' in both water supply and wastewater services, all of which are largely based on issues with infrastructure. 'Structural bottlenecks' do, however, list more institutional and organisational issues such as: lack of participation and co-ordination amongst stakeholders; inadequate delegation of authority and responsibility; and issues with technology and equipment (AAWSA, 2016). Importantly, the LTRM recognises that, whilst a large amount of AAWSA's goals and objectives hinge on infrastructural interventions, there is a need to address more broader institutional issues:

> *'Water supply and sewerage problems are just an engineering constraint but also reflect more a socio-cultural situation that requires transformation and reform in community, employees, leaders, and stakeholders behavior and attitudes towards water supply and sanitation services.'*
>
> Quote from AAWSA's 2016 Long Term Road Map (AAWSA, 2016)

It is also worth mentioning the 2017-2027 Addis Ababa City Structure Plan (henceforth referred to as the 'City Plan'). Whilst this is not a utility plan, AAWSA recognises the detailed strategic plans of the City of Addis Ababa as intertwined with its own service planning (AAWSA, 2011). For example, the City Plan includes environment actions that would fall under AAWSA's mandate, such as: effective, efficient, and sustainable waste management services (Goal 1); clean water and air

(Goal 2); and surface water development and wastewater treatment plant expansion (listed in the environment strategic plan) (ACCPPO, 2017).

The City Plan emphasises how the water and wastewater services of Addis Ababa are key elements of the economic development of the city – and country – in terms of growth in industry, productivity, housing, and tourism. The City Plan states that 'the state of service delivery in Addis Ababa is unsatisfactory' and that 'the provision of infrastructure (water, electric power, and ICT) is not on par with an African or national capital' these are deemed to have been a detrimental to Addis Ababa's development; new (local and foreign) investment opportunities, a liveable environment, good standard housing[85], business operations, productivity, are all mentioned to have been hindered by the inadequacy of service infrastructure in both volume and quality (ACCPPO, 2017). As well as water and wastewater services, the City Plan also places high emphasis on the water pollution issues within Addis Ababa. Pollution of surface and ground water resources from industrial and domestic wastewater discharges are said to pose 'health threats to residents as well as to those residing in downstream locations'. As a result, protection of surface and ground water resources are 'given emphasis' in the city plan.

8.1.3 AAWSA key issues

Over the past ten years, AAWSA's top water management issues have consistently been organisational structure, weak stakeholder involvement, the widening gap between supply and demand (as a result of multiple factors), and incomplete coverage of potable water distribution and sewerage in Addis Ababa (AAWSA, 2016, 2011). Similarly, solutions appear to be consistent in that supply development plans are based on: Legedadi treatment plant expansion and ground water development; developing and increasing surface water (from the prospective Gerbi and Sibilu Dams); NRW reduction[86]; operation improvement; and organisational development (such as increased decentralised responsibilities, creation of long-term strategic

[85] The City Plan states that, in 2007, 40% of available housing units were considered unfit for living and of substandard quality where one factor is the lack of related services such as water, sewerage and drainage systems, among others.
[86] NRW was stated to account for a loss of around 35-40% in 2011 where 'the daily volume of water loss in the system amounts to more than three times the production capacity of Gefersa treatment plant' and around 30% in 2016 (AAWSA, 2011, 2016).

directions, private sector involvement, and better handling of ‘large’ customers) (AAWSA, 2011).

An additional key issue also appears to be funding and finance. Although it also appears that there is a clear interest from the Federal Government in developing the water supply and sanitation services of Addis Ababa. This means that there is ‘priority support from the city administration and the Federal Government’ and ‘favourable government and Addis Ababa City Administration policies, strategies, proclamations, regulations for water resource and sewerage system development’ (AAWSA, 2016). At a more local level, AAWSA has become one of Addis Ababa City Administration’s highest budget consumers, taking around 12% of the city’s total budget in 2021 (Arup, 2021b).

Alongside these issues specific to AAWSA, other broader issues for the regional water governance in Addis Ababa are largely similar to those at Federal level (discussed in Chapter 9), namely ineffective decentralisation, lack of enforcement, and overlap of mandates. As pointed out in AAWSA’s Long-Term Road Map, despite the Government’s policy to decentralise political power to lower-level organs, AAWSA struggles to delegate ‘full authority, accountability and responsibility to branch offices’ (AAWSA, 2016).

8.2 Exploring AAWSA's water security system perspective

AAWSA's mandates and plans give some insight to the water security perspectives and priorities of the utility. To explore these further – as well as how these interact and interconnect – a series of workshops were conducted with AAWSA (the workshop structure and proceedings can be found in Appendix E). The workshops included a total of eight participants from different departments and seniorities in AAWSA including: wastewater collection and treatment, water distribution, groundwater, non-revenue water, planning, water quality, and sewerage networks. The workshop was conducted over two days, with the first day focusing on exploring water security and open systems and the second day focused on exploring boundaries.

8.2.1 The open system

The first workshop looked to explore the problem perception of water security for AAWSA. This was done both individually and as a group activity. Before the workshop began, participants were asked to fill out an open-ended questionnaire[87] based on their individual perspectives and priorities for water security. As well as information about their specific role in AAWSA, participants were also asked:

- What do you understand is included by the term 'water security'?
- What do you think is the most urgent issue (or issues) for water challenges in Addis Ababa?
- How do you think water issues in Addis Ababa are linked to issues beyond the city boundaries?

Responses to these questions demonstrated common themes of water security, such as: protection of water resources from 'contamination' and over abstraction; sustainable usage of water; and the development and 'securing' of water sources. Notably, all responses were based on water supply. In terms of the most urgent issues for water challenges in Addis Ababa, NRW was the most frequently mentioned main concern. After this, the mismatch between demand and supply

[87] Two additional AAWSA responses were collected outside of the workshop (see Section 8.4) making ten AAWSA questionnaire respondents. The answers to these questions were coded in NVivo qualitative computer software to organise and thematically code the responses. All questionnaire responses are available in Appendix E.

(sometimes linked to the urbanisation of Addis Ababa) and general scarcity/shortage of water in the city were the main concerns. Lastly, all responses recognised that, with Addis Ababa's water resources being outside of the city boundaries, cooperation and integration with the surrounding area is required. A few responses also demonstrated the concept of a wider socio-political influence outside of Addis' boundaries, pointing to the role of policy and actors such as the Ministry of Water and Energy (MoWE).

Individuals were then asked to write down Addis Ababa's water problems and rank them[88] based on their perspective. These were then brought into a group setting to share, discuss, and collaboratively allocate into broad themes (re-ranking if decided as a group). Group 1's broad themes consisted of resource institutional management, distribution system, and water source. Group 2's broad themes consisted of resource, policy, social issues, technology, environment, and coordination. The water problems listed and ranked under each of these for each group are demonstrated in Table 15 and Table 16. An immediate observation was that water problems were much more focused on social and institutional factors than in AAWSA's Business and LTRM Plans. In this exercise, many issues invoked discussions around wider institutional factors such as internal organisation, management, and capacity of AAWSA with some internal confusion of the responsibilities of different departments (see Appendix E).

The groups were then briefed on the concept of water security, introducing concepts of intersectionality (with other securities) and social scales. Groups were then asked to expand on each broad theme from the previous exercise based on impacts, causes, components, and connections between these, creating a causal loop diagram (CLD). Group 1 developed three CLDs (Figure 66) based on the three central issues of water governance, demand and supply gap, and the water distribution system, respectively. Group 2, on the other hand, developed a single CLD (Figure 67) based on the central problem of the demand and supply gap. The first part of this workshop concluded with an overarching CLD (Figure 68), being a combination of both groups CLDs.

[88] Based on a traffic light system of: red – the issue is severe/urgent/deadly; yellow – the issue is persistent and can vary in severity; green – the issue is inconvenient but not dangerous.

Table 15. Group 1 - ranking of water problems for Addis Ababa

(ranked based on a traffic light system of: red – the issue is severe/urgent/deadly; yellow – the issue is persistent and can vary in severity; green – the issue is inconvenient but not dangerous)

Group 1		
Resource institutional management	**Distribution system**	**Water source**
Lack of stakeholder collaboration	NRW	Unbalance of supply and demand
Management skills	Water distribution problem	Lack of catchment protection
Day to day operation technology	Distribution system	Urbanization
Collaboration with stakeholders	Poor water distribution system	Deterioration of surface and ground water
Water governance issue	Electric power fluctuation	Water source limitations
Lack of in integration in Oromia zone	Water quality problem (contamination)	Lack of alternative resource supply
	Non replacement of aged pipeline	Flooding problem
		Flooding problem
		Buffer zone protection
		Domestic water for construction and farming
		Deforestation
		Land-use change
		Urbanization
		Dry abstraction wells

Table 16. Group 2 - ranking of water problems for Addis Ababa

(ranked based on a traffic light system of: red – the issue is severe/urgent/deadly; yellow – the issue is persistent and can vary in severity; green – the issue is inconvenient but not dangerous)

Group 2					
Resource	**Policy**	**Social Issue**	**Technology**	**Environmental**	**Coordination**
Inflation	Population Growth	Knowledge about water sources	Management of water resource infrastructure	Flooding problem	Working with stakeholders
Budget Limitation	Industrial-isation	Absence of clear information	Water distribution problem	Catchment management problem	Working with other utilities
Human Limitation	Water supply project supply methods	Community damage to water supply	Non-revenue water (NRW)	Buffer zone protection	
Water Source Limitation	Management instability/high turnover	Customer knowledge	Efficiency	Deforestation	
Low tariff	Institutional efficiency problem			Land-use change	
Electric power interruption	Policy problems for developing water resources			Urbanization	
Electric power interruption				Deterioration of surface and ground water yield	
Demand and supply gap					
LC (USAID currency)					

Figure 66. AAWSA Group 1 causal loop diagrams for water security in Addis Ababa

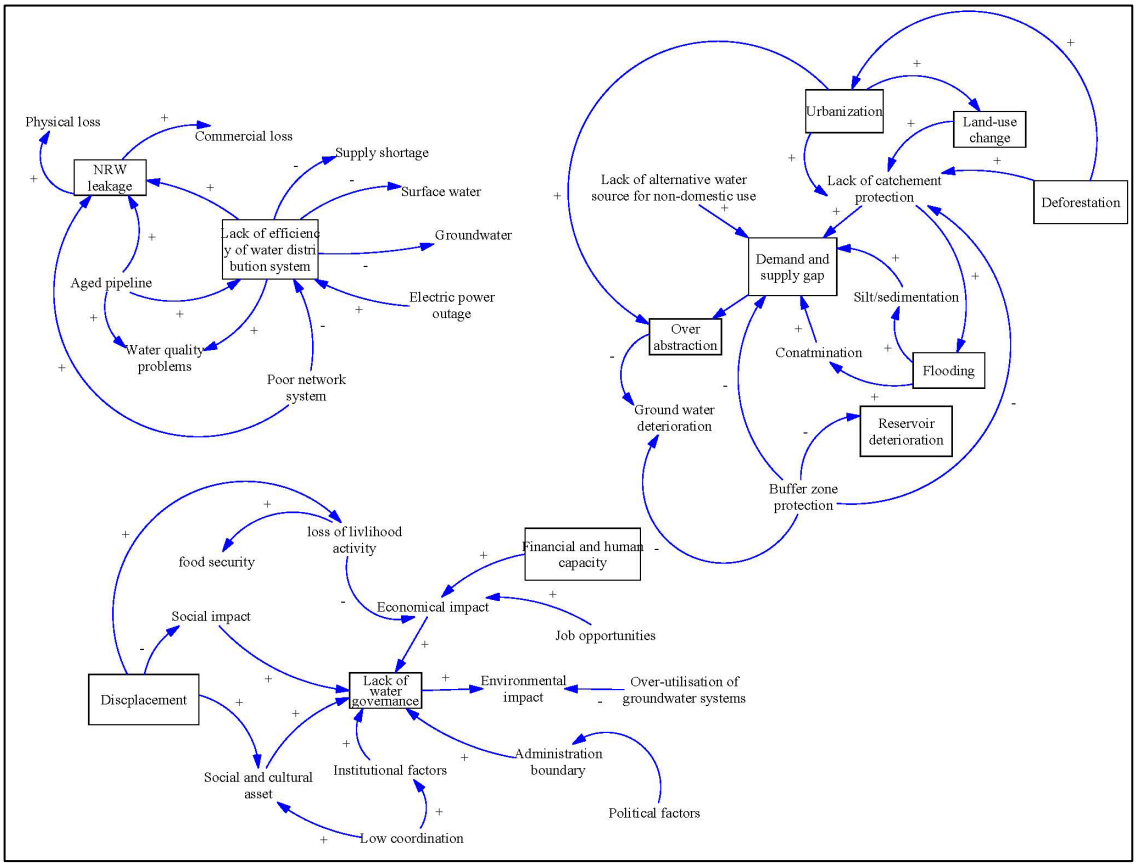


Figure 67. AAWSA Group 2 causal loop diagram for water security in Addis Ababa

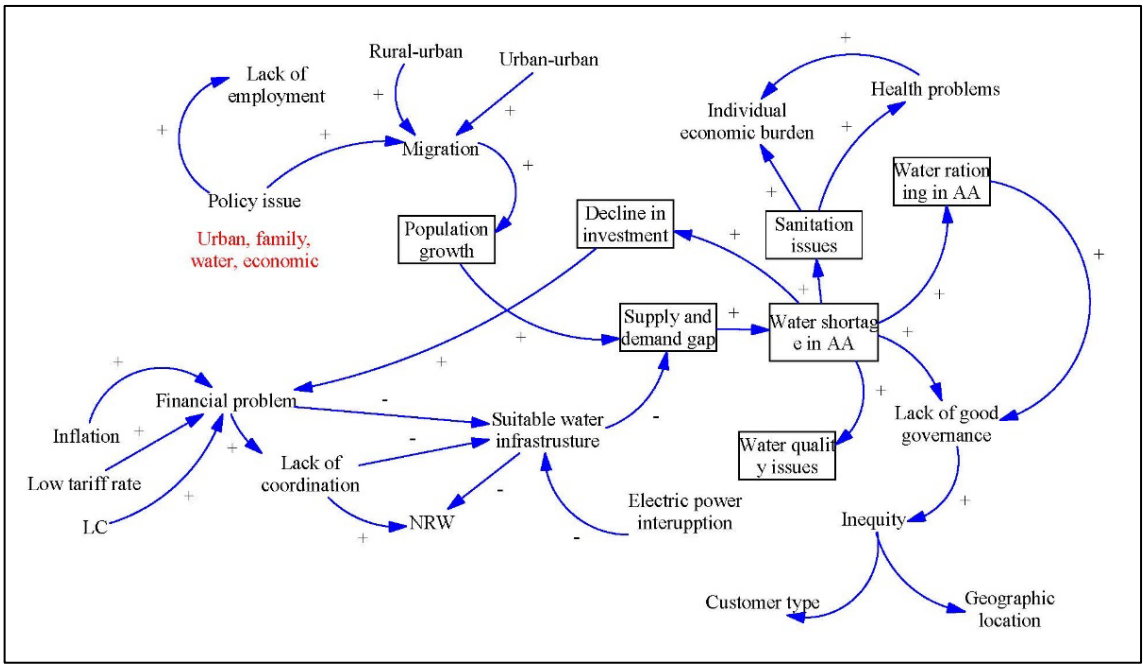
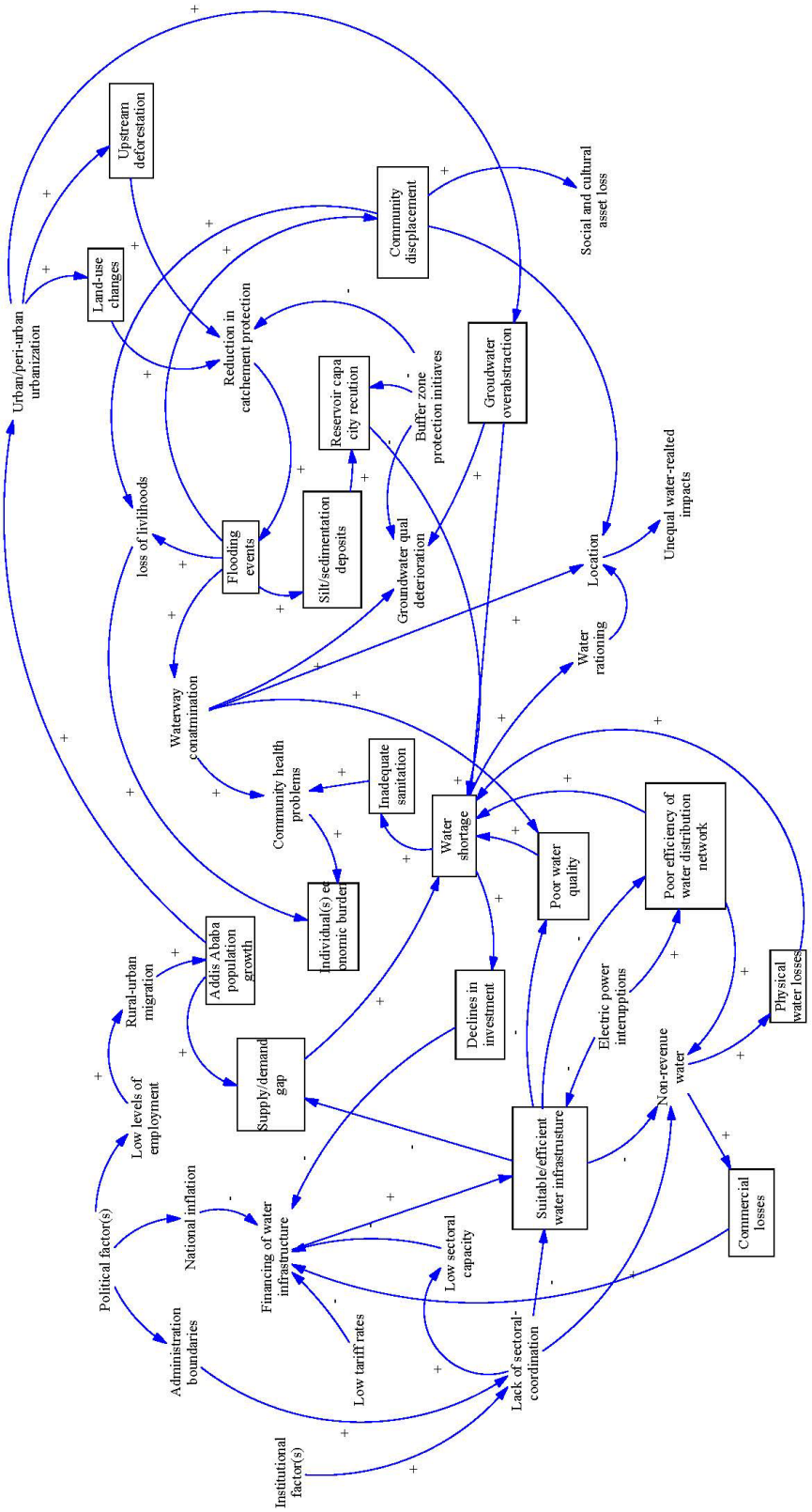


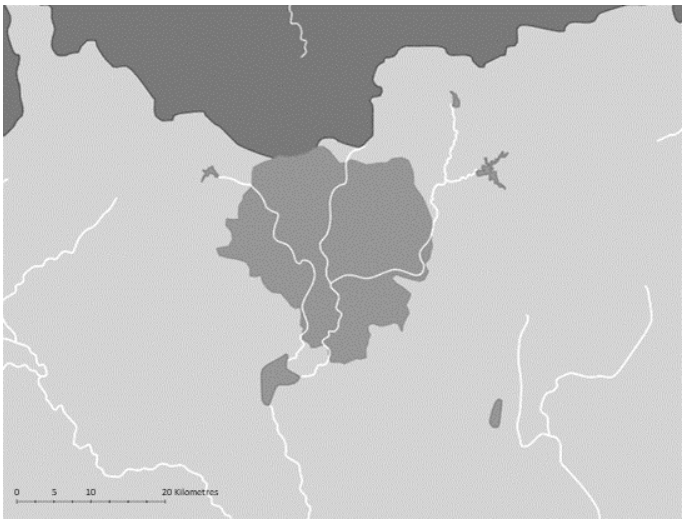
Figure 68. Combined AAWSA casual loop diagram



8.2.2 System boundaries

The second workshop sought to explore ideas of boundaries. Beginning with an exploration of ‘individual’ boundaries followed by group boundaries (based in the groups from the first workshop). Individuals were given a map of Addis Ababa, and its main rivers and reservoirs in the surrounding area (Figure 69) and invited to draw on their boundaries, prompted with: ‘What is your work boundary? Your responsibilities based on mandates, working areas, influence, decision making, infrastructure, people you work with…’. In general, those working in water supply mapped larger boundary areas than those in wastewater services; the boundary of supply extending to surface and ground water resources outside of Addis Ababa. One participant, from the planning and budgeting department, didn’t draw a specific boundary as ‘water and sanitation service of the authority [AAWSA] is a national issue’ and ‘we work with international organisations’ so ‘the boundary may not be limited to the city’. All of the individual boundary diagrams and descriptions can be found in Appendix E.

Figure 69. Map of Addis Ababa and surrounding area given to participants



After exploring individual boundaries, groups then worked together to explore the locations and boundaries of where water issues play out across areas in and around Addis Ababa. For this, various maps were provided (Figure 70-73) to encourage different scales of boundary thinking. Prompts were also given to encourage more interconnected thinking and exploration of social and physical boundaries:

- Where are many causes creating multiple water problems?

- Where do different environments or themes of water problems overlap (physical and decision-making environments i.e., institutional mandates)?
- Where and how do stakeholders interact with common water problems?
- How are boundaries determined – how and by whom?
- Where are multiple scales linked by a water problem?

Figure 70 (left) and Figure 71 (right). Maps for exploring boundaries as a group showing Addis Ababa and supply reservoirs (Figure 70) and the Upper Awash basin (Figure 71).

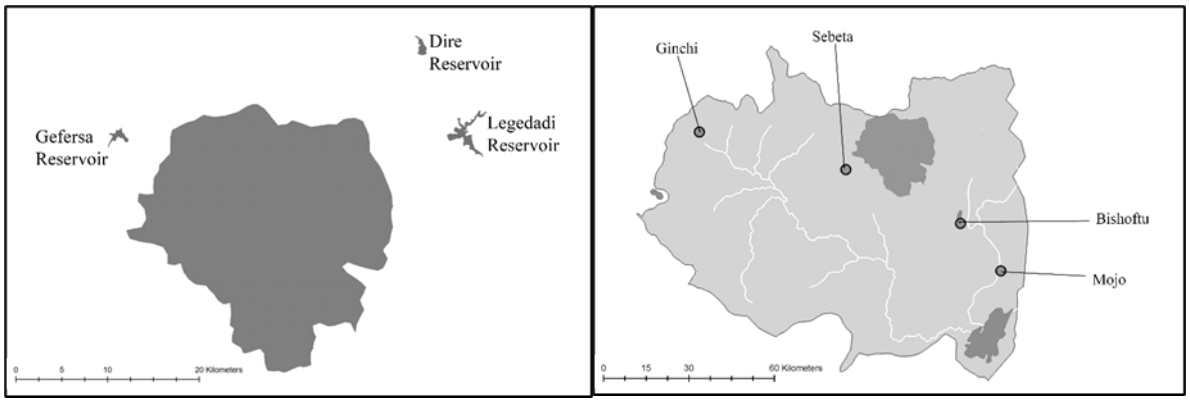
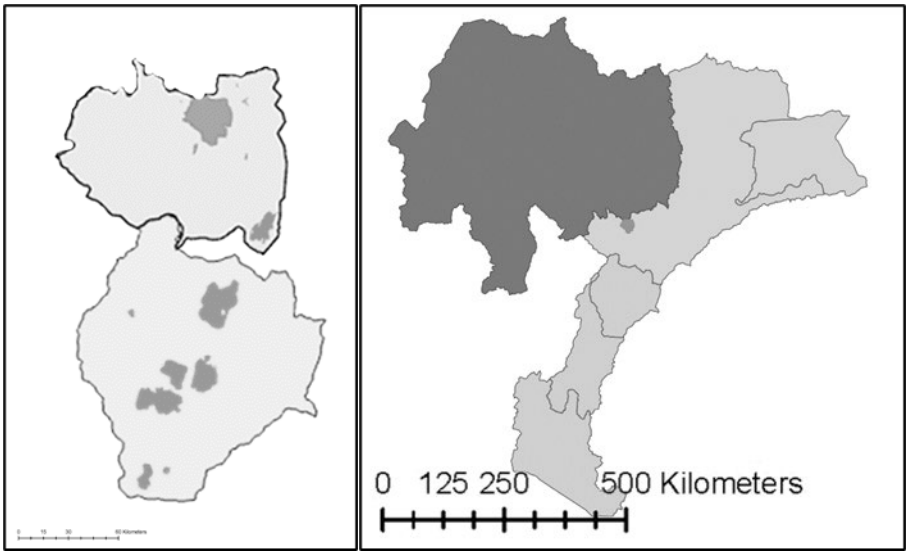


Figure 72 (left) and Figure 73 (right). Maps for exploring boundaries as a group showing The Upper Awash and Central Rift Valley Basins (Figure 72) and the three neighbouring basins of the Abbay, Awash, and Rift Valley (Figure 73).



Group 1 mainly focused on Addis Ababa as a boundary of discussion. Talking points included: absence of Integrated Water Resource Management (IWRM) planning (all agreed that this is the biggest central problem); absence of bulk water supply for Addis Ababa and the surrounding OSZ; and the capacity gap between planning and implementation. In terms of the boundary of Addis Ababa (and of AAWSA),

discussions were had about the building of non-water infrastructure in OSZ for communities (e.g., schools/clinics/etc) and the provision of water to these (e.g., around Gerbi). Ultimately, the group saw the hydrological zone as AWWSA's boundary of service, but this was mentioned as being in contrast with the government that uses geographic/political boundaries. Group 1 drew a general boundary around the OSZ (Figure 74), and within Addis Ababa is written 'population growth' and 'migration'.

For Group 2, however, the idea of boundary setting was discussed as being a very complex process. It became easier for the group to think of 'hotspot areas' where multiple and severe problems were overlapping rather than plotting several issues at the same time in different areas – this prompted more discussion on causes rather than the emergent problems themselves. For example, inside Addis Ababa, the east and west peripheries had a boundary of commonality, being the areas with the largest demand/supply gap and also hotspots for non-connected households (e.g., Koyefetche and Ayat Arafsa) (shown in Figure 77). In terms of water quality, old and central parts of city (e.g., Gulele) were highlighted as having both high population density and old pipe infrastructure, making them share a commonality boundary of poor water quality.

Similarly to Group 1, the provision of infrastructure and water supply in OSZ was discussed. Particularly noting that this made the periphery of Addis Ababa a 'fuzzy' boundary as AAWSA are involved with service provision in OSZ very regularly (in all directions from Addis Ababa administration boundary). Related to this were discussions around industrialisation in the corridor from Addis Ababa, to Bishoftu, to Mojo, to Adama, to Awash, and to Koka dam (shown in Figure 78). The increasing industrial zones in this corridor were discussed as another stress on water outside Addis Ababa by contributing to aquifer competition for groundwater with AAWSA. Additionally, in some instances contributing to wastewater disposal and placing pressure on wastewater treatment works, which were originally only designed for domestic waste.

It was also observed that, early on in this workshop, discussion was very much limited to bounds of AAWSA's geographical unit in Addis Ababa, but by the end this was effectively global; other large-scale processes being discussed in relation to

boundaries. For example, migration to the city at different time scales. This was noted to impact population settlement/growth distribution at the peripheries – a boundary where challenges exist for AAWSA to supply water. Another external boundary discussed was power supply. It was noted that origins for power supply for pumping are far from Addis Ababa – as far as Lake Tana in the Abbay basin – stretching the influence boundaries of AAWSA (shown in Figure 79). The implication of this extended boundary for power supply was speculated as being a contributing factor to power interruptions. With the power interruptions having the greatest impact on wellfield abstraction which affects the majority of all Addis Ababa's water supply. Lastly, there was a brief discussion on budget, which again stretched the boundary of discussion to more national and international processes.

Figure 74. Addis Ababa and AAWSA system boundaries, Group 1.

Within Addis Ababa is written ‘population growth’ and ‘migration’. The numbered descriptions are: (1) Overlap between water sources and Oromia development corridor - degradation, deforestation, agricultural expansion, industrialisation, urbanisation; (2) Boundary - hydraulic zone, jurisdiction boundary; (3) A board decides what infrastructure to build where - established by AAWSA and Finfine Zuria OSZ three years ago, provide infrastructure facilities to communities in Finfine Zuria OSZ (school, health post, water supply, veterinary clinic etc.); (4) (Infrastructure coordination) Yemeseret Limat Kinjit Director - supports institutions such as Tele, AAWSA, Roads Authority etc. to have a joint planning - but implementation is weak due to ignorance; (5) discharge of untreated waste; (6) (*) Groundwater: (*) Creates conflict/competition of interest.

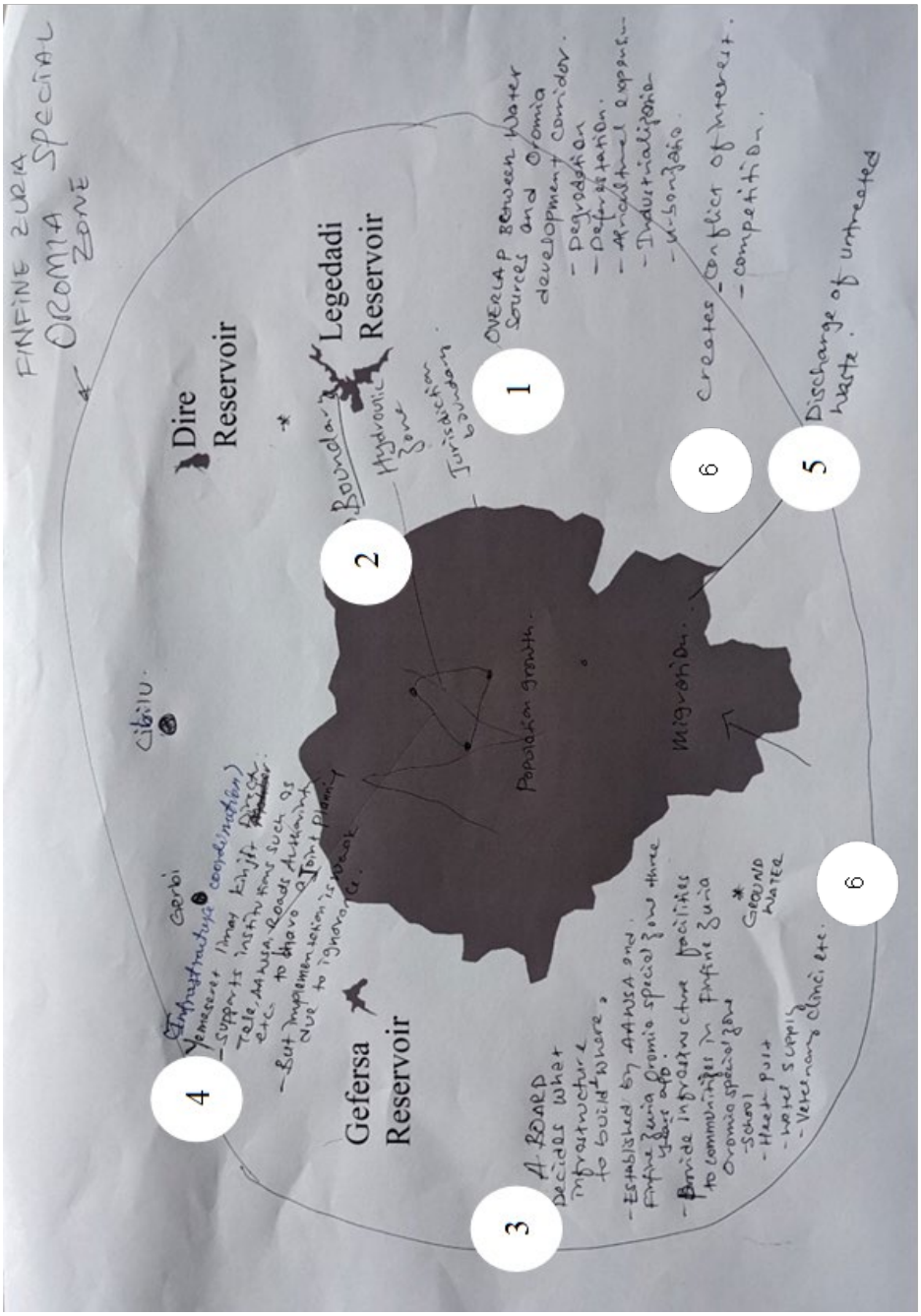


Figure 75. Upper Awash basin and AAWSA system boundaries, Group 1

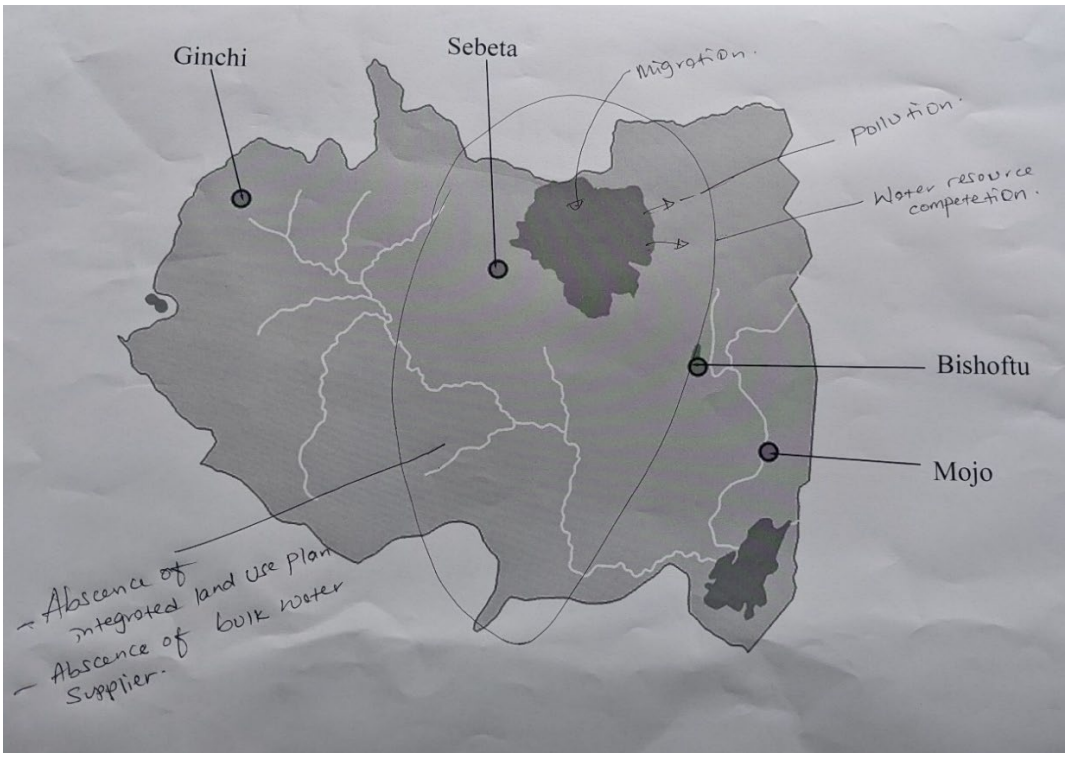


Figure 76. Abbay, Awash, and Rift Valley basins and AAWSA system boundaries, Group 1

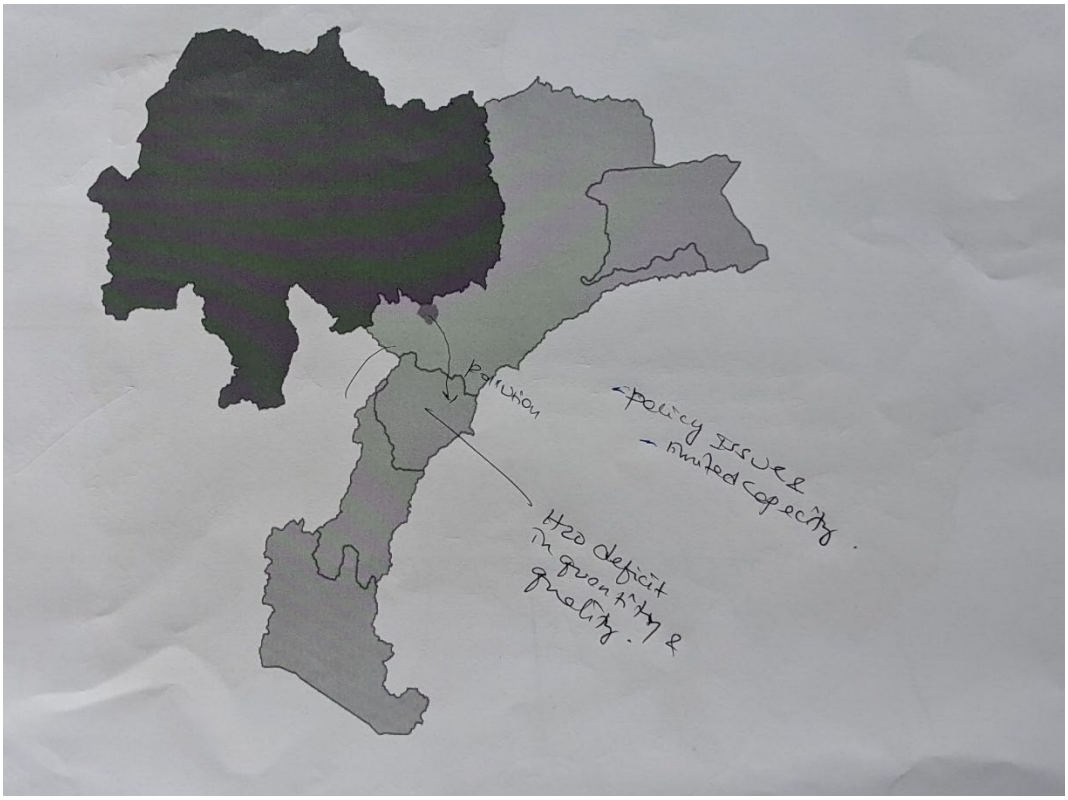


Figure 77. Addis Ababa and AAWSA system boundaries, Group 2

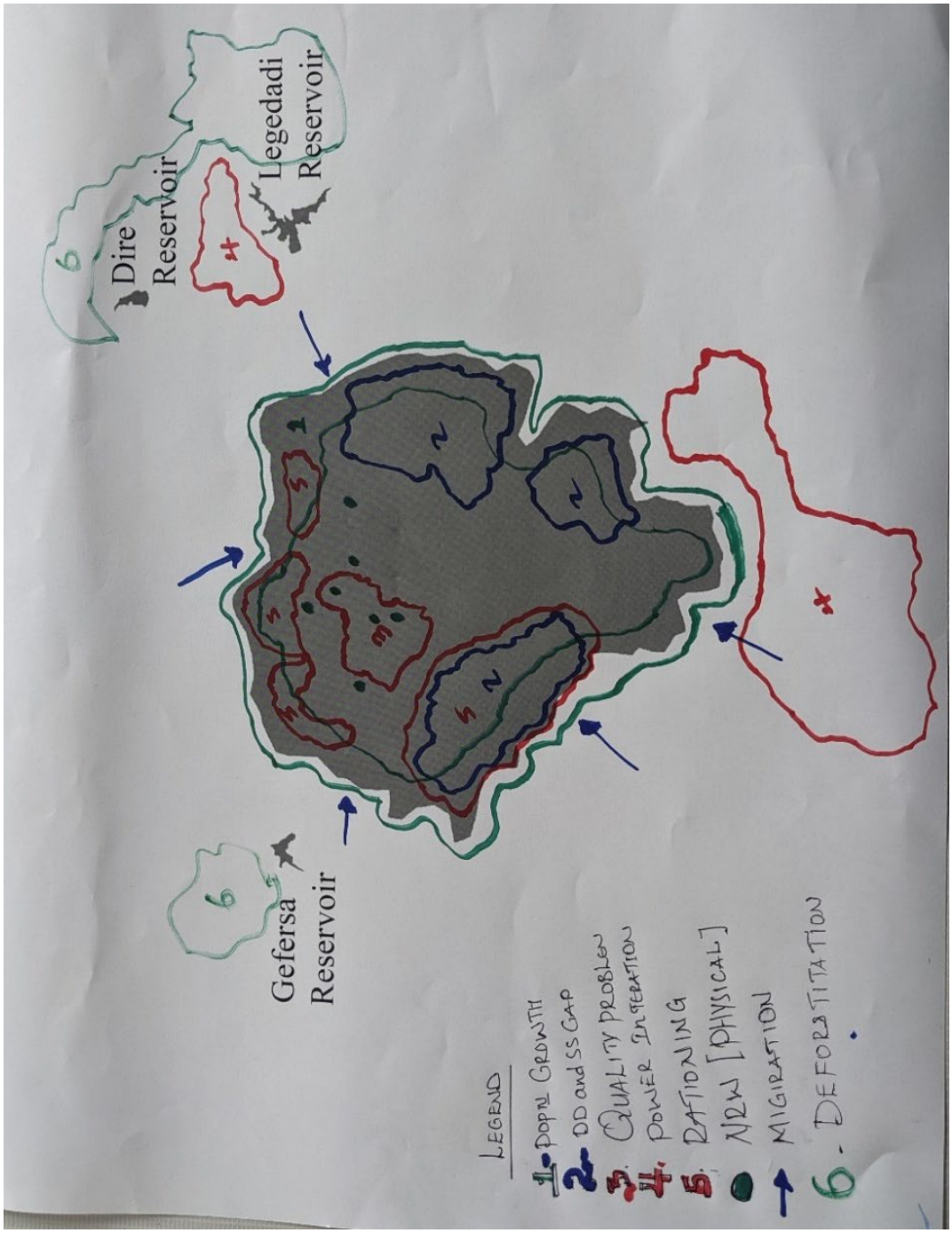


Figure 78. The Upper Awash basin and AAWSA system boundaries, Group 2

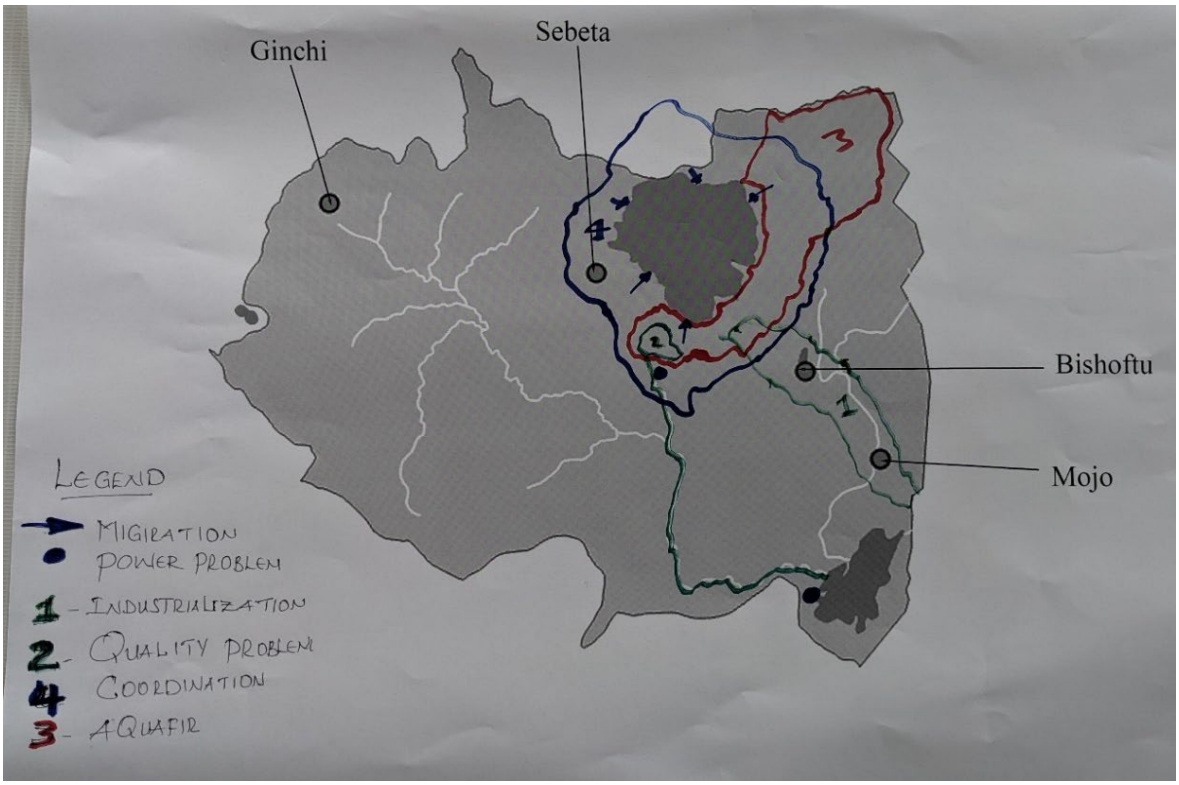
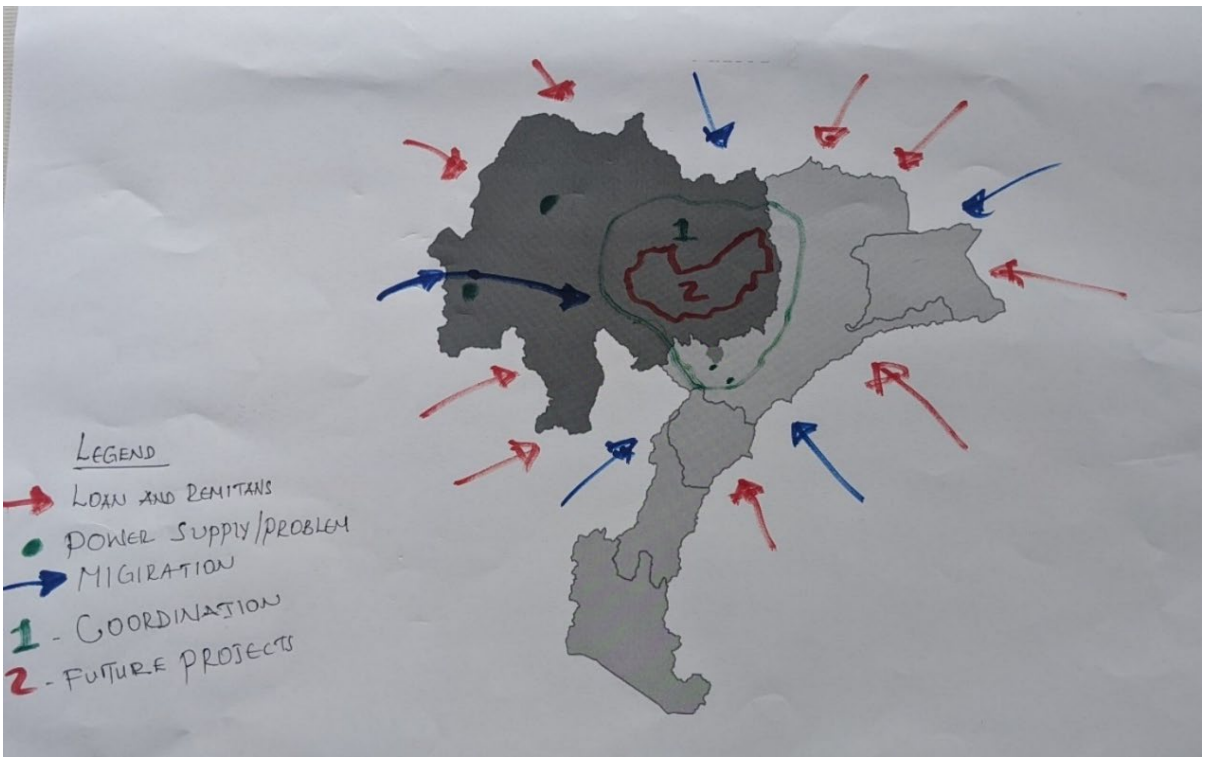


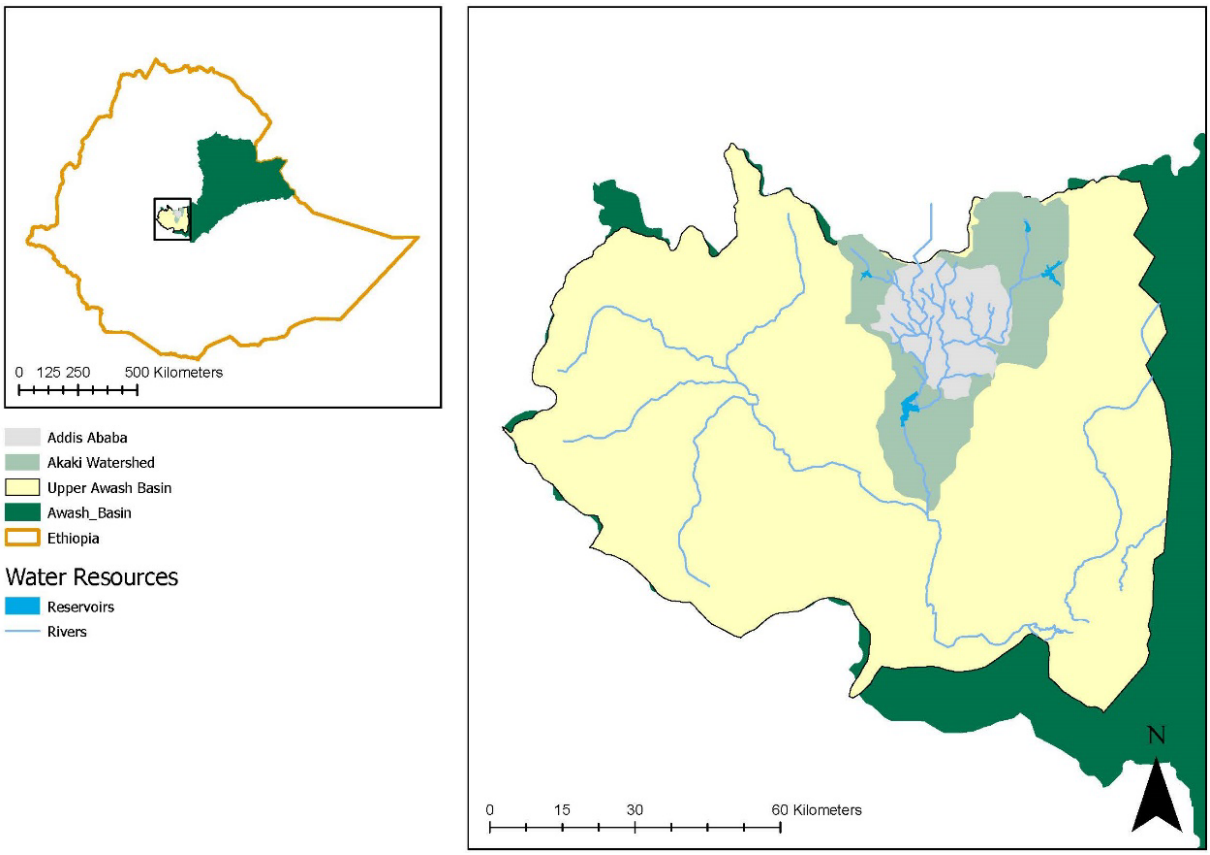
Figure 79. Abbay, Awash, and Rift Valley basins and AAWSA system boundaries, Group 2



8.3 The Oromia Water and Energy Bureau (OWEB)

The Oromia Regional State is a key stakeholder in Addis Ababa's water security development. According to AAWSA, the Oromia Regional State 'has stake in regional environmental safety, provision of water supply to surrounding cities, and irrigation efforts' (AAWSA, 2011) and 'the role and responsibility of the Oromia regional state in the development of infrastructure and service provision by AAWSA is very high and vital' (AAWSA, 2016). For the Oromia Regional State, the OSZ and the wider Akaki Catchment (in which Addis Ababa lies – see Figure 80) are significant socioeconomic spaces; whilst the Akaki catchment is the smallest catchment in Oromia Regional State (at only 0.5% of the area), it holds a significant geopolitical space in water resources development due to its high production of revenue, high growth of investment, and proximity to Addis Ababa (OPEDC, 2016).

Figure 80. Addis Ababa, the Akaki watershed, the Upper Awash Basin, and the Awash Basin



8.3.1 OWEB mandates

The Oromia Water and Energy Bureau (OWEB) is mandated by Oromia Regional State to 'ensure the population of the region has access to a sustainable, safe water

supply, to develop mineral resources of the region upon logical and strategic procedures' (OWERDB, 2021) and has the power to develop, manage, control, administer the resources (including Water Resources) of the regional government in order to cause social, economic, political changes within the region (OWEB, 2022).

The mandates of the OWEB[89] are comparable with AAWSA's in that both organisations are executive bodies of their respective regional states. Due to the size of Oromia Regional State (around 320,000 km^2 (City Population, 2022), Addis Ababa is around 540km^2 (Abdissa & Degefa, 2011; Worku, 2017) for comparison), the OWEB is composed of 20 Zonal structures, 300 rural Woreda structures, and 103 water supply and sanitation utilities that represent towns (OWERDB, 2021), these all adopt OWEB's mandates. OWEB's mandates are similar to AAWSA's in the study/research of water resources, the construction and maintenance of services, and involvement of the public.

Under the Oromia Region Potable Water and Sewage Services (OWSS) Proclamation No. 288/2020 (Caffee of Oromia National Regional State, 2020), there are also local water and sewerage organisations[90] with their own mandates for Kebele-level water service provision. In the opening statements of the OWSS Proclamation, it makes clear that it is the Oromia government's duty to supply clean and adequate potable water and sewage disposal services as part of implementing fundamental human rights. Additionally, this section states that it is 'essential to establish a modernized and efficient potable water and sewage services provision system' and 'provide the potable water and sewage services fairly and sustainably' through responsible, self-sufficient structures and organisational set ups. Building on these opening statements, the OWSS Proclamation defines six objectives based around: improvement and development of potable water supply and sewerage services, protection against pollution of water sources, and the financial independence of related water supply and sewerage delivery bodies at various levels (Article 5). The powers and duties given to local water and sewerage organisations to

[89] See OWERDB (2021) that translates the OWEB mandates from Proclamation No. 213/2011 E.C.

[90] "Organization" meaning organisations established to provide potable water and sewage services for the public in the urban or rural of multiple kebeles (Article 2:8)

achieve these objectives are stated in Article 8 and are focused on infrastructure provision and development for water services.

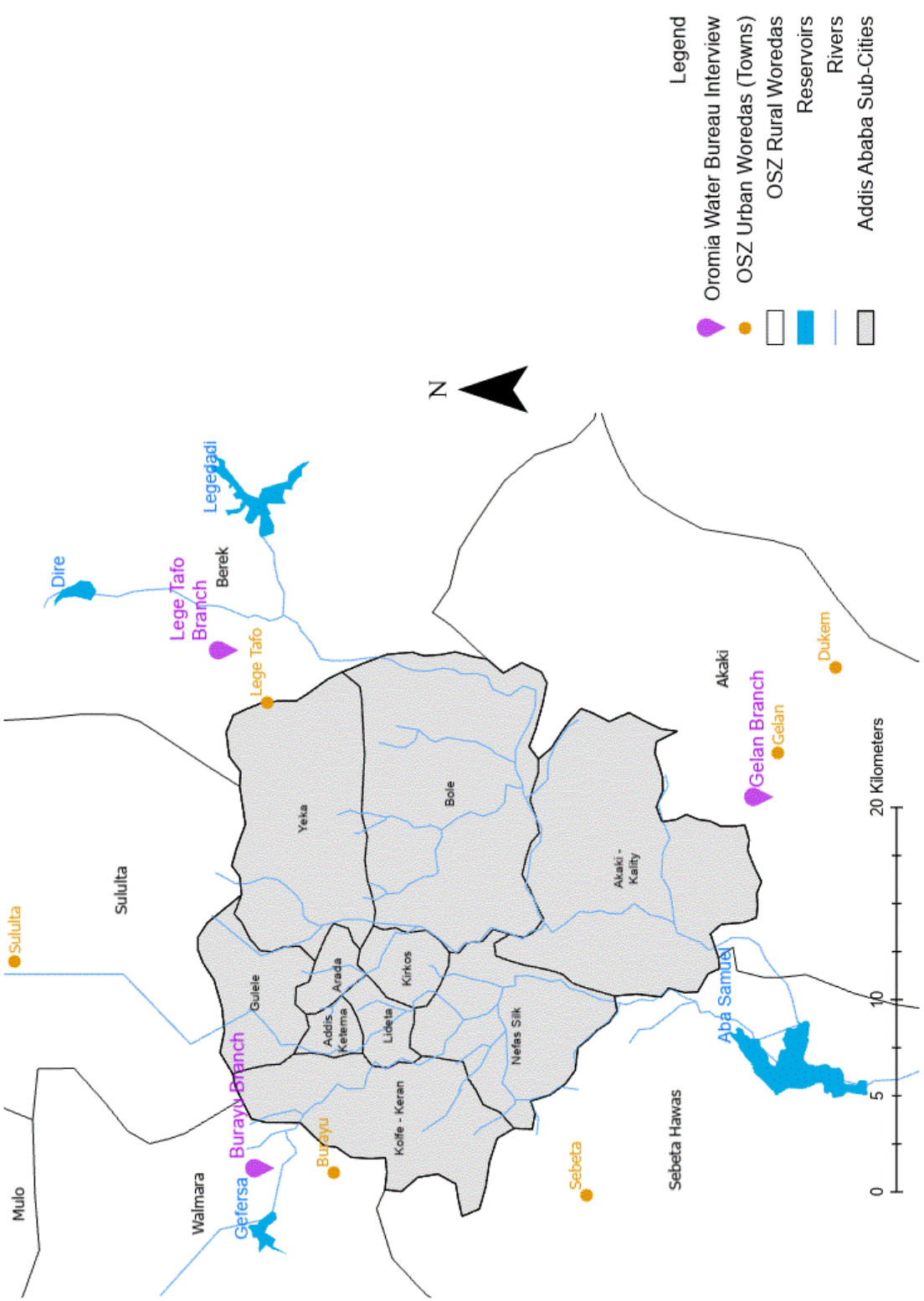
Interestingly, Part Eight of the OWSS Proclamation is specifically concerned with the 'Protection and Nurturing or Water Source and **Securing the Resource'**. This section contains statements around: protection of potable water (Article 50); 'nurturing', maintaining, and controlling water sources and their surrounding environments (Article 51); development and safeguarding of water resources (Article 52); permitted uses for 'pure potable water service' (Article 53 and 54); and sewage disposal (Article 55).

8.3.2 Exploring OWEB's water security systems perspective in the OSZ

As demonstrated in Figure 65, the OWEB is different to AAWSA in that it reports to both Oromia Regional State and MoWE i.e., there is not a direct channel to the Prime Minister's office. This means that districts (and some towns) have their own water bureaus which then report back to the OWEB for the region of Oromia. In the legal establishment of the OSZ in 2000, the OSZ is defined by six rural Woredas – Welmera, Sebeta Hawas, Akaki, Sululta, Mulo, Berek – and eight urban Woredas – Dukem, Lege-Tafo Lege-Dadi, Sendafa-Beke, Sululta, Holota, Burayu, Sebeta, and Gelan (OPEDC, 2016, 2021a) each with their own water bureau. Three key informant (KI) interviews were conducted with OWEB managers in the urban OSZ Woredas of Lege-Tafo Lege-Dadi, Burayu, and Gelan (as shown in Figure 81)[91]. As well as beginning with the same open-ended questionnaire as AAWSA and other stakeholders (Section 8.2 and 7.4), interviewees were encouraged to discuss water problems, impacts and causes, and stakeholders and boundaries in the interview as well as their OWEB role and local knowledge of water issues. Figures 82-85 provide an interpretation of these discussions and questionnaire responses as water security systems, similarly to Figures 66-68.

[91] Full transcripts of these can be found in Appendix F.

Figure 81. Locations of Key Informant Interviews with the Oromia Water and Energy Bureau (OWEB)



Before the semi-structured interview began, KIs were asked to fill out an open-ended questionnaire[92] based on their individual perspectives and priorities for water security. As well as information about their specific role in OWEB, participants were also asked:

- What do you understand is included by the term ‘water security’?
- What do you think is the most urgent issues (or issues) for water challenges locally and nationally?
- How do you think water issues in are linked to issues beyond basin or regional boundaries?

Common themes of water security amongst OWEB responses were (clean) water availability, with additional mentions of drinking water, water for livestock, and water for industry. In terms of urgent local water challenges, water quality was consistent amongst respondents. Migration from Addis was mentioned by one KI as an urgent challenge and by another as a water issue beyond the basin/regional boundary. Two KIs additionally mentioned ‘the city’ – Addis Ababa – in discussing water issues outside of the region; water being for ‘the city's pleasure (benefit)’ and there being a ‘lack of coordination’ with Addis Ababa.

KIs were then encouraged to discuss water problems, impacts and causes, and stakeholders and boundaries in a semi-structured interview format. The three OWEB key informants (hereby referred to as KI1 for Lege-Tafo Lege-Dadi, KI2 for Burayu, and KI3 for Gelan) discussed similar issues to AAWSA (those in Table 15 and Table 16), such as water supply, wider technology, and organisational capacity – these came across as consistent important dimensions of pursuing water security amongst KIs. The main concern, however, amongst KIs was over abstraction, accessibility, and availability of groundwater. Specifically, the drying up of wells – leading to having to drill more wells – was mentioned by all three KIs. The decline of groundwater availability was linked to Addis Ababa’s well-fields in the OSZ by KI1; ‘Addis Ababa city water has many wells in this area. And because of uses this, it causes the other water sources to dry up… when Addis Ababa took water from here and the source dried up… Addis Ababa uses up to one hundred litres per second. Thus, there is a

[92] The answers to the open-ended questionnaire questions were coded in NVivo qualitative computer software to organise and thematically code the responses. All questionnaire responses and interview transcripts are available in Appendix E.

very intensive exploitation of water use. This type of water exploitation may one day dry it up' (KI1). There was no mention of surface water resources amongst any KIs. Water quality was often mentioned as the 'second' concern or priority after water supply or availability, as demonstrated by the quotes below. Specific concerns around lack of a testing and monitoring system for water supply were raised, as well as river pollution, issues with waste collection, and industry presence.

> *'… the problem of water: one is scarcity. It is second, quality. The third is accessibility.'*
>
> Key informant 1, OWEB (Lege-Tafo Lege-Dadi)

> *'Our first priority in Burayu City is water supply. The second is to keep the water clean.'*
>
> Key informant 2, OWEB (Burayu)

Aside from these more physical aspects of water security (i.e., dimensions concerned with the physical availability and state of water), all interviewees mentioned aspects of governance, technology, and capacity as key determinants of good water resources management and therefore improved water security. As with AAWSA, all KIs recognised the need for more comprehensive policy and better policy implementation. KI1 believed that the 'policy problem' lies in the inequity of water supply and distribution but also government policy implementation; 'I think there is also a policy problem. For example, when one entity [region] benefits [from water services], it should also benefit the community of that area… First government is responsible [for water problems]. Therefore, the issue of water should be managed through policy. Government bodies must implement what is in the policy'. The idea of inequity between regional benefits associated with water services is also mentioned by KI3 who states that there should be a policy that ensures 'that the areas that are sources of water resources have access to water first'. The idea of government responsibility is also repeated by KI2 who holds the government to account for the worsening water issues; '…the government must also fulfil its responsibilities'.

For local-level governance, KI2 described the way local governance and communication support the exchanging of water-related information between the Burayu OWEB and the local community (see quote below). This description

demonstrates effective channels of communication, participation, and action between the local community and the Water Bureau. This is different from the perspectives and experiences of KI1 and KI3; KI1 alluded to a lack of awareness and participation from the 'society' and whilst KI3 also described working closely with the City Mayor, they suggest that society does not currently work together 'for the common benefit of water development'.

> *'The problem first comes from village, Kebele. We have regular meetings not only on water issues but also on other issues. We will also talk about water there. When there are various problems related to water and other issues, the city mayor's office gathers the people and discusses them every Wednesday. Incidentally, the mayor of the city is also the chairman of the Water Development Board. Any problem of the society will be presented and discussed. When there is a problem with water, the community gives information by calling or directly in person; and also asks a question. Another, we open a Telegram group on social media and connect with certain people who will give us information if there are problems with water. This is how we access and exchange information.'*

Key informant 2, OWEB (Burayu)

At a more general governance level, there seems to be a disparity – even in the close proximity of these three OSZ water bureaus – in the use of frameworks and guidelines in providing water services. Both KI1 and KI3 said that they did not use guidelines or frameworks to support their work, whilst KI2 suggested a more organised system (specifically for water quality testing):

> ***'Interviewer:** Are there any different guidelines and frameworks that you use in the work you do on water supply, quality and safety?*
>
> ***Interviewee:** We don't use anything. We just give it [water] away.'*

Discussion with Key informant 1, OWEB (Lege-Tafo Lege-Dadi)

> *'In the Oromia region, the work structure of the water service has brought the framework down. What used to be done in the past is being guided by a framework. With this, a higher body will come and*

take a laboratory sample to confirm the quality of the water. A work structure has been organized to monitor the quality of water regularly.'

Key informant 2, OWEB (Burayu)

***'Interviewer:** In the city of Gelan, do you have a work framework that allows you to facilitate your work on the work you do or the water work?*

***Interviewee:** Not even that much... We are working with various governmental and non-governmental stakeholders to solve our problems.'*

Discussion with Key informant 3, OWEB (Gelan)

The last consistent themes amongst OWEB key informants were technology and capacity, both being interlinked and specifically connected to the ability to provide water services. The continuation of activities to provide water services, whilst not being supported by science and technology, was mentioned to be hindering the efforts to supply potable water in terms of infrastructure coverage and maintenance, water quality testing, and network operation and monitoring. Capacity, in terms of expertise and human resources, was also mentioned as lacking and therefore impacting the delivery and maintenance of water supply infrastructure.

Figure 82. System interpretation of elements and interconnections from key informant interviews with the Oromia Water Bureau

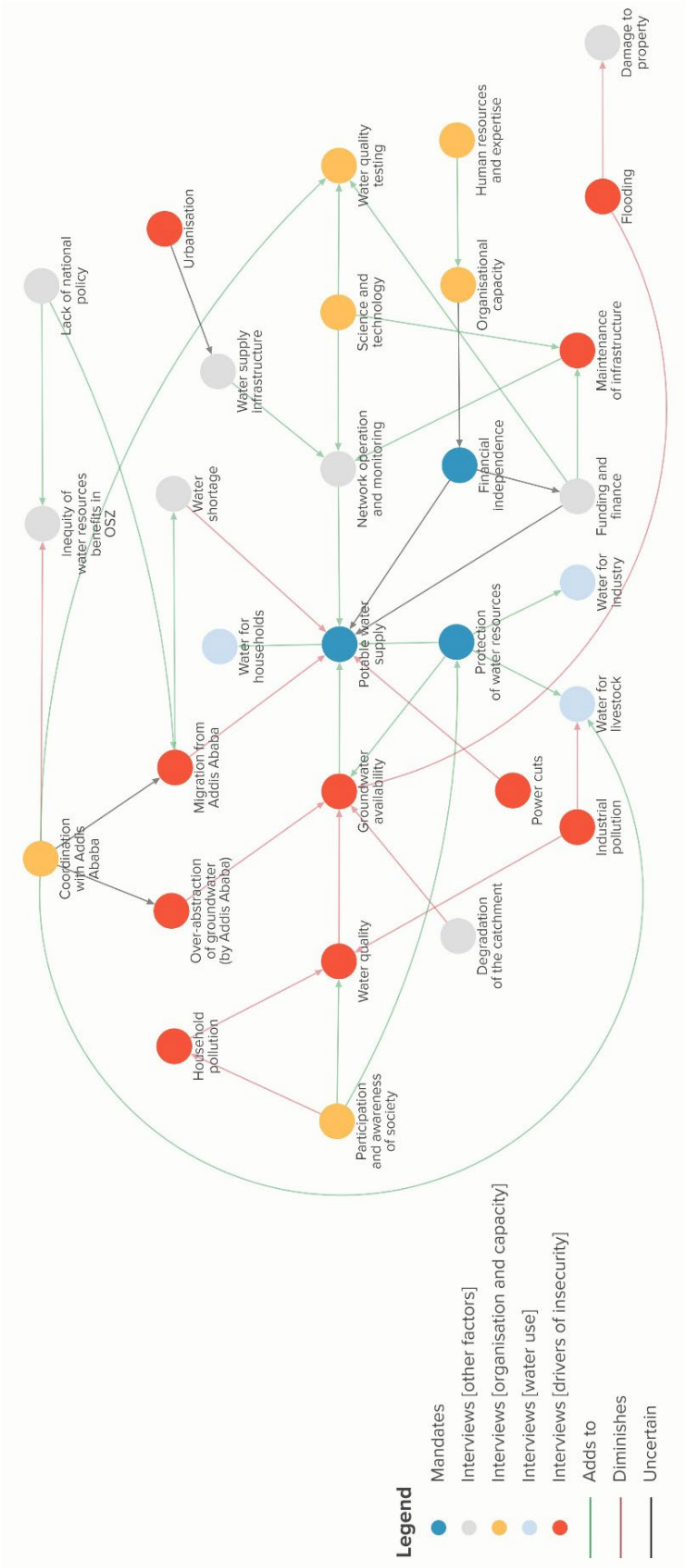


Figure 83. System interpretation of elements and interconnections of Legetafo-Legedadi key informant

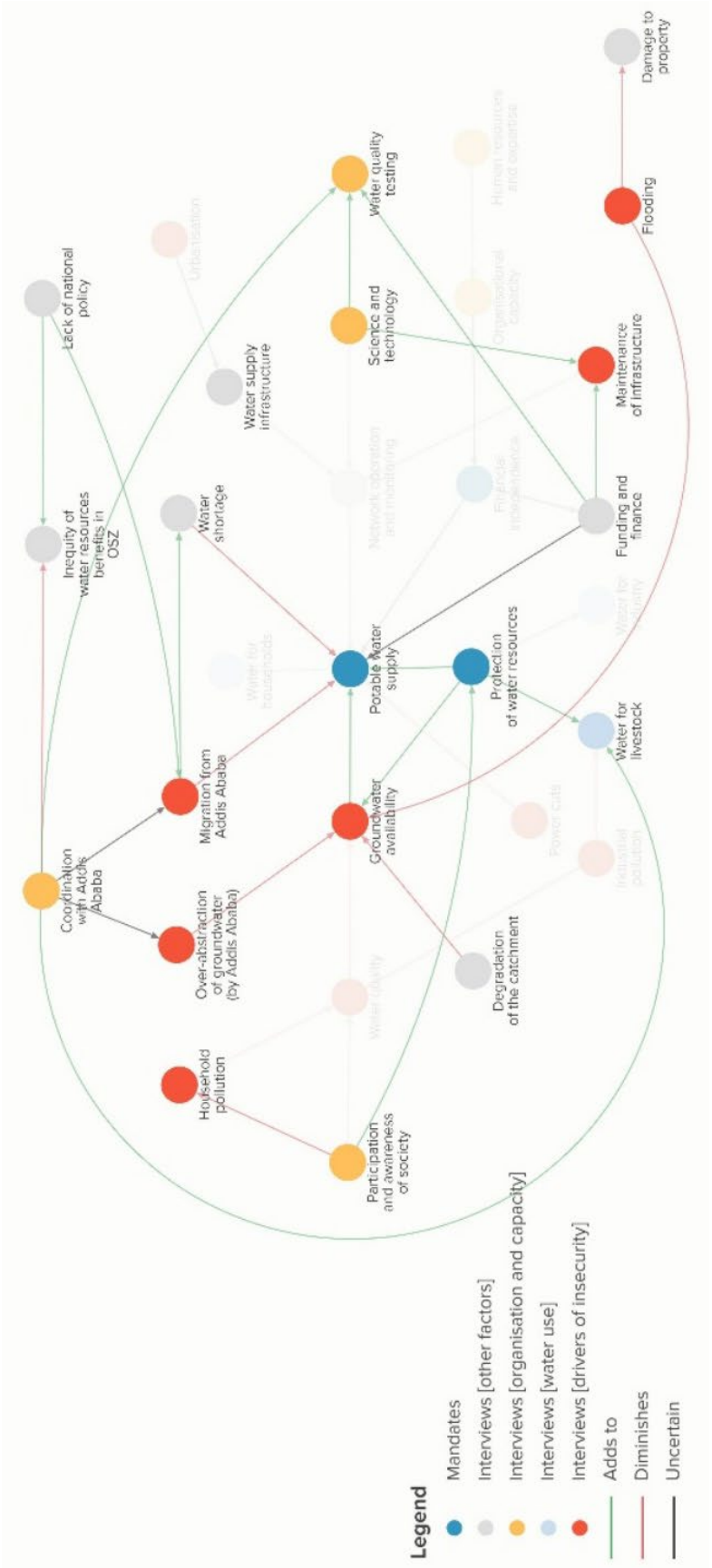


Figure 84. System interpretation of elements and interconnections of Gelan key informant

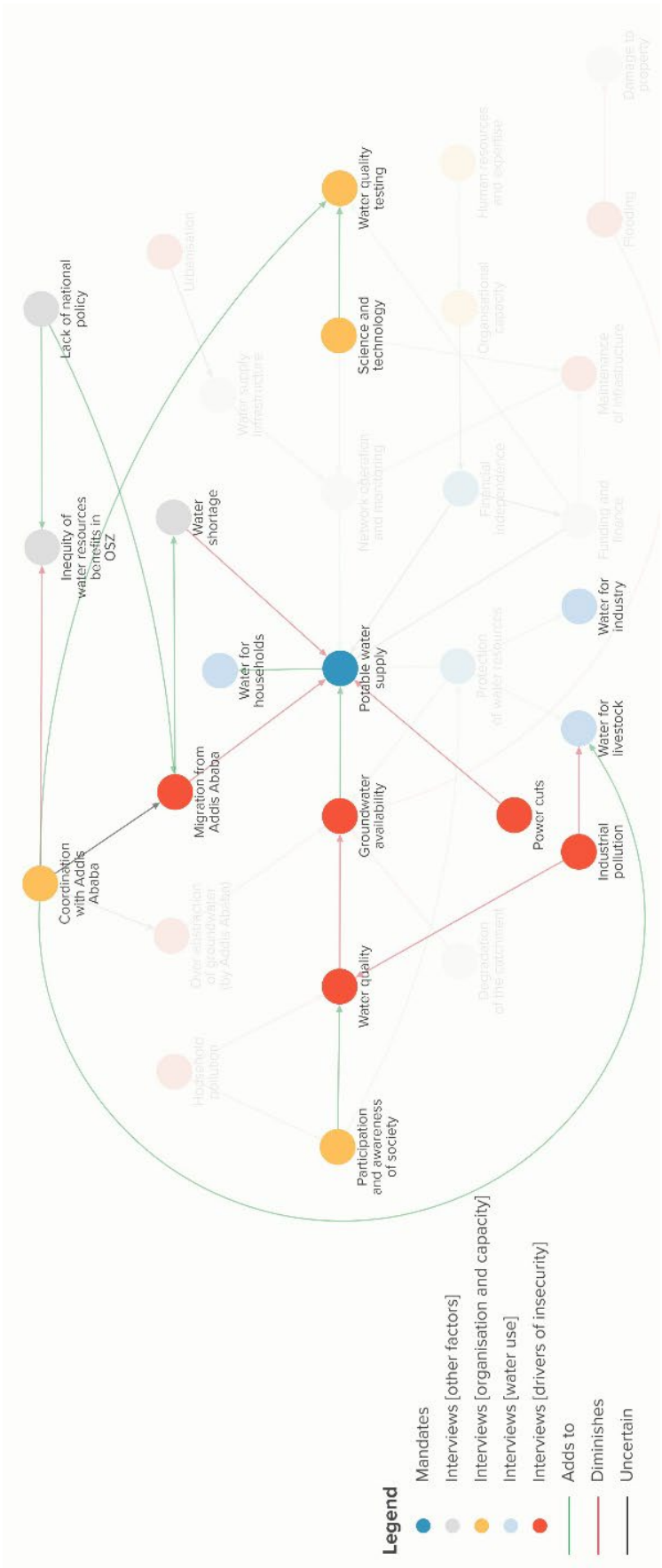
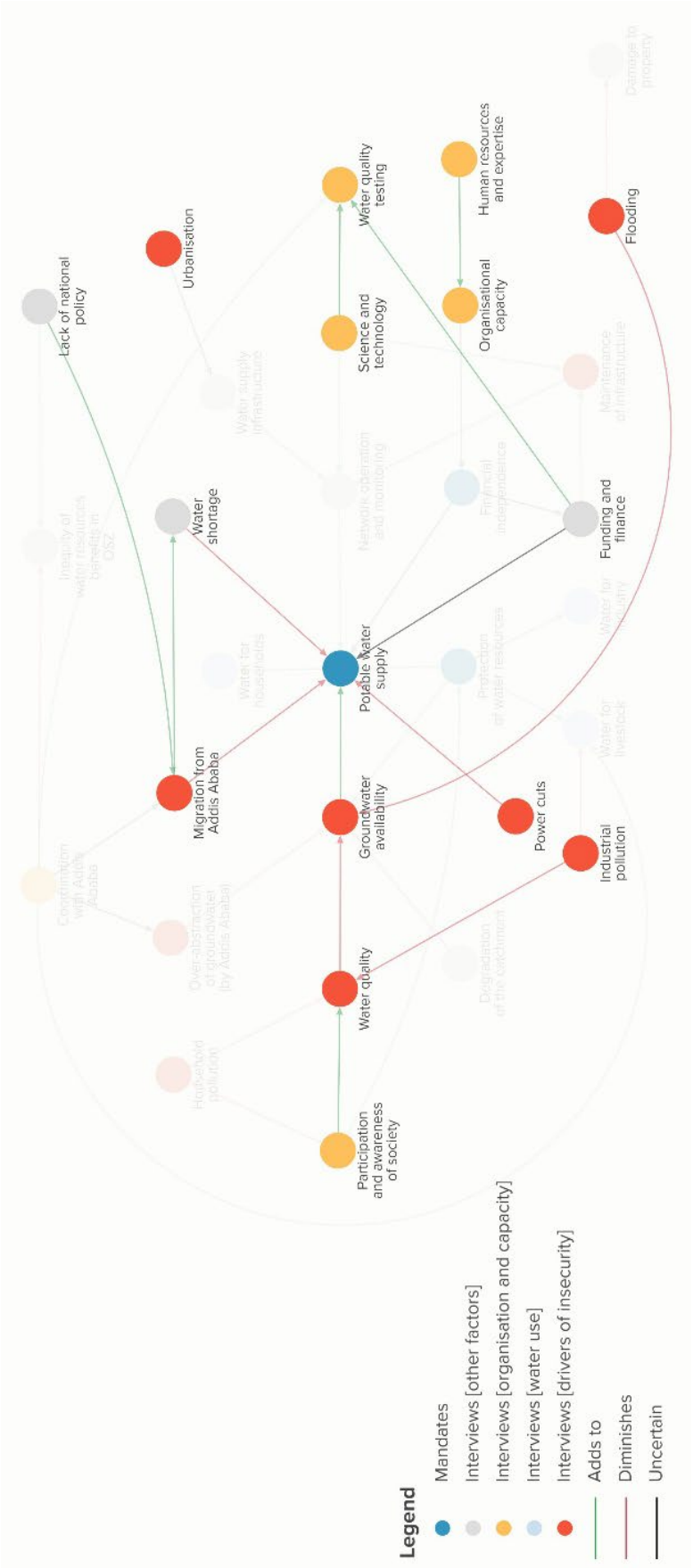


Figure 85. System interpretation of elements and interconnections of Burayu key informant



8.4 Water security perspectives amongst other regional actors

The open-ended questionnaire conducted with AAWSA and OWEB was also conducted with other actors within Addis Ababa. The full list of questionnaire responses can be found in Appendix E. These 14 actors were part of a working group[93] contributing to the development of water and climate adaptation strategies for Addis Ababa; individuals of the group were of interest as they represented a number of non-utility water-related organisations from research institutions, to contractors, to regional bodies, such as:

- Addis Ababa Planning and Development Commission
- Addis Ababa Science and Technology University
- Ethiopian Construction Design and Supervision Works Cooperation
- Africa Centre of Excellence for Water Management
- Awash River Basin Authority
- Others (who chose to remain anonymous)

The open-ended questionnaire responses demonstrated both consistency and diversity around water security perspectives and priorities amongst these actors. There was a common opinion that water security came from a combination of water quantity and quality, in terms of the former, the physical ‘securing’ of water was mentioned in responses such as ‘water security means securing the limited resource’ and ‘water security means to secure water’. There were also consistencies in water security perspectives around appropriate water use, specifically sustainable use for the ‘future generation’. Interestingly, and different to the responses from AAWSA and OWEB, poor water management was mentioned as a factor of water security, linking the degree of water security with appropriate regulation, policy, and demand management of water resources. In terms of the most urgent water issues for Addis Ababa, water quality and water pollution were a priority amongst nearly all responses. Again, management, policy, and capacity were mentioned as significant challenges to water resources management, specifically watershed/catchment management. Generally, there were similarities with AAWSA and OWEB in the concerns of the impact of urbanisation and population growth on water resources.

[93] The Addis Ababa Adaptation Network

Water infrastructure was also mentioned several times as an urgent issue for Addis Ababa in terms of wastewater treatment, distribution networks (pipes), and NRW or leakage.

There was an understanding amongst nearly all responses that water issues are caused by a mismatch between hydrological (basin) and administrative (regional) boundaries. This was expressed in several ways (see quotes below), such as: water transfers taking place across both basin and regional boundaries; water sources being in one place and users being in another; transboundary basins and rivers not obeying administrative boundaries; and the various hydrological processes that cross regional boundaries e.g., surface water flow and groundwater recharge. More political aspects were also mentioned such as financing, cross-sectoral cooperation, and political agendas that originate at a national level and aren't confined to either hydrological or regional boundaries.

> *'…the boundary of water (surface water and groundwater) resources is beyond basin or region. Thus, anything related to water management, security, monitoring, etc. which are water issues pass over basin or regional boundaries.'*

Ethiopian Construction Design and Supervision Works Cooperation respondent

> *'…the water resources are not bound by basin and regional boundaries and they are interconnected these make the water issues are the issues everyone should take into account that it is the matter of everyone's need/basic necessity. In additional, the water resources for instance river basins may be trans-boundary and connects between regions. Therefore, the water issue arising out of the misuse of this kind of river may impact all the regions /basins along the stream.'*

Anonymous respondent #7

'It is linked to basin because any water source groundwater or surface water developed around basin so it is lightly linked to basin to get sufficient water sources reached to demand planned. Linked to regional boundaries because most the time water supply for cities are for apart from the cities and coming crossing mainly administrations, these administration are the parts of regions so it is big issues to take into account regional benefits to properly managing water developed for cities.'

Anonymous respondent #8

'Water issues are linked beyond the boundary of a certain city or region. Because surface water is flowing starting somewhere and goes to follow the slope of the geographical space (landscape). Whether it is out or in the region. If it is get any problem at any time that affects the supply. Also the groundwater recharged anywhere or upper slope and flows the lower slope. Therefore, water issue has linkage with outside the boundary.'

Anonymous respondent #10

8.5 Comparisons of regional-level water securities in Addis Ababa

The previous sections demonstrate both consistencies and variations in the priorities and perspectives of water security amongst regional-level actors in Addis Ababa. It can be observed that the three statements of water security, as defined by this thesis[94], are reflected in the priorities and perspectives of water resources management and water security across these actors. In general, agreements are observed to exist amongst more physical dimensions of water security such as water availability, potable water, and water quality. With more inconsistencies between social and political dimensions of water security in the role of stakeholders, governance, and policy, and which of these are considered outcomes or functions of water resources management and water security.

The first water security statement defined by this thesis, water security as defined by physical water insecurity, appears to be the most developed and consistently agreed dimension of water security amongst actors. Water security as lack of physical water in both quantity and quality – specifically water quantity as inaccessible or unavailable potable water, and water quality as contaminated potable and environmental water – is an obvious consistency across all actors. Amongst these, similar opinions of drivers of water insecurity are demonstrated, such as source limitations and scarcity (both surface and ground water), population growth and urbanisation, and poor infrastructure. Additionally, shared opinions are given about the main impacts of water insecurity; a growing demand and supply gap, contamination of water resources, water loss (NRW), and general water shortages in the City.

Interestingly, AAWSA and OWEB appear to prioritise water quantity dimensions of water security (in terms of potable water supply and water resources) over water quality dimensions. The other non-utility actors instead prioritise water quality, mentioning it as the most urgent issue for the City, which is also consistent with the Addis Ababa City and Structure Plan (discussed in Section 8.1.2). This could largely reflect AAWSA's mandates and priorities being focused on increasing water supply

[94] Water Security as defined by physical water insecurity; water security as a social and political practice, process, and value; water security as indivisible from human security and justice.

coverage to meet internal and external success targets. Additionally, that the mandate of environmental protection, in terms of the degradation of environmental water, falls within the powers and duties of the Ethiopian Environmental Protection Authority (FDRE, 2002a; Ethiopian Environmental Protection Authority, 2023) and not local water utilities.

The second water security statement defined by this thesis, water security being a social and political practice, process, and value, is less explicit across regional-level actors than the first statement. There are, however, two main themes that can be observed that do reflect this second statement of water security: the place of water management in water security and the role and responsibility of stakeholders in water governance. The first of these presents a slight discrepancy between the utilities (AAWSA and OWEB) and other regional actors. AAWSA appear to believe that water management is a separate issue to water security (from questionnaire responses) and that it is not an urgent issue (see Table 15 and Table 16). This is perhaps because many of AAWSA's mandates and plans hinge on infrastructural interventions rather than catchment/watershed management; over the past 10-years[95] it appears that AAWSA's solutions to many water issues have been based on supply development such as treatment plant expansion, ground and surface water development, and NRW reduction. Other actors, however, appear to see water management as a dimension of water security where water security is a product of good water management. OWEB is an exception here as water management is not mentioned explicitly at all by OWEB in the questionnaire responses or the key informant interviews. Although, the lack of coordination (with Addis Ababa) and government responsibility (to implement water management policy) are mentioned as factors of water insecurity, perhaps reflecting the third statement of water security more than this second one.

The second theme that demonstrates water security as a social and political practice, process, and value, is the role and responsibility placed on stakeholder involvement in improving water security. The involvement of stakeholders in achieving water security, and more broadly improving water governance, is mentioned across all

[95] Based on the 2011-2020 Business Plan and the Long Term Road Map, as discussed in Section 8.1.2.

regional actors and in AAWSA's mandates and plans. Specifically, many actors mention the lack of stakeholder/community involvement and awareness as both dimensions of and priority issues for water security, this being a social process consistently believed to be required to facilitate water security. It can also be observed that in Burayu this isn't the case, and there appears to be frequent involvement and participation of the community; KI2 describes effective channels of communication, participation, and action between the local community and the Water Bureau, for example.

Another demonstration of water security as a social and political practice, process, and value, is in the hydropolitical relationship between Addis Ababa and the surrounding OSZ – demonstrated by the water security priorities and perspectives of AAWSA and OWEB. The coordination and cooperation between AAWSA and OWEB in the OSZ are seen as a priority for both parties. There are, however, questions as to whether this exists or not. On the one hand, AAWSA alluded to[96] a collaborative (but possibly inactive) platform with the OWEB bureaus in the OSZ. Additionally, OWEB KI1 (Lege-Tafo Lege-Dadi) mentioned that communication with AAWSA did happen in that they 'ask for it [discussion with AAWSA] when we [the OWEB] are in trouble, but not for the normal'. On the other hand, there was no evidence for the existence of any collaborative platform in discussions with OWEB, and the situation described by KI1 was not supported by a formal cooperation framework.

Furthermore, it seems debatable whether the cooperation between OWEB and AAWSA is necessary for the water resources development of Addis Ababa. From the perspective of OWEB, it appears important for ensuring that Addis Ababa does not operate an exploitative relationship with the OSZ (both in terms of water abstraction and pollution) and that the water resources within its boundaries can be used for benefits within the OSZ. However, as Addis Ababa appears to be a more powerful actor[97] with a perceived higher reliance on water security for its socioeconomic

[96] In the workshops – see workshop notes in Appendix E.

[97] In terms of international and national significance and mainstreamed water resources development processes and funding.

development[98], its capability to pursue water security is stronger than OWEB – observably turning the water security situation in the OSZ into a zero-sum game between AAWSA and OWEB with this form of relationship currently benefitting Addis Ababa the most.

The hydropolitical relationship between Addis Ababa and the OSZ additionally demonstrates some of the third statement of water security defined by this thesis; water security being indivisible from human security and justice. It is apparent from the OWEB interviews that inequity[99] of water resources development is felt in the OSZ; concerns are raised around the beneficiaries of water resources development in the OSZ area. Additionally, it appears to be the opinion of OWEB that AAWSA's groundwater extraction activities in the OSZ are a source of increasing water insecurity and reduced capability to independently provide water to those in the OSZ. Lastly, there appear to be more considerations in the mandates of the OWEB for the role of water security as a more general human security than with AAWSA; in the opening statements of the OWSS Proclamation (No. 288/2020), it makes clear that it is the Oromia government's duty to supply clean and adequate potable water and sewage disposal services as part of implementing fundamental human rights, for example.

To summarise, all three statements of water security can be observed amongst actors in Addis Ababa. As demonstrated, however, water security as the 'securing' of physical water for potable distribution is a much more consistent dimension of water security. Specifically, water source protection (from both pollution and over abstraction), water source availability/reliability, water source sustainability (based on different uses and demands), water access for community (e.g., wells, bono[100], piped supply) and water source development (e.g., ability to access and utilise

[98] The City Plan emphasises how the water and wastewater services of Addis Ababa are key elements of the economic development of the city – and country – in terms of growth in industry, productivity, housing, and tourism (ACCPPO, 2017).

[99] KI1 describes an inequity in the beneficiaries of water supply 'when one entity [region] benefits [from water services], it should also benefit the community of that area'. The idea of inequity between regional benefits associated with water services is also mentioned by KI3 who states that there should be a policy that ensures 'that the areas that are sources of water resources have access to water first'.

[100] ቦኖ – *Bono* – public water taps

ground and surface water resources) are described by nearly all actors. The other two statements of water security appear to be less developed and consistent than the first. Although, it is evident amongst all actors that the involvement of stakeholders in water governance is a central part of the social process for improved water management, but it is unclear what this means in practice. Additionally, a key part of the political process for water security appears to be the hydropolitical relationship between Addis Ababa and the OSZ, and therefore AAWSA and the OWEB, which seems to currently be unfunctional. This can also be viewed as a larger representation of the link between water security and justice – or in OWEB's opinion, injustice – caused by Addis Ababa's water utilisation activity and development in the OSZ. For AAWSA and OWEB, OWEB appears to be more of a stakeholder to bring on board rather than an active partner in water resources development.

8.6 Regional water security systems: interpretation and analysis

Unlike the investigation of water security systems at local level (Chapter 7), water security perspectives and priorities across actors at regional level in Addis Ababa seem to be less diverse. The fundamental systems concepts of open systems and boundary judgments, as described in Chapter 3, can provide a means to critically assess and compare these systems of regional water security. Broadly, at regional level, there appear to be more consistencies in what is considered inside and outside the water security system of Addis Ababa; the elements, interconnections, and functions of water security being more agreed between actors as well as what is in the external physical and social environment. In terms of boundary judgements, however, there appears to be some discrepancy amongst the judgements between actors that determine the perception of the problem situation that is water insecurity.

8.6.1 The open system

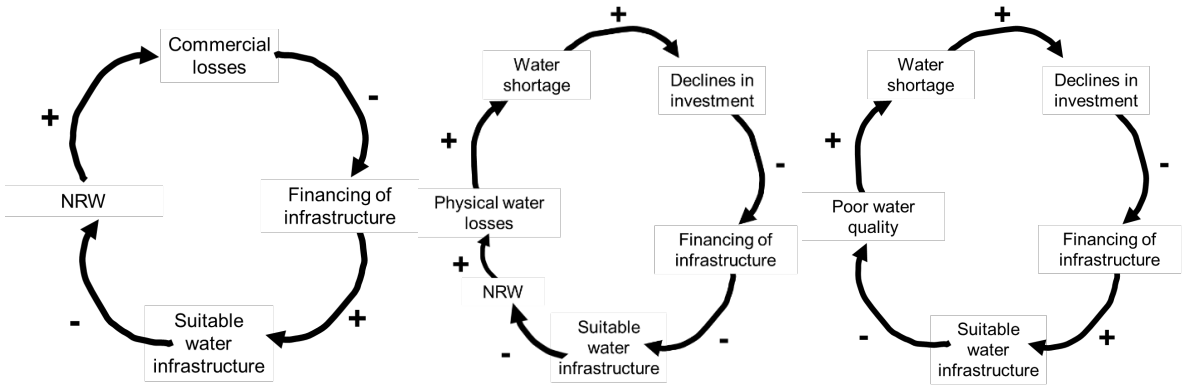
The system contains elements, interconnections, and functions. An open system[101] interacts with its social and physical environment, which is interpreted through values, expectations, and ideals (Emery, 2000; Ulrich, 1988). The open system is also influenced by other system's boundaries. As previously mentioned, there appear to be some consistencies of elements, interconnections, and functions of water security amongst actors in Addis Ababa. Additionally, the values and expectations of water security that shape the system's environment appear to be similar as well as the transactions between system and environment, although the strength and reliability of these transactions appear to differ.Figure 66 and Figure 67 demonstrate AAWSA's perceived central functions of some separate sub-systems of water security in Addis. Notably these are largely based around water supply and not water treatment or quality, reflecting the weighting of AAWSA's priority of water supply coverage as discussed earlier in this Chapter. The central functions of these sub-systems are: (1) the demand and supply gap; (2) water governance; and (3) water distribution/ infrastructure efficiency. With regards to (1), this aligns with priorities in the AAWSA business plan and LTRM (see Section 8.1.2). The functions and processes of (1), however, appear to be different between the two AAWSA workshop groups. Group 1, for example, describe the water security system behaviour across

[101] See Chapter 3 for more on the fundamental of an open system.

Addis as largely interconnected and a product of the interactions between land-use change, water resources utilisation, and flooding. Group 2 on the other hand view the supply and demand gap as sub-systems split into sanitation, governance, investment, infrastructure, and population growth. These sub-systems are noticeably disconnected compared to Group 1's. With regards to (2) and (3), it can be observed that these are viewed as their own sub-systems by Group 1, but part of the wider supply and demand sub-system for Group 2. Perhaps demonstrating a perspective in Group 1 that these three water security functions are not interrelated.

The combination of Group 1 and 2's CLDs (Figure 68) demonstrates the wider open system concept for AAWSA. Within this there are elements and interconnections, some of which form feedback loops. These feedback loops (simplified in Figures 86-88 below) appear to all involve the 'Financing of infrastructure' and 'Suitable/efficient water infrastructure' elements. The relationships within these feedback loops present reinforcing behaviours that demonstrate AAWSA's perceived importance of the role of funding in physical water security as well as the complexity of water shortages being a product of both quality and quantity issues. It would appear from these feedback loops that, from AAWSA's system perspective, more financing of infrastructure is the key leverage point in the water security system. Taking a broader overview of the whole system, however, demonstrates that this is a complex product of multiple drivers and not easily controlled by AAWSA.

Figure 86, Figure 87, and Figure 88. [left to right] Simplified feedback loops from AAWSA's causal loop diagram of water security in Addis Ababa



Furthermore, the social environment of AAWSA's open system appears different to that of other actors. For example, there is nothing in AAWSA's CLD that specifically

mentions OSZ – there are elements of ‘Administration boundaries’ and ‘Lack of sectoral coordination’ but these are disconnected from groundwater and reservoir water resources so assumed to not be related to governance in the OSZ. Similarly, there is no presence of the roles and responsibilities of communities in AAWSA’s system map. There are representations of community impacts such as displacement, loss of livelihoods and sociocultural assets, and individual economic burden, but no representation of the roles communities play in contributing to the water security in the city, even though this was a significant part of the questionnaire responses, the OWEB KIs, and the AAWSA plans. Interestingly, however, ‘Collaboration with stakeholders’, ‘Lack of integration in Oromia Zone’, ‘Customer knowledge’, ‘Working with stakeholders’, and ‘Working with other utilities’ were mentioned as priority water issues for AAWSA in both Table 15 and Table 16. The consideration of these issues as priority issues but not as part of the systems representation could demonstrate a lack of knowledge of connections with other factors, therefore not knowing how this social environment integrated with the physical environment of water security, or perhaps as being viewed as less important than other issues.

It is also important to recognise that, despite many differences, there appears to be a partly shared systems perspective between AWWSA and OWEB for water security. This can be demonstrated by the shared elements and connections within AAWSA’s CLD (Figure 68) with those in OWEB questionnaire responses and key informant interviews. For example:

- The link between water shortage and over abstraction of groundwater
- The role of increasing population and urbanisation on water demand
- The link between low sectoral capacity having an effect on suitable and efficient water infrastructure
- Wider political factors being a driver behind processes that impact Addis Ababa’s water security
- The role of finance and funding in the ability to provide water security
- The impact of catchment protection, or lack thereof, on water (in)security – especially driven by deforestation and cause for flood events

As a last reflection on the open system of regional water security, one exchange between the system and its environment – knowing the environment through

learning[102] - is observed as being an important determinant of the ability to pursue water security across all actors. Whilst this importance is demonstrated in AAWSA's plans, AAWSA's and OWEB's mandates[103], the OWEB KI interviews, and the questionnaire responses, it is, however, not represented in AAWSA's systems perspective (Figure 68) (although, 'Knowledge about water resources' is highlighted by Group 2 in the workshop as a medium priority issue, see Table 16). These exchanges between the water security system and the wider social and physical environment that form part of the ability to pursue water security are observed to also extend to the wider social and economic environment that influences the water security capability of the utilities. For example, the capability to pursue water security being hindered by capacity; knowledge (research and technology), institutional capacity (power, policy, direction), human/workforce capacity, and financial capacity. Meaning the ability to learn about the system's environment is not just hindered by lack of scientific knowledge or technology, but also lack of access to knowledge about political processes, policies, and spaces for decision-making.

8.6.2 Boundary judgements between actors

As previously discussed, there are similarities as to what is considered inside the water security system of Addis Ababa among actors. In terms of boundary judgements, however, there appears to be some discrepancy amongst the judgements between actors that determine the perception of the problem situation that is water security; differing less across physical elements and more across other dimensions of social value and inequities of water security.

Whilst physical aspects of water security (quality and quantity of water) appear to be more consistently agreed. There is still variation in the perception of the problem situation (water insecurity) boundary. It is consistently agreed across all actors, for example, that one physical boundary of water security for Addis Ababa is inclusive of the administrative boundaries of the city as well as the water resources (surface and

[102] As discussed in Chapter 3, in the open system concept, the system acts on the environment through planning and the environment acts on the system and is known through the process of learning (Emery, 2000).

[103] Both OWEB and AAWSA have it included in their mandates to study and collect data on water resources and distribution (OWERDB, 2021; The City Government of Addis Ababa, 2012).

ground) in the OSZ. Furthermore, it is also recognised that the polluting impacts of Addis Ababa create another water security boundary beyond the city, but only downstream towards the Koka Dam[104] (Figure 78). OWEB interviews carried out upstream, in Burayu and Lege-Tafo Lege-Dadi, specifically mention that there are no water quality issues in these areas. Lastly, as part of physical water security, there are frequent mentions of the hydrological boundary of water security, the (Akaki) catchment; lack of catchment and buffer zone protection and upstream land use change (demonstrated in Figure 77) are raised as concerns by all actors. This extends the water security boundary further north than the water supply reservoirs of Addis and further south than the Aba Samuel reservoir.

Outside of these judgements of physical water security, perceptions of the problem situation of water insecurity create variations in boundary judgements between actors. Noticeably, these judgements extend the boundary of water security in Addis Ababa beyond the city, to sometimes a national and international level. For example, as described in the notes on the workshop discussions in Appendix E, discussions towards the end of the AAWSA workshop began to debate the boundaries of water security that exist at national level. This included discussions around the water security implications to Addis Ababa that come from wider national and international socioeconomic processes such as: migration to the city at different time scales; reliability of power supply for wellfield abstractions (stretching as far as Lake Tana in the Abbay basin, see Figure 79); and financing of water infrastructure where international loans were briefly mentioned in passing, with no specific details. These are reflected in AAWSA's overall water security perspective (Figure 68) where 'Political factors' are key drivers of wider water security elements, largely around supply and demand. This aligns with perspectives of other actors where more national-level influences, such as policy implementation, government responsibility, and bureaucratic power, are described as key drivers of water security in and around Addis Ababa.

Where this begins to differ, however, is around the boundary judgements of water security governance. It appears that, even though lack of coordination in the OSZ is highlighted as a key issue for AAWSA, it could be observed that the current water

[104] Also discussed in (Polaine et al., 2022).

security governance boundaries of AAWSA excludes the OWEB in the OSZ. AAWSA mandates and plans, as well as the AAWSA system perspective (Figure 68), appear to not adequately represent the role of the OWEB in the OSZ as a stakeholder, beneficiary, or decision-maker for water security in Addis Ababa (more broadly, water management). Whereas the OWEB water security governance boundary is very much centred around Addis Ababa, in terms of a perceived perpetrator of water insecurity in the OSZ (through both water abstraction and water pollution), as well as dynamics of urbanisation and migration coming from Addis. In this sense, it could be interpreted that for AAWSA, water security in the in the OSZ means water security for Addis, but for OWEB, water security in the OSZ, means water security for those in the OSZ. These conflicting boundaries appear to create competing water securities at regional level where the more powerful actor, seemingly Addis Ababa, is able to assert its water security at the detriment of the water security of the surrounding area.

8.7 Conclusions

To summarise, the water security perspectives and priorities of 29 regional level actors for Addis Ababa and its hinterland were captured in questionnaire responses. Additionally, water security was further explored at regional level using a systems perspective through key informant interviews with OWEB and two workshops with Addis Ababa's sewerage and water authority – AAWSA. This demonstrated the open-system interactions and boundaries that govern some of the water security system perspectives and priorities in the Addis Ababa area.

The main conclusion is that there are similar perspectives on elements that contribute to water security; quantity and utilisation of available water, quality of water, adequate policy and governance, stakeholder involvement, suitable infrastructure, and research and technology, for example. And similarly, elements that drive water insecurity; urbanisation (of Addis Ababa and the surrounding area), supply and demand gaps, low financial capacity, and competition over (ground) water resources, for example. Among agreed elements, however, there is a noticeable weighting towards physical dimensions of water security, with elements becoming less agreed as they tend towards more social and political dimensions of water security.

This chapter has also further highlighted the disconnectedness between AAWSA and OWEB in both a general lack of cooperation and coordination as well as a mismatch in some perspectives and priorities of water security in the OSZ; water security for the OWEB being inseparable from Addis Ababa's water security, whereas water security for AAWSA excluding the water security of OWEB in the OSZ. Despite both AAWSA and OWEB suggesting that there needs to be better cooperative and coordinated water management in the OSZ, and the suggestions of both informal and formal (but ineffective/inactive) communication between the two, there doesn't appear to be any policy, memorandum of understanding, or framework to facilitate cooperation between OWEB and AAWSA in the OSZ.

Lastly, and as part of the observed disconnectedness between AAWSA and OWEB in the OSZ, this work demonstrates how, as a more powerful actor, AAWSA (or more aptly, Addis Ababa) has more capability to pursue its water security at the detriment

of the water security in the surrounding area. The political power Addis Ababa has over the surrounding area coming from a mixture of: a different bureaucratic system allowing Addis Ababa to bypass some accountability (from MoWE, for example); the economic significance and production of the city compared to surrounding areas; and, Addis Ababa's status as a national and international hub, all of which give the City a priority place in wider governmental decision making. Despite this, however, AAWSA is still hindered in pursuing water security for Addis Ababa; the biggest hindrance to AAWSA's capability to pursue water security appearing to not be securing the resource but the technical and managerial capacity of the organisation. Unlike, OWEB, who's main concern is securing the resource for themselves.

Chapter 9. Ethiopian water governance structures, key policies, plans, and laws at national level: where is water security?

This chapter investigates the perspectives and priorities of water security at national level through examining relevant Ethiopian water resources management policies, plans, and laws. As no water security policy or plans currently exist for Ethiopia, dimensions of water security are interpreted from other legislative documents. The various documents chronologically discussed in this chapter (Table 17) were identified from key informant interviews, documents reviewed as part of previous chapters, and legislation identified through cross-examination of these sources (as described in Chapter 5, Section 5.2). These documents are therefore speculated to reflect the fundamental national planning guidelines and objectives for water management since The 1995 Constitution[105] – shaping subsequent legal proclamations and regulations and guiding the direction and priorities of water governance for Ethiopia over the past few decades.

Additionally, some documents are discussed that are not specifically water resources management policies or plans but are identified as significant socioeconomic strategies of the country that include water resources management. In this sense, these provide key insight into water resources management in the wider context of national goals and objectives and therefore capture important dimensions of water security for Ethiopia.

Table 17. List of documents reviewed by year and type relevant to water resources management in Ethiopia at federal level (1995-2020)

Year	Proclamations and regulations	Policy, plans, and programmes
1995	• No.1/1995 The Constitution of the FDRE • No. 9/1995 Environmental Protection Authority Establishment Proclamation	
1997		• The Conservation Strategy of Ethiopia: The Environmental Policy of Ethiopia

[105] Some water resources management initiatives do, however, pre-date the 1995 Federal Constitution. For example, the establishment of the first Water Resources Development Department (1956), the AWaSH Valley Authority (1962), the National Water Resources Commission (1971), the Ministry of Resources Development and Environmental Protection (1991), the National Resources and Environmental Protection Bureaus of regional government (Proclamation No.41/1993), the National Health Policy (1993), and the Water Resources Utilisation Proclamation (No. 2/1994) (Behailu et al., 2015; Woldemariam, 2009).

1998		• Ethiopian Water Resources Management Policy
2000	• No. 197/2000 The Ethiopian Water Resources Management Proclamation	
2001		• Water Sector Strategy
2002		• Ethiopian Water Sector Development Program
2005	• No. 115/2005 Ethiopian Water Resources Management Regulations	
2010		• Growth and Transformation Plan I (2010-2014)
2011		• Universal Access Plan • Climate-Resilient Green Economy Strategy
2013		• ONEWASH National Programme Phase 1
2015		• Climate Resilience Strategy: Water and Energy
2016		• Growth and Transformation Plan II (2015-2019)
2018		• ONEWASH National Programme Phase 2
2019		• Climate Resilience Strategy: National Adaptation Plan
2020		• Draft National Water Policy and Strategy • Urban Water Supply and Sanitation Project-II • Ten Years Development Plan (2020-2030)

9.1 The foundations of water resources management in Ethiopia

The water resources management structure in Ethiopia largely reflects the federal system of the country[106]. Water governance responsibilities are shared between the federal and regional state governments; proclamations and regulations are implemented through powers transferred from the relevant Ministry[107] (largely the Ministry of Water and Energy – MoWE – in this case) to Regional States (see Chapter 8) and River Basin Organisations (see Appendix G). Many other national bodies are also involved with water management in Ethiopia; several Federal ministries and authorities (e.g., the Ministry of Water and Energy, the Ministry of Finance and Economic Affairs[108], the Ministry of Agriculture, the Ministry of Livestock and Fisheries, the Ministry of Irrigation and Lowland Areas, and Environmental Protection Authorities), Water Utilities, Water Bureaus of Regional States, Zonal Administrations, Construction Works Corporations, and local communities (Tekle, 2019). The foundation of water management for Ethiopia, however, comes from the resource management laws in the 1995 Constitution.

9.1.1 The 1995 Constitution of the Federal Democratic Republic of Ethiopia

The 1995 Constitution (Proclamation No.1/1995) sets out the fundamentals of natural resources management for Ethiopia. It is the 'supreme law of the land' (Article 9), setting out powers and functions of the Federal Government, Council of Ministers, Regional State Governments, and Ethiopian citizens in natural resources utilisation, administration, and development in accordance with Federal laws (FDRE, 1995b). Additionally, it describes political, economic, social, cultural, and environmental objectives for both the Federal Government and Regional States (Article 85). Whilst water resources management is not an explicit focus of the Constitution, natural resources are, which include the country's water resources, hence this proclamation

[106] Under Proclamation No. 1/1995 Ethiopia became a federal and democratic state with Addis Ababa as its capital city. This proclamation divided Ethiopia into nine member states based on ethnicity (Article 47), known as ethnic federalism, and additionally made Addis Ababa a city state that operates in a form of autonomous self-rule.

[107] Being the executive arm of the Federal Government.

[108] The Ministry of Finance and Economic Affairs are responsible for the channelling of multilateral, NGO, and bilateral donor funding towards various water-related development projects (as per Proclamation No.268/2002, Article 5:2) (FDRE, 2002b).

is the foundational legal basis for all water resources policy in Ethiopia. Interpretation of The Constitution can therefore demonstrate some foundational state priorities and perspectives of water security.

The Constitution presents a clear link between water security (through natural resources mobilisation, utilisation, and development) and the socioeconomic development potential of the country. This is expressed physically in terms of the access to material resources and clean water (e.g., Article 89:1, Article 90:1), politically in terms of the roles and responsibilities of multiple bodies in natural resources management and conservation (e.g., Article 40:3, Article 51:5, Article 52:2,d, and Article 92:4), and socially in terms of rights, provision of public health, healthy environments, and sustainable development (e.g., Article 41:4, Article 43:3, Article 44:1, Article 92:1). Whilst there appears to be a shared responsibility for natural resources and the environment between the Federal State, Regional States, and the peoples of Ethiopia (Article 52:2,d, Article 40:3, Article 92:4), The Constitution ultimately gives the ownership of natural resources to the Federal State in that it is the ultimate allocator, regulator, and utiliser of these (Article 41:4, Article 51:5, Article 51:11).

9.1.2 The Ministry of Water and Energy

The Ministry of Water and Energy (MoWE) is the executive arm, regulator, and research institute for water resources management of the Federal Government. MoWE was established in 2021 under The Definition of Powers and Duties of the Executive Organs Proclamation No. 1263/2021 (FDRE, 2021) that transferred the rights and obligations of the Water Development Commission, Basin Development Authority, Office of Water Resources Development Fund, and the previous Ministry of Water, Irrigation, and Energy, to MoWE (Proclamation No. 1263/2021 Article 106:12). Formerly, similar powers and duties existed under The Ministry of Water Resources (2000-2018) and The Ministry of Water, Irrigation, and Energy (2018-2021) as the executive ‘supervising bodies’ of the Federal Government responsible for water resources management. MoWE executes its activities under three pillars, that themselves have further subdivisions, the three pillars are: Water Resources; Water and Sanitation; and Energy. The pillar of Water Resources includes subdivisions of

hydrology, IWRM implementation, watershed management, transboundary issues, and informatics, etc (Key Informant Interview (MoWE), 2022).

Several proclamations (e.g., Proclamation No. 1263/2021 and No. 197/2000) detail the powers and responsibilities of MoWE. Under The Ethiopia Water Resources Management Proclamation (see Section 9.2.3.1), for example, MoWE is responsible for ‘the planning, management, utilisation, and protection of water resources’ (Article 8:1). This includes water supply, sanitation, as well as strategy delivery and directive issuing for management of the country’s water resources (MoWE, 2023a; Arup, 2021b; Tamrat, 2008). Part of these powers and duties can be delegated to ‘appropriate bodies’ (Proclamation No.197/2000, Article 8:2) i.e., another accountable institution or other federal and regional institution (Proclamation No. 1263/2021, Article 9:3).

As mentioned previously, other Ministries are also important to the water resources management of Ethiopia but play a much smaller role in the shaping of policy, strategy, and law for the country’s water resources. For example, Proclamation No. 1263/2021 also gives powers and duties to the Ministry of Agriculture and the Ministry of Irrigation and Lowland Areas in water resources management and development. The Ministry of Agriculture has the powers and duties to utilise and develop surface and ground water and conserve river basins and wetlands (Proclamation No. 1263/2021, Article 20:n,o). The Ministry of Irrigation and Lowland Areas are also given the powers and duties to facilitate the utilisation of ground and surface water resources, administer dams and water infrastructure and (in collaboration with Ministry of Agriculture and Ministry of Water and Energy) expand water centred basin development activities and irrigation development (Proclamation No. 1263/2021, Article 33:1).

9.2 Ethiopian water resources management policy, plans, and laws

9.2.1 The Environmental Protection Authority Establishment (1995)

As one of the first environmental laws after The 1995 Constitution, and perhaps building on the first two phases of the Conservation Strategy of Ethiopia[109], the Environmental Protection Authority (EPA) Establishment (Proclamation No. 9/1995) created the environmental protection body of the Federal Government (the EPA) mandated with the protection of 'land, water, air, and similar other environmental resources' (Article 2:2,3) (FDRE, 1995a). To this extent, water security can be interpreted as mostly the sustainability of both the quality and quantity (Article 2:1) of water resources and the importance of this in the welfare of human beings (Article 2:2) as well the sustainability of the utilisation and development of physical resources ('resource bases') for socioeconomic development (Article 5). The EPA does, however, define environmental management as the 'control of the utilization of the environment in general' (Article 2:3) implying that, much like The Constitution, water security is also about securing the material resource of water. The EPA is given a range of powers and duties under the Federal Government, which could be a reflection of the state trying to increase its capacity to pursue water security, including the preparation and implementation of environmental protection policies and laws, evaluating the impact of social and economic development projects, and advising Regions on environmental protection, among others. The functioning of the EPA also relies on a number of organisations; an Environmental Protection Council (Article 7) that includes members of several ministries (Agriculture, Trade and Industry, Health, Mines and Energy, and Water Resources) who have the power to evaluate and approve EPA directives and standards (Article 8 and 10).

[109] The first two phases of the Conservation Strategy of Ethiopia (CSE) predate the Constitution; Phase I (1989-1990) developed an overview status report of the environmental situation in the country, Phase II (1991-1994) developed five volumes of strategy documents, and Phase III (1995-1998) developed the institutional, administrative, and technical arrangements at Federal and Regional levels for the implementation of the Conservation Strategy of Ethiopia (IUCN, 1997).

9.2.2 The Environmental Policy of Ethiopia (1997)

The Conservation Strategy of Ethiopia[110] (1989-1998) set out to manage the country's natural resources base and help to develop future national resource policies. One of the subsequent policies was the 1997 Environmental Policy of Ethiopia (EPE) (Tekle, 2019) – the first environmental policy of the FDRE Government. The EPE begins with the statement 'natural resources are the foundation of the economy' and the overall policy goal 'to improve and enhance the health and quality of life of all Ethiopians and to promote sustainable social and economic development' through the management and use of resources and the environment (FDRE, 1997). This sets the tone of the rest of the EPE, where water security becomes fundamental to the proposed policies of socioeconomic development; the contribution of water security to the vision of the EPE can be mostly inferred from links to agriculture, energy, and the role of communities.

Physical characteristics such as rainfall, topography (highlands vs. lowlands), climate variability, and diverse environmental conditions, are targeted in EPE policies for better water management and water use practices (mainly in irrigation, farming, and agriculture) as well as for irrigation expansion. Consequently, the specific section on water resources policy is largely focused on irrigation potential – defining water security in the physical sense of infrastructure (dams and irrigation), quantity and quality of water resources, recharge of surface and ground water, climate variability, and monitoring. The EPE especially highlights, in the contribution of agriculture to the national economy, various policies and objectives being based around increasing agricultural production and sustainably improving and intensifying existing farming systems.

As well as agriculture, the water security of the country can be inferred to play a large role in the energy security of Ethiopia (i.e., the hydroelectric potential of Ethiopia). The EPE specifically states that 'water resources play an important role to meet Ethiopia's energy demand'. Additionally, that hydroelectricity is also a part of low-environmental impact and sustainable energy solutions; 'Ethiopia's environmental

[110] The preparation of the conservation Strategy of Ethiopia began before 1995 but continued until 1998. Phase I ran from 1989-1990, Phase II from 1991-1994, and Phase III from 1995-1998.

and long-term economic interests and its energy prospect coincide with the need to minimize atmospheric inputs of greenhouse gases' (FDRE, 1997, sec.3.9).

Furthermore, a large part of the EPE is community, the EPE repeatedly makes the point that both the community **and** the Federal Government have high responsibility in implementing and executing policies in the EPE. To facilitate this, the EPE specifically requires the 'empowerment and participation of the people and their organizations' in environmental management activities through 'necessary legislation, training, and financial support' and 'effective methods of popular participation in the planning and implementation of environmental and resource use and management projects and programmes' (FDRE, 1997). Whilst this demonstrates means to act on the 'duty' given to the peoples of Ethiopia in protecting the environment (The 1995 Constitution, Article 92:4), it also passes down many responsibilities from state to community. For example, in environmental management, pollution control, and the formulation of local resource use and management plans. When it comes to community and water resources policies (Section 4.4 of the EPE), the federal idea of community water security can be implied as simply involvement with 'the planning, design, implementation, and follow up in their localities of water policies, programmes and projects' – which are largely associated with physical water-use relationships such as irrigation and farming in the EPE.

The EPE additionally recognises that the state's ability to pursue water security (through policy implementation) is reliant on capacity. The EPE looks to build state capacity in research, analysis, monitoring, technology, institutional frameworks, sectoral guidelines, and teaching and training at higher-education level. There is also a large focus on increasing capacity for the implementation and management of resources and the environment. For policy implementation (Section 6 of the EPE), decentralisation is a key policy, but it is also recognised that legally established coordination management bodies from federal down to the community level would be needed to 'handle the sectoral and cross sectoral planning and implementation issues' of federal executive organs, ministries, regional and municipal governments, authorities and bureaus, elected councillors, NGOs, community representatives, representatives of professional environmental associations and the private sector (FDRE, 1997, sec.5.1). Additionally, a separation between organisations of

‘environmental and natural resources development and management activities on the one hand, and environmental protection, regulation and monitoring on the other’ is suggested to ‘avoid conflicts of interest’ which seems to contradict the integrated management message in the rest of the EPE (FDRE, 1997, sec.5.1).

Lastly, the EPE adheres to one of the fundamentals of the Constitution - the right to live in a clean and healthy environment, further adding the right of ‘a secure and uninterrupted access to it [land] and to renewable natural resources on it (e.g. trees, water, wildlife and grazing)’. With this, the well-being of ‘people living in the country’ is linked to an adequate environment and the assurance of this under policy and law. And the ‘well-being of the environment’ is mentioned as an impacting factor to ‘issues of poverty, health, education, and empowerment’. This perhaps demonstrates the consideration of a more interconnected, diverse, and social water security, being linked strongly to human security and justice rather than simply physical water access.

9.2.3 The Ethiopian Water Resources Management Policy (1999)

The goal of the 1999 Ethiopia Water Resources Management Policy (EWRMP) was to ‘enhance and promote all national efforts towards the efficient, equitable and optimum utilisation of the available water resources of Ethiopia for significant socioeconomic development on sustainable basis’ (MoWR, 1999). It has five policy objectives and six fundamental principles. The policy objectives are largely based on physical dimensions of water security and include: (1) the equitable sustainable development of water resources; (2) the allocation of water based on efficiency, equity, and sustainability; (3) management of water-related disasters through allocation, redistribution, transfer, storage, and efficient use; (4) sustainable mitigation of flood events; and (5) conservation and protection of water resources. These are, however, based on six fundamental water management principles that demonstrate boarder water security goals; water security, again, being strongly linked with economic and human security. The six fundamental water management principles are: water being commonly owned by all Ethiopians; every Ethiopian having access to clean water to the extent the country’s resources permit; water being recognised as both an economic and social good; water resources development being based on a rural-centred, participatory, decentralised

management approach and an integrated framework; water management that ensures social and economic sustainability; and water management that promotes the participation of all stakeholders.

By observing the contents of the EWRMP, it is clear how important physical water security is to the federal state especially in terms of water supply and sanitation, irrigation, and hydropower, all of which have their own sectoral policy chapters. The EWRMP also makes clear the links between this physical dimension of water security and the energy, food, and economic security of Ethiopia, stating that: ‘This policy was formulated with the belief that an appropriate water resources management policy for the sector will enhance the development of the country's water resources to make optimum contribution to an accelerated socioeconomic growth’. In particular, the securing of water resources through hydropower schemes, irrigation development and expansion, and water supply schemes, are clear pursuits of improved water security. With regards to the former, the link between water security, energy security, and development for Ethiopia is particularly emphasised in the EWRMP with water resources providing a means to meet energy demands but also contribute to the Gross National Economy through trade with neighbouring countries. Whilst the EWMRP’s approach to physical water security appears siloed, there is some consideration of the interdependent nature of these various dimensions of physical water security; suggesting the development of the country’s water resources rests on an integrated and unionised approach from different activities in water supply and sanitation, irrigation and drainage, hydraulic structure, and watershed management.

Despite the weighting towards a more physical water security in the EWRMP there are, however, sections that reflect a more social perspective. The importance of stakeholder involvement (including gender considerations), enabling environments, and research activities are also addressed in this policy. Here, it becomes apparent that the water security provided by supply is not only significant to the socioeconomic development of the country but also to the ‘wellbeing and productivity of the peoples of Ethiopia’. Additionally, institutional factors’ ability to hinder the pursuit of water security are mentioned and addressed in the general water resources management strategies of the EWRMP. For example, the strategy to ‘build and strengthen the necessary capacity in terms of: institutions, legislation, and facilities; human

resources, finance; information systems, research, and studies; …and capacity building at the decentralised and lowest level'.

9.2.3.1 The Water Resources Management Proclamation (2000)

The Water Resources Management (WRM) Proclamation (Proclamation No. 197/2000) followed the EWRMP as its legally binding counterpart that aimed to 'ensure that the water resources of the country are protected and utilised for the highest social and economic benefits of the people of Ethiopia…and that the management of water resources is carried out properly' (Proclamation No. 197/2000, Article 3) (FDRE, 2000). The WRM Proclamation (No. 197/2000) is the basic legal instrument governing the management, planning, utilisation, and protection of water resources in Ethiopia (Tamrat, 2008). It details MoWE's roles and responsibilities as the executive arm of the Federal Government responsible for Ethiopia's water resources (Proclamation No. 197/2000, Article 2:7); to 'ensure and administer that the management of any water resource is put to the highest social and economic benefits of the Ethiopian people in accordance with the provisions of the Ethiopian Water Resources Policy, Basin Master Plan Studies and water resources laws'. (Proclamation No. 197/2000, Article 6:3). Although the WRM proclamation is based on the EWRMP, a fundamental of which is IWRM, it does not list coordination or cooperation with other Federal or Regional bodies as part of MoWE's responsibilities.

9.2.3.2 The Ethiopian Water Resources Management Regulations (2005)

The Ethiopian Water Resources Management (WRM) Regulation (No. 115/2005) provides 'detailed provisions for the effective implementation of its parent legislation on the Water Resources Management Proclamation' (Tamrat, 2008). The WRM Regulations recognise that the 'supervising body' for water resources management activities is applicable to more than just MoWE; it includes any body that has had powers and responsibilities delegated to it by MoWE related to water resources management (No. 115/2005, Article 2:7) (FDRE, 2005). With this definition of 'supervising body' the subsequent Articles create confusion as to who is responsible for permit issuing, termination/suspension, and transfer for water resource utilisation, water works, and discharge of wastewater, as well as who is responsible for the enforcement of charges related to these. Furthermore, the WRM proclamation gives MoWE the powers to decide on water resources disputes between Regional States

(No. 197/2000 Article 18:d), but the WRM regulations give this to the ‘supervising body’ defined as ‘ the Ministry of Water Resources or any organ delegated by the Ministry’ (No. 115/2005 Article 2:7).

9.2.4 The Water Sector Strategy (2001)

The 2001 Ethiopian Water Sector Strategy (WSS) aimed to further put the EWRMP ‘into action’ through a road map that reformed the water sector and the formed a national water sector strategy. Its overarching goal was to ‘enhance and promote all national efforts towards the efficient, equitable and optimum utilisation of the available water resources of Ethiopia for significant socioeconomic development on a sustainable basis’ (MoWR, 2001). The WSS reinforces the main foundations of The 1995 Constitution, the EWRMP, and the WRM policy: water as commonly owned by all Ethiopians; every Ethiopian having access to clean water to the extent the country’s resources permit; water being recognised as both an economic and social good; water resources development being based on a rural-centred, participatory, decentralised management approach and an integrated framework; and water management that ensures social and economic sustainability. The objectives of the WSS are to make contributions towards improvements in living standards and socioeconomic wellbeing, food security and self-sufficiency, extending water supply and sanitation coverage, enhancing the contribution of water resources to national development, and promoting IWRM (MoWR, 2001). The WSS also establishes and promotes several new bodies and institutions as well as plans related to water resources management as part of the water sector reform.

The WSS is composed of 11 main strategic directions, which largely draw from the EWRMP cross-cutting issues: water resources development; water resources management; the enabling environment; transboundary waters; finance and economics research and development; stakeholder participation; gender mainstreaming; disasters and public safety; environment and health; and technology and engineering. The various interventions within these appear to consider a broader perspective on water resources management and therefore the pursuit of water security. For example, the WSS is more concerned with wider capability to pursue water security driven by institutional arrangements, organisation coordination,

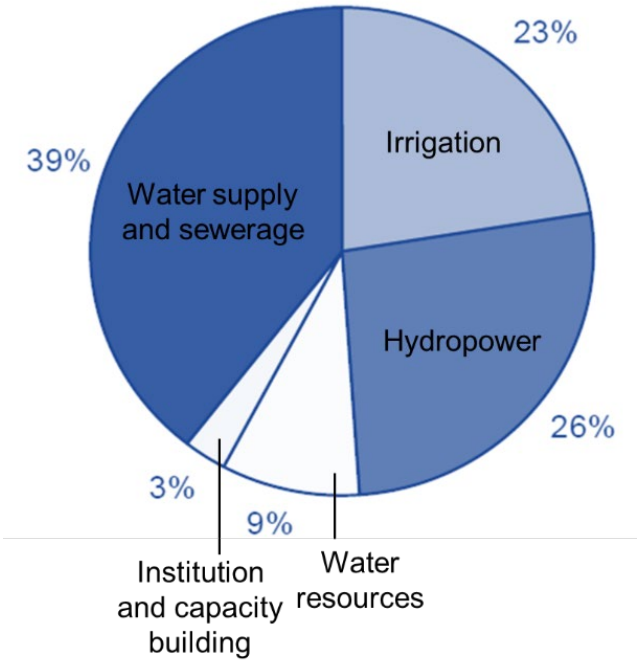
financing, research and knowledge, and devolution of responsibilities to community level.

9.2.5 Water Sector Development Program (2002)

The Water Sector Development Program (WSDP) was part of one of the four building blocks in the Poverty Reduction Strategy Paper (PRSP) – a ‘strategy for economic growth based on agricultural and industrial development’ (MoFED, 2002). It aimed to adhere to principles of the National (Ethiopian) Water Resources Management Policy (Section 9.2.3), the National Water Sector Strategy (Section 9.2.4), as well as support the UN Millennium Development Goals its activities. It also adopts the basin as the ‘planning until for development and management of water resources’ (MoWR, 2002).

The WSDP places water security at the centre of socioeconomic development, food security, and electricity production whilst recognising the impacts of pollution on the ability utilise water resources as well as the environmental impacts of associated activities. Hence its associated sectoral priorities and targets are based around areas of: water supply and sewerage development; irrigation development; hydropower development; water resources development; and institution and capacity building. Although, this is heavily weighted towards water supply and sewerage programs over the other areas (see Figure 89). The sectoral priorities and targets of the WSDP demonstrate diverse perspectives of water security; a number of water security dimensions from drinking water and sanitation, to livestock watering, to irrigation, to hydroelectric power, to industrial development, to recreational uses, are mentioned for example.

Figure 89. Coverage of programmes within the Water Sector Development Program (adapted from MoWR (2002) fig.2)



The importance of the capability to pursue water security is also reflected in the targets associated with capacity building for creating an enabling environment defined as ‘an appropriate legal and regulatory framework, and enforcement of the policy and strategy’ (MoWR, 2002). As part of this enabling environment, the WSDP suggest the reorganisation of MoWE[111] as well as creation of ‘seven basin authorities and a few other institutions; and strengthening of regional institutions’ (MoWR, 2002). The WSDP gives the execution of the plan to a number of organisations including Federal (MoWE), Regional (water bureaus), private sector, NGOs, external support agencies, and local communities and individuals, demonstrating the importance of several types of actors in facilitating pursuing water security in Ethiopia.

9.2.6 The Draft National Water Policy and Strategy (2020)

In 2020, Ethiopia proposed the revision of the national water policy (the EWRMP) and water sector strategy (the WSS). As a result, a Draft National Water Policy and Strategy (NWPS) was prepared by MoWE and is still under review and discussion.

[111] At the time, the Ministry of Water Resources (MoWR).

The draft NWPS recognises changes and developments – since the EWRMP and WSS – at national, regional, and international levels in addition to the increasing demand for water in all sectors being cause for updating the existing water policy and associated strategies (MoWIE, 2020). Additionally, it recognises that the EWRMP and WSS do not integrate various macro-economic policies, such as: GTPI and II (see Section 9.3.1), CRGE (see Section 9.3.3), the AU 2063 Agenda, the Africa Water Vision 2025, the recognition of the human right to drinking water, the 2030 Agenda for Sustainable Development, and the UN Sustainable Development Goals, amongst others. In this sense, the draft NWPS further revaluates the role of water security in the socioeconomic development of Ethiopia, and how water insecurity could jeopardise ‘people’s livelihoods, health, and the entire ecosystem’s services… and consequently, the overall socioeconomic development trajectory may be under serious threat’ (MoWIE, 2020).

The NWPS has 12 objectives and 12 guiding principles that cover water management, allocation, conservation, institutions, monitoring, research, and interventions under IWRM. Guiding principle 12 specifically states that water resources should be developed and managed on the principles of: the polluters pay principle; the users pay principle; the precautionary principle; the good governance principles; and the principle of holistic systems thinking (MoWIE, 2020, p.13). There is a general theme among various strategies in the Draft NWPS of strengthening the capacity of basin institutions and better integration (and decentralisation of water management mandates) between federal-level, river basin, regional, and local administration(s) to better pursue water security (MoWIE, 2020, secs6–8). The NWPS also reinforces the principles of IWRM for water resources management. Although it updates the definition of IWRM from the EWRMP to include allocation and monitoring of water, land and related resource use, and intergenerational equity (MoWIE, 2020).

9.3 National socioeconomic strategies and plans

As mentioned in the introduction to this chapter, some documents do not directly address water resources management but are significant socioeconomic strategies of the country that include water resources management. These documents demonstrate the perceived national role of water resources for some of Ethiopia's wider state-level goals and objectives. They therefore capture important dimensions of state-level water security and are worth discussing alongside water resources specific documents.

9.3.1 The Growth and Transformation Plan I & II (2010, 2016)

The Ethiopia Growth and Transformation Plan (GTP) was first issued by the Ministry of Finance and Economic Development (MoFED) in 2010 for the period of 2010-2015 (GTP I). It was then reissued by the National Planning Commission of Ethiopia in 2016 for the period of 2015-2020 (GTP II). Both GTPs detail the national social and economic development strategy of the country, being adopted by both the House of People's Representatives and the Council of Ministers as the national planning document of Ethiopia.

9.3.1.1 GTP I (2010-2014)

GTP I states that priorities for water resources management should be in supporting GTP objectives and sub sector priorities; meeting international targets (in this case, the UN Millennium Development Goals), fulfilling national social and economic priorities (water supply coverage and irrigation expansion), improving water resources utilisation, and ensuring fair and equitable utilisation of water resources under different scenarios (MoFED, 2010, p.77). Additionally, that the approach to this should be integrated and consider the 'parallel needs of resource usage such as water supply, development of irrigation, river basin administration, watershed management and related activities' (MoFED, 2010, p.77). This is partly reflected in GTP I's recognised combined importance of agricultural and rural development, industry, infrastructure, social and human development, good governance, and democratisation in pursuing water security, along with the socioeconomic growth and security the country.

9.3.1.2 GTP II (2015-2019)

GTP II sought to increase the productivity of agriculture and manufacturing, improve the quality of production, and stimulate competition in the economy (NPCE, 2016, p.ix). As a result, GTP II is focused on water-intensive agricultural 'scaling up' and a development-led industrialisation strategy, especially focussing on the role of water resources in investment attraction and energy production. Additionally, under the strategic direction for *Potable Water Supply and Irrigation Development*, the main objectives are 'provision of access to safe and sustainable water supply and improved waste water disposal systems; improving potable water supply services and accessibility as well as urban sewerage systems; assessing the quantity and quality of the country's water resources and their contribution to the development of the economy, also mitigate flood and runoff impacts' (NPCE, 2016, p.182). In GTP II, water security for Ethiopia is deemed critical for 'the achievement of rapid and sustainable socioeconomic development' with interventions for water resources being focused on water supply, irrigation and drainage development, hydropower study and design, surface and ground water study, integrated master plans, and watershed management (NPCE, 2016, p.181).

9.3.2 The Universal Access Plan (2011)

The Universal Access Plan (UAP) was first ratified in 2005 and aimed to enable the provision of safe water to all Ethiopian citizens (MoWIE, 2015b). However, it was revised in 2011 to accommodate: alignment with GTP I; the near completion of the National WASH inventory; the WASH implementation framework; the self-supply policy guidelines for enhancing local actions in achieving UAP targets; the sanitation and hygiene development plan; and the integration of the 2006 WASH Memorandum of Understanding (MoU) between Ministries of Water, Health, Education, and Finance (MoWE, 2011a, 2011b). The revised UAP is split into four parts[112]: (I) Rural Water Supply; (II) National Hygiene and Sanitation; (III) Urban Water Supply; (IV) Urban Sanitation. These parts act as planning milestones for WASH implementation under the WASH implementation framework, agreed in the 2006 WASH MoU (MoWE, 2011b).

[112] Parts I, III, and IV were prepared by MoWE, Part II was prepared by the Ministry of Health.

The UAP demonstrates the significance of potable water supply as a dimension of water security for Ethiopia. The UAP also demonstrates the shared responsibility for potable water security across the Federal Government (MoWE), Regional States, and Basin Authorities, in the coordination and monitoring of UAP/GTP implementations (both WASH and catchment/watershed protection) (MoWE, 2011a, pp.47, 58). In particular, the UAP demonstrates how the mandate of drinking water supply is passed down from MoWE to Regional States' water bureaus and utilities[113].

9.3.3 The Climate Resilience Strategy for Water and Energy (2015)

The Climate Resilience Strategy for Water and Energy was developed as part of Ethiopia's Climate-Resilient Green Economy (CRGE) Initiative (2011). The CRGE initiative aimed to develop Ethiopia's green economy based on pillars of improving crop and livestock production, protecting and re-establishing forests, expanding renewable electric power generation, and 'leapfrogging' to modern and energy-efficient technologies (FDRE, 2019a). Additionally, seven sectors of the economy most vulnerable to climate change hazards were identified and priority regional adaptation plans were developed for these: agriculture, health, water and energy, buildings, and transport (FDRE, 2019a).

The Climate Resilience Strategy for Water and Energy, prepared by MoWE, set out some implementation priorities that built on the CRGE initiative. Similar to GTP I, the main dimensions of water security are water for agriculture and access to WASH. However, dissimilarly, the resilient development of water resources is listed under cross-cutting issues with the CRGE Water and Energy Strategy taking the opportunity to highlight the importance of incorporating effective water resources management into development plans to 'minimise situations of water scarcity and to make strategic choices about different water uses' (MoWIE, 2015a, p.34). In balancing water demands, the strategy calls for better management of various growing water demands including better regulation and licensing of abstraction (MoWIE, 2015a, p.41). This must fall under MoWE's and Regional States' mandates

[113] The UAP recognises that MoWE has no legal mandate concerning drinking water supply but that it is 'the entity in charge of setting policies for water supply and to channel donor funds in the sector to local government entities' (MoWE, 2011c, p.8). As part of this, the UAP further promotes decentralisation of oversight and operations related to water supply and resources management.

as RBOs had not yet been established as the River Basin Councils and Authorities Proclamation was yet to be fully implemented (MoWIE, 2015a, p.43).

9.3.4 ONE WASH National Programme Phase 2 (2018)

The ONE WASH National Programme (OWNP) has a Phase I (2013-2017) and Phase II (2018-2020) that mirror GTP I and GTP II, respectively. As per its title, the focus of the OWNP is on WASH services and so water security from potable water supply is the main focus; it was developed to 'contribute towards improving the health, well-being and economic activity of both rural and urban populations by increasing water supply and sanitation access and the adoption of good hygiene practices in an equitable and sustainable manner' (FDRE, 2018b). The OWNP is the first federal document that uses the specific wording of 'water security'; in the OWNP approach, 'the water supply system is to be completely overhauled, leaving no one behind, with a new approach that allows comprehensive investment that creates resilient infrastructure, adequate and reliable access, **water security**, disaster reduction and secure investment efficiency contributing to Ethiopia's growth and transformation' (FDRE, 2018a). More broadly, the OWNP links WASH with broader water, food, tenure, and social security.

There is, however, no clarity in OWNP what water security means in the context of these plans. It can only be inferred that it is largely: (1) a combination of physical reliability and diversity of water resources; (2) the technological and institutional capability to utilise water resources and reuse water; and (3) sustainable water use behaviours. With regards to (1) and (2), these draw on the OWNP Phase I's major conceptual bases for climate resilient WASH, which is where water security is specifically mentioned (FDRE, 2018a, sec.8.15). With regards to (3), this draws on Phase II's general perspective of water security being a social process, a product of behaviour change, social mobilisation, and community communication and engagement. Notably, Phase II's mention of water security is under the area of advocacy (activities to persuade and mobilise people and decision makers to take action) (FDRE, 2018b, table 1.1) not water resources, climate resilience, or capacity development, for example.

9.3.5 The National Adaptation Plan (2019)

The National Adaptation Plan (NAP) was also part of the CRGE initiative and built on GTP II. The NAP's goal is to reduce vulnerability to climate change through building adaptive capacity and resilience; guided by principles of participation, coherent interventions, stakeholder empowerment, gender sensitivity, equitable implementation, and partnership (FDRE, 2019b). Under the eight identified 'most vulnerable' sectors (agriculture, forestry, health, transport, power, industry, water, and urban) there are 18 adaptation options and five strategic priorities. The implementation of NAP falls under the mandate of several sectoral institutions, one of which is MoWE (FDRE, 2019b, pp.69–70). Whilst the NAP discusses the potential climate change impacts on water in the country (such as decrease in potable and non-potable supply, increase in water pollution, and damage and decline of aquatic habitats), it does not specifically mention water security. Although, water resources management appears central to many adaptation options in addressing vulnerability to climate change impacts; improving water conservation, availability, access, efficiency, governance, and development are all mentioned as being required for climate resilience. Specifically, adaptation option three (strengthening sustainable natural resource management through safeguarding landscapes and watersheds) specifically identifies the role of water resources management in climate resilience in terms of its role in energy production, health, and agriculture (FDRE, 2019b, p.56). There are, however, no adaptation options or strategies that specifically deal with the water resources governance structures, mandates, or policies.

9.3.6 Ethiopia Ten Years Development Plan (2020)

The current national planning document of Ethiopia is the 10-year Development Plan (EDP10), that takes over from the end of the GTP II period. In the scope of the EDP10, macroeconomic, sectoral, and structural reforms are put forward to improve economic management, monitoring, and stability. Under the sub-section of the *Infrastructure Development Plan*, water resources development is listed as an area of reform which includes 'the provision of potable water and sanitation services as well as irrigation and river basin development' (PDCE, 2020, p.53). The objectives of the Water Resources Development Plan within the EDP10 are 'to ensure equitable provision and accessibility of potable water, sanitation and hygiene services that

meet quality standards; and to enhance the development and utilization of the river basin and irrigation resources of the country' (PDCE, 2020, p.53). It is understood in the EDP10 that these objectives require increasing the practice of IWRM to be achieved in the next ten years. It is observed, however, that the main focuses in the Water Resources Development Plan within EDP10 are not built on water resources management development around IWRM but instead largely expansion of potable water supply and medium and large-scale irrigation schemes (PDCE, 2020, sec.6.2).

9.4. State-level water security perspectives and priorities

It can be observed that, across both state-level water resources management and socioeconomic planning documents, consistent water security themes appear over the past few decades: potable water security from improved WASH and supply coverage linked with health security; food security as a product of improved water security for irrigation and livestock; and the link between Ethiopia's energy security and water security as a result of utilising its hydropower potential. All of which feed into a wider socioeconomic security for the country.

Seemingly, the legal foundations of water security for Ethiopia germinate from The 1995 Constitution where the utilisation and ownership of natural resources is solidified as a crucial component of the socioeconomic development potential of the country. For water security, The Constitution implies physical dimensions (access to material resources and clean water e.g., Article 89:1, Article 90:1), social and political dimensions (the roles and responsibilities of multiple bodies in natural resources management and conservation e.g., Article 40:3, Article 51:5, Article 52:2,d, and Article 92:4), and dimensions of human security and justice (in terms of rights, provision of public health, healthy environments, and sustainable development e.g., Article 41:4, Article 43:3, Article 44:1, Article 92:1) of water security.

Subsequent water resources management documents, however, are largely dominated by more physical water security (securing of water resources), especially how this is intertwined with the country's energy security (hydropower), food security (irrigation and agriculture), economic security (irrigation, livestock, industry, and tourism), and health security (WASH and potable supply coverage). Additionally, social dimensions of water security become focused around the state value of water resources as well as the roles and responsibilities of certain water resources management actors and the organisation of these – with frequent renaming, redefining, and restructuring of federal executive bodies and their mandates. This is linked with the state's capability to pursue water security through institutional and organisational capacity, a dimension of both social water security and capability to pursue water security, forming a large part of policies and plans. The EWMRIP,

WSS, and WSDP all mention the role of an enabling environment[114], for example, in the ability to utilise water resources. Additionally, the EWRMP and WSS also state that water is a social good as well as economic. This is more pronounced in the role of potable water supply and network coverage in improving living standards, productivity, and attracting investment. Lastly, within EDP10 water-related objectives are not built on water resources management development around IWRM but instead largely expansion of potable water supply and medium and large-scale irrigation schemes (PDCE, 2020, sec.6.2).

Moreover, The 1995 Constitution, on which much of the subsequent water resources policy, plans, and laws draw on, specifically details some rights of the individual that could be interpreted as a right to dimensions of water security. Notably, the right to improved living standards (Article 43:1), the right to a clean and healthy environment (Article 44:1), and the right to public health (Article 41:4). However, it appears that the water security of the individual becomes diluted in both water resources management and socioeconomic plans, particularly the right to a clean and healthy environment (Article 44:1) appears to not be upheld across these documents despite the EPE linking individual's well-being to an adequate environment and the assurance of this under policy and law (FDRE, 1997). Hence, it appears that over time the recipient of water security moves away from the peoples of Ethiopia and towards the federal state.

It is highly noticeable across these different documents that the link between water security and the socioeconomic development of Ethiopia is critical to national strategy. For example, the EPE appears to specifically link physical water security with irrigation management and expansion in agriculture for the socioeconomic development of the country. Similarly, water management considerations are notably discussed explicitly under Economic Sector Development and Economic Infrastructure, in GTP I and II respectively, as *Potable Water Supply and Irrigation Development*. Specifically, GTP I is primarily built around the intensification, development, and improvement of the utilisation of water resources in agricultural

[114] Defined as 'an appropriate legal and regulatory framework, and enforcement of the policy and strategy' in the WSDP (MoWR, 2002).

development and economic growth rather than water resources management, governance, and democratisation (MoFED, 2010, pp.23, 46). Furthermore, both GTPs highlight the role of and reliance on water-intensive agriculture and irrigation development as the main backbone for high case economic growth scenarios. This largely reflects the recognition of water as an economic good as stated in the EWRMP and WSS.

9.4.1 Water security actors: water security as a social and political practice and process

A number of governmental and non-governmental[115] bodies and organisations are discussed across these state-level documents that, on paper, play a key part in the water resources management of the country and therefore the pursuing of water security at this level. These are worth discussing as part of Statement 2: water security as a social and political practice, process, and value.

Primarily, The 1995 Constitution (Proclamation No. 1/1995) sets the powers and functions of the Federal Government, Council of Ministers, Regional State Governments, and Ethiopian citizens in natural resources utilisation, administration, and development in accordance with Federal laws. In particular, the Council of Ministers, led by the Prime Minister, have ‘the highest executive powers’ (Article 72:1). This includes, to ‘decide on the organisational structure of the ministries’ (Article 77:2) and ‘formulate and implement economic, social, and development policies and strategies’ (Article 77:6). This includes MoWE as well as other Ministries that have a stake in water security; the Ministry of Agriculture, Ministry of Trade and Industry, Ministry of Health, Ministry of Mines and Energy, Ministry of Economic Development and Cooperation, and the Ministry of Finance and Economic Affairs, for example, are all mentioned in the EPE and EPA as having key roles in environmental protection and water resources management (FDRE, 1995a, 1997).

[115] Several documents mention the roles of international actors in the water resources management of Ethiopia. This includes adherence to multilateral agendas and targets in state-level plans (e.g., the UN Millennium and Sustainable Development Goals, which are also linked to the adoption and implementation of IWRM) as well as the direct involvement of NGOs in execution of state-level plans (largely in those related to WASH and potable water delivery).

Additionally, Regional States (particularly regional water bureaus) are often mentioned in federal documents as sharing the roles and responsibilities of water resources management with the Federal State (as per The Constitution), and hence needing their relevant institutions strengthened as part of wider water sector development. The role of Regional States in water resources management are discussed in Chapter 8. In a similar vein, and as part of Ethiopia's adoption of IWRM as a framework for water resources management, River Basin Authorities (RBAs) also become a key actor in the coordination and implementation of water resources development at basin level. RBAs frequently appear in federal documents as means to strengthen water resources management at basin-level (MoWR, 1999, 2002) as well as take responsibility for some of the coordination and monitoring of state plans (e.g., the UAP and GTPI/II (MoWE, 2011a, pp.47, 58)). RBAs are discussed in more detail in Appendix G. The roles of Regional States and RBAs mentioned in Federal documents, however, represent a broader component of water resources management in Ethiopia – decentralisation.

The devolving of roles and responsibilities from Federal level (i.e., from the executive arm – MoWE), to Regional, Zonal, Woreda, Kebele, and community level, is a recurring theme in water resources management policy and plans. Decentralisation is mentioned as a key part of policy implementation needed to 'handle the sectoral and cross sectoral planning and implementation issues' of federal executive organs, ministries, regional and municipal governments, authorities and bureaus, elected councillors, NGOs, community representatives, professional environmental associations, and the private sector (FDRE, 1997, sec.5.1). To facilitate this, coherent and streamlined institutional frameworks are mentioned to be needed to be developed between Federal, Regional, Zonal, Woreda and Kebele levels (MoWR, 1999) as well as the strengthening and integration of relevant institutions at these various levels (MoWIE, 2020, secs6–8).

From Federal to Regional level (see Chapter 8), the effectiveness of decentralisation of power and responsibilities for water resources management is questionable. Firstly, an apparent high institutional turnover is observed to contribute to decentralised mandates getting lost between bodies and the forming of disparities and overlaps between accountable bodies for implementation of different river basin

management activities and actions. This high institutional turnover is observed to have also created loopholes for water utilisation born out of various interpretations and non-succinctness of the definitions of the constitutions and other policy documents which, again, have led to potential conflicts between 'owners' of the water resource as well as between users of the resource (Awash Basin Authority, 2017). The high institutional turnover appears to have also led to a general confusion of the awareness of policies and regulations. Where, at the high levels, policies, regulations, and guidelines are known whereas at the level of regional bodies, these are 'not well noticed or well accepted' and the water resource management tasks given to these bodies are unclear (Key Informant Interview (AwRBA), 2022).

Lastly, the inclusion of stakeholder and community groups are somewhat part of the decentralisation efforts but are also brought into the water resources management arena through the supposed involvement in decision-making and implementation. Specifically, consultation with stakeholder and community groups in policy creation and implementation including their involvement in the design, planning, implementation, operation and maintenance, and follow up of water programmes and projects (FDRE, 1997; MoWR, 1999). For example, the UAP is built on community led approaches in line with the promotion of public participation set out in GTP I (MoWE, 2011b) and the CRGE Water and Energy Strategy reinforces that the effective management of water resources relies on the future collaboration, cooperation, and close partnership between communities, RBAs, RHCs, Regional Governments, Regional Agriculture and Industry Bureaus, and Federal Ministries (MoWIE, 2015a, pp.34, 43–45).

9.4.1.1 Water governance issues for MoWE

As the executive arm of the federal government responsible for the water resources management of the country, this work has also highlighted some key issues for MoWE[116] which are worth exploring as one of the most significant actors and facilitators of water security for Ethiopia.

Fundamentally, MoWE's mandates include the development, utilisation, protection, and allocation of Ethiopia's water resources. However, with MoWE's ability to

[116] A key informant interview was undertaken with a member of MoWE, which can be viewed in Appendix I.

delegate some of its powers and duties (as per Proclamation No. 197/2000, Article 8:2; Regulation No. 115/2005, Article 2:7; and Proclamation No. 1263/2021, Article 9:3 (FDRE, 2021)) these mandates become overlapping among different water resources management organisations at multiple governance levels. Hence, responsibilities such as permit issuing and enforcement for water resources utilisation, water works, and water discharge fall under the powers and duties of multiple bodies. For example, MoWE (under Proclamation No. 197/2000, Article 8:1a,g,j), any body that has had powers and responsibilities delegated to it by MoWE (under Proclamation No. 115/2005, Article 2:7), and RBAs (under Proclamation No. 534/2007, Article 15) all have the powers to issue permits for water use and works.

As part of these overlapping mandates, regulatory and operational loopholes exist (Key Informant Interview (MoWE), 2022). MoWE appears to therefore struggle to regulate equity, enforcement, and exploitation from permitting activities because of these loopholes. For example, those who have special interests in water resources development (e.g., industry, agriculture, floriculture etc) and pass some of MoWE's legal requirements, can use more water than they are permitted to use without penalty (Key Informant Interview (MoWE), 2022). Additionally, perhaps due to lack of integration between MoWE, regional water bureaus, and the EPA, there appears to be a disconnection between abstraction and discharge activities; where permits can be issued for water abstraction but the consequential wastewater can be released without treatment (Key Informant Interview (MoWE), 2022).

There also appear to be multiple water resources development conflicts for MoWE, for example: (1) the hydrological (basin) unit versus the administrative (regional) unit for implementing IWRM, and (2) the pressure to focus on water issues related to macroeconomic agendas. In relation to the latter, in many policies and plans that MoWE is mandated to implement, the focus of water resources development is on irrigation expansion and increasing the coverage of potable water supply (e.g., GTP I and II, UAP, CRGE, NAP, EDP10). This places pressure on the ministry to meet these targets under different growth periods and planning goals. This is observed to mean that other important aspects of water resources management (e.g., capacity building, coordination, stakeholder engagement) are pushed to the side of development aims, appearing to have less specific targets and therefore becoming

addressed less readily. In relation to (1), Ethiopia has adopted the basin unit as the unit of water resources governance for IWRM implementation in many of its economic strategies of which MoWE is mandated to implement. The issue with the implementation of IWRM within the adopted basin unit, however, appears to be that many waters in Ethiopia are transboundary (trans-state and a some are trans-national). As the RBAs act within the basin unit, the Regional Governments utilise their water resources within their state boundaries[117], and there is no mandate amongst Regional bodies for coordination or cooperation, a natural conflict appears between federal (i.e., MoWE) water resources utilisation, protection, and allocation at the basin (IWRM) level and water resources utilisation, protection, and allocation within regional administrative boundaries.

[117] Regional States have the right to develop and utilise their water resources as per The Constitution.

9.5 Conclusions

Water security perspectives and priorities for Ethiopia have been interpreted from several key water resources management policies, plans, and laws that have been produced since The 1995 Constitution. As discussed, consistent water security themes appear over the past few decades: potable water security from improved WASH and water supply coverage linked with health security; food security as a product of improved water security for irrigation and livestock; and the link between Ethiopia's energy security and water security as a result of utilising its hydropower potential. All of which feed into a wider socioeconomic security for the country and the recognition of water resources as an economic and social good – a recognition that is repeated in the EWRMP and WSS, and consistently reflected in national planning documents (e.g., GTP I and II, CRGE, EDP10, etc).

It is clear that water security for Ethiopia is largely legally built on some fundamentals of The Constitution: the physical access to material resources and clean water (e.g., Article 89:1, Article 90:1); the roles and responsibilities of multiple bodies in natural resources management and conservation (e.g., Article 40:3, Article 51:5, Article 52:2,d, and Article 92:4); and, adherence to rights and provision of public health, healthy environments, and sustainable development (e.g., Article 41:4, Article 43:3, Article 44:1, Article 92:1). However, whilst the first two of these appear to be consistently carried through subsequent policy and plans, the adherence to the natural resources-related rights given to individuals in The Constitution appears to fade over time. For water security, the right to a clean and healthy environment (Article 44:1), the right to improved living standards and to sustainable development (Article 43:1), the right to consultation on environmental policies and projects that affect them directly (Article 92:3), as well as the duty to protect the environment (92:4), are key reflections of hydrosocial capabilities that might impact the ability to achieve water security. And, as a legal framework, the rights given to individuals in The Constitution can be a means to make claims of injustice if they are not realised.

It could be observed that, if the water security paradigm was to be realised in a policy similar to other existing water resources management policy, it could fall into the same pitfalls; whilst it is evident that good policies and plans exist for water resources management, the institutional capacity, legal regulatory framework and decentralised

delegation structure are inefficient and ineffective. Many national planning documents and legal frameworks identify the role of water resources management in socioeconomic development, climate resilience, and environmental conservation, but there are, however, no adaptation options or strategies that specifically address water resources governance structures, mandates, or policies. The national planning documents and legal frameworks also appear to forget the rights of the Regional Governments in developing their own water resources, creating difficulties in implementing IWRM at basin level with respect to this. Essentially, it could be observed that national development plans and legal frameworks are so focused on increasing the irrigation potential and potable water coverage for better socioeconomic growth that water management, whilst frequently mentioned, is not well integrated into national plans and policies for growth, climate resilience, or water sector strategy.

Part three Discussion, reflections, and conclusions

Chapter 10. Degrees of interconnectedness and disconnectedness between water security landscapes at local, regional, and national level

This thesis has explored the paradigm of water security, as framed by three statements, at various water resources management levels in Ethiopia. At regional and local level, water security was explored in Ethiopia's capital city, Addis Ababa, using a systems approach to investigate and compare perspectives and priorities. At national level, the institutional water resources management context was investigated through analysis of laws, policies, plans, and other legislative documents, and used to interpret water security perspectives and priorities for Ethiopia. Crucially, the discussions and conclusions of this research hinge on: (1) the three statements of water security as defined in Chapter 2; and (2) the systems fundamentals of methodological pluralism, boundary judgements, and open systems (explained in Chapter 3) used to critically explore and compare water security. Both provide means to structure discussions around the objectives of this work.

This chapter will therefore discuss the implications and themes of the findings in the previous chapters that investigated water security at local (Chapter 7), regional (Chapter 8), and national (Chapter 9) level. It will summarise the cross-cutting findings of contextual water security for Addis Ababa through discussion around the three statements of water security that frame this research, triangulating the various findings and discussing the degrees of connectedness between the perspectives and priorities of water security, as revealed by this research. It will further draw on these findings to structure a broad discussion around the operationalisation of water security as a water resources management paradigm for Ethiopia.

10.1 Contextual water security for Addis Ababa

The water security perspectives and priorities for Addis Ababa are largely explored in Chapters 7 and 8 for local (individual) and regional (utility) water security, respectively. The objectives associated with these chapters being:

- Understand community perceptions and priorities of water security and how these may vary in different areas of Addis Ababa e.g., location in the city (urbanisation levels) and position in the catchment (upstream/downstream)
- Understand water security from the perspective of the local utility, including the range of factors that are perceived to contribute to water insecurity in Addis Ababa

In meeting these objectives, the main finding of Chapters 7 and 8 was that, for Addis Ababa, there are many diverse water securities; heterogeneity being observed between these based on the characteristics of community location. Additionally, the range of contextual factors perceived to contribute to water security between the local utility (AAWSA), the utility of the bordering OSZ (OWEB), and other stakeholders within the city were also found to differ. The following sections will discuss some specific findings for contextual water security in Addis Ababa, as framed by the three statements of water security defined in Chapter 2 of this research, triangulated between analysis across chapters. This discussion also contributes to the objective of *Present an understanding of water security in Addis Ababa as a product of various contextual factors, unique to the area*.

10.1.1 Water security as defined by physical water insecurity

As discussed in Chapter 6, it is currently thought that Addis Ababa only meets between 40-60% of its water requirements. Whilst the validity of this figure was not investigated by this research, water shortages (or no water supply at all) were described at both local and regional level suggesting that consistent, reliable water supply is not currently possible in Addis Ababa. Hence, water security defined by this particular dimension – physical water insecurity – was notably both a consistent perspective and priority within Addis Ababa.

At a local level, the pursuit to improve water security through physical water security was an apparent struggle especially in areas with frequent shortages or those that were not connected to the water supply network. Additionally, several contextual

drivers were identified for the perceived cause of this dimension of water (in)security; lack of Bono taps, siltation of wells, poor water quality of piped and river water (particularly described by those who used to be able to drink the river water), urbanisation in Addis Ababa, and local land-use changes, as some examples. Consequentially, in Chapter 7, individuals described a range of contextual adaptation and coping mechanisms to improve their physical water security, demonstrating exchanges with the social and physical environment of individual water security systems:

- Buying bottled water
- Damming and collecting river water
- Digging individual (private) wells
- Sharing water (inter-community water markets, for example)
- Getting water from a different city area with better supply
- Reporting

Furthermore, at regional level, ‘securing the resource’ was a consistent narrative thread among actors in Addis Ababa, reflecting an interpretation of water security as the physical securing of water i.e., more water equals more secure. Participants in the AAWSA workshops, for example, explicitly described their concerns for the widening supply and demand gap in the city. This perspective of water security is consistent with narrative in AAWSA’s 2011-2020 Business Plan and 2016 Long Term Road Map that focus on physical water security over the past 10 years; improving water security through supply development such as treatment plant expansion, ground and surface water development, and NRW reduction. Additionally, the perspectives and priorities of other actors in Addis Ababa used this language where the physical ‘securing’ of water was mentioned in responses such as ‘water security means securing the limited resource’ and ‘water security means to secure water’. Key informant interviews with three water bureaus in the OSZ also confirmed a similar understanding of this physical dimension of water security. Specifically, in terms of potable water availability and supply. Water insecurity in this case, however, was specifically linked to Addis Ababa; over abstraction of groundwater and urban expansion being the commonly mentioned perpetrating activities. The former

perhaps reflecting Addis Ababa's increasing groundwater abstraction over the last 10 years[118].

Furthermore, at both local and regional level, a considerable factor of physical water security also appeared to be water quality, with water security being described as a product of both sufficient water quality and quantity on several occasions. Whilst this was occasionally referred to as the quality of water supply[119], environmental (river) water quality appeared to be more of a concern for Addis Ababa in terms of pollution of water courses within and outside of the city. Non-utility actors in Addis Ababa placed water quality and pollution as the top water security priority for the city over water quantity, for example. This is consistent with the 2017-2027 Addis Ababa City Structure Plan that also places high emphasis on water pollution issues within Addis Ababa due to health threats and downstream impacts from industrial and domestic wastewater discharges (ACCPPO, 2017). At local level, concerns for water quality were also expressed in recounts of bad smelling river water, visible litter and waste in the river, mixing of river water and sewerage, and the changing of the colour of river water to black, sometimes described using strong negative feelings such as fear, concern, danger, and harm. In these descriptions, it becomes difficult to discern whether these issues of environmental water quality are a dimension of physical water (in)security or are more associated with human security and justice.

10.1.2 Water security as a social and political practice, process, and value

As discussed in Chapter 2, the threshold between water security and insecurity can be expressed through social relations with the environment as well as multiple forms of value in water. Across this research, water security as a social and political practice, process, and value has been found to be a significant dimension of water security. The materialisation of this, however, is observed to vary significantly and the line between the social and political is hard to distinguish without further investigation. Furthermore, for Addis Ababa in particular, water security as a social

[118] As described in Chapter 6, the split between surface and groundwater supply shifting from 80:20 (2009), to 70:30 (2017), to 50:50 and 40:60 more recently (Worku, 2017; Van Rooijen & Taddesse, 2009; Arup, 2021a, 2021b; Birhanu et al., 2022).

[119] In Chapter 8, AAWSA mention poor water quality as a result of old pipe distribution networks and OWEB mention the lack of capacity to monitor and test the quality of water. Individuals describe their concerns of the visible dirtiness of water when it comes (Chapter 7, Section 7.2.3).

and political practice, process, and value, appears highly interrelated with human security and justice.

10.1.2.1 Political water security

In Chapter 6, the historical context of water resources development in Addis Ababa was explored. This demonstrated the many personalities of Addis Ababa: a political and economic centre for East Africa, being host to a number of international organisations as well as an industrial capital; the capital city of the Federal Government of Ethiopia; the seat of the Oromia Regional State government; the Oromia Regional State capital city, *Finnfinee*; and an autonomous state with self-ruling government. In addition to, and perhaps as a result of, these many personalities, there are strong national and regional incentives and support to develop the water and wastewater services in Addis Ababa (ACCPPO, 2017); federal favour towards Addis Ababa's policies, strategies, proclamations, regulations for water resource and sewerage system development (AAWSA, 2016) and financial favour from the City Administration (Arup, 2021b), for example. All of these contextual characteristics of Addis Ababa are considerable contributing factors to its ability to assert itself as a powerful actor, showing how the pursuit of water security can be a political practice in a situation where water resources are in competition, and therefore how more powerful actors can assert their water security over others. This appears to particularly be the case for the relationship between Addis Ababa and the surrounding OSZ (discussed more in Section 10.2).

As another reflection of water security as a political practice, process, and value, there appears to be a strong link between the capability to pursue water security and the institutional capacity or enabling environment at both federal and regional level. This enabling environment was expressed as missing by various regional actors, with consistent themes around low sectoral capacity, weak policy implementation, poor ability to enact mandates, and high organisational turnover. These appear to act as significant systemic barriers in the capability to pursue water security as a political practice and process. The 2011-2020 AAWSA Business Plan, for example, lists plans to improve organisation and capacity as key elements of its institutional development and therefore its ability to be an 'efficient public service provider' (AAWSA, 2011). Additionally, AAWSA's 2016-2030 Long-term Road Map identifies

‘sufficient skilled manpower’, ‘lack of well institutionalised and appropriate regulatory frameworks’, and ‘inadequate delegation of authority and responsibility’ as bottlenecks to AAWSA’s service provision (AAWSA, 2016). These perspectives were further reflected in the opinions of participants in the AAWSA workshops where discussions were had around wider institutional factors such as internal organisation, management, and capacity of AAWSA. Moreover, Chapter 8 demonstrated that OWEB also recognise the need for more comprehensive policy and better policy implementation. Issues of capacity were also seen as the lack of adequate technology, knowledge, and policy, that hinder OWEB’s ability to provide water services. Furthering this, OWEB specifically linked lack of adequate policy with wider equity issues surrounding water supply and distribution.

These perspectives of low institutional and organisational capacity were also paired with themes of responsibility, largely of the Federal Government, as accountable for the failings of organisation, regulation, and capability to pursue water security. This is noticeable at both local and regional level. At local level, interviewees discussed the government not ‘paying attention’ to them along with feelings of being ignored through negligence and lack of acknowledgement or correspondence with the authoritative bodies. At regional level, both AAWSA and OWEB linked the lack of policy implementation from the government with failure to take responsibility for water issues in the Addis Ababa-OSZ area.

10.1.2.2 Social water security

Water security as a social value at both local and regional level manifested in multiple ways. A consistency, however, was the link between water security and socioeconomic security, with this relationship reflecting a key dimension and value of water security at all governance levels. The OWEB, AAWSA, and the Awash RBOs, for example, all linked the development of water resources surrounding Addis Ababa (at various scales, e.g., city, catchment, basin) with socioeconomic development that directly influences wider development at both the regional and federal scale (OWEB, 2022; FDRE, 2007; AAWSA, 2016).

At regional level, the importance of water security for Addis Ababa was frequently linked to the city’s socioeconomic development. This appeared to be a bidirectional dynamic whereby socioeconomic growth of the city requires the development of

water and wastewater services as a response, but also that the development of water and wastewater services encourages further socioeconomic growth of the city as a response. At local level, the socioeconomic value of water security in Addis Ababa was expressed through the economic value associated with broader livelihood security (see Section 7.3.1 in Chapter 7). This was found to particularly be the case where the contextual livelihoods of individuals directly relied on water (e.g., livestock, agriculture, sand mining). In these cases, the threshold of water (in)security was largely influenced by the disruption to local occupations, water and land use habits, health, and safety, such as: the destroying of crops from flood events; lack of access to working land from flooding; destruction of current and historical houses from flooding; inadequacy (in water quality) of river water for making products and washing (clothes); and health impacts associated with contact with poor water quality of river water, for example. Opposingly to the expressions of socioeconomic water security from AAWSA and the Addis Ababa City Government, the relationship between water security and socioeconomic security at local level appeared more orientated around environmental (river) water over piped, potable water supply.

10.1.2.3 The merging of social and political water security

The social and political practice, process, and value of water security is largely expressed through the coordination of action to pursue water security and proactively assert a collective water security. Whilst, at local level, the pursuit of a collective water security was not always the case, in some areas community action around flood defence, pollution control, and resource sharing were prevalent social processes; fundamental to adapting, maintaining, and ultimately pursuing water security.

The most significant example of this collective pursuit of water security was in the Akaki-Kality area (see Figure 31). This part of Addis suffers from poor river water quality as well as high exposure to flooding events. In response to this, the human insecurity associated with flood events is mitigated through community early warning systems between upstream and downstream communities, warning systems within the Akaki-Kality community itself, and community funded and constructed flood defences (earth bunds). Furthermore, the Akaki-Kality community successfully engaged in collective action to improve the water quality of the downstream Big Akaki

river through group pressure and collectively applying for ‘filtering’ or ‘cleaning control’. As a reflection of water security being a social practice, process, and value, the Akaki-Kality area in particular demonstrated the social process of pursuing a common water security as part of environmental and social justice.

10.1.3 Water security as indivisible from human security and justice

It was observed in Chapter 2 that water security is intrinsically linked to human security and justice due to it being a cross-sectoral security concern for all people in all aspects of their lives; health, education, hunger, malnutrition, environmental hazards, social vices or even lack of political spaces (Woldetsadik, 2015). The intersectionality of water security with wider securities was found to significantly demonstrate the role water security plays in broader human security. When investigating dimensions of water security at local level, for example, broader securities of health, well-being, amenity, livelihood, and more, were all related to the degree of water (in)security felt.

Additionally, the ability to pursue water security was observed to be linked to claiming water justice; broader than simply water access, but a water security that included engagement in hydrosocial processes and the associated well-being and agency. For example, among the expressions of disempowerment and injustice among individuals in Addis Ababa (see Chapter 7, Section 7.3.2), three dominant themes emerged: water security injustices from lack of piped water supply; water security injustices from urbanisation; and water security injustices from disempowerment through overlooking and exclusion in decision-making spaces. Across these themes, inadequacies in well-being and agency were the particular hydrosocial relations in which human insecurity and water security injustice are observed to become realised. It was also observed, however, that injustices associated with water security were observed to be difficult to fully separate from the other two water security statements; physical water insecurity and the social and political dimensions of water security being inherent influencers over the perceptions of injustices caused, and expressions of injustice being intertwined with social dynamics, struggles, and claims.

10.2 Addis Ababa and the Oromia Special Zone

The water security relationship between Addis Ababa and the OSZ requires a cross-cutting perspective of all three statements of water security. In meeting the objective of *Understand the historical context of water resources development in Addis Ababa* in Chapter 6, it was observed that this relationship is critical in the conceptualisation and operationalisation of water security in this area. Hence, providing a unique contextual dynamic for Addis Ababa's water security, and contributing to the objective of *Present an understanding of water security in Addis Ababa as a product of various contextual factors, unique to the area*. It is not within the scope of this thesis to examine the relationship between Addis Ababa and the OSZ in detail. It is, however, near impossible to be able to facilitate a discussion on the contextual water security of Addis Ababa without partly understanding the water resources relationship between these two areas and the actors within them. This section, therefore, attempts to reflect on this relationship based on the research conducted as part of this thesis but does not have the scope to conduct a detailed analysis of the complex institutional dynamic between Addis Ababa and the OSZ.

The establishment of Addis Ababa and the OSZ, discussed in Chapter 6, demonstrates how the dynamic between these two areas is built on a complex social, political, and environmental history with embedded historical ethnic tensions over land and resource ownership and use. Water security for Addis Ababa is therefore inherently political due to its relationship with the surrounding OSZ; the development and expansion of Addis Ababa bordering with the surrounding Oromia Regional State in the buffer zone of the OSZ. In particular, the development of water resources has led to a situation where a large proportion of water supply (groundwater and surface water) originates from sources outside of the city's administrative boundaries. As a political practice, process, and value, the evidence among the OWEB key informants and members of AAWSA consulted as part of this research showed limited coordination and cooperation between the two municipal service authorities. Additionally that, as the more powerful actor, Addis Ababa appears to have a higher ability to assert its water security over those in the surrounding OSZ leading to heightened water insecurity in this area.

Chapter 6 also discussed how the water resources development to meet Addis Ababa's demand has required the securing of diverse water resources over time, initially being a combination of springs, ponds, and hang-dug wells, with the construction of the first water supply reservoir (Gefersa) being in c.1944, located in the OSZ. This was followed by the Legedadi in c.1970 and the Dire in c.1999, also located in the OSZ. Along with the development of surface water resources, groundwater resources have also been developed as various well-fields within the OSZ. Observably, Addis Ababa's water resources development has therefore largely taken place outside of its administrative boundaries. This appears to make the pursuit of physical water security cross-cutting with social and political processes and, for those in the OSZ, cross-cutting with themes of injustice as they no longer feel they are the main beneficiaries of the water resources in their area.

The observed competition for water resources, particularly groundwater resources, between Addis Ababa and those living in the OSZ appears to also be heightened by the socioeconomic reliance on these resources for both areas. For the Oromia Regional State, the OSZ is an area of high production of revenue and high growth of investment. Additionally, the majority of households in the OSZ are dependent on agriculture and livestock (with crop production and grazing being among the most dominant land uses) and therefore vulnerable to livelihood insecurities associated with water insecurity.[120]. This, combined with Addis Ababa's dependence on the water resources in the OSZ for the increasing urbanisation of the city.[121], means that certain water securities for both Addis Ababa and Oromia rely on utilising water resources in the same hydrological and hydrogeological areas and therefore competition.

It can also be observed that this competition for the water resources has created a zero-sum game for water security in the OSZ (where water security for one means water insecurity for another). And, with Addis Ababa being the more powerful actor

[120] For example, shortage of water causing higher cases of livestock disease and 'too much or too little rainfall' being one of the 'major agricultural constraints' in the OSZ as the majority of crop production is from rain-fed farming (OPEDC, 2021b).

[121] The link between water security and socioeconomic value for Addis Ababa is discussed in Section 10.1.2.2.

as previously discussed, it appears to be able to assert its water security over those living in the OSZ. This can be largely demonstrated by the political favour shown towards Addis and the consequential inequity expressed by OWEB interviewees. Interviewees[122] specifically noticing the inequity of benefits; those living in the OSZ not currently receiving the benefits of the water resources there first, with it being relatively recent that the water resources benefits extracted by Addis were shared with those in the OSZ at all. In addition to this, all OWEB interviewees described a reduction in the reliability of groundwater resources in the area, leading to more boreholes being needed or existing boreholes needing to reach greater depths to obtain water. One interviewee in particular connected this phenomenon with groundwater over abstraction by Addis Ababa, suggesting that this has caused the drying up of the groundwater supply.

Finally, the Addis Ababa City Government Revised Charter (Proclamation No. 361/2003) states that the relationship between the Addis Ababa City Administration and the Oromia Region rests on ‘fruitful cooperation’ (Article 62). It was observed, however, that in terms of water resources development in the OSZ, there appeared to be a general lack of evidence of formal cooperation and coordination between the respective utilities of AAWSA and OWEB i.e., a lack of ‘fruitful cooperation’. Whilst Chapter 8 demonstrated that both AAWSA and OWEB saw collaboration between the utilities as a priority for the water resources development in the OSZ, it also found that there was no consistent cooperation or formal coordination (i.e., frameworks, working groups, etc) for this relationship. Whilst AAWSA did mention a board established by AAWSA and Finfine Zuria OSZ three years ago[123], there was no evidence among the OWEB interviewees that such cooperation existed[124]. With the Lege-Tafo Lege-Dadi branch stating that communication (with AAWSA) only happened when there was a problem, but it wasn’t ‘the normal’.

[122] In Chapter 8, for example, KI1 describes an inequity in the beneficiaries of water supply ‘when one entity [region] benefits [from water services], it should also benefit the community of that area’. Additionally, KI3 also states that there should be a policy that ensures ‘that the areas that are sources of water resources have access to water first’.

[123] To provide facilities (e.g., school, health, water supply, veterinary clinics, etc) to communities in the OSZ as part of water resources development.

[124] Although, it could be possible that these were simply not known by the OWEB interviewees or not relevant at the bureaus interviewed.

10.3 Systems of water security across Addis Ababa

This research has used a systems approach to explore the water security perspectives and priorities at local and regional level. This helped to critically understand the interconnectedness of complex processes that could characterise contextual water security for Addis Ababa. The systems perspective drew upon three fundamentals; methodological pluralism, boundary judgements, and open systems. Whilst the approaches differ, these three fundamentals remain central to the analysis and interpretation of the interconnected perspectives and priorities of water security in Addis Ababa. Chapter 7 and 8 provide a more in-depth analysis of the water security systems at individual and regional level, as well as diagrams showing the system interpretation of elements and interconnections at these levels. This section instead provides a comparison between the water security systems at individual and regional (utility) level.

Between both individual and regional water security in Addis Ababa, a notable commonality is the presence and importance of potable water supply – with this being a common element within the boundary of water security system perspectives. The values of physical water security and the problem situation of insecurity do, however, vary which can be demonstrated by differences in boundary judgements. For example, the systems perspective highlights that individual potable water security is not defined by piped water supply alone (other forms of water supply such as Bono, river water, hand dug wells, and bottled water, all contribute to physical water security). Furthermore, the system perspective also demonstrates that it is not simply the presence of piped water supply, but the reliability, quality, and water pressure associated with this; if water is supplied by pipe but not reliable it does not improve water security. This effect is observed to be further exacerbated when the other forms of water supply previously mentioned are removed in favour of piped water, leaving communities or individuals water insecure.

Another notable common element across water security system perspectives is urbanisation as a driver of water insecurity. At community level, individuals described how they felt that new housing sites on the outskirts of the city have reduced the availability of water and it how water must now be released ‘in turn’. Similarly, both AAWSA and OWEB included urbanisation as a driver of water issues in their problem

perceptions of water (in)security. Both AAWSA and OWEB also mentioned migration to urban centres, the consequential increase in water demand, and the consequential over abstraction of groundwater to meet this, as interconnected drivers associated with urbanisation and therefore perceived water insecurity.

Another commonality between systems of water security at individual and regional level was water quality. Whilst both individuals and utilities centre a large part of their water security system around water quality, the system of the individual is highly influenced by interactions with other systems, such as livelihoods, health, and well-being. Additionally, for the individual, the boundary of the water security system extends across other values of water quality, such as smell, appearance, and changes to usage, being important to the wider environmental water security of communities. Whilst AAWSA show interconnections between water quality and health in their systems perspective, these other interconnected values of water quality are not represented. Lastly, as drivers of poor water quality, both industrial and household pollution are represented in the systems understanding of both utilities and individuals. Industrial activities and industrial pollution appearing to be large, uncontrollable, drivers to this dimension of water insecurity.

It was also observed that, as an open system, a key exchange between the water security system of the individual or utility and the environment is with a wider water governance system. At individual level, notable exchanges with the social and physical environment take place largely as coping mechanisms to avoid water insecurity; interacting with other social systems of governance institutions or other individual's water security to pursue a more collective community water security. Importantly, where exchanges between the boundary of induvial water security and the wider social and physical environment appeared to be blocked, injustices or disempowerment was observed. This was especially the case where an individual's water security system was not able to interact with wider water governance systems. For example, lack of recognition, response, or action from higher governance levels to expressed community or individual issues related to water and exclusion from decision-making spaces.

At regional level, utilities also demonstrated this interaction with a wider water governance system. Although, this was expressed more in terms of the representation

of local dynamics and processes being impacted by both regional and national factors such as government responsibility, implementation of policy, and coordination between Addis Ababa and those in the OSZ. Although, in terms of the latter, this was noticeably not within the boundary of the water security system for AAWSA. Interestingly, however, the dynamic between AAWSA and OWEB was frequently mentioned by OWEB, suggesting that the coordination between these two bodies is perhaps a more important system driver and influencer for OWEB's water security than AAWSA's. AAWSA's water security system boundary also notably excluded community governance and the presence of other actors aside from the utility. This was particularly interesting given that AAWSA's plans and mandates stressed the importance of awareness and inclusion of local stakeholders and communities. This was not the case in the system interpretation of OWEB's water security where community participation and awareness were a central system dynamic to the water security of the area.

An additional observation on the interaction of governance systems at regional level was the perceived degree of disconnectedness among certain sub-systems within AAWSA's perceived water security system. For example, one system interpretation consisted of three disconnected sub-systems of water security that centred around infrastructure (leakage and efficiency of distribution), the demand and supply gap, and wider socioeconomic processes. It could be argued that this disconnection, and therefore the lack of interaction between different sub-systems of water security, demonstrates a perceived separation of environmental processes, utility activities, and broader water service governance with different goals and drivers for Addis Ababa.

Overall, the physical elements of water security appear to be the most commonly shared between systems of water security at local and regional levels e.g., water supply, water availability, and water quality. The social and political elements appear to differ, with perceptions of injustice differing to an even higher degree, in terms of system elements, interconnections, and boundaries. Notably, at individual level, the system of water security was observed to be highly diverse with notable consistencies between elements and value themes[125], but varied interconnections

[125] Three dominant value themes emerged among individuals that reflected the wider social and physical environments of water security: potable water access; environmental (river) water quality; and protection from harm. These were consistent judgements among individuals that appeared to determine and define the problem situation that is water (in)security.

and functions, observably shaped by the lived experiences of individuals and therefore the boundaries of water security systems (shaping value, interests, and perceptions of reality). The regional water security system, however, appeared to be much less diverse, mainly prioritising physical water security and organisational coordination and capacity, policy, and finance. The judgements of the problems situation of water security therefore largely centred around utility performance e.g., water supply connections, piped water quality, efficiency of infrastructure, and finance (NRW and budget).

10.4 Water security at a national level

The objective of *Explore the institutional context of water security through analysing relevant and appropriate documents related to national water resources management* was largely met through the examination of relevant federal policies, plans, and laws in Chapter 9. Additionally, the analysis of some regional plans was also presented in Chapter 8. This provided a broader understanding of the political landscape of water resources management in Ethiopia and therefore the ability to interpret how water security may fit into this at national level. This section combines the findings of Chapters 7, 8, and 9 to demonstrate some challenges that could arise in the theoretical adoption of water security as a water resources management paradigm in policy for Ethiopia, therefore meeting the objective of *Demonstrate the various challenges that may arise at a national level for water security if adopted as a water resources management paradigm for Ethiopia*. These difficulties are observed to be largely centered around questions of:

- Whose water security is being pursued i.e., managing the differing water security perspectives and priorities between federal, regional, and individual governance levels
- The appropriate geographical and social scale to manage water security i.e., hydrological vs. administrative and region vs. city vs. community
- The responsibility of water security i.e., who's mandate does water security become?

It was demonstrated in Chapter 9 that the perspectives and priorities for water security at national level largely support the physical dimensions of water security, particularly utilisation of the country's water resources for water supply, irrigation and drainage development, and hydropower. At national level, this also plays into the social and political values of water security being critical for the socioeconomic security of the country. In this sense, the reoccurring phenomena of water scarcity, drought, and flooding in Ethiopia's history (Chapter 6, Section 6.1) feeds into the national discourse of water security being central to the country's food, livelihood, and economic security. The rhetoric of water insecurity as a perceived propagator for poverty and unproductivity in the country can therefore be seen across federal policy, plans, and laws, where socioeconomic security is observed to hinge on water security.

It could arguably be expected that these institutional priorities and perspectives of water resources management would remain focal to the pursuit of water security at national level; utilisation of physical water resources for developing water supply, irrigation, and hydropower. As demonstrated by this research, however, these are not the same as the priorities and perspectives of water security at regional and individual level. A key challenge for water security as a water resources management paradigm is therefore accounting for, and managing, the differing water securities at various governance levels. In a more effective governance system, this challenge could perhaps be addressed through decentralised structures, clear mandates between executive bodies, and cross-sectoral working. As discussed across previous chapters, however, the functioning of the water resources management structure in Ethiopia is questionable in its effectiveness. For example, whilst on paper the vision of decentralisation appears to be realised through the water governance structures from federal government to regional states, the reality seems to be somewhat different; appropriate bodies exist to encourage decentralisation, but institutional frameworks appear to be insufficient in executing this through clear mandates between multiple bodies and legal frameworks to support power and authority. This has led to overlapping mandates, poor enforcement power, and uncoordinated water resources development activities.

An additional example is the apparent high institutional turnover in the country's water resources management structure. This appears to create a situation where mandates get lost between organisations and disparities, or overlaps, form between accountable bodies for implementation of different water resources management activities and actions. This high institutional turnover appears to have also created loopholes for water utilisation born out of various interpretations and non-succinctness of the definitions within The Constitution and other legislative documents which, again, have led to potential conflicts between those who own and those who use water resources. This high institutional turnover has also appeared to create a general confusion of the awareness of policies and regulations. Where, at the higher levels, policies, regulations, and guidelines are known whereas at the level of regional bodies, these are unknown and therefore the water resource management tasks given to these bodies are unclear. Without an effective water resources management governance structure, particularly without a working

decentralised structure, there are questions around the institutional capacity to implement and operationalise water security. As two key systemic barriers discovered through this research, for example, the appropriate management unit of water security (i.e., basin or administrative) and the responsibility of water security (i.e., who's mandate?) would be critical to resolve in the adoption of water security as a water resources management paradigm in Ethiopia.

In terms of the responsibility of water security, if theoretically adopted as a water resources management paradigm, federal ministries and authorities as well as regional states would need to be involved, as is the case with the current water resources management strategy of the country. However, as demonstrated as part of this research, water security is multidimensional in drivers of insecurity as well as intersectional in its impacts. This therefore creates a difficulty in the responsibility of water security and appears to make the case for a more cross-sectoral approach. Additionally, the research has demonstrated how the dimensions of water security identified at local and regional level would fall under the responsibilities of various ministries and executive bodies and would therefore not be appropriate being the responsibility of MoWE alone, for example.

To address the challenge of accounting for differing water securities at various governance levels, inclusive and purposeful community participation and involvement in decision-making spaces would also be required[126]. Whilst community participation and involvement in water resources development were found to be a consistent goal in Ethiopian water resources management policy, there appeared to be a lack of an environment that promotes and centres community priorities and partnerships, particularly in a structured and consistent way. Furthermore, this research has highlighted that community involvement in decision-making spaces is currently a concern for both individuals and organisations. The responsibility of facilitating this would have previously been MoWE's, but (under Proclamation No. 1223/2020), it is now the mandate of the Ministry of Agriculture to coordinate, support, monitor, and regulate community user group formation and activities in the community watersheds in the woreda (Article 30, Article 32:3). This reinforces the case for cross-sectoral

[126] Which is in line with The Constitution as the citizen's right to consultation on environmental policies and projects that affect them or their community directly (Article 43:2, Article 92:3).

working and also further demonstrates why water security should not only fall under the responsibility of MoWE alone.

The last question for the theoretical adoption of water security as a water resources management paradigm for Ethiopia is a question of geographical scale. This research has demonstrated differing water security scales across community (Chapter 7), city (Chapter 8), basin (Appendix G), and country (Chapter 9). It is apparent from the research that the scales of water security for communities and Addis Ababa are based on social and administrative boundaries respectively, whereas the basin unit is a hydrological boundary favoured by the federal state[127]. Contrary to the basin unit, however, is the right that Regional States have to develop the water resources within their administrative boundary[128], creating conflicting boundaries for water resources management and therefore water security. Ultimately, it appears that the disparity between the two planning units of hydrological (basin) and administrative (region) has created an uncoordinated approach to water resources management that seems to further breed overlapping mandates, repeated research, and lack of coordinated enforcement between Federal and Regional water resources governance. As such, a difficulty in adopting water security as a water resources management paradigm would meet this same issue of conflicting boundaries for operationalisation. It would therefore be important to re-examine the appropriateness of different geographical and social scales for operationalising water security.

[127] Adopted as the official planning unit for water resources management of Ethiopia in c. 1999 in the EWRMP; IWRM was adopted as the primary water resources management framework of the country in the EWRMP with one of the main outcomes being the adoption of the basin unit as the planning unit of water resources management of the country.

[128] With a lack of clarity on the power relationship between RBOs and regional states, as discussed in Appendix G.

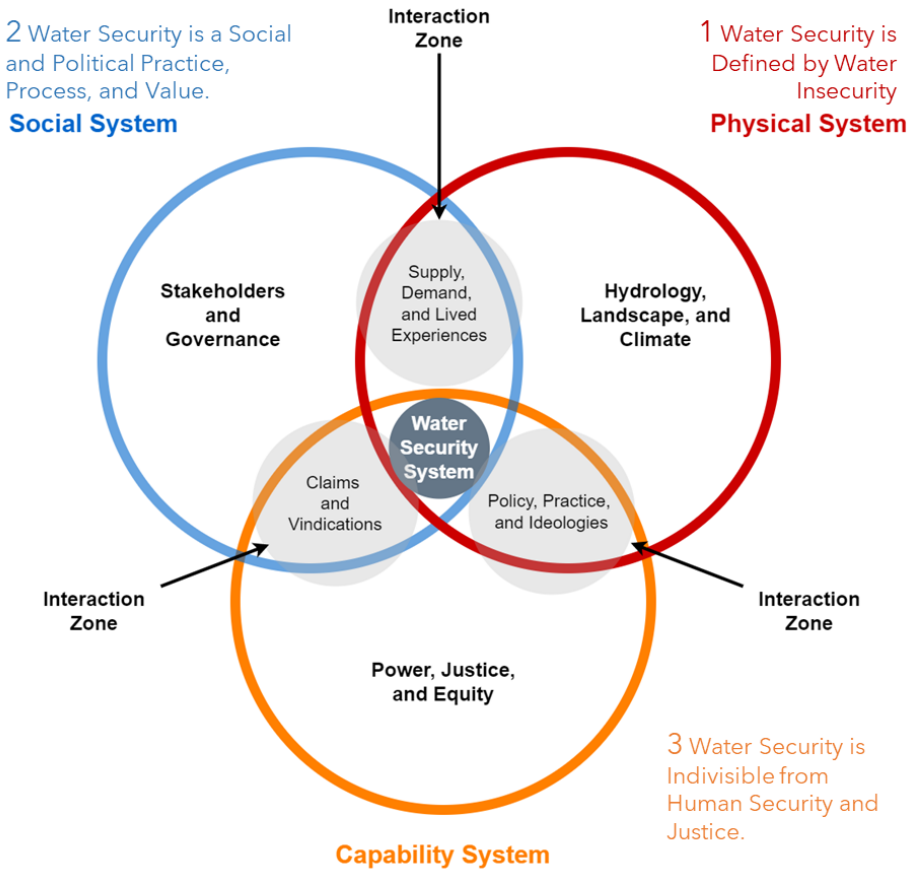
10.5 Conclusions

This research has provided a contextual understanding of water security in Addis Ababa through exploring water security as defined by three statements of: water security as defined by physical water insecurity; water security as a social and political practice, process, and value; and water security as indivisible from human security and justice. This has demonstrated water security to be diverse and distinct to the conditions in which it exists, the recognition of contextual water security therefore being paramount to any effective operationalisation as a water resources management paradigm. Furthering this, exploring water security using these three statements has shown how, to be water secure, several water relationships must be fulfilled outside of potable water supply alone.

It can also be observed that certain dimensions of water security do not sit solely within one of these three statements. Water quality, for example, can be observed to impact physical water availability and be an important factor in perceived injustices. Similarly, the location of communities can be observed to be a factor in physical water access, environmental water impacts, and inequities in water use and supply. Furthermore, the capability to pursue water security at various social scales was observed to play a key role in the degree of water security, which is not fully captured by the three statements of water security[129]. This was occasionally expressed in terms of the capability of an organisation to function (as a product of institutional structures, funding, and knowledge, for example) or as capability to access decision-making spaces and influence changes in a local area. In these cases, the three statements of water security fail to account for the observed dimensions of water security, especially those that sit between statements. To better understand water security, the three statements of water security could therefore more broadly represent wider spheres of physical, social, and capability systems associated with the three statements of water security, with overlaps between these areas as shown in Figure 90.

[129] In this sense, sitting between the statements of *water security as a social and political practice, process, and value* and *water security as inseparable from human security and justice*.

Figure 90. A wider systems perspective of water security



This research has also used a systems approach to structure and critique perceived elements, interconnections, and functions of water security, allowing for an assessment of the degree of connectedness between water security perspectives and priorities of utilities and communities. Water security is observed to be both an expectation and ideal in Addis Ababa for all governance levels, but the problem situation of water insecurity varies. It is further observed that differences in perspectives and priorities of water security are not the issue, but the areas of connections between these. This is particularly the case between Addis Ababa and the OSZ, where differences in system boundaries, as well as strength and type of interactions between the water security system and its social and physical environment, show how the perceived problem situation of water insecurity differs between the two respective utilities and creates an unsustainable water resources management situation. Additionally, the systems approach has shown how, at individual level, the problem situation of water security is highly connected to other securities in different aspects of people's lives. Most importantly, however, the

individual system of water security has shown how water security is not fulfilled by the supply of piped water alone, contrary to dominant perspectives and priorities of utilities. This perhaps raises questions of the ability of a utility alone to be the provider of water security in Addis Ababa, as appears currently perceived.

Lastly, the above observations on water security in Addis Ababa in combination with an understanding of national policy, plans, and laws, has also demonstrated some of the challenges for the theoretical adoption of water security as a water resources management paradigm in Ethiopian policy. Namely those corresponding to possible difficulties in managing the differing water security perspectives and priorities between governance levels, appropriate social and geographical units of management, and the responsibility of water security. It is therefore observed that a few fundamentals would be critical for the adoption of water security as a water resources management paradigm: a shared water security vision, where the meaning of water security is agreed at multiple governance levels; cross-sectoral coordination at ministry level; and inclusive, purposeful, and consistent community engagement and participation in decision-making spaces.

Chapter 11. Evaluating the research and implications of findings

The aim of this research was to assess the contextual factors that contribute to different problem perceptions of water (in)security in Addis Ababa and the homo/heterogeneity between these. Additionally, to relate these findings back to the broader institutional context of water resources management in Ethiopia, identifying challenges for operationalising water security in broader water resources management policy. The research also sought to investigate how systems approaches, more generally, can facilitate a better understanding of water resources management issues. Objectives were consequently developed to investigate water security in Addis Ababa, and were divided as:

- Identify key discourses that have contributed to water security and understand how these frame water security for this research (Chapter 2)
- Understand the fundamentals and variety of systems approaches (Chapters 3 and 4), how these are currently used in water resources research (Chapter 4), and therefore which may be suitable for structuring an investigation of water security
- Identify what data is needed to support and evidence a systems approach to investigating water security (Chapter 5)
- Understand the historical context of water resources development in Addis Ababa (Chapter 6)
- Understand community perceptions and priorities of water security and how these may vary in different areas of Addis Ababa e.g., location in the city (urbanisation levels) and position in the catchment (upstream/downstream) (Chapter 7)
- Understand water security from the perspective of the local utility, including the range of factors that are perceived to contribute to water insecurity in Addis Ababa (Chapter 8)
- Explore the institutional context of water security through analysing relevant and appropriate documents related to national water resources management (Chapter 9)
- Present an understanding of water security in Addis Ababa as a product of various contextual factors, unique to the area (Chapter 10)
- Demonstrate the various challenges that may arise at a national level for water security if adopted as a water resources management paradigm for Ethiopia (Chapter 10)
- Reflect on taking a systems approach for investigating water security and the methods used to inform this research (Chapter 11)

Observably, the conceptual foundations of this research are crucially defined in the meeting of the first two objectives at the beginning of the thesis; the researcher's positionality on *What is water security?* and *What is a systems approach?* both of which are explored in Chapters 2 and 3, respectively. In conclusion to the former, three statements of water security are presented over a singular definition: (1) Water security as defined by physical water insecurity; (2) Water security as a social and political practice, process, and value; and (3) Water security as indivisible from human security and justice. These are used to frame water security for the subsequent research. In conclusion to *What is a systems approach?*, Chapters 3 and 4 explore the evolution of systems thinking as well as the practice of this in current water resources research, respectively. Chapter 3 concludes with three fundamentals that shape the systems approach in this research. The first being an explorative approach, described in terms of complementarism and methodological pluralism, taken from critical systems thinking. The second being the concept of boundary judgements that define what is inside and outside the system, being shaped by value, interests, and perceptions of reality. Lastly, the model of an open system, where the system interacts with its social and physical environment through exchanges of information that manifest in values, expectations, and ideals. These conclusions contribute to the methods presented in Chapter 5, that meet the objective of *identify what data is needed to support and evidence a systems approach to investigating water security*.

The findings associated with the remaining objectives were partly covered in Chapter 10 and are summarised in the following sections. Additionally, the wider implications of these for water security, systems thinking, and water governance, and their nexus which enables systems thinking to be used to improve water resources management, are discussed. Furthermore, reflections are made on the methods used including their relevance, adequacy, and therefore recommendations for further work and improvements to the research.

11.1 Key findings and observations

The key findings of this research can be divided into three broader areas: contextual water security; using a systems approach to explore water security; and operationalising water security as a water resources management paradigm. These findings are derived from the investigations associated with the objectives of this research.

11.1.1 Contextual water security

This research has demonstrated the diversity of water security across different scales of water governance through meeting the objectives associated with Chapters 7, 8, and 9. Variations on perspectives and priorities can be seen at city-scale between urban and peri-urban areas, upstream and downstream areas, and local stakeholders. Variations are also observed at regional scale between water utilities and at national scale between multilateral goals and international agendas. The multiplicity of water security is observed to be dependent on lived experiences, interests, and ideals associated with the value of water in many forms and as intersectional with many other securities, the interconnections of which are highly contextual to the area, in this case Addis Ababa.

The research also observes that water security is more than provision of potable water supply alone. It also includes the preservation of unique human-water relationships and values; conservation of environmental water security, protection and safety from water-related risks and hazards, and preservation of water-dependent livelihoods are also found to also be key determinants of the degree of contextual water (in)security. This means that water security is both a social and environmental product. Taking this into consideration provides an argument for water security therefore more appropriately being *water securities.* This is consistent with discussions in Chapter 2 of water security being more than simply securing physical water, but the pursuit of other forms of water security through socio-nature, socio-hydrological, and socio-political relationships (as discussed in Budds (2009); Loftus (2007); Jepson et al., (2017), for example). The research also demonstrates, however, that whilst it appears to be understood that the existence of water security sits outside of physical water security alone (in academia and multilateral initiatives,

for example, see Chapter 2), in practice the understanding of water security for water resources management does not appear to reflect this, especially in the case of utilities.

11.1.2 Using a systems approach to explore water security

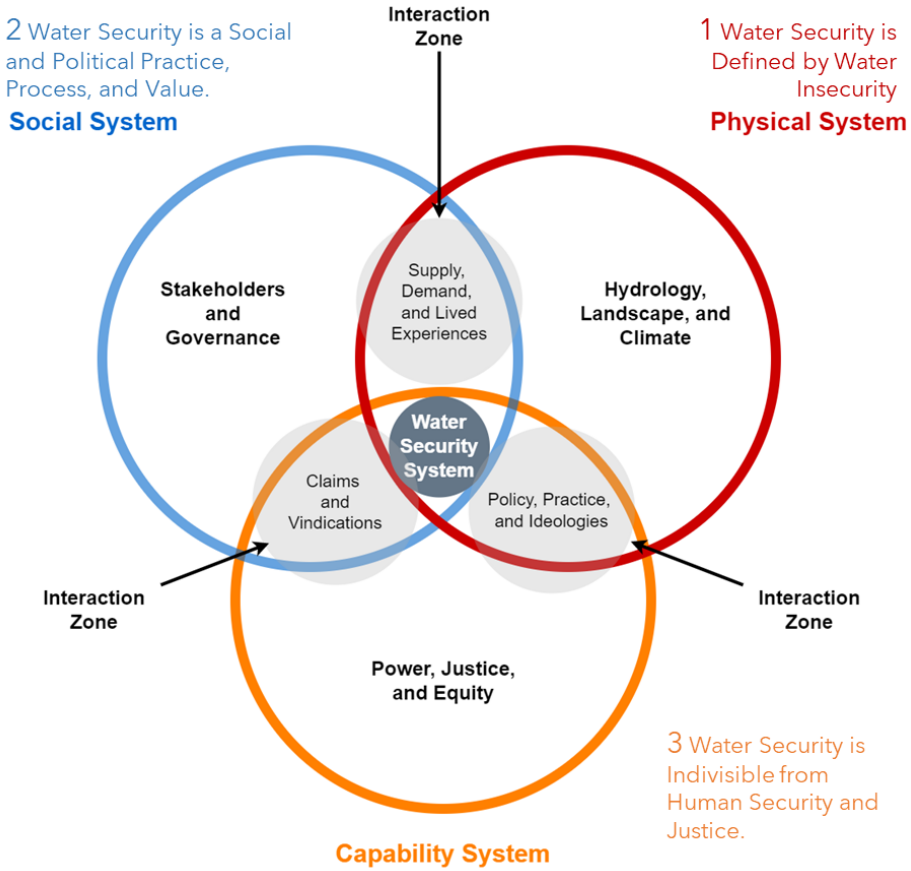
As well as contributing to the field of water security research, this thesis also contributes to the field of systems thinking for understanding and analysing water management issues more broadly. It provided an overview of systems theory and development of systems approaches (Chapter 3) as well as how systems approaches are currently used in water resources research (Chapter 4). The reflections on using a systems approach in the context of water security are as follows.

The use of a systems approach allowed for a more multidisciplinary investigation into water security; understanding interconnected factors, multiple drivers, and diverse problem perceptions. Similarly, by using a systems approach, it became easier to communicate and demonstrate the multidimensional and interconnected nature of water security – particularly how water security is more than physical water security alone. Understanding and using the construction of systems as perceptions of a problem situation (in this case water security), rather than truth, has additionally been a useful tool in understanding the degree of alignment of priorities and perspectives. To this extent, identifying how water security as a value is created socially, politically, and environmentally, and therefore where ideals between social groups are not met and tensions have the potential to form. This would have not been identified through a more linear, siloed approach.

Another key finding demonstrated by the systems approach, is that for water security to exist it must fulfill a variety of interconnected relationships with water. As well as the availability and reliability of physical water, governance structures, individual rights, and environmental ideals, for example, must also be met. Additionally, that in terms of the open system, the strength and reliability of exchanges between a system and its environment was as critical as simply the presence of these exchanges. A key observation of this research is therefore the suggestion that a better interpretation of the system of water security can be understood by the broader interactions between

areas of social, physical, and capability and the overlapping areas between these, reflective of the goals that are to be realised to define the water security system (Figure 91). Within each area, the phenomenon of water security is to be viewed as a contextual social product whereby different types of water security interpretations are informed by lived experiences.

Figure 91. High level systems of water security



11.1.3 Operationalising water security as a water resources management paradigm

It still appears debatable whether the adoption of water security as a water resources management paradigm would improve water resources management in Addis Ababa or Ethiopia. As the previous chapters demonstrate, there are various challenges in adopting water security in national policy, for example. And, more locally, difficulties in managing the multiple water security agendas within Addis Ababa, the surrounding OSZ, and the basin. As a fundamental, this research has therefore demonstrated that facilitating water security is more than just water management, but involves heavy

political commitment and cooperation, as well as alignment of multiple institutions, putting the water securities of community at the forefront of water management decisions.

For water security to be improved, water security must be therefore understood as an intersectional product of many other relationships with water alongside physical water. Furthermore, in the case of Addis Ababa, it has been demonstrated how the relationship between Addis Ababa and the OSZ is a critical leverage point for the water security of both. As the water security relationship between the two areas appears to be currently unsustainable, a crucial first step to improving water security would therefore be a joint water security vision that can mediate between the different interconnected priorities and perspectives of various actors.

11.2 Implications of findings and general observations

As demonstrated by Tables 8 and 9, there are few existing studies on water security in Addis Ababa[130]. Of these existing studies, many focus on water security as a hydrological phenomenon associated with water resources availability and the supply and demand balance (Heyi et al., 2022; Assefa et al., 2018; Hailu et al., 2022; Taye et al., 2018). Such studies largely investigate issues with infrastructure and service provision or reliability, and potential climate change impacts on water security as changes to mean flows, rainfall, and potential evaporation. A few other existing studies also consider the influence of institutions, capacity, and hydrosocial cycles on water security (Laituri, 2020; Hailu et al., 2019). These are largely orientated towards sociopolitical dynamics that govern water security, specifically the role of institutions in coordination and political commitment to water security as well as consensus and coordination in water planning between communities and government. What is observed in these existing studies, is that the understanding of contextual water security is formed from a siloed approach; none appear to integrate various dimensions of water security with each other (e.g., the physical, with the institutional, with the social etc), none appear to investigate the different water security priorities and perspectives among stakeholders and communities within Addis Ababa, and none relate integrated findings back to a wider policy context. What this research has therefore attempted to contribute to the study of water security in Addis Ababa, is an interconnected perspective of hydrological, environmental, social, and institutional drivers and impacts unique to the city.

The main implications of these findings are therefore an integrated contextual understanding of water security in Addis Ababa that has considered multiple perspectives, scales, and meanings of water security. This is important in demonstrating the multitude of water-use and water-value relationships that appear to influence water security in Addis Ababa, importantly showing that water security is not simply a product of water supply. This not only has implications for future policy making within Addis and Ethiopia, but also more broadly in international agendas – demonstrating a need for understanding the contextual challenges of water security,

[130] The majority of which focus on the Awash or Upper Awash basin, with Addis Ababa taken into account in the findings due to the significance of the city.

realising the interconnectedness of water security with many other forms of security, considering water (in)security as both socially and environmentally produced, and importantly responding to *water securities* over water security. This ultimately redefines the fulfillment of water security and arguably disrupts a dominant water security narrative for research and practice within Ethiopia, and more globally, of more water equals being more water secure.

With regards to the systems approach taken in this research, this provides an example for researchers and practitioners in investigating complex socioenvironmental issues; this research has reflected on the concept of *taking a systems approach* in general but, more specifically, it has explored using a systems approach for water security that can successfully capture and analyse multiple *water securities*. This research also contributes to the understanding of types of data that can be considered to represent a system of water security. The findings of this research also highlight some new drivers and impacts of water security that are currently unmeasured or unaccounted for in more traditional indices of water security (Aboelnga et al., 2020; van Ginkel et al., 2018). Furthermore, it demonstrates a hybrid approach whereby a traditional system understanding of elements, interconnections, and functions, is complemented by critical analysis around boundary judgements and open system interactions as reflections of values, interests, and perceptions of reality. The core steps of this systems approach for water security were:

- Understand the social and physical environment of the water security system:
    - Historical (the social and environmental dynamics of water resources development over time)
    - Institutional (water resources management structures and organisations relevant to the area)
    - Physical (hydrology, climate, infrastructure)
    - Environmental (land-use, water-use)
- Conduct a bottom-up building and collection of systems perspectives:
    - i.e., communities, stakeholders, utilities, regional actors, national actors
    - Build elements, interconnections, and functions within the social and physical environment of the system
- Compare and critique the various systems perspectives:
    - Identify key transactions between the open systems and its environment

    - Identify the different boundaries of water security
    - Compare the degree of (dis)connectedness between systems perspectives
- Relate the various water security systems back to the social and environmental context to understand the drivers and impacts of water security in the area and how these influence the system

Lastly, further implications of this research are those concerning the governance or operationalisation of water security as a water resources management paradigm more broadly. As demonstrated through analysis of water resources management structures and agendas in Ethiopia, there are a number of challenges associated with adopting water security as a water resources management paradigm. Most notably these are varied social and geographical management scales and unclear responsibilities. This is broadly applicable to other global contexts. This research has demonstrated that there is a strong link between the capability to pursue water security and the institutional capacity or enabling environment at both federal and regional level; a mismatch being revealed between how institutions are organised versus the complexity of the problem, leaving gaps in how more complex issues are managed and addressed. The implication is therefore that the differing water securities between actors is not necessarily a problem in itself but that the disconnectedness or misalignment between these causes competition, tension, and miscommunication for water security.

11.3 Reflections and further work

Evaluation of this research raises a few reflections on the methodology, findings, and possible further work for water security and systems research. To begin with, reflections on the use of a systems approach. The systems approach allowed for a research perspective that could embrace and collect different water security perceptions; structuring and presenting perceptions of the problem situation as interconnected unique drivers, mediators, and perpetrators of water security. Exploring the interconnectedness of impacts and drivers of water security is observed to be critical in understanding the complexity of water security, whereas a linear, siloed investigative approach would struggle to capture this. Furthermore, the collaborative approach to building a system of water security with AAWSA (Chapter 8) proved systems thinking to be a useful skill in communication between departments within the utility. Notably one of the main outcomes of SSM is the communication and discussion of different problem perceptions, which proved to be particularly useful for sharing expertise and understanding within the utility, it was discussed how this could be useful for future water resources planning and functioning for AAWSA. Due to the limitations of time, however, the next stages of SSM (feasible and realistic action to improve the situation – exploring what change is needed (Checkland, 2000)) were not able to be investigated. This is partly seen as a limitation of the systems approach taken by this research; it largely sits within the explorative phase of problem perception and identification and does not move into the action phase of systems change and systems transformation. It would therefore be recommended that the work could be furthered by revisiting the findings of this research with the utility and other local stakeholders and using it to structure contextual intervention options and policy recommendations.

Moreover, the explorative systems approach allowed for multiple data types to be collected. These helped to inform and provide evidence for system construction; multiple forms of qualitative data were used to inform systems interpretations at local and regional level and to record the various dimensions of contextual water security. A main reflection on this work, however, is the quantity of empirical data collected. It was in the initial scope of this research to inform a systems understanding of water

security with a much larger and diverse foundation of empirical data[131]. As a result, the regional perspectives of water security are empirically based on AAWSA over other regional bodies. The findings of this research would therefore be strengthened by investigating water security perspectives and priorities in Addis Ababa among other stakeholders and organisations in more detail. Furthermore, many elements, interconnections, and functions of water security were identified using this systems approach, some of which could be further supported by both qualitative and quantitative data. A hybrid approach could therefore be explored through integration of both qualitative and quantitative evidence to inform a more refined systems understanding of water security; using the systems approach to triangulate multiple types of data.

The ability to expand the base of empirical data that contributes to this research was significantly hindered by shortcomings in time due to the Covid-19 pandemic. This impacted the ability to travel, conduct face-to-face workshops and interviews, and organise dissemination activities (e.g., stakeholder closing workshops and dissemination of recommendations and conclusions). If there had been more time, this research could have therefore been further developed through, for example:

- Additional community and key informant interviews (including revisiting interviewees with additional questions and clarifications)
- Gaining more of a systems understanding at other governance levels (i.e., conducting community systems workshops and ministry systems workshops)
- Key informant interviews with NGOs working in the water security field in Ethiopia/Addis Ababa
- More comparisons of diversity of water security in different locations e.g., types of household, accommodation type, specific water distribution areas of the city, age, gender, rural, peri-urban, urban, etc
- Dissemination workshop with AAWSA to discuss and verify findings and implications of the research, including how to achieve systems change through targeted intervention areas in the water security system

As a last reflection, it is observed that this research has offered a human-centric perspective for investigating and understanding water security. Further research

[131] Not all key informants from Table 13 were able to be interviewed, for example, due to limitations of time. Of the ideal listed in Table 13, only five were interviewed from Oromia Water Bureau (3), the Ministry of Water and Energy (1), and the Awash River Basin Authority (1).

could therefore develop the understanding and application of the water security paradigm by considering and/or comparing a more ecosystem-centric investigation and interpretation of water security. By adopting the human-centric perspectives and priorities of water security, for example, managing water to preserve human interest and security is placed at the centre of the discussion. Nature, however, could be debated to have values of water security independent of human uses of water.

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To finalise, as demonstrated, water security remains difficult to succinctly capture, understand, analyse, and respond to. This is perhaps reflective of the many direct and indirect interconnections it is demonstrated to have as well as its multiple intersections with other disciplines and sectors. Arguably, this is reflective of many complex and dynamic socioenvironmental issues that exist today. This, however, should not be seen as a barrier or deterrent for research and practice, but an opportunity to rethink the traditional means of approaching these issues. This research has demonstrated how, by using a systems approach, a different perspective on complexity can be offered that provides a means to embrace rather than reject it.

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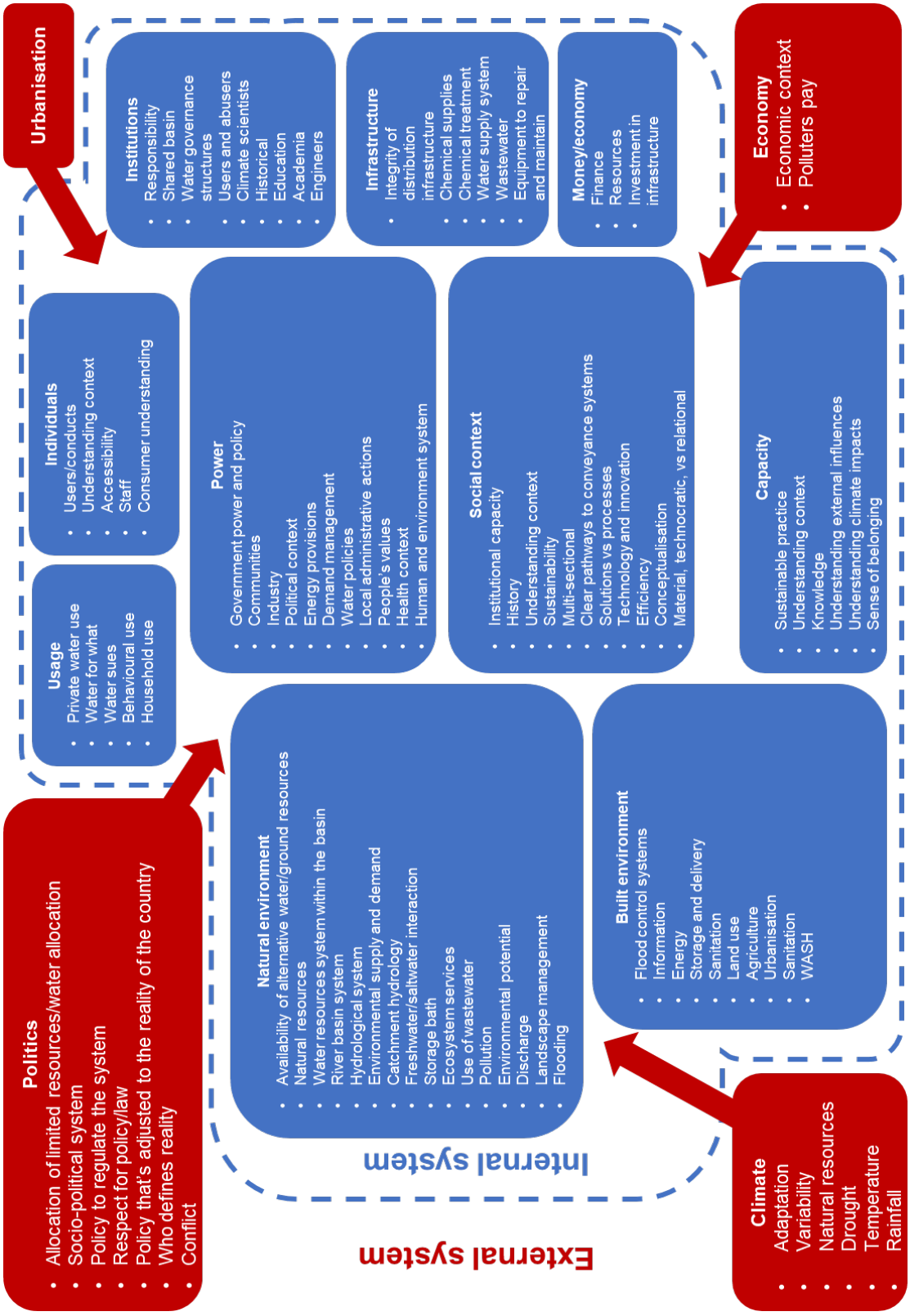
Appendices

Appendix A. Systems thinking in water resources research

An expert panel discussion took place in February 2020, being part of a GCRF workshop for the second Water Security and Sustainability Hub Assembly. The discussion included twenty senior academics from eight international universities who were asked to debate what components should be included in a water security system. These were written on post-it notes and placed onto three large sheets of A1 paper. The post-it notes were then categorised into sub-topic areas. The results of the activity can be seen in Figure A1, these are re-drawn for clarity in Figure A2.

Figure A1. Photo of activity results from expert panel discussion as part of the GCRF Water Security and Sustainable Development Hub, February 2020

Figure A2. Simplified diagram demonstrating the results from the activity in Figure A1.



Appendix B. Methods materials

B.1 Workshop outline

DAY ONE

09:30 Registration and Completion of Questionnaire

- Individual completions of questionnaire
- The purpose of this form is to establish what individuals, departments, and AAWSA understand as water security before taking part in the workshop. This way there can be a comparison of before and after perspectives on water security in Addis.

09:45 10-minute Presentation from AAWSA

- Introduction to AAWSA (role, structure, duties)
- Current supply/demand challenges
- Mandates of AAWSA and its units

10:00 10-minute Presentation from GCRF Hub/IWMI

- Introduction to the Hub

15-minute break

10:30 Instructions and Introduction to Workshop 1

Workshop 1 is focused on identifying water problems in Addis Ababa. A water problem can be very broad (e.g., “supply and demand” of the resource itself) or it can be very specific (e.g., an amount of flooding in the same area every year), or wider issues surrounding institutional complexity and managing water resources. Ultimately, it refers to an issue related to water that causes some sort of negative impact on people and/or the environment.

Use of traffic light system.

Discussion Points and Themes

- How do you perceive water security problems in the city of Addis Ababa?
- What water problems do you work with in your role?
- What water problems do you come across more frequently than others?

- What water problems do you often face whilst conducting your activities in the field?
- What water problems do you experience personally when going about your day-to-day activities?
- What problems do you come across that are related to water but not supply and demand?
- What differences do you observe in terms of water problems at different scales (over time, and over different areas)?

10:45 Workshop 1 Activity

Individuals will be given 15-minutes to write a list of water problems from their perspective for Addis Ababa on sticky notes. Please use a traffic light system to indicate the severity of these problems.

After this time, two groups will be formed, and collections of water problems will be shared.

There is an opportunity to add any new water problems to the collection of individual collections after a quick 5-minute discussion.

The remainder of the time will be spent categorising these water problems into types and then grouping them in clusters/themes (note: more than one problem can be in multiple categories and more problems can be added at any time). See example for more guidance.

The output should be one big, categorised list on a sheet of A1 paper (see example).

Break (1-hour)

13:00 A discussion on water security

- What do we mean by security?
- What is hybrid water security – what is water security?
- How is water security linked with other securities?

15-minute break

13:45 Introduction and Instructions for Workshop 2

Workshop 2 is focused on understanding and exploring causes and components of water problems.

Discussion Points and Themes

- What do you think causes this problem? Is it an individual thing or a combination of things?
- What sources, characteristics, responsible bodies, management actors, do these water problems have?
- What would/could/does worsen these problems?
- What environment(s) do these problems exist in?
- What causes variations in these problems (e.g., seasonality, level of urbanisation).
- Who ‘owns’ these problems?

14:00 Workshop 2 Activity

The two groups from the previous session remain.

A new A1 piece of paper per category of ‘type’ of water problem from the previous session.

On each piece of paper, begin to expand these problems into causes and components based on the above discussion points and themes. These do not have to be confined to Addis, they can be sub-basin, basin, national, international. Additionally, causes and components do not have to be purely physical/hydrological – they can be macro and local economic causes, organizational structure(s), extreme events, the movement of people, and virtual water (i.e., water in/for food and other traded goods).

Depict this by writing the single water problem in a circle and drawing connected lines to these causes and elements (see example). A (+) indicates it adds to or is added to by the component, a (-) indicates it reduces or is reduced by the component. Feel free to use the sticky notes to add comments where a (+) or (-) isn’t appropriate but there is some important information.

The outcomes are A1 sheets of ‘expanded’ water problems for Addis.

30-minute break

16:00 Debrief

30 minutes for a demonstration of today's outputs as a whole group. Discussions on similarities and differences – exploring the heterogeneity through an open discussion. To end with; a brief round of any questions, as well as a follow on to tomorrow's session.

DAY 2

09:00 Introduction to key themes and Boundaries

The key themes for day 2 are: interconnectedness between problems, components, and causes; ideas of scale, space, and boundaries (nestedness). As well as this, discussing the similarities and differences between systems interpretations.

- What do we mean by a boundary?
- How does this link with ideas of hybrid water security?
- What are the implications of different boundaries for water management?
- Mini activity: What is your work boundary?

15-minute break

10:30 Instructions and introduction to Workshop 3

Workshop 3 explores the ideas of scale and boundaries.

Discussion Points and Themes

- Where do causes and components cause multiple water problems?
- Where do different environments or categories of water problems overlap (physical and decision-making environments i.e., institutional mandates)?
- Where and how do stakeholders interact with common water problems?
- How are boundaries determined – how and by whom?

10:45 Workshop 3 activity

The outputs of yesterday's activities from both groups will be used to form the content of this session. But the session will be undertaken with the whole group.

Using the A1 sheets of water problems, elements, and causes, observe where these appear multiple times across the sheets of paper. These are likely the interconnections.

There will be various maps of different scales available to the group.

On these maps, draw where the water problems, elements and causes take place or exist. Interconnections should be shown where appropriate using arrows. Again, colour code for relative importance (using traffic light system).

The outcome should be various maps showing the boundaries in which these problems take place.

Break (1-hour)

13:00 Presentation of workshop outcomes

- Presentation of the outcomes from workshops 1-3
- An open discussion on similarities and differences between interpretations
- An open discussion on the overall outcomes

15-minute break

14:15 Discussion on how outputs can be used

- How do the outputs fit within the workstreams/structure of AAWSA?
- How would this help to achieve AAWSA's 10-year water management plan?
- How does this connect to their planning framework/process in achieving WASH purposes in the next 5/10-years?
- How has this helped in understanding water security problems?
- What do these outcomes mean in terms of your individual activities in AAWSA? …and connections with other activities?

15-minute break

15:30 Feedback discussion

This is an opportunity to discuss the outputs from the workshop. As this is a collaboration session, we will also be looking for feedback on this process and its outputs. This will be an informal discussion between the Workshop attendees.

- How was the workshop?
- Was the structure good?
- Were the instructions clear?
- Were the sessions too long or too short?

16:30 Follow up

- How do we progress from here?
- What could be a useful next step in putting these outcomes ‘to-work’?
- Could these outcomes be used with AAWSA stakeholders?

B.2 Interview Protocol for Communities (English)

Introduction to research.

This research looks at understanding water issues across the Akaki catchment.

I am interviewing lots of people from around this area to help understand how water issues are caused and what the impacts are from different perspectives.

This interview will be 1 hour, and it will be semi-structured. This means there are topics of discussion, but it is mostly directed by you, the participant. Audio will be recorded.

You will be paid 300Br each for taking part.

I will be using the answers as data to build a picture of water issues in the Akaki basin and provide recommended management solutions. Even though we are recording, the discussion we have will be completely anonymous.

I will share any relevant findings with you once my research is concluded if you wish. But I will need to take your contact details. These will not be shared with anyone else without your permission.

You are allowed to stop the interview at any time and your responses will not be used.

Do you have any questions?

If you would like to proceed, could you please sign the consent form.

Interviewer Guide

Opening

- ☐ Thank the participants for taking their time to help with this research
- ☐ Introduce the research using the interview brief
- ☐ Ask if they have any questions about the interview brief or the research
- ☐ Ask them to sign to the consent form
- ☐ Ask them if they have any questions about the consent form
- ☐ Repeat that they can withdraw from the interview at any time and the responses will not be used

☐ Repeat that their responses will remain anonymous

☐ Say that the interview and recording will now begin.

The Interview

The interview is semi-structured meaning the topics should be covered, but the interview should be led by discussion with the interviewee(s). If an interesting discussion appears, then use your initiative to follow and nurture the discussion to understand the issue further. The topics to be covered are described below along with some question prompts if needed.

Social water security (lived experiences).

For this topic, we are trying to understand the social experiences of the participant(s) over time in terms of water. This can include changes and memories in the areas they have lived in, uses of water, and experiences of extreme events. The interview should try to remain on the topics of water, changes of the seasons, land-use, water-use, water quality, frequency of flooding/drought, rainfall, urbanisation etc.

Try to keep the direction of these experiences grounded in issues related to water.

Some question prompts if needed:

- How long have you lived in this area?
    - Why did you move here? Where did you live before? What was it like there?
    - Did your parents also live here? What did they do? Why did they move here? Did they share any memories with you (related to water)?
- What memories do you have of water and land use here?
    - What has changed since you lived here (e.g., the seasons, land-use, water-use, water quality, frequency of flooding/drought etc.)?
    - What do you remember about using water when you were younger? Did you play? Did you swim? Did you fish? Did you collect water from certain places?
    - What do you think is the biggest change since you have lived here?
- How do use water in your day-to-day life?
    - For your work?

- For household tasks?

Physical water insecurity.

For this topic, we are trying to understand the various uses of water (demand) and the various issues with supply (quality, quantity, access etc.). Also, to try and obtain an insight into scales of severity (e.g., how bad something is, how urgent something is, how important something is) as well as a perspective of how/if these things have changed over time.

Some question prompts if needed:

- What is your biggest concern for water?
  - Drinking water supply?
  - Reduction in quality?
  - Flooding?
  - Rainfall variability?
  - Explore these between rainy season and dry season
  - Explore how water is obtained for different purposes and if that has been different over time
- When do you feel most and least concerned about water? Quantity, quality, availability, extreme events?
- Have you noticed a reduction in water availability since living here?
  - Explore quantity, quality, and access

Human security and justice.

For this topic, we are trying to understand how various water issues are related to human security and justice. Additionally, whether feelings of injustice have created action such as the forming of groups to give solutions to issues or to raise awareness. Or perhaps there have been other forms of campaigns (e.g., petitions, protests), or maybe there are a select few community individuals who take it upon themselves to try to fix water issues.

Some question prompts if needed:

- Do you feel there is equal access to water in this area? What about in Addis?

- Do you, as a citizen or community, feel like a priority for water access?
    - If not, why?
    - If not, who do you think is the priority and why?
- How does your community respond to the main water challenges in this area? (e.g., is there a flooding action group? Is water access shared between households?)
- How do you personally respond to water issues here?

Closing

- ☐ Raise awareness that the interview is coming to an end
- ☐ Ask if there is anything that hasn't been mentioned that they feel is important
- ☐ Ask them if they have any questions for you
- ☐ Ask if they can sign the payment form and exchange payment with them
- ☐ Thank them again for taking part
- ☐ Tell them that you will let them know how their responses are used if they wish

B.3 Interview Protocol for Communities (Amharic)

ቃለ መጠይቅ

መግቢያ

ይህ ምርምር በአቃቂ ዙሪያ የውሃ ጉዳዮችን መረዳትን ይመለከታል።

የውሃ ጉዳዮች እንዴት እንደሚፈጠሩ እና ተፅኖዎቹ ከተለያዩ አመለካከቶች ምን እንደሆኑ ለመረዳት ለማገዝ ከዚህ አካባቢ ብዙ ሰዎችን ቃለ ምልልስ እያደረግሁ ነው።

ይህ ቃለ-መጠይቅ ለ1 ሰዓት ይሆናል ፣ እና በከፊል የተዋቀረ ይሆናል. ይህ ማለት የውይይት ርዕሰ ጉዳዮች አሉ ፣ ግን በአብዛኛው እርስዎ በተሳታፊው እርስዎ ነው የሚመራው. በቃለመጠቅ ወቅት ድምጽ ይቀረፃል።

ለቃልመጠይቁ የምትሳተፉ ሰዎች ለትብብራቹ እያንዳንዳቹ 300BR ይከፈላቹሃል።

በአቃቂ ተፋሰስ ውስጥ የውሃ ጉዳዮችን ስዕል ለመገንባት እና የሚመከሩ የአስተዳደር መፍትሄዎችን ለማቅረብ መልሶችዎን እንደ መረጃ እጠቀማለሁ. ምንም እንኳን ደምዕዎን የምንመዘግብ ቢሆንም ፣ ያገኘነው ውይይት ሙሉ በሙሉ ስም-አልባ ይሆናል.

ከፈለጉ ምርምርዬ ከተጠናቀቀ በኋላ ማንኛውንም ጠቃሚ ግኝቶች ለእርስዎ እጋራለሁ. ግን የእረሶን የመረጃ ዝርዝሮችን መውሰድ እፈልጋለሁ. እነዚህን ግኝቶች ያለፍቃድዎ ለሌላ ለማንም አይጋሩም.

ቃለመጠይቁን በማንኛውም ጊዜ እንዲያቆሙ ተፈቅዶልዎታል እናም ምላሾችዎ ጥቅም ላይ አይውሉም.

ምን ጥያቄዎች አሉዎት?

ለመቀጠል ከፈለጉ እባክዎን የስምምነት ቅጹን መፈረም ይችላሉ.

ቃለ መጠይቅ መመሪያ

መክፈቻ

- በዚህ ምርምር ለማገዝ ጊዜያችሁን ለምትወሰዱ ተሳታፊዎች አመሰግናለሁ።
- ለቃለ መጠይቁ አጭር መግቢያውን በመጠቀም ጥናቱን ያስተዋውቁ ።
- ስለ ቃለመጠይቁ ወይም ስለ ምርምሩ ምንም ጥያቄዎች እንዳሏቸው ይጠይቁ።
- የስምምነት ቅጽ እንዲፈርሙ ይጠይቁ።
- ስለ ስምምነት ቅጽ ምንም ጥያቄዎች እንዳሏቸው ይጠይቁ።
- ከቃለ መጠይቁ በማንኛውም ጊዜ መውጣት እንደሚችሉ እና ምላሾችም ጥቅም ላይ እንደማይውሉም ይድገሙላቸው።
- ምላሻዎቻቸው ስም-አልባ እንደሆኑ ይድገሙላቸው።
- ቃለመጠይቁ እና ድምዕ ቀረፃው አሁን ይጀምራል።

ቃለመጠይቅ

ቃለመጠይቁ በከፊል የተዋቀረ ነው፣ ከስር ያሉትን ርዕሶች መሸፈን አለባቸው ፣ ግን ቃለመጠይቁ ከቃለ መጠይቆች ጋር በመወያየት መምራት አለበት፡፡ የተለያየ ውይይት ከተነሱ ጉዳዩን የበለጠ ለመረዳት ውይይቱን በተገቢው ሁናቴ ይከታተሉ፡፡ የሚሸፈኑ አርእስቶች ከዚህ በታች ከተወሰኑ ጥያቄዎች ጋር ተገልጻል.

ርዕስ- <u>የኑሮ ልማዶች</u>

ለዚህ ርዕስ ፣ ከውሃ አንፃር ከጊዜ በኋላ የተሳተፋውን ተሞክሮ ለመረዳት እየሞከርን ነው. ይህ የወቅቶች ለውጦች ፣ የመሬት አጠቃቀም ፣ የውሃ አጠቃቀም ፣ የውሃ ጥራት ፣ የጎርፍ መጥለቅለቅ / ድርቅ ፣ የዝናብ ውሃ ፣ የከተማ ልማት ወዘተ ባሉባቸው አካባቢዎች ከኖሩ ልምዶች ሊሆን ይችላል፡፡

ከውሃ ጋር በተያያዙ ጉዳዮች ላይ የእነዚህ ልምዶች አቅጣጫ ለማስቀመጥ ይሞክሩ፤

አንዳንድ ጥያቄዎች አስፈላጊ ከሆነ ያነሳሉ፤

- በዚህ አካባቢ ምን ያህል ጊዜ ኖረዋል?
    - እዚህ አካባቢ ለምን ለመኖር ወሰኑ? ከዚህ በፊት የት ነበር የሚኖሩት? እዚያ የነበረው ኑሮ ምን ይመስል ነበር?
    - ወላጆችዎ እዚህ ይኖሩ ነበር/ይኖራሉ/? ምን ነበር የሚሰሩት? ወላጆችዎ እዚህ ለምን ለመኖር ወሰኑ? ከውሃ ጋር የተዛመዱ ማንኛውንም ትውስታዎች ወላጆችዎ አካፍሎዎታል?
- እዚህ የውሃ እና የመሬት አጠቃቀም ምን ትውስታዎች አለዎት?
    - እዚህ ከኖሩ በኋላ ምን አይነት አይተዋል? (ለምሳሌ፡ የአየር ወቅቶች ፣ የመሬት አጠቃቀም ፣ የውሃ አጠቃቀም ፣ የውሃ ጥራት ፣ የጎርፍ መጥለቅለቅ / ድርቅ ወዘተ...)
    - ወጣት በነበሩበት ጊዜ ስለ ውሃ አጠቃቀም ምን ያስታውሳሉ? ተጫውተዋል? ዋኝተዋል? ዓሳ ነበር? ከአንዳንድ ቦታዎች ውሃ ይቀዱ ነበር?
    - እዚህ ከኖሩበት ጊዜ ጀምሮ ትልቁ ለውጥ ምን ይመስልዎታል?
- በዕለት ተዕለት ሕይወትዎ ውስጥ ውሃ እንዴት ይጠቀማሉ?
    - ለስራዎ?
    - ለቤት ሥራዎች?

ርዕስ- <u>የአቅርቦት እና የፍላጎት ተግዳሮቶች</u>

ለዚህ ርዕስ የተለያዩ የውሃ አጠቃቀምን (ፍላጎት) እና የተለያዩ አቅርቦቶችን (ጥራት ፣ ብዛት ፣ ተደራሽነት ወዘተ) ለመረዳት እየሞከርን ነው፡፡ ስለ ከባድነት ሚዛን ፣ መሞከር እና ማስተዋልን መፈለግ አስፈላጊ ነው (ለምሳሌ ፣ አንድ መጥፎ ነገር ምን ያህል መጥፎ እንደሆነ ፣ አንድ ነገር ምን ያህል አጣዳፊ እንደሆነ፣ አንድ ነገር ምን ያህል አስፈላጊ ነው) እንዲሁም እነዚህ ነገሮች ከጊዜ ወደ ጊዜ እንዴት እንደተለወጡ ማየት አስፈላጊ ነው፡፡

አንዳንድ ጥያቄዎች አስፈላጊ ከሆነ ያነሳሳሉ፡፡

- የውሃ ትልቁ የሚያሳስብዎ ጉዳይ ምንድነው?
    - የመጠጥ ውሃ አቅርቦት?

    - በጥራት መቀነስ?
    - ጎርፍ?
    - የዝናብ ልዩነት?
    - እነዚህን በዝናባማ ወቅት እና በደረቅ ወቅት መካከል ያብራሩ
    - ውሃ ለተለያዩ ዓላማዎች እንዴት እንደሚገኝ ያብራሩ እና መልስዎ ከጊዜ በፊት የተለየ ከሆነ ግለፁ
- ስለ ውሃ በጣም የሚያሳስቦት እና በዙም የሚያሳስቦት መቼ ነው? ብዛት ፣ ጥራት ፣ ተገኝነት ፣ እጅግ በጣም ከባድ ክስተቶች?
- እዚህ ከመኖርዎ ጊዜ ጀምሮ የውሃ አቅርቦት መቀነስ አስተውለሃል?
    - ብዛትን ፣ ጥራትን እና ተደራሽነትን ያብራሩ

ርዕስ - <u>የይገባኛል ጥያቄዎች እና ምልክቶች</u>

ለዚህ ርዕስ የተለያዩ የውሃ ጉዳዮች እንዴት እርምጃ እንደሚፈጥሩ ለመረዳት እየሞከርን ነው፡፡ ይህ ለችግሮች መፍትሄ ለመስጠት ወይም ግንዛቤን ለማሳደግ በቡድኖችን በመከፋፈል መሆነ ይችላል፡፡ ሌሎች የዘመቻ ዓይነቶች ከኖሩ (ለምሳሌ ፣ አቤቱታዎች ፣ የተቃውሞ ሰልፎች) ወይም ምናልባት አንዳንድ የውሃ ጉዳዮችን ለማስተካከል ለመሞከር እራሳቸውን በራሳቸው ላይ የሚወስዱት ጥቂት የማህበረሰብ ግለሰቦች ሊኖሩ ይችላሉ፡፡

አንዳንድ ጥያቄዎች አስፈላጊ ከሆነ ያነሳሉ፡፡

- በዚህ አካባቢ የውሃ እኩል ተደራሽነት እንዳለ ይሰማዎታል? በአዲስ አበባስ ውስጥስ?
- እንደ ዜጋ ወይም ማህበረሰብ እንደመሆንዎ የውሃ አቅርቦት ቅድሚያ እንደሚያገኙ ይሰማዎታል?
    - ካልሆነ ፣ ለምን?
    - ካልሆነ ፣ ቅድሚያ የሚሰጠው ማን ይመስልዎታል? ለምን?
- ማህበረሰብዎ በዚህ አካባቢ ላሉት ዋና የውሃ ችግሮች እንዴት ምላሽ ይሰጣል? (ለምሳሌ ፣ የጎርፍ መጥለቅለቅ ቡድን አለ? የውሃ ተደራሽነት በቤተሰቦች መካከል ይጋራ ይሆን?)
- በዚህ የውሃ ጉዳዮች እና ችግሮች በግል እንዴት ምላሽ ይሰጣሉ?

መዝጊያ

- ቃለመጠይቁ ወደ ፍጻሜው እየመጣ መሆኑን ያስገንዝቡ
- አስፈላጊ ነው ብለው ያልተጠቀሱ ነገሮች ካሉ ይጠይቁ
- ለእርስዎ ምንም ጥያቄዎች እንዳሏቸው ይጠይቁ
- የክፍያ መጠየቂያ ቅጽ መፈረም እና ከእነሱ ጋር ክፍያ መለዋወጥ እነዲችሉ ይጠይቁ
- ለመሳተፋቸው እንደገና ያመሰግኑ
- ምላሻዎቻቸው እንዴት ጥቅም ላይ እንደሚውሉ ወደፊት ከፈለጉ እንደሚያሳውቁ ይንገሯቸው

B.4 Interview Protocol for Key Informants

Introduction to research.

This research looks at understanding water issues across the Akaki catchment and beyond.

I am interviewing key informants, citizens, and relevant authorities, ministries, and organizations. This is to help understand how water issues are caused and what the causes and impacts are from different perspectives.

This interview will be no more than 1 hour, and it will be semi-structured. This means there are topics of discussion, but it is mostly directed by you, the participant and it is more of an open-ended discussion. Audio will be recorded.

There are three parts to the interview: (i) an initial survey; (ii) water issue discussion based on boundaries; (iii) water issue discussion based on your role, knowledge, and experience.

I will be using the answers as data to build a picture of water issues in the Akaki basin and beyond and provide recommended governance solutions. Even though we are recording the audio, the discussion we have will be completely anonymous and you will not be identifiable in any recounts of the interview.

I will share any relevant findings with you, with your permission, once my research is concluded. But I will need to take your contact details. These will not be shared with anyone else without your permission.

You are allowed to stop the interview at any time and your responses will not be used.

Do you have any questions?

If you would like to proceed, could you please sign the consent form.

Opening

- ☐ Thank the participants for taking their time to help with this research
- ☐ Introduce the research using the interview brief
- ☐ Ask if they have any questions about the interview brief or the research
- ☐ Ask them to sign to the consent form
- ☐ Ask them if they have any questions about the consent form
- ☐ Repeat that they can withdraw from the interview at any time and the responses will not be used
- ☐ Repeat that their responses will remain anonymous
- ☐ Say that the interview and recording will now begin.

The Interview

The interview is semi-structured meaning the topics should be covered, but the interview should be led by discussion with the interviewee(s). If an interesting discussion appears, then use your initiative to follow and nurture the discussion to understand the issue further. The topics to be covered are described below along with some question prompts if needed.

Physical water insecurity.

For this topic, we are trying to understand the various uses of water (demand) and the various issues with supply (quality, quantity, access etc.). It is important to try and get an insight into scales of severity (e.g., how bad something is, how urgent something is, how important something is) as well as a perspective of how/if these things have changed over time.

Some question prompts if needed:

- What is your biggest concern for water?
    - Drinking water supply?
    - Reduction in quality?

    - Flooding?
    - Rainfall variability?
    - Explore these between rainy season and dry season
    - Explore how water is obtained for different purposes and if that has been different over time

- When do you feel most and least concerned about water? Quantity, quality, availability, extreme events?
- Have you noticed a reduction in water availability since working here?
    - Explore quantity, quality, and access
- How do you personally respond to water issues in your working role?

Political water security (role and knowledge).

For this topic, we are exploring the specific role and knowledge of the key informant in relation to water security. This involves their perspective of water security and priorities in relation to their work as well as any specific guidelines/mandates they operate within that they believe is related to water security.

- What is your perspective of water security?
    - What do you think formed this perspective? E.g., work, education, where you live, media, etc.?
    - What water security priorities are there in your work? Do you think these differ from your personal life?
- Do you work within any frameworks, guidelines, or mandates that specifically focus on water security?
    - What are these?
    - At what level do they exist? E.g., regional, national, international etc.?
    - If there is not a specific framework then what frameworks do you feel promote water security?

Closing

- [ ] Raise awareness that the interview is coming to an end
- [ ] Ask if there is anything that hasn't been mentioned that they feel is important
- [ ] Ask them if they have any questions for you

- [ ] Thank them again for taking part

- [ ] Tell them that you will let them know how their responses are used if they wish

☐[PLEASE TICK TO CONFIRM] I am happy for this response to be used for academic use by IWMI and the GCRF Water Security and Sustainable Development Hub.

B.5 Questionnaire

Affiliation	
Job Title, Department, Role Description	
Question 1	
What do you understand included by the term “water security”?	
Question 2	
What do you think is the most urgent issue (or issues) for water challenges locally and nationally?	
Question 3	
How do you think water issues are linked to issues beyond basin or regional boundaries?	
Any Other General comments on water security from your perspective?	

Appendix C. Community interview transcripts

C.1 Community interview 1 [English 1]

I have lived in this area for about six years. I lived in Wolita Sodo before I lived here. The reason I came to this area is for work. My family still lives there in the countryside of Wolita Sodo. They manage their lives in the agricultural living sector.

I have learned the river water measurment on the moment, so I am working in this professional sector. It feels great to be able to tell my family that I'm doing this. My family lives around the river. They use the river water for many things (i.e. for drinking, clothing, & agriculture). The river where my family lives has changed over time. The occurrence of landslides and reduction of river water levels is mentioned as the major changes.

There has been no flooding since I started living here. The landscape of the area I live in has been not been a threat to flood. However, I've heard that there were various flood events along the river.

There was a serious problem when it comes to drinking water. Back where I used to live, I utilized river water for drinking purposes.

In the area where I lived with my family before, we used river water for drinking purposes. But now the system is changed by a different kebele in providing tap water for the community. This has been extremely beneficial to my family.

However, there is a supply of water through the pipe lines in the area where I now live. This water is used for drinks, clothing, washing, and other purposes.

One of the most serious concerns about water quality is water being polluted due to flooding and rain.

Water is scarce in my current neighborhood, and we only have access to it two days per week. This water is used for a variety of household necessities. I doubt that water will reach every part of Addis Abeba. This is because the population is overburdened and the water supply is inadequate. Water shortages will occur in various locations until all are met. Water scarcity is particularly acute in areas outside the city center.

I wish water to be accessible to everyone, not just to me.

Water tanker is committed to addressing the issue of water supply in the community where I live. This is due to complaints and applications from the community in appropriate circumstances of lack of water supply. However, because the water from the water tanker supply is of poor quality, I am purchasing water to drink.

Finally, if there is a flood problem in my area, I will make every effort to save the people who live in the downstream area. When the rainfall exceeds expectations, I try to notify higher officials from where I work at in order to help out and prevent major effect on the downstream community.

C.2 Community interview 1 [English 2]

Question: How long have you lived in this area?

Response: Six years

Question: Why did you come here? What is the reason?

Response: I came for work.

Question: Where did you live before?

Response: I was lived in Wolaita Sodo in the province, in the southern region.

Question: What kind of work does your family do?

Response: It is by farming work.

Question: Did your family share any memories with related to water?

Response: The area where my family lives is by the river. They will be very happy when I learn and tell them how to measure river rainfall.

Question: Is the river still standing near your family? Or has it changed?

Response: No, it's reduced. There are also landslides. But from what I have seen, Terracing has been done.

Question: Before or after you came to this neighborhood, what memories do you have related to water?

Response: As far as the rain on the ground goes, I've got a good deal on my side. There are no floods in this neighborhood because the land is flat. Elsewhere in Addis Ababa, for example, there may be flooding in Kebena, Saris area. But around here, I have learned how much rain penetrates the ground.

Question: Do you have any memories related to water before or after coming to this neighborhood?

Response: We used to drink water associated with floods. There is no tap water. It's just now, recently piped. It is far from this neighborhood, but it is used by many people. There are two pipes in this neighborhood. We use three kebeles together. But, before

we drink river water. Now it has improved a bit. I have never fished or swam in my memory with the water.

Question: How do you use water in your daily life?

Response: I live as a renter; we use tap water for everything, everyone in Addis Ababa.

Question: What are your concerns about water?

Response: First, seasonal change is a major threat to water scarcity. Another concern is that the quality of the water may be in hazardous as it may be connected to flooding. There may be a ruptured pipe when plumbers work; I am concerned that this system will allow the water to mix up the flood. Because of this, sometimes the water changes its colour.

Question: Have you ever experienced a water shortage in your neighborhood?

Response: There is a shortage this year. We only get water twice a week.

Question: Do you think all areas of Addis Ababa are equally accessible in the use of water?

Response: It is not equally accessible. There has never been a shortage of water here in the city center like this year. I think that the problem of water shortage is caused by the fact that water distribution is too much and it is released in turn. There are new neighborhoods outside the city center. When water is distributed to all these settlements, water shortages may occur. So water workers can reduce the water coming into the city center and send it to new neighborhoods on the outskirts of the city; at that time there will be a shortage of water.

Question: Do you think there should be an individual (including you) or a community that should be prioritized when using water? If your answer is "Yes", how? If your answer is "No" then why?

Response: Priority is not only for me but for everyone. It's not just for me.

Question: When you face a water shortage or problem in your area, what action do you take as a member of the community?

Response: Water and Sewerage Authority is supplying boti (water tank) water. We are drinking this water. But it may not be clean. The local or regional people order and bring it. And we use it for drinking. When there is another problem, the local community refers it to the relevant authorities. Apart from this, when there is a shortage of water, personally, I buy water from the store as much as I can and use it.

Question: Do you have any additional ideas that you have not mentioned or would like to express regarding the points we have raised so far, that is, water and water use?

Response: Lack of drinking water is not only with us but with everyone. The problem around Addis Ababa is with everyone. I think that the problem of flooding is specific to each neighborhood. The direction of the flood is not known. If there is a river or a flood in this area, apart from my personal help, I will tell the concerned bodies to know the problem and take the necessary measures.

Thank you!

C.3 Community interview 1 [Amharic 1]

የቃለመጠይቅ 1 ምዝግብ መረጃ - የአማርኛ ቅጂ

ጥያቄ፡- በዚህ አካባቢ ለምን ያህል ጊዜ ኖረዋል?

መልስ፦ ሰድሰት ዓመት

ጥያቄ፡- ወደዚህ አካባቢ የመጣችሁት ለምንድን ነው? በምንስ ምክንያት ነው?

መልስ፦ ለሰራ ነው የመጣሁት፡፡

ጥያቄ፡- ከዚህ በፊት የኖሩት የት አካባቢ ነበር?

መልስ፦ ክፍለ ሀገር፣ በደቡብ ክልል ወላይታ ሶዶ ነበር የምኖረው፡፡

ጥያቄ፡- ቤተሰብዎ በምን ሥራ ነው የሚተዳደሩት?

መልስ፦ በእርሻ ሥራ ነው፡፡

ጥያቄ፡- ቤተሰቦችህ ከውሃ ጋር የተያያዙ ምን ምን ትዝታዎች አካፍለውሃል?

መልስ፦ ቤተሰቦቼ ያሉበት አካባቢ ወንዝ ዳር ነው፡፡ የወንዝ ዝናብ መለኪያን ተምሬ አውቄ ስነግራቸው በጣም ይደሰታሉ፡ ፡

ጥያቄ፡- በቤተሰቦችህ አካባቢ ያለው ወንዝ አሁንም እንዳለ ነው? ወይስ ተለውጧል?

መልስ፦ አይ ቀንሷል፤ የመሬት መንሸራተትም አለ፡፡ ነገር ግን እኔ ካየሁት በኋላ የእርከን ሥራ ተሰርቷል፡፡

ጥያቄ፡- በፊትም ሆነ እዚህ ከመጡ በኋላ የውሃ እና የመሬት አጠቃቀምን በተመለከተ ምን የታዘቡት ነገር አለ? ምን የተቀየረ ነገርስ አለ?

መልስ፦ በመሬቱ ዝናብ ምን ያህል እንደሚገባ፣ በራሴ በኩል ጥሩ ነገር አግኝቻለሁ፡፡ እዚህ ሰፈር መሬቱ የተደላደለ ስለሆነ ጎርፍ የለም፡፡ ሌላ ቦታ አዲስ አበባ ለምሳሌ፦ ቀበና፣ ሳሪስ አካባቢ ጎርፍ ሊኖር ይችላል፡፡ እዚህ አካባቢ ግን ዝናብ ወደመሬት ምን ያህል እንደሚገባ እውቀት አግኝቻለሁ፡፡

ጥያቄ፡- በፊትም ሆነ ወደዚህ ሰፈር ከመጡ በኋላ ከውሃ ጋር የተያያዘ ምን የሚያስታውሱት

ትዝታ ነገር አለ?

መልስ፡- ድሮ ጎርፍ ጋር የተገናኘ ውሃ ነበር የምንጠጣው፡፡ የቧንቧ ውሃ የለም፤ አሁን ነው፣ ቅርብ ጊዜ ቧንቧ የተሰራው፡፡ ከዚህ ሰፈር ይርቃል እንጂ ብዙ ሰው ነው የሚጠቀመው፡፡ እዚህ ሰፈር ሁለት ቧንቧ አለ፤ ሦስት ቀበሌ በአንድ ላይ ነው የምንጠቀመው፡፡ በፊት ግን የወንዝ ውሃ ነው የምንጠጣው፡፡ አሁን ትንሽ ተሻሽሏል፡፡ ከውሃ ጋር ባለኝ ትዝታ አሳ አጥምጄም ሆነ ዋኝቼ አላውቅም፡፡

ጥያቄ፡- በዕለት ተዕለት ሕይወትዎ ውስጥ የውሃ አጠቃቀምዎ እንዴት ነው?

መልስ፦ ተከራይቼ ስለሆነ የምኖረው፣ ለሁሉም ነገር ሁሉም የአዲስ አበባ ሰው የቧንቧ ውሃ ነው የምንጠቀመው፡፡

ጥያቄ፡- ስለውሃ ያለዎት ስጋት ምንድን ነው?

መልስ፦ የመጀመሪያው፣ የወቅት መቀያየር ለውሃ እጥረት ትልቅ ስጋት ነው፡፡ ሌላው ውሃው ከጎርፍ ሊገናኝ ስለሚችል ጥራቱ አደጋ ላይ ሊወድቅ ይችላል የሚል ስጋት አለኝ፡፡ የውሃ ባለሙያዎች ሲሰሩ የተቀደደ ቱቦ ሊኖር ይችላል፤ ይህ አሰራርም

ውሃውን ከጎርፍ ጋር ለመገናኘት ወይም ለመቀላቀል ያስችለዋል የሚል ስጋት አለኝ፡፡ በዚህ ምክንያት አንዳንዴ ውሃው መልኩን ይቀይራል፡፡

ጥያቄ፡- በሰፈራችሁ የውሃ እጥረት አጋጥሟችሁ ያውቃል?

መልስ፦ ዘንድሮማ በጣም እጥረት አለ፡፡ በሳምንት ሁለት ጊዜ ብቻ ነው ውሃ የምናገኘው፡፡

ጥያቄ፡- በውሃ አጠቃቀም ሁሉም የአዲስ አበባ አካባቢ እኩል ተደራሽ ነው ብለው ያስባሉ?

መልስ፦ እኩል ተደራሽ አይደለም፤ እዚህ መሃል ከተማ ላይ እንደዘንድሮ የውሃ እጥረት አጋጥሞ አያውቅም፡፡ የውሃ እጥረት ችግሩ የሚፈጠረው የውሃ ከፍፍል ስለሚበዛና በየተራ ስለሚለቀቅ ይመስለኛል፡፡ ከመሃል ከተማው ወጣ ያለ አዳዲስ ሰፈር አለ፤ ውሃ ለእነዚህ ሰፈሮች ሁሉ ሲከፋፈል የውሃ እጥረት ሊያጋጥም ይችላል፡፡ ስለዚህ የውሃ ሰራተኞች ወደመሃል ከተማ የሚመጣውን ውሃ በመቀነስ ወደከተማው ዳር ወደአሉ አዳዲስ ሰፈሮች ሊልኩት ይችላሉ፤ በዚያን ጊዜ የውሃ እጥረት ይከሰታል፡፡

ጥያቄ፡- ውሃ ስትጠቀሙ ቅድሚያ ሊሰጠው የሚገባ ግለሰብ (እርስዎን ጨምሮ) ወይም ማኅበረሰብ ሊኖር ይገባል ብለው ያስባሉ? መልስዎ ‹‹አዎ›› ከሆነ እንዴት? መልስዎ ‹‹አይ አይገባም›› ከሆነ ለምን?

መልስ፦ ቅድሚያ ለእኔ ብቻ ሳይሆን ለሁሉም ነው፡፡ ለእኔ ብቻ ተብሎ የሚሰጥ አይደለም፡፡

ጥያቄ፡- በአካባቢያችሁ የውሃ እጥረት ወይም ችግር ሲያጋጥማችሁ አንደማኅበረሰብ ምን ርምጃ

ትወስዳላችሁ?

መልስ፦ ውሃና ፍሳሽ ባለስልጣን የቦቲ ውሃ እያቀረበ ነው፡፡ እኛ ይሄን ውሃ ነው እየጠጣን ያለነው፡፡ ግን ንጹህ ላይሆን ይችላል፡፡ የአካባቢው ወይም የቀጠናው ሰዎች፣ ያሳዝዙና ያመጡታል፡፡ እኛ ደግሞ ለመጠጥ ነው የምንጠቀመው፡፡ ሌላ ችግር ሲያጋጥም የአካባቢው ማኅበረሰብ ለሚመለከተው አካል ያመለክታል፡፡ ከዚህ ውጪ የውሃ እጥረት ሲያጋጥም በግሌ፣ ባለኝ አቅም ከሱቅ ነው ውሃ ገዝቼ የምጠቀመው፡፡

ጥያቄ፡- እስካሁን ባነሳናቸው ነጥቦች፣ ማለትም በውሃ እና የውሃ አጠቃቀም ዙሪያ ያልጠቀሱት

ወይም ሊገልጹት የሚፈልጉት ተጨማሪ ሐሳብ ካለዎ?

መልስ፦ የመጠጥ ውሃ እጥረት እኛ ጋር ብቻ አይደለም ሁሉም ጋር ነው ያለው፡፡ በአዲስ አበባ ዙሪያ ችግሩ ያለው ሁሉም ጋር ነው፡፡ የጎርፍ ችግር ደግሞ በየሰፈሩ መርጦ መርጦ ያለ ይመስለኛል፡፡ ጎርፉ በየት በኩል እንደሚበዛ አቅጣጫው አይታወቅም፡፡ በዚህ አካባቢ ወንዝ፣ ቢኖር፣ ውሃ ሙላት ወይም ጎርፍ ቢከሰት፣ በግሌ ከማደርገው ርዳታ ባሻገር የሚመለከታቸው አካላት ችግሩን እንዲያውቁና አሰፈላጊውን እርምጃ እንዲወስዱ እነግራቸዋለሁ፡፡

አመሰግናለሁ!

C.4 Community interview 1 [Amharic 2]

በዚህ አካባቢ ስድስት ዐመት ያህል ኖሬያለሁ፡፡ እዚህ አካባቢ ከመኖሬ በፊት የምኖረው ወላይታ ሶዶ ነበር፡፡ ወደዚህ አካባቢ የመጣሁት ምክንያት ለስራ ብዬ ነው፡፡ ቤተሰቦቼ አሁንም የሚኖሩት እዛው ወላይታ ሶዶ ገጠር ውስጥ ነው፡፡ ኑሮዋቸውን የሚያስተዳድሩት በግብርና የኑሮ ዘርፍ ነው፡፡

እኔ በአሁን ላይ የወንዝ ውሃ ልኬት ተምሬያለሁ፣ በዚህም የሙያ ዘርፍ እየሰራሁ እገኛለሁ፡፡ ይህን እየስራሁ እንደሆነ ለቤተሰቦቼ ስነግር በጣም ነው ደስ ያላቸው፡፡ ቤተሰቦቼ ወንዝ ዳር አካባቢ ነው የሚኖሩት፣ የወንዙን ውሃ ለብዙ ነገሮች (ለምሳሌ ለመጠጥ፣ ለልብስ፣ ለግብርና)ይጠቀሙበታል፡፡ ቤተሰቦቼ በሚኖሩበት ቦታ ያለው ወንዝ በጊዜያት ለውጥ አሳይቷል፡፡ ከታየው ለውጥ ውስጥ የመሬት መንሸራተት እና የወንዙ ውሃ መጠን መቀነስ በዋነኛነት ይጠቀሳል፡፡

እዚህ አካባቢ መኖር ከጀመርኩ ጀምሮ ጎርፍ የለም፡፡ የአካባቢው የመሬት አቀማመጥ እንደሚታየው ለጎርፍ አስጊ አደለም፡፡ ነገር ግን በወንዝ ዙሪያ የተለያየ የጎርፍ ከስተቶች እንደነበር ሰምቻለሁ፡፡

በፊት ከቤተሰቦቼ ጋር በምኖርበት አካባቢ የወንዝ ውሃ ለመጠጥነት እና ለተለያየ የቤት ውስጥ አገልግሎቶች እንጠቀም ነበር፡፡ በአሁኑ ሰዐት ግን በተለያየ ቀበሌ ቦኖ ተዘጋጅቷል፤ እናም ይህን ለመጠጥነት እየተጠቀሙ ይገኛሉ ቤተሰቦቼ፡፡

አሁን በምኖርበት አካባቢ ግን የውሃ አቅርቦት በቧንቧ አማካኝነት አለ፡፡ ይህን ውሃ ለመጠጥ፣ ለልብስ ፣ ለመታጠቢያ እና ለመሳሰሉት እጠቀማለሁ፡፡

የውሃ ነገር በትልቁ ከሚያሳስበኝ ጉዳዮች መሃል የውሃ ጥራት በጎርፍ አማካኝነት እና የዝናብ ወቅት ናቸው፡፡

አሁን በምኖርበት አካባቢ የውሃ እጥረት አለ፣ ውሃ የምናገኘው በሳምንት ሁለት ቀን ነው፡፡ ይህን ውሃ በለተለያዩ ለቤት አስፈላጊ ነገሮች ይውላል፡፡

በአዲስ አበባ ውሃ በሁሉም አካባቢ ይደርሳል ብዬ አላስብም፡፡ ይህ የሆነው ትልቁ ምክንያት በአዲስ አበባ ህዝቡ ስለበዛ እና የውሃ አቅርቦት ከህዝቡ ልክ ስላልሆነ ነው፡፡ በየተራ ሁሉም ጋር እስኪዳረስ የተለያዩ ቦታዎች የውሃ እጥረት የገጥማቸዋል፤ በተለይ ከመሃል ከተማ ወጣ ያሉ አካባቢዎች የውሃ አጥረት ይገጥማቸዋል፡፡

እንደዜጋ ውሃ ለእኔ ብቻ ሳይሆን ለሁሉም እንዲዳረስ ነው የምፈልገው፡፡

በምኖርበት ማህበረሰብ ውስጥ ለሚከሰተው የውሃ አቅረቦት ችግር፤ የውሃ ቦቴ ችግሩን ለመቅረፍ የመጣልናል፡፡ ይህ ሊሆን የቻለው ማህበረሰቡ በተገቢው ሁናቴ በሚያቀርበው ቅሬታ እና ማመልከቻ አማካኝነት ነው፡፡ ነገር ግን የቦቴው ውሃ ጥራቱን የጠበቀ ስላልሆነ፤ ለመጠጥ የሚውል ውሃ እየገዛሁ ነው የምጠቀመው፡፡

በመጨረሻም ልናገር የምፈልገው፤ በምኖርበት አካባቢ የጎርፍ ችግር ቢመጣ ወደ ታችኛው አካባቢ የሚኖሩትን ሰዎች ለማዳን እሞክራለሁ፡፡ የዝናብ መጠን ከተጠበቀው በላይ በሚሆንበት ጊዜ ለበላይ አካላት በማሳወቅ ሊጠቁ የሚችሉ ማህብረሰቦች እንዳይጎዱ ጥረት አደርጋለሁ፡፡

C.5 Community interview 2 [English]

Question: How long have you lived in this area?

Answer: Six years

Question: Why did you come here? What is the reason?

Answer: We lived in a rented house. But now we have bought a house here.

Question: Where did you live before?

Answer: Sidist Kilo (Addis Ababa)

Question: What kind of work does your family do?

Answer: By working in a tea house here.

Question: Did they share any memories with you related to water?

Answer: No, there is no water in this neighborhood in summer; and it's fetched by row parade (donkeys). This is what I remember.

Question: What have you noticed about water and land use since you came here? What has changed?

Answer: Houses are built. There is a water problem. But now the water problem is decreasing to a small extent. But there is no flood here.

Question: Before or after you came to this neighborhood, what memories do you have related to water?

Answer: When I was a child and now, I never swum except for splashing and splashing.

Question: What has changed since you came here?

Answer: The environment has changed. This area used to be very rural. Now it is becoming a little better town.

Question: How do you use water in day today life?

Answer: We don't use it daily for bathing and hair washing. Instead, it is used for drinking and food preparation. Sometimes we use it for a weekly bath.

Question: What is your biggest concern for water?

Answer: I am concerned about water scarcity and water quality. There is a shortage of water in this neighborhood, so I think there should be no shortage of water, especially in the summer. And also I am concerned about the quality of the water when it comes in, as it is occasionally contaminated or dirty.

Question: Is there any flood problem or threat in your area?

Answer: Even if there is a flood, it will go down because the area is steep. Therefore, there will be no flood in this neighborhood. But sometimes it can be difficult to farm.

Question: Do you feel that Addis Ababa and this area are equally accessible in water use?

Answer: No, there is no equal access. Even if you don't want to save water here, you should. But Addis Ababa has no problem because there is tap water; there’s water from a piped supply. You can use it however you want. But here it is difficult because you are fetching by row parade (donkeys).

Question: Do you think there should be an individual or a community that should be prioritized when using water? If your answer is "yes", how? If your answer is "no" then why?

Answer: yes; some come with a baby, There may be a sick person; I think it should be prioritized for these types of people. Apart from that, priority should not be given to a healthy person who has no problems. They can fetch a queue.

Question: When you face a water shortage or problem in your area, what action do you take as a member of the community?

Answer: The water comes from a higher place. The water tank is flushed when it gets dirty; occasionally people go and wash. But at the individual level, nothing can be done. If there is a problem somewhere, they themselves go and dig, take out the dirt and water will come. There is no other work to be done.

Question: When there is a water shortage or problem, have you ever asked or applied to the local district or kebele administrative bodies?

Answer: We have never gone to Keble or district for water issues. Kebele and water development are different. When there is a problem, it is water development that fixes it; it’s not a kebele. It is concerned with Water Development Bureau. However, lack of water is a big problem in our village, especially in summer.

Question: Do you have any additional ideas that you have not mentioned or would like to express regarding the points we have raised so far, that is, water and water use?

Answer: I don't have any. I’m done.

Thank you!

C.6 Community interview 2 [Amharic]

ጥያቄ፡- በዚህ አካባቢ ለምን ያህል ጊዜ ኖረዋል?

መልስ፡- ሰድሰት ዓመት

ጥያቄ፡- ወደዚህ አካባቢ የመጣችሁት ለምንድን ነው? በምንስ ምክንያት ነው?

መልስ፡- በቤት ኪራይ ነበር የምንኖረው፤ አሁን ግን እዚህ ቤት ገዝተን ነው፡፡

ጥያቄ፡- ከዚህ በፊት የምትኖሩት የት አካባቢ ነበር?

መልስ፡- ሰድሰት ኪሎ

ጥያቄ፡- ቤተሰቦችሽ በምን ሥራ ነው የሚተዳደሩት?

መልስ፡- ያው እዚህ ሻይ ቤት በመስራት

ጥያቄ፡- ከውሃ ጋር የተያያዙ ምን ምን ትዝታዎችን ተጋርተው አሳልፈዋል?

መልስ፡- ኣይ፣ ቢጋ ላይ እዚህ ሰፈር ውሃ የለም፤ እናም በሰልፍ ነው የሚቀዳው፤ ይህን ነው የማስታውሰው፡፡

ጥያቄ፡- እዚህ ከመጣችሁ በኋላ የውሃ እና የመሬት አጠቃቀምን በተመለከተ ምን የታዘቡት ነገር አለ? ምን የተቀየረ ነገርስ አለ?

መልስ፡- ቤቶች ተሰርተዋል፤ የውሃ ችግር አለ፤ ነገር ግን አሁን ላይ የውሃ ችግር ግን በትንሹም ቢሆን እየቀነሰ ነው፤ ጎርፍ ግን እዚህ ሰፈር የለም፡፡

ጥያቄ፡- በፊትም ሆነ ወደዚህ ሰፈር ከመጡ በኋላ ከውሃ ጋር የተያያዘ ምን የሚያስታውሱት ትዝታ ነገር አለ?

መልስ፡- *በፊት ህዳን እያለሁም ሆነ አሁን በውሃ መጫዎት፣ መንቦራጨቅ እንጂ ዋና ሂጂ ወይም ዋኝቼ አላውቅም፡፡*

ጥያቄ፡- ወደዚህ ከመጡ በኋላ ምን ለውጥ አለ?

መልስ፡- አካባቢው ተቀይሯል፡፡ ይህ አካባቢ ድሮ በጣም ገጠር ነበር፤ አሁን ትንሽ እየተሻሻለ ከተማ እየሆነ ነው፡፡

ጥያቄ፡- በዕለት ተዕለት ሕይወትዎ ውስጥ ውሃን እንዴት ይጠቀማሉ?

መልስ፡- በቀን በቀን ለገላ እና ጸጉር መታጠብ እንጠቀምም፡፡ ይልቁንም ለመጠጥና ለምግብ ዝግጅት አገልግሎት ላይ ይውላል፡፡ አንዳንድ ጊዜ በሳምንት ለገላ መታጠብ እንጠቀማለን፡፡

ጥያቄ፡- ለውሃ በጣም የሚያሳስብዎት ነገር ምንድን ነው?

መልስ፡- የውሃ እጥረት እና የውሃ ጥራት ያሳስበኛል፡፡ እዚህ ሰፈር የውሃ እጥረት ስላለ በተለይ ቢጋ ላይ ውሃ እጥረት እንዳይኖር አሰባለሁ፡፡ ሌላው ውሃ ሲመጣ ደግሞ አልፎ አልፎ የተበከለ ወይም ቆሻሻ ስለሚሆን የውሃ ጥራት ያሳስበኛል፡፡

ጥያቄ፡- በአካባቢያችሁ የጎርፍ ችግር ወይም ስጋት የለም?

መልስ፡- ጎርፍ ቢመጣም አካባቢው ቁልቁለት ስለሆነ ወደታች ነው የሚሄደው፡፡ ስለሆነም እዚህ

ሰፈር ጎርፍ አይመጣም፡፡ ግን አንዳድ ጊዜ ለእርሻ ሊያስቸግር ይችላል፡፡

ጥያቄ፡- በውሃ አጠቃቀም አዲስ አበባ እና ይህ አካባቢ እኩል ተደራሽ እንደሆነ ይሰማዎታል?

መልስ፦ ሸረ፣ እኩል ተደራሽነት የለውም፤ እዚህ ውሃ መቆጠብ ባትፈልግም ውሃ መቆጠብ አለብህ፡፡ አዲስ አበባ ግን የቧንቧ ውሃ ስላለ ችግር የለውም፤ እንደፈለግክ መጠቀም ትችላለህ፡፡ እዚህ ግን እየቀዳህ ስለሆነ ይቸግራል፡፡

ጥያቄ፡- ውሃ ስትጠቀሙ ቅድሚያ ሊሰጠው የሚገባ ግለሰብ ወይም ማኅበረሰብ ሊኖር ይገባል ብለው ያስባሉ? መልስዎ ‹‹አዎ›› ከሆነ እንዴት? መልስዎ ‹‹አይ አይገባም›› ከሆነ ለምን?

መልስ፦ አዎ፤ ልጅ አስተኝተው የሚመጡ አሉ፤ የታመመ ሰው ሊኖር ይችላል፤ ለእነዚህ ዓይነት ሰዎች ከሆነ ቅድሚያ መሰጠት አለበት ብዬ አስባለሁ፡፡ ከዚያ ውጪ ግን ለጤነኛና ችግር ላላገጠመው ሰው ቅድሚያ መሰጠት የለበትም፡፡ በሰልፍ ተሰልፎ መቅዳት ይችላል፡፡

ጥያቄ፡- በአካባቢያችሁ የውሃ እጥረት ወይም ችግር ሲያጋጥማችሁ አንደማኅበረሰብ ምን ርምጃ ትወስዳላችሁ?

መልስ፦ ውሃው የሚመጣው ከላይ ከከፍታ ቦታ ነው፤ የውሃ ታንከሩ ሲቆሽሽ ይታጠባል፤ አልፎ አልፎ ሰዎች ሂደው ያጥባሉ፡፡ በግለሰብ ደረጃ ግን ምንም ማድረግ አይቻልም፡፡ የሆነ ቦታ ችግር ካጋጠመ ራሳቸው ሂደው ቆፍረው ቆሻሻውን አውጥተው ውሃ ይመጣል፡፡ ከዚህ የተለየ ምንም የሚሰራ ስራ የለም፡፡

ጥያቄ፡- የውሃ እጥረት ወይም ችግር ሲከሰት ለአካባቢው የወረዳ ወይም ቀበሌ አስተዳዳር አካላት ጠይቃችሁ ወይም አመልክታችሁ ታውቃላችሁ?

መልስ፦ በውሃ ጉዳይ ቀበሌ ወይም ወረዳ ሂደን አናውቅም፡፡ ቀበሌ እና የውሃ ልማት ይለያያል፡፡ ችግር ሲኖር የውሃ ልማት እንጂ የሚያስተካክልልን ቀበሌ አይደለም፡፡ የሚመለከተው የውሃ ልማት ቢሮን ነው፡፡
ቢሆንም ግን በሰፈራችን በተለይ በበጋ ወቅት የውሃ እጥረት ትልቅ ችግር ነው፡፡

ጥያቄ፡- እስካሁን ባነሳናቸው ነጥቦች፣ ማለትም በውሃ እና የውሃ አጠቃቀም ዙሪያ ያልጠቀሱት ወይም ሊገልጹት የሚፈልጉት ተጨማሪ ሐሳብ ካለዎ?

መልስ፦ የለኝም፤ ጨርሻለሁ፡፡

አመሰግናለሁ!

C.7 Community interview 3 [English]

Question: How long have you lived in this area?

Response: I was born and grew up in this neighborhood. I am twenty years old now. Therefore, I have lived here for twenty years. My family also lives here.

Question: What kind of work does your family do?

Response: it is by business work.

Question: What memories have your family shared with you related to water? What do you remember?

Response: My family didn't share me, but we grew up walking and swimming around the river. I grew up watching and playing with floods.

Question: Before and after you came here, what did you observe regarding the use of water and land? What has changed?

Response: Nothing has changed. Water comes and goes. Everything is where it is. And the houses are as they are. Nothing has changed.

Question: During your stay in this neighborhood (in twenty years), could you tell us if anything has changed in terms of land use, floods, amount of water, and quality?

Response: Yes there is. Five years ago it was raining very hard. But not so much this year. Because there is a river on this side, a strong flood will come down here. It means that it contains black water, muddy soil. Apart from the fact that the water we drink sometimes turns black, there is not much quality problem.

Question: Is there anything you would say is a big change when it comes to water?

Response: Floods are now less than before. Not much. The quality of the water we drink is safe. Better than the old one. However, the situation of water loss or absence is now worse than before. In the past, there was almost no water loss. But now it is missing for at least three days. Even if the water comes, they will send with less power.

Question: How do you use household water in your daily life?

Response: At home for food preparation, bathing and drinking etc. I use it for everyone. I take a bath once a week on Sunday.

Question: What are your concerns about water?

Response: It is raining well now due to the protection and abundance of green space. I don't think I have anything to fear; now rain is good. Drinking water, sometimes when the tank is flushed, nothing but dirty water comes down, I am afraid.

Question: Do you think that the use of water is equally accessible to all Addis Ababa society?

Response: I don't think. Addis Ababa Yes, I don't think often. If we look outside the city center, for example, there is no water in Yeka Abado. Right here in the center of Addis Ababa, there is nothing except in different places; if we look outside, there is none. It is disappearing with us. It is disappearing with us.

Question: Do you think there should be an individual (including you) or a community that should be prioritized when using water? If your answer is "Yes", how? If your answer is "No" then why?

Response: Not just for me, but it should reach for everyone equally. For those who are in need of water and those who are weak, we will give it to them, but if there is water, we will use it equally.

Question: When you face a water shortage or problem in your area, what action do you take as a member of the community?

Response: If there is no water in our village, we go to another place and fetch it to solve our problem, there is no other solution. Due to the lack of water, we never went and asked the concerned bodies. But when the water breaks, as individuals we sometimes go to the concerned bodies.

Question: Do you have any additional ideas that you have not mentioned or would like to express regarding the points we have raised so far, that is, water and water use?

Response: I want water to be accessible and distributed everywhere. I want everyone to have access to clean drinking water. I want us to have access to good water more often and for everyone to use water fairly and equally. Since there is pond water in our

area, I want to reduce the shortage of clean drinking water so that people are not vulnerable to diseases.

Thank you!

C.8 Community interview 3 [Amharic]

ጥያቄ፡- በዚህ አካባቢ ለምን ያህል ጊዜ ኖረዋል?

መልስ፦ እዚሁ ሰፈር ነው ተወልጄ ያደግኩት፡፡ አሁን ሃያ አመቴ ነው፡፡ ስለሆነም ሃያውንም ዓመት እዚሁ ነው የኖርኩት፡፡ ቤተሰቦቼም እዚሁ ነው የሚኖሩት፡፡

ጥያቄ፡- ቤተሰብዎ በምን ሥራ ነው የሚተዳደሩት?

መልስ፦ በንግድ ሥራ ነው፡፡

ጥያቄ፡- ቤተሰቦችህ ከውሃ ጋር የተያያዙ ምን ምን ትዝታዎች አካፍለውሃል? ምን ያስታውሳሉ?

መልስ፦ ቤተሰቦቼ ያጋሩኝ ሳይሆን እኛ ራሳችን ወንዝ አካባቢ እየሄድን እየዋኘን ነው ያደግኩት፡፡ ጎርፍ እያየን፣ እየተጫወትን ነው ያደግኩት፡፡

ጥያቄ፡- በፊትም ሆነ እዚህ ከመጡ በኋላ የውሃ እና የመሬት አጠቃቀምን በተመለከተ ምን የታዘቡት ነገር አለ? ምን የተቀየረ ነገርስ አለ?

መልስ፦ ምንም የተቀየረ ነገር የለም፡፡ ውሃ ይጠፋል ይመጣል፡፡ ሁሉም ነገር ባለበት ነው፤ ቤቶቹም እንዳሉ ናቸው፤ የተቀየረ ነገር የለም፡፡

ጥያቄ፡- በዚህ ሰፈር ቆይታዎ (በሀያ ዓመት ውስጥ) የመሬት አጠቃቀም፣ ጎርፍ፣ የውሃ መጠን፣ ጥራት የተቀየረ ነገር ካለ ቢነግሩን?

መልስ፦ አዎ፣ አለ፤ ከዛሬ አምስት ዓመት በፊት በጣም ኃይለኛ ዝናብ ይጥል ነበር፡፡ አሁን በዚህ ዓመት ግን ብዙም አይደለም፡ ፡ በዚህ በኩል ወንዝ ሰላለ፣ ኃይለኛ ጎርፍ በዚህ ይወርዳል፡፡ ጥቁር ውሃ፣ ጭቃ አፈር የያዘ ማለት ነው፡፡ የምንጠጣው ውሃ አንዳንድ ጊዜ የመጥቆር ሁኔታ ከማሳየቱ ውጪ ብዙም የጥራት ችግር የለበትም፡፡

ጥያቄ፡- ከውሃ ጋር በተያያዘ በጣም ትልቅ ለውጥ ነው የሚሉት ነገር አለ?

መልስ፦ ጎርፍ ከድሮው አሁን ቀንሷል፤ ብዙም የለም፡፡ የምንጠጣው ውሃ ጥራት ደህና ነው፤ ከድሮው አንጻር ይሻላል፡፡ የውሃ መጥፋት ወይም አለመኖር ሁኔታ ግን ከድሮ አንጻር አሁን ተባብሷል፡፡ ድሮ ውሃ ጠፍታ አታውቅም ማለት ይቻላል፤ አሁን ግን በትንሹ ለሦስት ቀን ያህል ትጠፋለች፡፡ ብትመጣ እንኳ ኃይሏንም ቀንሰው ነው የሚልኳት፡፡

ጥያቄ፡- በዕለት ተዕለት ሕይወትዎ ውስጥ የቤት ውሃ አጠቃቀምዎ እንዴት ነው?

መልስ፦ በቤት ውስጥ ለምግብ ማዘጋጃ፣ ለመታጠቢያም ሆነ ለሚጠጣ ወዘተ. ለሁሉም እጠቀማለሁ፡፡ ገላዬን ለመታጠብ በሳምንት አንድ ጊዜ እሁድ ቀን እጠቀማለሁ፡፡

ጥያቄ፡- ስለውሃ ያለዎት ስጋት ምንድን ነው?

መልስ፦ አረንጓዴ ቦታ ከመከለልና ከመብዛቱ የተነሳ በአሁኑ ጊዜ ዝናብ ጥሩ እየዘነበ ነው፡፡ የምሰጋው ነገር ያለ አይመስለኝም፤ አሁን ዝናብ ጥሩ ነው፡፡ የመጠጥ ውሃ አንዳንድ ጊዜ ታንከር በሚታጠብበት ጊዜ ቆሻሻ ውሃ ነው የሚወርደው እንጂ ሌላ የምሰጋው ነገር የለም፡፡

ጥያቄ፡- የውሃ አጠቃቀም ለሁሉም የአዲስ አበባ ሕብረተሰብ እኩል ተደራሽ ነው ብለው ያስባሉ?

መልስ፦ አላስብም፤ አዲስ አበባ ላይ አዎ፣ ብዙ ጊዜ አላስብም፡፡ ከመሃል ከተማው ወጣ ብለን ብናይ ለምሳሌ፦ የካ አባዶ ውሃ የለም፡፡ እዚሁ አዲስአበባ መሃል ከተማ ላይ የተሰያዩ ቦታዎች ላይ ካልሆነ በስተቀር ወጣ ብለን ብናይ የለም፡፡ እኛም ጋር እየጠፋ ነው፡፡

ጥያቄ፡- ውሃ ስትጠቀሙ ቅድሚያ ሊሰጠው የሚገባ ግለሰብ (እርስዎን ጨምሮ) ወይም ማኅበረሰብ ሊኖር ይገባል ብለው ያስባሉ? መልስዎ ‹‹አዎ›› ከሆነ እንዴት? መልስዎ ‹‹አይ አይገባም›› ከሆነ ለምን?

መልስ፡- ለእኔ ብቻ ሳይሆን ለሁሉም እኩል ነው መድረስ ያለበት፡፡ ውሃ ለሚቸገሩና ለአቅመ ደካሞች እኛ ቀድተን እንሰጣቸዋለን እንጂ ውሃ ካለች እኩል መጠቀማችን አይቀርም፡፡

ጥያቄ፡- በአካባቢያችሁ የውሃ እጥረት ወይም ችግር ሲያጋጥማችሁ አንደማኅበረሰብ ምን ርምጃ

ትወስዳላችሁ?

መልስ፡- በሰፈራችን ውሃ ከሌለች ሌላ ቦታ ሂደን ቀድተን በማምጣት ችግራችንን እንፈታለን እንጂ ሌላ መፍትሄ የለም፡፡ በውሃ መቅረት ምክንያት የሚመለከታቸውን አካላት ሂደን ጠይቀን አናውቅም፡፡ ውሃ ስትቋረጥ ግን እንደግለሰብ አንዳንድ ጊዜ ወደሚመለከታቸው አካላት እንሄዳለን፡፡

ጥያቄ፡- እስካሁን ባነሳናቸው ነጥቦች፣ ማለትም በውሃ እና የውሃ አጠቃቀም ዙሪያ ያልጠቀሱት

ወይም ሊገልጹት የሚፈልጉት ተጨማሪ ሐሳብ ካለዎ?

መልስ፡- ውሃ በሁሉም አካባቢ ተደራሽ እንዲሆንና እንዲሰራጭ እፈልጋለሁ፡፡ ሁሉም ሰው የንጹሕ ውሃ መጠጥ ተጠቃሚ እንዲሆን እፈልጋለሁ፡፡ ብዙ ጊዜ በደንብ ውሃ እንድናገኝ እና ሁሉም ውሃን በፍትሃዊነት እኩል እንዲጠቀም እፈልጋለሁ፡፡ በአካባቢያችን የኩሬ ውሃ ሰላለ ሰዎች ለበሽታዎች ተጋላጭ እንዳይሆኑ ንጹህ የመጠጥ ውሃ እጥረት እንዲቀረፍ እፈልጋለሁ፡ ፡

አመሰግናለሁ!

C.9 Community interview 4 [English]

Question: How long have you lived in this area?

Response: It's been a long time. I have lived here since 2007E.C/2014 G.C.

Question: Where were you first? Why did you come here? For what reason?

Response: We were somewhere else. We first left our hometown of Gondar and stayed in Gambella for a few years, and then we came here because of work.

Question: How is your use of water in the places you have been before and since you came here?

Response: All is well. When we had Gambella, we used river water. All is well now. I live with family.

Question: What kind of work does your family do?

Response: My father is a priest. My mother is a housewife..

Question: What memories have your family shared with you related to water? What do you remember?

Response: When we were kids, there was a river in our area, so we used to swim.

Question: What did you notice about water and land use before and after you came here? What has changed?

Response: A lot has changed. For example; the area we were in here was a farm. Water usage we use tap water. But floods happen sometimes, not usually.

Question: How do you use household water in your daily life?

Response: There is a loss or interruption of water supply in our neighborhood. But if the interruption is said to last, it will last for two days and cannot last more than that.

Question: What are your concerns about water?

Response: Due to inconvenience of the camp, there are burst pipes around every toilet in the area. It is vulnerable to water pollution. Sometimes floods also occur. The area is not suitable for water. Thus, pollution mainly related to drinking water is a major concern.

Question: Is there anything you would say has been a big change in terms of water in your time here?

Response: However, the water shortage situation is getting worse now compared to the past. It was as good as I remember before. We didn't bother getting lost most of the time. But now there are times when it sometimes lasts more than two days. This is a long day. But there is no change in the water quality. It's the same.

Question: Do you think the use of water is equally accessible to all communities in this area?

Response: Maybe not; Water scarcity may vary from village to village. While a neighborhood with better water infrastructure has access to better water, another may be vulnerable to shortages. Therefore, it cannot be said that it has equal access.

Question: Do you think there should be an individual (including you) or a community that should be prioritized when using water? If your answer is "Yes", how? If your answer is "No" then why?

Response: No, I won't. I want us to have equal access to water. But it is okay gives priority to the needy and the weak.

Question: When you face a water shortage or problem in your area, what action do you take as a member of the community?

Response: That kind of thing doesn't happen much around here; it will not be done. Unless maybe some road crew saw it, I don't think anyone would go out and fix it for them. But on an individual level, if there is no water in our neighborhood, I would like to call for water development office. There is no other option. Maybe when some pipes are cut on the road to make or repair another, our water could be cut off. But as a community, we have never raised a common question about water.

Question: Do you have the experience of sharing the water you have when there is no water?

Response: Yes, it is important. But they are buying and taking.

Question: Do you have any additional ideas that you have not mentioned or would like to express regarding the points we have raised so far, that is, water and water use?

Response: There are sections of society in this area that are in need of water. And I want them to be noticed and noticed. Because the area they are in is muddy. If it is not a donkey to carry water, they will have a hard time. And they are buying the water from there. I would say if there is a solution for them.

Question: Have these disadvantaged members of society lived in this area for a long time?

Response: Yes, since this area was a farm and it was theirs, they had been living here since before I came here.

Thank you!

C.10 Community interview 4 [Amharic]

ጥያቄ፡- በዚህ አካባቢ ለምን ያህል ጊዜ ኖረዋል?

መልስ፡- ብዙ ጊዜ ሆኖኛል፤ ከ2007 ዓ.ም ጀምሮ እዚህ ኖሬያለሁ፡፡

ጥያቄ፡- መጀመሪያ የት ነበራችሁ? ወደዚህ አካባቢ የመጣችሁትስ ለምንድን ነው? በምንስ ምክንያት ነው?

መልስ፡- ሌላ ቦታ ነበር የነበርነው፤ መጀመሪያ ከትውልድ ቦታችን ጎንደር ተነስተን ጋምቤላ ትንሽ ዓመት ቆይተን፣ ከዚያ በሥራ ምክንያት እዚህ መጣን፡፡

ጥያቄ፡- በፊት በነበራችሁባቸው ቦታዎችና እዚህ ከመጡ በኋላ የውሃ አጠቃቀምዎ እንዴት ነው?

መልስ፡- ሁሉም ጥሩ ነው፤ ጋምቤላ ሲያለን የወንዝ ውሃ ነበር የምንጠቀመው፤ አሁን ሁሉም ጥሩ ነው፡፡ ከቤተሰብ ጋር ነው የምኖረው፡፡

ጥያቄ፡- ቤተሰብዎ በምን ሥራ ነው የሚተዳደሩት?

መልስ፡- አባቴ ቄስ ነው፤ እናቴ የቤት እመቤት ናት፡፡

ጥያቄ፡-ቤተሰቦችህ ከውሃ ጋር የተያያዙ ምን ምን ትዝታዎች አካፍለውሃል? ምን ያስታውሳሉ?

መልስ፡- ልጆች እያለን ባለንበት አካባቢ ወንዝ ስለነበር፣ እንዋኝ ነበር፡፡

ጥያቄ፡- በፊትም ሆነ እዚህ ከመጡ በኋላ የውሃ እና የመሬት አጠቃቀምን በተመለከተ ምን የታዘቡት ነገር አለ? ምን የተቀየረ ነገርስ አለ?

መልስ፡- ብዙ የተለወጠ ነገር አለ፤ ለምሳሌ፡- እዚህ እኛ ያለንበት አካባቢ እርሻ ነበር፡፡ የውሃ አጠቃቀም ቧንቧ ውሃ ነው የምንጠቀመው፡፡ ጎርፍ ግን አንዳንድ ጊዜ ነው የሚከሰተው እንጂ ብዙውን ያህል የለም፡፡

ጥያቄ፡- በዕለት ተዕለት ሕይወትዎ ውስጥ የቤት ውሃ አጠቃቀምዎ እንዴት ነው?

መልስ፡- በሰፈራችን የቧንቧ ውሃ መጥፋት ወይም መቋረጥ ይከሰታል፡፡ ነገር ግን መቋረጡ ቆየ ከተባለ ሁለት ቀን ይቆያል እንጂ ከዚያ በላይ ሊቆይ አይችልም፡፡

ጥያቄ፡- ስለውሃ ያለዎት ስጋት ምንድን ነው?

መልስ፡- ሰፈሩ ምቹ ባለመሆኑ በአካባቢው በየመጸዳጃ ቤት አካባቢ የፈነዱ ቱቦዎች አሉ፤ ይህም ለውሃ ብክለት የተጋለጠ ነው፡፡ አንዳንድ ጊዜ ጎርፍም ይከሰታል፡፡ አካባቢው ለውሃ ምቹ አይደለም፡፡ በመሆኑም በዋናነት ከመጠጥ ውሃ ጋር የሚገናኘው ብክለት ትልቅ ሰጋት ነው፡፡

ጥያቄ፡- በዚህ አካባቢ ቆይታዎ ከውሃ ጋር በተያያዘ በጣም ትልቅ ለውጥ ነው የሚሉት ነገር አለ?

መልስ፡- የውሃ መቆራረጥ ሁኔታ ግን ከድሮ አንጻር አሁን እየባሰ መጥቷል፡፡ በፊት እንደማስታውሰው ከሆነ ጥሩ ነበር፡፡ ብዙ ጊዜ እየጠፋ አንቸገርም ነበር፤ አሁን ግን አንዳንድ ጊዜ ከሁለት ቀን በላይ የሚቆይበት ጊዜም አለ፡፡ ይህ ደግሞ ረኸርም ቀን ነው፡፡ የውሃ ጥራቱ ላይ ግን ለውጥ የለም፤ ያው ነው፡፡

ጥያቄ፡- የውሃ አጠቃቀሙ፣ በዚህ አካባቢ ለሁሉም ጎብረተሰብ እኩል ተደራሽ ነው ብለው ያስባሉ?

መልስ፡- ምናልባት ላይሆን ይችላል፤ በየሰፈሩ የውሃ እጥረት ሊለያይ ይችላል፡፡ የተሻለ የውሃ መሰረተልማት የተዘረጋበት ሰፈር የተሻለ ውሃ ሲያገኝ፣ ሌላው ደግሞ የእጥረቱ ተጋላጭ ሊሆን ይችላል፡፡ ስለሆነም እኩል ተደራሽነት አለው ማለት አይቻልም፡፡

ጥያቄ፡- ውሃ ስትጠቀሙ ቅድሚያ ሊሰጠው የሚገባ ግለሰብ (እርስዎን ጨምሮ) ወይም ማኅበረሰብ ሊኖር ይገባል ብለው ያስባሉ? መልስዎ ‹‹አዎ›› ከሆነ እንዴት? መልስዎ ‹‹አይ አይገባም›› ከሆነ ለምን?

መልስ፡- አይ፣ አልልም፡፡ እኛ እኩል የውሃ ተደራሽነት እንዲኖረን ነው የምፈልገው፡፡ ነገር ግን ለሚቸገሩና ለአቅም ደካሞች ቅድሚያ ቢሰጥ ችግር የለውም፡፡

ጥያቄ፡- በአካባቢያችሁ የውሃ እጥረት ወይም ችግር ሲያጋጥማችሁ አንደማኅበረሰብ ምን ርምጃ

ትወስዳላችሁ?

መልስ፡- እዚህ አካባቢ ብዙም እንደዚህ ዓይነት ነገር አይደረግም፤ አይደረግም፡፡ ምናልባት አንዳንድ የመንገድ ሰራተኞች ካላዩት በስተቀር፣ ሰው ለራሱ ብሎ ወጥቶ የሚያስተካክል አይመስለኝም፡፡ በግለሰብ ደረጃ ግን በሰፈራችን ውሃ ከሌለች ወደውሃ ልማት መደወል ነው፤ ሌላ አማራጭ የለም፡፡ ምናልባት አንዳንድ ቱቦዎች መንገድ ላይ ሲቋረጡ ሌላውን ለመስራት ወይም ለመጠገን ሲሉ የእኛ ውሃ ሊቋረጥ ይችላል፡፡ እንደማኅበረሰብ ግን በውሃ ጉዳይ በጋራ ጥያቄ አቅርበን አናውቅም፡፡

ጥያቄ፡- ውሃ በማይኖርበት ጊዜ ያላችሁን ውሃ የመካፈል ልምድ አላችሁ?

መልስ፡- አዎ ግድ ነው፤ ነገር ግን እየገዙ ነው የሚወስዱት፡፡

ጥያቄ፡- እስካሁን ባነሳናቸው ነጥቦች፣ ማለትም በውሃ እና የውሃ አጠቃቀም ዙሪያ ያልጠቀሱት

ወይም ሊገልጹት የሚፈልጉት ተጨማሪ ሐሳብ ካለዎ?

መልስ፡- እዚህ አካባቢ በውሃ የሚቸገሩ የኅብረተሰብ ክፍሎች አሉ፤ እና እነሱ ላይ ትኩረት እንዲደረግና እንዲታዩ እፈልጋለሁ፡፡ ምክንያቱም ያሉበት አካባቢ ጭቃ ነው፤ ውሃ ለመውሰድ በአህያ ካልሆነ በጣም ይቸገራሉ፡፡ ውሃውንም ከዚህም እየገዙ ነው የሚወስዱት፤ ለእነሱ መፍትሔ ቢፈጠርላቸው እላለሁ፡፡

ጥያቄ፡- እነዚህ የሚቸገሩ የኅብረተሰብ ክፍሎች ያሏቸው በዚህ አካባቢ ሲኖሩ ብዙ ጊዜ ቆይተው ነበር?

መልስ፡- አዎ፣ ይሄ አካባቢ እርሻ ስለነበርና የእነሱ ስለነበር እኔ እዚህ ከመምጣቴ በፊት ጀምሮ እዚሁ ነበር የሚኖሩት፡፡

አመሰግናለሁ!

C.11 Community (group) interview 5 [English]

There are three participants in this group interview, to remain anonymous these are referred to as 01, 02, and 03.

Question 1: How long have you lived around Akaki?

01: I was born and grew up here. I have lived in this Akaki River area for over thirty years, at least since I knew myself. My family has lived here for a long time. My grandparents also lived here. They were right here.

02: I'm here too. It will be at least nineteen, twenty years since I started living around here. I live around here. I grew up around here. But I lived in the countryside before. I came from the countryside and came to my grandparents because my grandparents are here. Then I started living with them.

03: I was born and grew up here. My family is here. This is where we lived. My mother's family is Welega. But my father's family is here.

Question 2: What kind of livelihood work does your family?

02: My family, my grandparents here are self employed. They work on cattle breeding. They are pastorialist. They live in urban agriculture.

01: They were originally farmers. When their lands were confiscated, my father became a carpenter. Their livelihood is carpentry. Since agriculture is related to animal husbandry, they used to live in both agriculture and animal husbandry.

03: Our livelihood is urban agriculture. I am also a farmer.

Question 3: When you lived in this area, how would you describe the contents of water and landscape? What do you think has changed?

01: Before, the water was deep down. Not like now. It was very low down. And again there were not only lower but inland seas. There were deep seas. It was sand; it was a stone. Sand and rocks were visible in some areas of the waterfall. That is, when I was a child. The depth is three reeds, one meter; one reed is nine meters long. There were places that were about twelve meters deep, and more, when they were ignited and plunged three layers down. And this is what it looks like before. And the water was not so dirty. It was used by the community for drinking.

And when we come to the present, the waters are shallow; it’s close. It's dirty littered everywhere. There are plastics. There are dropped canteens or bottles; Moreover, every year the direction of the water changes; It expands once here and once there. Compared to before, it has a difference. Because the water used to run so low, there were slight slopes, five to eight meters high, on each side of the river. Only the river goes down and it's that high. There was a time when even birds made nests and lived in the heights. But looking at it now, none are that high. The height of the water is less than two meters at least, except in some places. That's before. But now the flow is very close to overflowing.

02: I have no intention of changing as much as he (01) has. The said ideas are correct. Here, where the water of the Akaki River used to be, when I saw and observed it, and now its current state has changed and changed a lot. The surrounding rivers also have garbage and other things. Polluted water is released from every place, every factory. It has changed the existing condition of the river by releasing different chemicals. The water drinks in the first; it is clean. It has nothing. Pebbles appear in the river. It is very white water. Pebbles appear. Everything, anything in the water is festooned, dirt is clearly visible. Even now it is very difficult to see. It also brings many allergens to the body. That is allergic to humans. Now, for example: There are children working sand here in the river. They get Vaseline oil and go into the river water to extract sand. That is to prevent water from getting into them. If they don't use Vaseline, they may be allergic to it. It's going to be rubbish. And the condition of the river, the changing of the seasons, especially winter is very difficult. In winter, the river fills up. The land around here does not look the same; it covers it all. Hence, floods occur. For example: My grandparents' house was destroyed by flood. A flood took it away. And also based on our experience we see it all the time, there is water pollution. The color of the water is constantly changing. This harms humanity.

03: We became children, in the days when I was, this water of the river was drunk. Farms are plowed in winter. Wheat and teff was sown. Now some time later, since the constructions are over, winter work is left. Water is abundant now. The river used to drink. Cattle also drink here. People drink from this river. There was no pipe like now. There was a spring around here; then it will fitched. At the top there is water

spring of Keble 10. In our time, water was taken from springs and rivers. Now after time it is broken, and the water is abundant in winter; sewage at that. Most of the water goes into the ground. It goes into the river. Due to the number of constructions, the ground is made of cement, so the water quickly enters the river. As a result, water abounded; dirty, spoiled now he won't drink. Now we use it to water vegetables, but people don't drink it. They doesnt wash their clothes. There is a big difference between the past and the present. Now the water is polluted.

In the past there was no flood here. It just started happening recently. We don't know floods.

Question 4: What memory was in the water? Did you swim in the water? Was it a fish?

01: Yes, there are fish. And our living was with the fishes; we will swim. But since we didn't have much experience in fishing at that time, there was no one to bring out fish.

02: It was rare to see a river full. We also rarely saw floods.

03: Since the water does not come out of the river, we are goining to run to see it fill up. We were swimming in the water. Fish has fishing recently. There is not much in the past. But now there is.

Question 5: How do you use water in your daily life?

02: Most of our life is related to water. We use water every day. We get and use drinking water from taps. Before, we used from river or another. There were springs of water. We used spring and river water. But at this time there is none. It is very difficult to use hand washing even for drinking.

03: We get drinking water from taps in our homes. But we use the river for cattle, for growing vegetables.

Question 6: What do you think is the most serious thing in relation to drinking water demand, supply, quality, rain, floods?

01: There is no water problem in our area. If you dig in the ground in any direction, you will find water. In fact, there is a possibility of sending water from Akaki to the city. But now there is water shortage in our area. The incoming water has no power;

it is small. It's difficult to say that we use it as we want. There may be another area; in our area, however, the water level has decreased. It comes either night or day. And I don't think it's enough for us. That is not the existence of Water Problem. If we dig here now, there is water. There were wells everywhere; but they become coverd. For example: Akaki textile factory had about three or four water wells in this area. Now they are covered because of the silt. After the company was sold, the machines were stolen. Those places are covered and filled with silt. And I don't believe there is a water problem. If we use it, if the government can work, not only for us but also for other areas water will accessible.

When it comes to water quality, when roads are built, then dirty water enters the water line. It is only when the road is being built; unless, dirty cannot enter the water.

02: He (01) explained most of the ideas. We don't have water problem; but there is the problem of water use. We have not been able to use and hold the water properly, but the rains and rivers flow on time. More water is wasted than we use. However, there is a problem with the use of tap water as he (01) says. Due to the large population and the amount of water drawn by tankers during the day, there may be a slight shortage. Recently, when the population of Addis Ababa is increasing, the demand and supply may not be balanced. I can say that there is a slight problem with this. I have nothing else to add.

03: There is no problem with lack of water. There is water in Akaki. Perhaps the most worrying thing about the vegetables we grow, the chemicals pollute the water. The Heineken, Walia breweries around here were releasing chemicals. At the top, there were many to releases. They were releasing a lot of chemicals. And the chemicals smell awful. They were just releasing the chemicals without filtering. Now we have applied, they have done a filtering for it and it has stopped. It doesn't exist now.

01: Polluted water was coming from the Kebna River.

03: Yes, chemical emissions from factories have stopped. We were really worried then. We allways inform agresively at different places, telling them to filter, and now they stopped. They don't to send without filtering. As said, Akaki has no water problem. By the way, I don't drink this river here; my relatives are drinking it now.

This river water goes and Father Samuel enters. Then he passes and when he reaches the bottom he drinks. They drink it. They drink straight from the river.

01: The water is being filtered.

03: After the river crosses different areas and reaches the countryside, the villagers drink it. For example, I went to the countryside and drank. It has nothing. The more the water goes, the more it is filtered by the sand. The water will be clean.

01: After the dam, the water is being filtered. Garbage inside remains filtered.

02: Before this factory was closed in 2001 E.C., as he (01) mentioned, ground water was used by the factory here. The other one was in my field, and the third one was there. There were three wells in total till 2001 E.C. After that it already disappeared. It is not dry; there is the well. But it was closed. It was generating by electricity for the factory. The factory's electricity was cut off and stope there.

01: Now there is; the water does not dry up. I know the places that have water. There were water wells here and there. As the water is underground, it is sufficient. If it still works, it's full of water; there is no water problem at Akaki. Right now, recently, many holes were buried.

03: The well we had here was filled with silt this year. We tried the water not to be buried. This year it's coverd. The water will be identifed a short distance away.

01: The water location is known; now there is water if alitle of dug up.

Question 7: Are there any specific changes you see in relation to water quality in winter and summer?

02: There is a shortage of water in winter. Although there are about five water filters, the water is underground, so I think that is the reason why there is a shortage of water. It is not like what we get in summer, but there is a severe shortage of water. In fact, it was night that the water came.

01: This came, now for example: roads work; there is construction work. Sometimes short-term water pipes restrict the flow of water somewhere; they close. Most of the time, water shortages are related to road construction; not water shortages.

Question 8: Do you think that water is equally accessible to everyone in this area?

03: Yes, it is accessible. In the past there were water taps. When there was no water in every house, people used water in Bono (public water). Now all those bonos have stopped. With out rare cases, all homes have water. Bono is now closed. It has stopped.

01: They have no user.

03: One Bono I Know 08 Kebele Kidanemhret the one who has it, there is. Some people use it. But there is none. Every house has water.

02: But it's not enough. Is that enough? Now society has a hard time finding a shower. It is enough to drink. Now it's much less for clothes, showers, miscellaneous things. It is not a water problem.

03: You, (01) how are the water in your village? There is also a shortage of you.

01: There is a shortage of water with us.

03: I think it depends on the environment. Now he (01) and I are in the same neighborhood. But I think the lack of water is caused by the separation of lines. Our neighborhood has never had water cut off. It is very powerful unless we limit its power.

01: Our line is new. The problem is the lost of power. The previous existing line was fine. It had power. Now they construct a new line; and we will lose water sometimes even a week.

03: The difference is the the water line construction. When they change the line, they have done something.

Question 9: Do you think that there is a body that should be given priority in terms of water access?

02: In this respect we cannot compare. There is always water here.

01: No, it's not like a city here. There is water. There are plenty of water supplies here. There are several places of water around here.

03: Now the water goes up to make the toilet. It is a spring.

01: No water problem. There is no water problem in our area.

Question 10: How does the community protect itself from floods in this area?

03: Of course, when there is a flood; in the past, most of the floods occurred in this area. Flooding is most common in the winter around here and below. Most of the time, the flood happens in the 03 kebele and the lower part of the countryside. But this is where it starts. The flood causes damage. It destroys crops. At that time, there is an act of exchanging information among the society. When the flood come us, we will inform to the society below they will be aware that a flood has come. This is what we convey to the rural society. We give information for them either by phone or in different directions. Around here, around 2010 E.C., when Abiy Goverment came to power, there was a very heavy flood. There was a time people was picked up by a helicopter man to protect against floods. It was a tough time. It rained for 12 hours. We were able to get the children and cattle out through the backyard. It was impossible to get out in front. We removed the tin wall in the house. That's when a severe flood occurred. It's better after that.

01: In relation to this, the biggest thing was the works done to reduce the risk of flooding. They were the leaders of the district. We were all there. It is our advantage that we are residents here. The first thing that needs to be done is how to prevent floods. Many people have done research. But their research was wrong. We suggested that it should be fitted like this. Besides, the bridge was very close. The bridge also had a dam.

02: The dam gets water; it will return quickly.

01: We brought and showed them that area should be dug. It was dug up. After dredging, the sand dredgers began to come down as they dredged sand. The water level was getting lower and lower. The dredging and widening of the river, as well as the sand mining, make the river deeper than it used to be.

02: Since there is a gap, the bridge is open to it, so it has a tendency to go freely. The water is backing up because of the bridge is suffocating. If the bridge is high, the water will not stand much longer. If the water runs straight, it won't stop in this area. Because the bridge is short, the water comes and drowns it. When the water is choked, it goes back. it doesn't have the temperament to go freely. Or it jumps over the bridge.

03: Along with the flood, there were destroyed houses. We do not believe that it is appropriate demolish of those houses. They are historical houses.

02: Yes, there were historical sites.

01: They should not have been destroyed; after demolish, we are trying to covering soil, growing grass and preventing flooding. There was a way to prevent it. It was not possible; it was not. The water level is still known. The amount of water coming in is known. With care, flood victims can be kept out of harm's way. But what the government is doing now is to lift the flood victims from the area. Lifting work is being done. But while those people are there, different flood protection dams are built in the area where they live, and it is possible to create an opportunity for those people to live without being displaced from their place. For example: Flood was in prison, wasn't it?

03: Yes

01: After we did this, by looking at ours, by throwing soil to prevent it from entering the prison, work was done to prevent it from entering the flood. Those who worked at the prison saw it from us.

03: In 2008 E.C, 2010 E.C, floods had get in prison.

Question 11: Do you produce agricultural products in this area?

03: It's mostly vegetables. But the farmer sows teff and wheat on the mountain ground. Those who sow wheat and teff will not be flooded. Vegetables are often grown along the floodplain. They have a different place for teff. They use it on the river. Winter will leave. They come back in the summer and clean it up and grow vegetables. The Teff and wheat sow place are different.

01: They use it only once during the flood. In the past they can use it twice. They plant cabbage, vegetables, and various potatoes on top and after they pull it out, they plant something else. But at this time they only use it once. They use it once. As soon as winter leaves, it is the same again.

02: I know we used it twice last year.

03: Because the place is hilly, it is not flooded.

02: Yes; it’s because it's uphill. But this year, it is difficult to say that we will use it. We just planted corn. But it was flooded. However, it did not spoil anything. But this year, maybe if the bridge will demolish, we can use it.

03: If the bridge is built higher.

02: If the bridge will not demolish, then we can't use it. Because of the water flow is blocked.

03: This will block as it is; the water is reversed.

02: So the water flows in that.

Question 12: If you have contributed to the water problem, please share it with me?

01: For example: - It was going to work to prevent the soil from eroding. Experts came up with a plan to build a large terrace. When we talked to some people, they came without a plan or program. As money was released to them, there was an intention to take that money. So, there is no point in working here. I suggested that if it was to be built, the river would break in that direction. It would be good if he (03) explained what happened after that.

03: Yes, when they first came, they didn't think to work, but to leave saying we did it. I took the people who had come and showed them the main place where the water would break. If you start from here and work down, you will also prevent the flood; I told them it would be good for you too. I told them that this is the closing place to prevent the place from being eroded by floods. Halfway through them stopped. I asked why they don’t continue. They said no, this year's budget is over and it's for next year. After that, they disappeared. Since their work was not sincere, the flood protection dam they built was also destroyed that year. In general, no permanent work has been done on flood prevention.

01: They tried to work in the direction we gave them, but did not study. They don't know. They don't know anything but let's just work.

03: They are going in the direction of the water intake that we have guided them to.

02: It is good if their work is focused on the local community. Because of a community in that area knows the area more and better than an expert. Most of the

time, they only work based on short-term planning. They don't have a long term plan. To complete the budget obtained; they done Pretend work and go. They don't work properly. This river is easy if you plan and work from year to year, from era to era. It is not that much that displaces the people and causes damage. The problem was not so obvious. But the government bodies have a sincere desire to work for them. Budget will be released; eats. Then they go. They will disappear. Although there is no solution in this regard, if you work and dream about it, and if the government pays attention to it, this river will be dammed. The society will not harm year after year. People who work in gardening and urban agriculture around here will not be harmed. The damage will decrease.

Question 13: If you have any other ideas that you would like to inform us about?

03: Now the bridge is being built. It's good that the bridge is built. But they have come up with a new idea; to divert the river. We spoke to the engineer in charge. They did a peg job. Engineers were brought in and they were digging in every direction. We have done the work of countering that. Their idea is to replace the bridge, to make the job easier for them. It was to cut costs. But we told them that it is not right, it is not appropriate. Because their plan was to divert the river; and we know the flow of the river; we know how much it increases in winter. As it is now, we are struggling to keep the water from going to the community. If the water has changed direction, there is a very wide possibility of directly entering the community and school. It means that there was more harm than good. What knowledge do they have about the area first when doing this work? They should not only divert the river but also consult the community. This means we have given them a lot of information. After that I think it's left for now.

01: Yes, they cut off our land and planned to take the water back on the land. Because of the water, there are displaced people around here. Now the river has changed its direction, which means that this school will be destroyed. At the end, I think it is impossible. They are professionals; but they have no awareness of the environment.

0 3: Changing the direction of the river means displacing and destroying the people and society. Starting from the bridge, they planned to divert the river 30 meters before; now 12 meters closer to that.

Thank you!

C.12 Community (group) interview 5 [Amharic]

There are three participants in this group interview, to remain anonymous these are referred to as 01, 02, and 03.

ጥያቄ 1፡- እዚህ አቃቂ ዙሪያ ምን ያህል ጊዜ ኑራችኋል?

01፡ ተወልጄ ያደግኩት እዚሁ ነው፡፡ ቢያንስ ራሴን ካወቅኩ ጀምሮ ከሰላሳ ዓመታት በላይ በዚህ አቃቂ ወንዝ አካባቢ ኖሬያለሁ፡፡ ቤተሰቦቼም ለረዥም ጊዜ እዚሁ አካባቢ ነው የኖሩት፡፡ አያቶቼም እዚሁ ነው የኖሩት፤ እዚሁ ነበሩ፡፡

02፡ እኔም እዚሁ ነኝ፡፡ እዚህ አካባቢ መኖር ከጀመርኩ ቢያንስ አንድ አስራ ዘጠኝ፣ ሃያ ዓመት አካባቢ ይሆነኛል፡፡ የምኖረው እዚህ አካባቢ ነው፤ ያደግኩትም እዚህ አካባቢ ነው፡፡ ከዚህ በፊት የኖርኩት ግን ገጠር ነበር፡፡ ከገጠር የመጣሁት እዚህ አያቶቼ ስላሉ ወደአያቶቼ መጥቼ ነው፡፡ ከዛም አብሬያቸው መኖር ጀመርኩ፡፡

03፡ እኔ እዚሁ ነው ተወልጄ ያደግኩት፡፡ ቤተሰቦቼ እዚሁ ናቸው፡፡ እዚሁ ነው የኖርነው፡፡ የእናቴ ቤተሰቦች ወለጋ ናቸው፡ ፡ የአባቴ ቤተሰቦች ግን እዚሁ ናቸው፡፡

ጥያቄ 2፡- ቤተሰቦቻችሁ የሚተዳደሩት በምን ስራ ነው?

02፡ የእኔ ቤተሰቦች እዚህ ያሉት አያቶቼ የግል ሥራ ይሰራሉ፡፡ ከብቶች ያረባሉ፤ የሚተዳደሩት በከተማ የግብርና ስራ ነው፡ ፡

01፡ መጀመሪያ ገበሬ ነበሩ፡፡ መሬቶቻቸው ሲወሰዱ፣ አባቴ አናጺ ሆነ፡፡ በአናጺነት ሙያ ነው መተዳደሪያ ስራቸው፡፡ የግብርና ሥራ ከከብት እርባታ ጋር የተያያዘ ስለሆነ በፊት በእርሻ ስራም ሆነ በከብት እርባታ ይተዳደሩ ነበር፡፡

03፡ የምንተዳደረው በከተማ ግብርና ነው፡፡ እኔም ገበሬ ነኝ፡፡

ጥያቄ 3፡ እዚህ አካባቢ ስትኖሩ፣ የውሃና የመሬቱ አቀማመጥ ወይም ይዞታ እንዴት ነበር ብላችሁ ትገልጹታላችሁ? ምንስ ተቀይሯል ብላችሁ ታስባላችሁ?

01፡ የበፊቱ ውሃው ወደታች ጥልቀት ነበረው፡፡ እንደአሁኑ አይደለም፤ በጣም ወደታች ዝቅ ያለ ነበረ፡፡ እንደገና ደግሞ ዝቅ ማለት ብቻ ሳይሆን ወደውስጥ ባሕሮች ነበሩ፡፡ ጠለቅ ያሉ ባሕሮች ነበሩ፤ አሸዋ ነበር፤ ድንጋይ ነበር፡፡ አንዳንድ ፏፏቴ አካባቢዎች ላይ አሸዋ እና ድንጋዮች ይታዩ ነበር፡፡ እኔ ህጻን በነበርኩበት ጊዜ ማለት ነው፡፡ ጥልቀቱ ብዙዎች የሚያዎሩት ሦስት መቃ፣ አንዱ ሜትር፣ አንዱ መቃ ዘጠኝ ሜትር ርዝመት አለው፡፡ ተቀጣጥለው ወደሦስት መቃዎች ወደታች ሲከተቱ ወደአስራ ሁለት ሜትር፣ ከዚያም በላይ ጥልቀት ያላቸው ቦታዎች ነበሩ፡፡ እና የበፊቱ ይኼን ይመስላል፡፡ ውሃውም ደግሞ እንደዚህ ቆሻሻ አልነበረም፤ ለመጠጥነት ማጎበረሰቡ ይጠቀም ነበር፡፡

ወደአሁኑ ደግሞ ስንመጣ፣ ውሃው ጥልቀት የለውም፤ ቅርብ ነው፡፡ በየቦታው ላይ በቆሻሻዎች የተሞላ ነው፡፡ ፌስታሎች አሉ፤ የውሃ መያዣ ሃይላንዶች አሉ፤ በዚያ ላይ ደግሞ በየዓመቱ የውሃው አቅጣጫ ይቀያየራል፤ አንድ ጊዜ ወደዚህ አንድ ጊዜ ወደዚያ ይሰፋል፡፡ ከበፊቱ ጋር ስናነጻጽረው ልዩነት አለው፡፡ በፊት ውሃው በጣም ዝቅ ብሎ ይሄድ ስለነበረ፣ በየወንዙ ዳር ላይ በትንሹ፣ ከአምስት እስከ ስምንት ሜትር ከፍታ ዳገቶች ነበሩ፡፡ ወንዙ ብቻ ታች ወርዶ

የዚያን ያህል ከፍታ አለ፡፡ ወፎች እንኳ እቤት ጎጆ ሰርተው እዚያው ከፍታው ውስጥ የሚኖሩበት ወቅት ነበረ፡፡ አሁን ላይ ግን ስንመለከት፣ የዚያን ያህል ከፍታ ያለው የለም፡፡ የውሃው ከፍታም አልፎ አልፎ የተወሰኑ ቦታዎች ላይ ካልሆኑ በስተቀር፣ ቢያንስ ከሁለት ሜትር በታች ያነሰ ግርግዳ ነው ሰርቶ ያለው፡፡ የበፊቱ ያ ነው፡፡ ያሁኑ ግን ፍሰቱም ወደውጪ ለመፍሰስ ብዙ ቅርብ ነው ማለት ይቻላል፡፡

02፡ እሱ (01) ካለው ብዙም የለውጥ እሳቤ የለኝም፡፡ የተባሉ ሐሳቦች ትክክል ናቸው፡፡ እዚህ፣ የኢቃቂ ወንዝ ውሃ በድሮ በነበረበት፣ እኔ ባየሁበትና በተመለከትኩበት ጊዜ እና አሁን ነባራዊ ሁኔታው በጣም የተለዋወጠና የተቀያየረ ነው፡፡ በዙሪያው ያሉ ወንዞችም ቆሻሻና የተለያዩ ነገሮች አሏቸው፡፡ ከየቦታው፣ ከየፋብሪካ የተበከለ ውሃ ይለቀቅበታል፡፡ የተለያየ ኬሚካል እየተለቀቀት የወንዙን ነባራዊ ሁኔታ ቀይሮታል፡፡ ውሃው በፊት ይጠጣል፤ ንጹህ ነው፡፡ ምንም ነገር የለውም፡፡ ወንዙ ውስጥ ጠጠሮች ይታያሉ፡፡ በጣም የነጣ ውሃ ነው፡፡ ጠጠር ይታያል፤ ሁሉም ነገር፣ ውሃ ውስጥ ያለ ነገር ፈስታል፣ ቆሻሻ በግልጽ ይታያል፡፡ አሁን እንኳን መታየት በጣም ይከብዳል፡፡ ለሰውነትም ብዙ አላርጂክ ያመጣል፡፡ በሰው ልጅ ላይ አላርጂክ አለው፡፡ አሁን ለምሳሌ፡- እዚህ ወንዝ እኛጋ አሸዋ የሚሰሩ ልጆች አሉ፡፡ ቫዝሊን ቅባት ተቀብተው ነው አሸዋ ለማውጣት ወደወንዙ ውሃ የሚገቡት፤ ውሃ ወደውስጣቸው እንዳይገባ ለማድረግ፡፡ ቫዝሊን ካልተቀቡ ሰውነታቸው በመሉ አላርጂክ ነው ይሆናል፡፡ ቆሻሻ ነው የሚሆነው፡፡ እና ወንዙ የነበረበት ሁኔታ፣ የወቅት መፈራረቅ ሁኔታ፣ በተለይ ክረምት ክረምት እጅግ አስቸጋሪ ነው፡፡ በክረምት ወንዙ ይሞላል፤ እዚህ አካባቢ ያለው መሬት አንድ አይታይም፤ ሁሉንም ይሸፍነዋል፡፡ ስለሆነም የጎርፍ አደጋ ይከሰታል፡፡ ለምሳሌ፡- እኔ የነበርኩበትን የአያቶቼ ቤት በጎርፍ ፈርሷል፤ ጎርፍ ወስዶታል፡፡ እና ደግሞ በየጊዜው በምናየው ያለን ልምድ መሰረት፣ የውሃ ብክለት አለ፡፡ በየጊዜው የውሃው ቀለም እየተቀያየረ ይመጣል፤ ይህም በሰው ልጅ ላይ ጉዳት ያደርሳል፡፡

03፡ እኛ ልጆች ሆነን፣ እኔ በነበርኩበት ዘመን፣ ይኼ የወንዙ ውሃ ይጠጣል፡፡ እርሻ ክረምት ይታረሳል፡፡ ስንዴ፣ ጤፍ ይዘራ ነበር፡፡ አሁን ከተወሰነ ጊዜ በኋላ፣ ግንባታዎች ከበዙበት ጊዜ ጀምሮ ነው የክረምት ስራ የቀረው፡፡ ውሃም የበዛው አሁን ነው፡፡ ድሮ ወንዙም ይጠጣል፡፡ ከብቶችም የሚጠጡት እዚሁ ነው፡፡ ሰውም የሚጠጣው ከዚህ ከወንዙ የተቀዳ ነው፡፡ እንዳሁኑ ቧንቧ አልነበረም፡፡ እዚህ አካባቢ አንድ ምንጭ እዚያጋ ነበር፤ ከዚያ ይቀዳል፡፡ ከላይ ደግሞ ቀበሌ 10 እንድ ምንጭ አለ፡፡ በእኛ ጊዜ ከምንጭ የተገኘና ከወንዝ የተገኘ ውሃ ነበር የሚጠጣው፡፡ አሁን ከጊዜ በኋላ ነው ተበላሽቶ፣ ክረምትም ውሃ በዛ፤ ፍሳሽ በዛ፡፡ በብዛት ብዙው ውሃ ወደመሬት ነው የሚገባው፡፡ ወደወንዝ ነው የሚገባው፡፡ ከግንባታ ብዛት መሬቱ ስሚንቶ ስለሆነ ውሃው ፈጥኖ ወደወንዝ ነው የሚገባው፡፡ በዚህም ምክንያትም ውሃ በዛ፤ ቆሸሸ፣ ተበላሸ አሁን አይጠጣም፡፡ አሁን አትክልት ለማጠጣት እንጠቀምበታለን እንጂ፣ ሰው አይጠጣውም፤ ልብስም አያጥብበትም፡፡ ድሮ የነበረውና አሁን ያለው በጣም ልዩነት አለው፡፡ አሁን ውሃው ተበላሽቷል፡፡

ድሮ እዚህ አካባቢ ጎርፍ አልነበረም፤ አሁን ቅርብ ጊዜ ነው መከሰት የጀመረው፡፡ እኛ ጎርፍ አናውቅም፡፡

ጥያቄ 4፡ በውሃው ውስጥ ምን ምን ትውስታ ነበር? ውሃው ላይ ትዋኙ ነበር? አሳ ነበር?

01፡ አዎ አሳዎች አሉ፡፡ ውሏችንም ከአሳዎች ጋር ነበር፤ እንዋኛለንም፡፡ ነገር ግን በዚያን ወቅት አሳ የማውጣት ብዙም ልምድ ስለሌለን፣ አሳዎችን የሚያወጣ ሰው አልነበረም፡፡

02፡ ወንዝ ሲሞላ ለማየት ብርቅ ነበር፡፡ ጎርፍ ማየትም ብርቃችን ነበር፡፡

03፡ ውሃው ከወንዝ ውስጥ ስለማይወጣ ሲሞላ ለማየት እንሮጥ ነበር፡፡ ውሃ ውስጥ እንዋኝም ነበር፡፡ አሳ በቅርብ ጊዜ ነው የመጣው፤ ድሮ ብዙም የለም፡፡ አሁን ግን አለ፡፡

ጥያቄ 5፡- በዕለት ተዕለት ህይዎታችሁ የውሃ አጠቃቀማችሁ ምን ይመስላል?

02፡ አብዛኛውን ጊዜ ህይዎታችን ከውሃ ጋር የተያያዘ ነው፡፡ በየቀኑ ውሃን እንጠቀማለን፡፡ የመጠጥ ውሃን የምናገኘውና የምንጠቀመው ከቧንቧ ነው፡፡ በፊት ከወንዝም፣ ከሌላም እንጠቀም ነበር፤ የውሃ ምንጮች ነበሩ፡፡ የምንጭና የወንዝ ውሃ እንጠቀም ነበር፡፡ በዚህ ሰዓት ግን የለም፤ እንኳን ለመጠጣት ለእጅ መታጠብ መጠቀም በጣም ይከብዳል፡፡

03፡ የመጠጥ ውሃ የምናገኘው በየቤታችን ከቧንቧ ነው፡፡ ነገር ግን ለከብቶች፣ ለአትክልት ልማት ወንዙን ነው የምንጠቀመው፡፡

ጥያቄ 6፡- ከመጠጥ ውሃ ፍላጎት፣ አቅርቦት፣ ከጥራት፣ ከዝናብ፣ ከጎርፍ ጋር በተያያዘ በጣም አሳሳቢ ነው ብላችሁ የምታስቡት ነገር ምንድን ነው?

01፡ አካባቢያችን ላይ የውሃ ችግር የለም፡፡ ከርሰምድርን በፈለግሽው አቅጣጫ ብትቆፍሪ ውሃ ታገኚያለሽ፡፡ እንደውም ከአቃቂ ወደከተማ ውሃ የሚላክበት እድል አለ፡፡ ግን አሁን እኛ አካባቢ ላይ የውሃ እጥረት አለ፡፡ የሚመጣው ውሃ ኃይል የለውም፤ አነስተኛ ነው፡፡ ብዙም እንደልባችን እንጠቀማለን ለማለት ይከብዳል፡፡ ሌላ አካበቢ ሊኖር ይችላል፤ እኛ አካባቢ ላይ ግን የውሃው መጠን የቀነሰ ነው፡፡ ወይ ሌሊት ወይ ቀን ነው የሚመጣው፤ እናም እኛጋ በቂ ነው ብዬ አላስብም፡፡ የውሃ ችግር ኑሮ አይደለም፡፡ እዚህጋ አሁን ብንቆፍር ውሃ አለ፡፡ በየቦታው የጉድጓድ ውሃዎች ነበሩ፤ ተደፍነዋል፡፡ ለምሳሌ፡- አቃቂ ጨርቃ ጨርቅ ፋብሪካ፣ እዚህ አካባቢ ወደሦስት አራት የሚሆኑ የውሃ ጉድጓዶች ነበሩት፡፡ አሁን በደለሉ ምክንያት ተደፍነው ነው ያሉት፡፡ ድርጅቱ ከተሸጠ በኋላ ማሽኖቹ ተሰረቁ፡፡ እነዚያ ቦታዎች ደግሞ ተደፍነው፣ በደለል ተሞልተው ነው ያሉት፡፡ እና የውሃ ችግር አለ ብዬ አላምንም፡፡ ከተጠቀምንበት፣ መንግስት መስራት ከቻለ ለእኛ ብቻ አይደለም ሌላም አካባቢ ውሃ መድረስ ይችላል፡፡

ከውሃ ጥራት ጋር በተያያዘ፣ መንገዶች ሲሰሩ፣ ያን ጊዜ የቆሸሸ ውሃ ወደውሃው መስመር ይገባል፡፡ መንገድ ሲሰራ ነው እንጂ ከዚያ በተረፈ ውሃው ውስጥ ቆሻሻ ሊገባ አይችልም፡፡

02፡ ያው ብዙውን ሐሳብ እሱ (01) ገልጾታል፡፡ እኛ ውሃ አጠቃቀም እንጂ፣ የውሃ ችግር የለብንም፡፡ ውሃውን በአግባቡ መጠቀምና መያዝ አልቻልንም እንጂ፣ ዝናብም ወንዞችም ቤጊዜው ይፈሳሉ፡፡ ከምንጠቀመው ይልቅ፣ የሚጠፋው፣ የሚባክነው ውሃ ነው ይበልጥ የሚበዛው፡፡ ሆኖም ግን የቧንቧ ውሃ አጠቃቀም ላይ እሱ (01) እንዳለው ችግር አለ፡ ፡ የሕዝቡ ብዛትና በቀን ታንከር ላይ የሚሳብ የውሃ መጠን ትንሽ እጥረት ሊኖር ይችላል፡፡ ከቅርብ ጊዜ ወዲህ የአዲስ አበባ ነዋሪ በጣም እየበዛ፣ እየበዛ በመጣበት ሰዓት ፍላጎቱና አቅርቦቱ ትንሽ የተመጣጠነ ላይሆን ይችላል፡፡ በዚህ ምክንያት ትንሽ ችግር አለ ማለት እችላለሁ፡፡ ሌላ የምጨምረው ሐሳብ የለም፡፡

03፡ በውሃ እጥረት በኩል ችግር የለበትም፡፡ አቃቂ ውሃ አለ፡፡ ምናልባት እኛ በምናመርተው አትክልት ላይ አሳሳቢ ነገር ስንል የነበረው፣ ኬሚካሎች ውሃውን ይበክላሉ፡፡ እዚህ አካባቢ ባሉ የሄኒከን፣ ዋልያ ቢራ ፋብሪካዎች ኬሚካሎችን ይለቁ ነበር፡፡ ከላይ ደግሞ ብዙ የሚለቁ ነበሩ፡፡ ኬሚካሎችን በጣም ይለቁብን ነበር፡፡ ኬሚካሎቹ ደግሞ እጅግ

በጣም መጥፎ ሽታ የሚሸቱ ናቸው፡፡ ኬሚካሎችን ዝም ብለው ሳያጣሩ ነበር የሚለቁት፡፡ አሁን እኛም አመልክተን፣ ማጣሪያ ሰርተውለት አቁሟል፡፡ አሁን የለም፡፡

01፡ ከቀበና ወንዝም የተበከለ ውሃ ይመጣ ነበር፡፡

03፡ አዎ፣ አሁን ላይ ከፋብሪካዎች የሚለቀቅ ኬሚካል ቆሟል፡፡ እኛ እንደውም ስጋት ነበረብን ያን ጊዜ፤ በተለያየ ቦታ ጨኸን፣ እንዲያጣሩ፣ ያለማጣሪያ እንዳይልኩ ተብሎ አስቆሟቸው፡፡ እንደተባለው ኢቃቂ የውሃ ችግር የለባትም፡፡ በነገራችን ላይ ይኼን ወንዝ እዚህጋ ነው እንጂ እኔ የማልጠጣው፣ የእኔ ዘመዶች አሁን ላይ ታች ይጠጡታል፡፡ ይኼ የወንዝ ውሃ ይኼድና አባ ሳሙኤል ይገባል፤ ከዚያ ያልፍና ታች ወደቆላው ሲደርስ ይጠጣል፤ ይጠጡታል፡፡ ቀጥታ ከወንዙ ቀድተው ነው የሚጠጡት፡፡

01፡ ውሃው እየተጣራ ነው የሚሄደው፡፡

03፡ ወንዙ የተለያዩ አካባቢዎችን አቋርጦ ገጠር ከደረሰ በኋላ የገጠር ሰው ይጠጣዋል፡፡ እኔ ለምሳሌ እዚያ ገጠር ሂጄ ጠጥቻለሁ፡፡ ምንም ነገር የለውም፤ ውሃው ከመሄዱ ብዛት በአሸዋ እየተጣራ ይሄዳል፡፡ ውሃው ንጹህ ነው የሚሆነው፡ ፡

01፡ ከግድቡ በኋላ ውሃው እየተጣራ ነው የሚሄደው፡፡ ውስጥ ያሉ ቆሻሻዎች እየተጣሩ ይቀራሉ፡፡

02፡ ይኼ ፋብሪካ ከመዘጋቱ ከ2001 ዓ.ም በፊት፣ እሱ (01) እንደጠቀሰው፣ እዚህጋ ፋብሪካው የሚጠቀምበት የከርሰ ምድር ውሃ ነበር፡፡ ሌላው እንዱ እኔ ማሳ ላይ፣ ሦስተኛው ደግሞ እዚያጋ ነበር፡፡ በአጠቃላይ እስከ 2001 ዓ.ም ድረስ ሦስት ጉድጓዶች ነበሩ፡፡ ከዚያ በኋላ ነው የጠፋው፡፡ አልደረቀም፤ ጉድጓዱ አለ፤ ግን ተዘጋ፡፡ በኤሌክትሪክ ነበር ለፋብሪካው የሚያመነጨው፤ የፋብሪካው ኤሌክትሪክ ተቋረጠ በዚያው ቀረ፡፡

01፡ አሁን አለ፤ ውሃው አይደርቅም፡፡ ውሃ ያለባቸውን ቦታዎች እኔ አውቃቸዋለሁ፡፡ እዚህምጋ፣ እዛምጋ፣ ታችም ውሃ ጉድጓዶች ነበሩ፡፡ ውሃው የከርሰ ምድር ስለሆነ በቂ ነው፡፡ አሁንም የሚሰራበት ከሆነ፣ ውሃ ሞልቷል፤ ኢቃቂ ላይ የውሃ ችግር የለም፡፡ ብዙ ጉድጓዶች አሁን በቅርቡ ነው የተደፈኑት፡፡

03፡ እዚህጋ እኛጋ የነበረው የውሃ ጉድጓድ ዘንድሮ ነው ደለል የሞላው፡፡ እንዳይደፈን ሙከራ አድርገን ነበር፡፡ ዘንድሮ ደፈነ፡ ፡ ውሃው በቅርብ ርቀት ይለያል፡፡

01፡ ቦታው ይታወቃል፤ አሁን ጫር ጫር ቢደረግ ውሃ አለ፡፡

ጥያቄ 7፡- በክረምትና በቢጋ ወቅቶች ከውሃ ጥራት ጋር በተያያዘ የምታዩዋቸው የተለዩ ለውጦች አሉ?

02፡ ከረምት ላይ የውሃ እጥረት አለ፡፡ ወደአምስት የሚሆኑ ውሃ ማጣሪያዎች ቢኖሩም ውሃው ከርሰ ምድር ውስጥ በመሆኑ፣ በዚያ ምክንያት ይመስለኛል የውሃ እጥረት ያለው፡፡ በጋ ላይ እንደምናገኘው ሳይሆን ከዚያም በላይ ከፍተኛ የሆነ የውሃ እጥረት አለ፡፡ እንደውም ውሃ የሚመጣው ሌሊት ነበር፡፡

01፡ ይኼ የመጣው፣ አሁን ለምሳሌ፡- መንገዶች ይሰራሉ፤ የግንባታ ስራ አለ፤ አንዳንድ ጊዜ ደግሞ ድሮ ለአጭር ጊዜ ተብለው የተሰሩ የውሃ ቱቦዎች የሆነ ቦታ ላይ ውሃውን ይገድባሉ፤ ይዘጋሉ፡፡ አብዛኛውን ጊዜ የውሃ እጥረት የሚመጣው ከመንገድ ስራ ጋር በተያያዘ እንጂ ውሃ ጠፍቶ አይደለም፡፡

ጥያቄ 8፡- እዚህ አካባቢ ውሃ ለሁሉም ሰው እኩል ተደራሽ ነው ብላችሁ ታስባላችሁ?

03፡ አዎ፣ ተደራሽ ነው፡፡ ድሮ የውሃ ቦኖዎች ነበሩ፡፡ ውሃ በየቤቱ ባልነበረበት ሰዓት ሕዝብ ውሃን በቦኖ ይጠቀማል፡፡ አሁን እነዚያ ቦኖዎች ሁሉ ቆመዋል፡፡ አልፎ አልፎ ካልሆነ፣ ሁሉም የቧንቧ ውሃ በየቤቱ አለው፡፡ ቦኖ አሁን ተዘግቷል፤ ቆሟል፡፡

01፡ ተጠቃሚ የላቸውም፡፡

03፡ አንድ ቦኖ የማውቀው 08 ቀበሌ ኪዳነምህረት ያለቺው፣ እሷ አለች፡፡ የተወሰኑ ሰዎች ይጠቀሙባታል፡፡ እንጂ የለም፤ ሁሉም ውሃ በየቤቱ ነው ያለው፡፡

02፡ ግን በቂ ነው ማለት አይደለም፡፡ በቂ ነው ማለት ምድን ነው? አሁን ጎብረተሰቡ የሻወር አገልግሎት ለማግኘት በጣም ከባድ ነው፡፡ ለመጠጥ በቂ ነው፡፡ አሁን ለልብስ፣ ለሻወር፣ ለተለያዩ ነገሮች በጣም ያንሳል፡፡ የውሃ ችግር አይደለም፡ ፡

03፡ ውሃ እናንተ (01) ሰፈር እንዴት ነው? እናንተጋ እጥረት አለ፡፡

01፡ እኛጋ እጥረት አለ፡፡

03፡ እንደአካባቢው ይመስለኛል፡፡ አሁን እኔና እሱ (01) አንድ ሰፈር ነን፡፡ ግን የውሃ እጥረት በመስመሮች መለያት ምክንያት የሚፈጠር ይመስለኛል፡፡ እኛ ሰፈር ውሃ ተቋርጦ አያውቅም፡፡ ኃይሉን ካልገደብነው በስተቀር በጣም ኃይለኛ ነው፡፡

01፡ የእኛ አዲስ መስመር ነው፡፡ ችግሩም የኃይል ማነስ ነው፡፡ የበፊት ነባሩ መስመር ጥሩ ነው፤ ኃይል ነበረው፡፡ አሁን አዲስ መስመር ዘርግተው፣ አንዳንድ ጊዜ እኮ ሳምንትም ልንቸር እንችላለን፡፡

03፡ ልዩነቱ የመስመር ዝርጋታው ነው፤ መስመሩን ሲቀይሩ የሆነ ነገር አድርገውታል ማለት ነው፡፡

ጥያቄ 9፡- በውሃ ተደራሽነት ቀድሞ ሊሰጠው የሚገባ አካል አለ ብላችሁ ታስባላችሁ?

02፡ ከዚህ አንጻር ማነጻጸር አንችልም፡፡ እዚህ ሁልጊዜም ውሃ አለ፡፡

01፡ አይ እዚህ እንደከተማ አይደለም፡፡ ውሃ አለ፡፡ እዚህ ብዙ የውሃ አቅርቦት አለ፡፡ እዚህ አካባቢ በርካታ ቦታ ውሃ አለ፡፡

03፡ አሁን ሸንት ቤት ለመስራት እኮ ውሃ ወደላይ ነው የሚወጣው፡፡ ምንጭ ነው፡፡

01፡ የውሃ ችግር የለም፡፡ አካባቢያችን ውሃ ችግር የለበትም፡፡

ጥያቄ 10፡- እዚህ አካባቢ ማኅበረሰቡ ራሱን ከጎርፍ አደጋ እንዴት ነው የሚከላከለው?

03፡ በእርግጥ የጎርፍ አደጋ ሲደርስ፣ ድሮ እዚህ አካባቢ ነው በብዛት የጎርፍ አደጋ የሚደርሰው፡፡ ክረምት ላይ የጎርፍ አደጋ የሚበዛው እዚህ አካባቢና ወደታች ነው፡፡ ብዙ ጊዜ የጎርፍ አደጋው የሚከሰተው ወደ 03 ቀበሌና ወደታች ወደገጠሩ ክፍል ነው፡፡ መነሻው ግን ከዚህ ነው፡፡ ጎርፉ ጉዳት ያስከትላል፤ ሰብል ያጠፋል፡፡ በዚያን ጊዜ በጎብረተሰቡ ዘንድ መረጃ የመለዋወጥ ተግባር አለ፡፡ ጎርፉ እኛ ጋር እንደደረሰ፣ ተጠንቀቁ ጎርፍ መጥቷል ብለን ለሚመለከተው ወደታች ላለው ጎብረተሰብ እናስተላልፋለን፡፡ ይኼን ነው ለገጠሩ ጎብረተሰብ የምናስተላልፈው፡፡ በስልክም ይሁን በተለያየ አቅጣጫ ለእነሱ መረጃ እናቀብላለን፡፡ እዚህ አካባቢ 2010 ዓ.ም አካባቢ የዐቢይ መንግስት የገባ ዘመን፣ በጣም ከፍተኛ ጎርፍ አጥለቅልቆት ነበር፡፡ ከጎርፍ አደጋ ለመከላከል በኤሊኮፍተር ሰው የተለቀመበት ጊዜ ነበር፡፡ ከባድ የሚባለው እሱ ጊዜ ነበር፡፡ 12 ሰዓት ሙሉ ነበር የዘነበው፡፡ ልጆች እና ከብቶችን በጓሮ በኩል ነው ሰብረን ማስወጣት የቻልነው፡፡ ፊት ለፊት መውጣት አይቻልም ነበር፡፡ ቤቱ ውስጥ ከቆርቆሮ የሚሰራውን ግድግዳ ነቅለን ነው የወጣነው፡፡ ያኔ ነው ከባድ ጎርፍ የተከሰተው፡፡ ከዚያ በኋላ ይሻላል፡፡

01፡ ከዚህ ጋር በተያያዘ ግን ትልቁ ነገር፣ የጎርፍ አደጋን ለመቀነስ የተሰሩ ስራዎች ነበሩ፡፡ የክፍለከተማው አመራሮች ነበሩ፡ ፡ እኛ ሁላችንም ነበርን፡፡ እኛ እዚህ ነዋሪ መሆናችን ነው የጠቀመን፡፡ የመጀመሪያ መሰራት ያለበት ጎርፍ እንዴት መከላከል አለብን የሚለው ነው፡፡ ብዙ ሰዎች ጥናት አድርገዋል፤ የእነሱ ጥናት ግን ትክክል አልነበረም፡፡ እኛ እንደዚህ መገጠም አለበት ብለን ሐሳብ ሰጠናቸው፡፡ ከዚያ በተረፈ ደግሞ ድልድዩ በጣም ቅርብ ነበረ፡፡ ድልድዩም ግድብ ነበረው፡፡

02፡ ግድቡ ውሃ ይደርስበታል፤ ቶሎ ነው የሚመልሰው፡፡

01፡ ያ አካባቢ መቆፈር አለበት በሚል አምጥተን አሳየናቸው፡፡ ተቆፈረ፤ ከተቆፈረ በኋላ ደግሞ አሸዋ የሚያወጡ ሰዎች፣ አሸዋ በሚያወጡበት ጊዜ፣ የወንዙ ጥልቀት ወደታች ዝቅ እያለ መምጣት ጀመረ፡፡ የውሃው መጠን እየቀነሰ፣ እየቀነሰ ሄደ፡፡ በፊት ያደርሰው ከነበረው፣ መቆፈሩና ወንዙ መስፋቱ፣ ከዚያ በተጨማሪ ደግሞ አሸዋ የሚያወጡት ሰዎች፣ አሸዋ ማውጣታቸው ወንዙ ጥልቀት እንዲኖረው ያደርገዋል፡፡

02፡ ክፍተት ስለሚገኝ፣ ድልድዩ ስለተከፈተለት እንደልብ የመሄድ ባህሪ አለው፡፡ ድልድዩ እያፈነው ነው ውሃው ወደኋላ የሚመለሰው፡፡ ድልድዩ ከፍ ቢል ውሃው ብዙ አይቆምም፡፡ ቀጥታ ሩጦ ከሄደ፣ እዚህ አካባቢ ላይ አይቆምም፡፡ አጭር ስለሆነች ድልድይዋ ውሃው ይመጣል ታፍነዋለች፡፡ ውሃው ሲታፈን ወደኋላ ነው የሚመለሰው፤ እንደልብ የመሄድ ባህሪ የለውም፡፡ ወይም ዘሎ በድልድዩ በላይ ይሄዳል፡፡

03፡ ከጎርፍ ጋር ተያይዞ ደግሞ፣ የፈረሱ ቤቶች ነበሩ፡፡ እነዚያ ቤቶች መፍረሳቸው አግባብ ነው ብለን እኛ አናምንም፡፡ ታሪካዊ ቤቶች ናቸው፡፡

02፡ አዎ፣ ታሪካዊ ቦታዎች ነበሩ፡፡

01፡ መፍረስ አልነበረባቸውም፤ ከፈረሱ በኋላ አፈር ገድበን፣ ሳር አሳድገን ጎርፉን እየተከላከልን ነው፡፡ መከላከል የሚቻልበት መንገድ ነበረ፤ አልተቻለም፤ ሳይሆን ቀረ፡፡ አሁንም ቢሆን የውሃው መጠን ይታወቃል፡፡ ውሃው የሚመጣበት መጠን ይታወቃል፡፡ ከታሰበበት፣ ጎርፍ ተጠቂዎችን አደጋው እንዳይደርስባቸው ማድረግ ይቻላል፡፡ ግን አሁን መንግሥት እያደረገ ያለው ጎርፍ ተጠቂዎችን ከአካባቢው ማንሳት ነው፡፡ የማንሳት ሥራ ነው እየተሰራ ያለው፡፡ ግን እነዚያ ሰዎች

እያሉ፣ የሚኖሩበት አካባቢ ላይ የተለያዩ የጎርፍ መከላከያ ግድቦች ተሰርተው፣ እነዚያ ሰዎች ከቦታቸው ሳይፈናቀሉ መኖር የሚችሉበትን አጋጣሚ መፍጠር ይቻላል። ለምሳሌ፡- ጎርፍ ማረሚያ ቤት ገብቶ ነበር አይደል?

03፡ አዎ

01፡ እኛ ይኼን ከሰራን በኋላ የእኛን በማየት፣ ማረሚያ ቤት እንዳይገባ አፈር በመድፋት፣ ጎርፍ እንዳይገባ የመከላከል ሥራ ተሰርቷል። ማረሚያ ቤት ላይ የሰሩት ከእኛ አይተው ነው።

03፡ በ2008 ዓ.ም፣ በ2010 ዓ.ም ጎርፍ ማረሚያ ቤት ውስጥ ገብቶባቸው ነበር።

ጥያቄ 11፡- እዚህ አካባቢ የግብርና ምርቶች ታመርታላችሁ?

03፡ በአብዛኛው አትክልት ነው። ጋራ ጋራው ላይ ግን ገበሬው ጤፍም፣ ስንዴም ይዘራል። ስንዴና ጤፍ የሚዘሩት ላይ ጎርፍ አይደርስባቸውም። ጎርፉ በሚሄድበት ላይ ብዙ ጊዜ አትክልት ነው የሚለማበት። የጤፍ ቦታ የተለየ ነው ያላቸው። ወንዝ ላይ እንደኛው ነው የሚጠቀሙት፤ ክረምት ይለቃሉ፤ በጋ ተመልሰው ያጸዱና አትክልት ያመርቱበታል። የጤፍ እና የስንዴ የተለየ ነው።

01፡ ጎርፍ በሚገባበት ሰዓት አንድ ጊዜ ነው የሚጠቀሙት፤ ድሮ ሁለት ጊዜ መጠቀም ይችላሉ። ከላዩ ላይ ጎመን፣ አትክልቶች፣ የተለያዩ ድንች ይተክሉና ከነቀሉ በኋላ ደግሞ መልሰው ሌላ ነገር ይተክላሉ። በዚህ ሰዓት ግን አንድ ጊዜ ብቻ ነው የሚጠቀሙት። አንድ ጊዜ ይጠቀማሉ። ልክ ክረምት ሲለቅ ደግሞ፣ መልሶ እንደዛው ነው።

02፡ እኛ ባለፈው ዓመት ሁለት ጊዜ እንደተጠቀምን አውቃለሁ።

03፡ ቦታው ዳገት ስለሆነ፣ ጎርፍ ስለማይደርስበት ነዋ።

02፡ አዎ፤ ስለማይደርስበት ዳገት ስለሆነ ነው። ዘንድሮ ግን እንጠቀማለን ማለት ከባድ ነው። አሁን በቆሎ ነበር የዘራነው። ግን ጎርፍ ደርሶበታል። ቢሆንም ግን ምንም ያበላሸው ነገር አልነበረም። ዘንድሮ ግን ምናልባት ድልድዩ ከፈረሰ ልንጠቀምበት እንችላለን።

03፡ ድልድዩም ከፍ ተደርጎ ከተሰራ ይሆናል።

02፡ ድልድዩ ካልፈረሰ ግን፣ እንደዚሁ ከሆነ መጠቀም አንችልም። ምክንያቱም በዚህ ጋ ውሃው ቆርጦ የሚሄድበት ተዘግቷል፡ ፡

03፡ ይኼ እንዳለ ያፍነዋል፤ ውሃው ተመልሶ ይገለበጣል።

02፡ ስለዚህ ውሃው ወደዚያ ነው የሚፈሰው።

ጥያቄ 12፡- በውሃ ችግር ላይ መፍትሄ በመስጠት ያበረከታችሁት አስተዋጽዖ ካላችሁ ብታካፍሉኝ?

01፡ ለምሳሌ፡- የመሬቱ አፈር እንዳይሸረሸር ሊሰራ ነበር። ባለሙያዎች ሰፊ ቦታን የሚያካልል እርከን ለመስራት የሚያስችል ዕቅድ ነበር ይዘው የመጡት። የተወሰኑ ሰዎችን ስናናግር ያለእቅድና ያለፕሮግራም ነው የመጡት። ገንዘብ

ስለተለቀቀላቸው፣ ያንን ገንዘብ በልተው የመሄድ ሐሳብ ነበረ፡፡ ስለዚህ፣ እዚህጋ ብትሰሩ ምንም ጥቅም የለውም፡፡ መሰራት ካለበት ወንዙ የሚሰብረው በዚያ አቅጣጫ ነው ብዬ ጥቆማ ሰጠሁ፡፡ ከዚያ በኋላ ያለውን ደግሞ እሳቸው (03) ቢያብራሩት ጥሩ ነው፡፡

03፡ አዎ፣ ሲመጡ መጀመሪያ እነሱ ያሰቡት ለመስራት ሳይሆን፣ አደረግን ብለው ለመሄድ ነው፡፡ የመጡትን ሰዎች ወስጄ፣ ውሃው ሰብሮ የሚመጣበትን ዋና ቦታ አሳየኋቸው፡፡ ከዚህ ጀምራችሁ ወደታች ብትሰሩ ጎርፉንም ትከላከላላችሁ፤ ለእናንተም ይጠቅማል ብዬ ነገርኳቸው፡፡ ቦታው በጎርፍ እንዳይሸረሸር መዝጊያ ቦታው ይኼ ነው አልኳቸው፡፡ ግማሹን ሰርተው አቆሙ፡፡ ለምን አትቀጥሉም ስላቸው፣ አይ ዘንድሮ በጀት አልቋም ለከርሞ ነው አሉ፡፡ ከዚያ በኋላ በዚያው ጠፉ፡፡ ስራቸውም ከልብ ስላልሆነ የሰሩት የጎርፍ መከላከያ ግድብም በዓመቱ ፈርሷል፡፡ በአጠቃላይ በጎርፍ መከላከሉ ዙሪያ ዘለቄታ ያለው ሥራ አልተሰራም፡፡

01፡ እኛ በሰጠናቸው አቅጣጫ ሊሰሩ ሞከሩ እንጂ፣ ጥናት አላደረጉም፤ አያውቁትም፡፡ ዝም ብለው እንስራ እንጂ፣ ምንም ነገር የሚያውቁት የለም፡፡

03፡ እኛ በመራናቸው የውሃው መምጫ አቅጣጫ ነው የሚሄዱት፡፡

02፡ ስራቸው የአካባቢውን ማኅበረሰብ ያማከለ ቢሆን ጥሩ ነው፡፡ ምክንያቱም በዚያ አካባቢ ያለ ኅብረተሰብ ከባለሙያ የበለጠና የተሻለ አካባቢውን ያውቀዋል፡፡ አብዛኛውን ጊዜ እነሱ የሚሰሩት በአጭር ጊዜ እቅድ ብቻ ላይ ተመስርተው ነው፡፡ የረዥም ጊዜ እቅድ የላቸውም፡፡ የተገኘውን በጀት ለመጨረስ የይምሰል ስራ ሰርተው ነው የሚሄዱት፤ በአግባቡ አይሰሩም፡፡ ከዓመት ወደዓመት፣ ከዘመን ወደ ዘመን የሚሻገር ሥራ አቅደው ቢሰሩ፣ ይኼ ወንዝ ቀላል ነው፤ ያን ያህል ሕዝቡን የሚያፈናቅልና ጉዳት የሚያመጣ አይደለም፡፡ ችግሩም እንደዚህ ጎልቶ አይታይም ነበር፡፡ ግን የመንግስት አካላት ከልብ የመስራት ፍላጎት ላቸውም፡፡ በጀት ይለቀቃል፤ ይበላል፡፡ ከዚያም ይሄዳሉ፤ ይጠፋሉ፡፡ ከዚህ አኳያ መፍትሄ የማይገኝበት ሆኖ አንጂ፣ ቢሰሩበትና ቢያለሙ፣ መንግሥትም አቅጣጫ፣ ትኩረት ሰጥቶበት ቢንቀሳቀስ፣ በትክክል ይኼ ወንዝም ይገደባል፤ ኅብረተሰቡም ከዓመት ዓመት ጉዳት አይደርስበትም ነበር፡፡ እዚህ ዙሪያ በአትክልት ስራ፣ የከተማ ግብርና የሚሰሩት ሰዎችም ጉዳት አይደርስባቸውም፤ ጉዳቱም ይቀንሳል፡፡

ጥያቄ 13፡- ሌላ ያላነሳችሁትና ተጨማሪ ልታሳውቁን የምትፈልጉት ሐሳብ ካላችሁ?

03፡ አሁን ድልድዩ እየተሰራ ነው፤ ድልድዩ መሰራቱ ጥሩ ነው፡፡ ግን አዲስ ሐሳብ ይዘው መጥተዋል፡፡ ወንዙን አቅጣጫ የማስቀየር፡፡ የሚመለከተውን መሀንዲስ አናግረነው ነበር፤ ችካልም የመቸከል ስራ ሰርተው ነበር፡፡ መሃንድሶችም አምጥተው በየአቅጣጫው ሲያስለኩ ነበረ፡፡ ያንን የመቃወም ሥራ ሰርተናል፡፡ እነሱ ሐሳባቸው ድልድዩን ማስቀየር ነው፡፡ ሥራው እንዲቀልላቸው ነው፤ ወጭ እንዲቀንስላቸው ነበር፡፡ ያ ግን ትክክል እንዳልሆነ፣ አግባብ እንደሌለው ነው የነገርናቸው፡፡ ምክንያቱም እነሱ ያቀዱት እቅድ፣ ወንዙን አቅጣጫ የማስቀየር ስራ ነበር፡፡ እኛ ደግሞ የወንዙን ፍሰት እናውቀዋለን፤ ከረምት ላይ ምን ያህል እንደሚጨምር እናውቀዋለን፡፡ አሁን ባለበት ሁኔታ፣ ውሃው ወደማኅበረሰቡ እንዳይሄድ እኛ እየታገልን ነው፡፡ ውሃው አቅጣጫ ቀየረ ማለት፣ ወደማኅበረሰቡም፣ ወደትምህርት ቤትም ቀጥታ የመግባት እድሉ በጣም ሰፊ ነው፡፡ ከጥቅሙ ይልቅ ጉዳቱ ያመዝን ነበረ ማለት ነው፡፡ ይኼን ሥራ ሲሰሩ በመጀመሪያ ስለአካባቢው ምን ዕውቀት አላቸው? ወንዙን አቅጣጫ የማስቀየር ብቻ ሳይሆን ማኅበረሰቡንም ማማከር አለባቸው፡፡ ይኼ ማለት ብዙ መረጃዎች ሰጥተናቸዋል፡፡ ከዚያ በኋላ አሁን የቀረ ይመስለኛል፡፡

01፡ አዎ፣ መሬታቸንንም ቆርጠው ሰጥተው፣ ውሃውንም መልሰው በመሬቱ ላይ ሊወስዱት አሰቡ፡፡ እዚህ አካባቢ ያለ ሕዝብ ውሃው አፈናቅሎት የመጣ ነው፡፡ አሁን ደግሞ ወንዙ አቅጣጫውን ቀየረ ማለት ይኼ ትምህርት ቤቱ ይጥፋ ማለት ነው፡፡ መጨረሻ ላይ ሳይሆንላቸው ቀረ መሰለኝ፡፡ እነሱ ባለሙያ ናቸው፤ ግን ስለአካባቢው ግንዛቤ የላቸውም፡፡

03፡ ወንዙን አቅጣጫ ማስቀየር ማለት ሕዝቡንና ማኅበረሰቡን ማፈናቀል፣ ማጥፋት ማለት ነው፡፡ ድልድዩን መነሻ አድርገው፣ ወንዙን አቅጣጫ ለማስቀየር በፊት 30 ሜትር ነበር ያሰቡት፤ አሁን 12 ሜትር ወደዚያው ጠጋ አድርገውታል፡፡

C.13 Community interview 6 [English]

Question: How long have you lived in this area?

Response: thirty Years

Question: Where did you live thirty years ago?

Response: Tigray region

Question: What kind of work does your family do?

Response: They have work. Half of them are drivers.

Question: Why did you come to this area? For what reason?

Response: We were displaced due to the turmoil and conflict during the Derg regime. We are displaced because we are a military family.

Question: What was the use of water in this area thirty years ago?

Response: Thirty years ago, development was unknown in this area. But now we are dreaming of this river. But in winter, we stop working because the area is flooded. The water is useful. But chemicals released from factories pollute it. This is the problem. But if the chemical was not released, we would drink the water. But occasionally they add chemicals to it. The water is getting dirty and the quality is getting polluted.

Question: How long will it be after chemicals start to be released into the river?

Response: It will be at least ten years since this started. Ten years ago, they began to connect factories with pipes and discharge them into the river.

Question: Apart from polluting the river with chemicals, is there any other problem you have seen? Is there a flood problem?

Response: Yes, we went out by helicopter. The flood was flooding our house and sand was filling up. This happened in 2008 E.c.

Question: Did people swim here in the past? What about fish production?

Response: Yes. Fish are still rare.

Question: Why do you use water now?

Response: We grow vegetables. We water it from cattle. But it will not be a drink for human beings. It's broken. It also has a smell.

Question: When you used to drink water, did you use this river or is there another one?

Response: No, it is in the same river. That’s all. It is a tributary river.

Question: What do you say is the most serious problem in the current water situation?

Response: First, rivers are shrinking. Second, the chemicals released from each plant will eventually cause problems. We have discussed this problem many times in interviews. It was reduced. The problem is getting worse now that the government is not paying attention to it. No tracking.

Question: Do you see an exaggerated change in the water during the winter and summer months?

Response: In winter, the water fills up. It is very muddy. The water is useless.

Question: Where do you get water now?

Response: We have tap water; we have entered.

Question: Since the water that comes in winter will be dry and not drinkable for

Cattle, does it mean that it will be difficult for you?

Question: Who do you think is responsible for the chemicals being released into the water?

Response: The city will have cleaning control. We applied before now and it actually decreased. It has less critical in every meeting. Now there is no control, so it is loose. It comes with medical supplies and waste water. That waste causes a lot of danger. This garbage was reported in the media and reduced. And now it's back and added.

Question: How is the water supply in this area? Does everyone get water?

Response: There is currently a shortage of water. As the size of the city is increasing, water is brought once every three or four days. In general, there is water shortage and water crisis.

Question: When water comes, does it have the power to store it in different water containers?

Response: Not very powerful. But even slowly, it fills up eventually. As the people are getting used to the problem, we are taking precautions.

Question: Do you think all areas of Addis Ababa have equal access to water?

Response: Not equally accessible; There has never been a shortage of water here in the city center like this year. I think that the problem of water shortage is caused by the fact that water distribution is too much and it is released in turn. There are new neighborhoods outside the city center. When water is distributed to all these settlements, water shortages may occur. So water workers can reduce the water coming into the city center and send it to new neighborhoods on the outskirts of the city; at that time there will be a shortage of water.

Question: Do you think there should be an individual (including you) or a community that should be prioritized when using water?

Response: We want every citizen to get equal services. We share the problem, the loss, and the gain equally.

Question: Is there a culture of helping each other when you face a water shortage or a problem in your area?

Response: Yes, there is. There is both relief and precaution against floods. We will inform the police. They will cooperate with us.

Question: In your capacity as chairman, what solution have you contributed to the water problem?

Response: The problem with water is to fill the water container and use it sparingly. On the river, it is better if the body concerned does not drain into the river. I want to give this notice. If one citizen is harmed, the harm is to all Ethiopians. Therefore, I have the idea that the relevant parties should think that tomorrow is for me and fix it.

Question: If you have any other suggestions that have not been raised?

Response: I would like to add, if there is a budget for the future, it would be good if the rivers are fixed with dams to prevent them from overflowing and the river can be used by any citizen. This is my reminder. Because it will benefit from the development. It is good if all this wasted water is captured by the system. Now that there is more sun, there is no summer rain, so the water is decreasing. Wheat can be grown with water. Production of <<Teff>> is also starting. If rivers are widely used, the country will change. People change.

Question: Do you get early warning when a flood is coming?

Response: Yes. The city of Legedadi warned us in advance. They tell us to be careful not to be found on the river bank from July. They will call the city of Legedadi by phone and inform them through the media. Floods attack us from many directions. This is what is causing the biggest problem. It will be very difficult to live by the river in the future. The city is growing. Water silting is also increasing. As soon as we see a cloud in the sky, we become cautious.

Question: What is the status of exchanging information with associations in your region?

Response: We call each other. We will help each other. We lend them what we have. And we borrow what they have; In general, we live a good social life. They reach us when there is a problem, a meeting or a call. We are involved in everything together.

Question: How many associations are there?

Response: We are fifty five. In another association there are about thirty. We have many associations. There are about ten of us around here. There may be an association elsewhere.

Question: How did you establish the associations?

Response: We were founded by the unemployed. We are displaced from Eritrea and Tigray. No subsistence pension. At that time, an organization called Rehabilitation Fund was established in Addis Ababa. They gave us wheat aid for one year. After that, he gave us this, saying, "Get organized and work on this land." After that, we

gave birth, raised, graduated and lived for thirty years. Our children also give birth and live hard. People come together because of problems.

Question: Do you have any comments you would like to add?

Response: The future concern is that as rivers become more polluted; they become more susceptible to allergic reactions. And it is good if education is given widely to people who have tanneries.

C.14 Community interview 6 [Amharic]

ጥያቄ፡- በዚህ አካባቢ ለምን ያህል ጊዜ ኖረዋል?

ምላሽ፡- ሰላሳ ዓመት

ጥያቄ፡- ከሰላሳ ዓመት በፊት የኖሩት የት ነበር?

ምላሽ፡- ትግራይ ክልል

ጥያቄ፡- ቤተሰብዎ በምን ሥራ ነው የሚተዳደሩት?

ምላሽ፡- ሥራ አላቸው፤ ግማሾቹ ሹፌር ናቸው፡፡

ጥያቄ፡- ወደዚህ አካባቢ የመጣችሁት ለምንድን ነው? በምንስ ምክንያት ነው?

ምላሽ፡- በደርግ ጊዜ በነበረው ግርግር፣ ግጭት ምክንያት ተፈናቅለን ነው የመጣነው፣ የወታደር ቤተሰብ ስለሆን ተፈናቅለን ነው፡፡

ጥያቄ፡- ከሰላሳ ዓመት በፊት እዚህ አካባቢ የነበረው የውሃ አጠቃቀም ምን ይመስል ነበር?

ምላሽ፡- ከሰላሳ ዓመት በፊት እዚህ አካባቢ ልማት አይታወቅም ነበር፡፡ አሁን ላይ ግን በዚህ ወንዝ እያለማንበት ነው፡፡ ክረምት ላይ ግን አካባቢውን ጎርፍ ስለሚያጥለቀልቀው ስራ እናቆማለን፡፡ ውሃው ጥቅም አለው፤ ግን ከፋብሪካ የሚለቀቁ ኬሚካሎች ይበክሉታል፡፡ ይኼ ነው ችግሩ፡፡ ኬሚካሉ ካልተለቀቀ ግን ውሃውን እንጠጣው ነበር፡፡ ነገር ግን አልፎ አልፎ ኬሚካል ይጨምሩበታል፡፡ ውሃው ቆሻሻ እየሆነ ጥራቱ እየተበከለ መጣ፡፡

ጥያቄ፡- ኬሚካል ወደወንዙ መለቀቅ ከጀመረ ምን ያህል ጊዜ ይሆናል?

ምላሽ፡- ይህ መሆን ከጀመረ ቢያንስ አስር ዓመት ይሆነዋል፡፡ ከአስር ዓመት ወዲህ ፋብሪካዎችን በቱቦ እያገናኙ ወደወንዝ መልቀቅ ጀመሩ፡፡

ጥያቄ፡- በኬሚካል ወንዙን ከመበከል ባሻገር ሌላ ያዩት ችግር አለ? የጎርፍ ችግር አለ?

ምላሽ፡- አዎ በኤሊኮፍተር ነው የወጣነው፡፡ ጎርፍ ቤታችንን አጥለቅልቆት አሸዋ ወደላይ እየሞላ ነበር፡፡ ይህ የሆነው በ2008 ዓ.ም ነው፡፡

ጥያቄ፡- ድሮ እዚህ አካባቢ ሰዎች ይዋኙ ነበር? የዓሳ ምርትስ ነበር?

ምላሽ፡- አዎ፡፡ ዓሳ አሁንም አልፎ አልፎ አለ፡፡

ጥያቄ፡- አሁን ላይ ውሃን ለምን ለምን አገልግሎት ይጠቀሙበታል?

ምላሽ፡- አትክልት እናለማበታለን፡፡ ከከብቶች እናጠጣበታለን፡፡ ለሰው ልጅ መጠጥ ግን አይሆንም፤ ተበላሽቷል፤ ሽታም አለው፡፡

ጥያቄ፡- ድሮ ውሃ በምትጠጡበት ጊዜ የምትጠቀሙት ይኼን ወንዝ ነው ወይስ ሌላ አለ?

ምላሽ፡- የለም በዚሁ ወንዝ ነው፡፡ ይኼው ነው፡፡ ገባሪ ወንዝ ነው፡፡

ጥያቄ፡- አሁን ላይ ባለው የውሃ ሁኔታ በጣም አሳሳቢ ችግር ነው የሚሉት ምንድን ነው?

ምላሽ፡- አንደኛ፣ ወንዞች እየቀነሱ መጥተዋል፡፡ ሁለተኛ፣ ከየፋብሪካው የሚለቀቀው ኬሚካል ውሎ አድሮ ችግር ይፈጥራል፡ ፡ ይህንም ችግር ብዙ ጊዜ በቃለመጠይቅ አስተላልፈናል፡፡ ቀንሶ ነበር፡፡ አሁን ላይ መንግስት ትኩረት ስላልሰጠው ችግሩ እየባሰ መጣ፡፡ ከትትል የለም፡፡

ጥያቄ፡- በክረምትና በጋ ወራት ወቅት ውሃው ላይ የተጋነነ ለውጥ ታያላችሁ?

ምላሽ፡- በክረምት ውሃው ይሞላል፡፡ በጣም ድፍርስና ደለል ነው፡፡ ውሃው ለምንም አያገለግልም፡፡

ጥያቄ፡- አሁን ላይ ውሃ ከየት ነው የምታገኙት?

ምላሽ፡- ከቧንቧ፣ የቧንቧ ውሃ አለን፤ አስገብተናል፡፡

ጥያቄ፡- ክረምት ላይ የሚመጣው ውሃ ድፍርስ ስለሚሆን፣ ለከብቶች መጠጥም ስለማይሆን፣ አስቸጋሪ ይሆንባችኋል ማለት ነው?

ምላሽ፡- አስቸጋሪ ሳይሆን፣ ደለሉ ለመሬቱ እንደማዳበሪያ በመሆን ይጠቅማል፡፡ ዝናብ ሲጥል ደለል ከሌለ አትክልቱ ጥሩ አይሆኑም፡፡

ጥያቄ፡- ውሃው ላይ ለሚለቀቁት ኬሚካሎች ተጠያቂው ማነው ብለው ያስባሉ?

ምላሽ፡- የከተማው የጽዳት ቁጥጥር ይኖረዋል፤ ከአሁን በፊት አመልክተን እንደውም ቀንሰ ነበር፡፡ በየስብሰባው ስንተች ቀንሶ ነበር፡፡ አሁን ቁጥጥርም ስለሌለ ልቅ ሆኗል፡፡ የሀኪም ቤት ቁሳቁስና ቆሻሻ ውሃው ጋር አብሮ ይመጣል፡፡ ያ ቆሻሻ ብዙ አደጋ ያስከትላል፡፡ ይኼ ቆሻሻ በሚዲያ ተነግሮ ቀንሶ ነበር፡፡ አሁን ደግሞ ተመልሶ ጨምሯል፡፡

ጥያቄ፡- እዚህ አካባቢ የውሃ አቅርቦቱ እንዴት ነው? ሁሉም ሰው ውሃ ያገኛል ወይ?

ምላሽ፡- በአሁኑ ሰዓት ውሃ እጥረት አለ፡፡ የከተማው ስፋትም እየጨመረ ስለመጣ ውሃ በሦስት ቀንም ሆነ በአራት ቀን አንድ ጊዜ ነው የሚመጣው፡፡ በአጠቃላይ የውሃ እጥረትና የውሃ ችግር አለ፡፡

ጥያቄ፡- ውሃ ሲመጣ በተለያዩ የውሃ መያዣ እቃዎች አከማችቶ ለማቆየት የሚያስችል ኃይል አለው?

ምላሽ፡- ብዙም ኃይል የለውም፡፡ ግን በቀስታም ቢሆን ውሎ አድሮ ይሞላል፡፡ ሕዝቡም ችግሩን እየለመደ ሲመጣ ቅድመጥንቃቄ እያደረግን ነው፡፡

ጥያቄ፡- በውሃ አጠቃቀም ሁሉም የአዲስ አበባ አካባቢ እኩል ተደራሽ ነው ብለው ያስባሉ?

ምላሽ፡- እኩል ተደራሽ አይደለም፤ እዚህ መሃል ከተማ ላይ እንደዘንድሮ የውሃ እጥረት አጋጥሞ አያውቅም፡፡ የውሃ እጥረት ችግሩ የሚፈጠረው የውሃ ክፍፍል ስለሚበዛና በየተራ ስለሚለቀቅ ይመስለኛል፡፡ ከመሃል ከተማው ወጣ ያለ አዳዲስ ሰፈር አለ፤ ውሃ ለእነዚህ ሰፈሮች ሁሉ ሲከፋፈል የውሃ እጥረት ሊያጋጥም ይችላል፡፡ ስለዚህ የውሃ ሰራተኞች ወደመሃል ከተማ የሚመጣውን ውሃ በመቀነስ ወደከተማው ዳር ወደአሉ አዳዲስ ሰፈሮች ሊልኩት ይችላሉ፤ በዚያን ጊዜ የውሃ እጥረት ይከሰታል፡፡

ጥያቄ፡- ውሃ ስትጠቀሙ ቅድሚያ ሊሰጠው የሚገባ ግለሰብ (እርስዎን ጨምሮ) ወይም ማኅበረሰብ ሊኖር ይገባል ብለው ያስባሉ?

ምላሽ፡- ማንኛውም ዜጋ እኩል አገልግሎት ማግኘት ነው የምንፈልገው፡፡ ችግሩንም፣ ማጣቱንም፣ ማግኘቱንም እኩል ነው የምንካፈለው፡፡

ጥያቄ፡- በአካባቢያችሁ የውሃ እጥረት ወይም የጎርፍ ችግር ሲያጋጥማችሁ ርስበርስ የመረዳዳት ባህል አለ?

ምላሽ፡- አዎ፤ አለ፡፡ በጎርፍ ላይ መረዳዳትም ሆነ ቅድመጥንቃቄ አለ፡፡ ለፖሊስ አካላት እናሳውቃለን፡፡ እነሱም ይተባበሩናል፡፡

ጥያቄ፡- እርስዎ እንደሊቀመንበርነትዎ ባለዎት አቅም በውሃ ችግር ላይ ምን መፍትሔ አበርክተዋል?

ምላሽ፡- በውሃ ችግሩ ላይ ባላ የውሃ መያዣ ዕቃ ሞልቶ በቁጠባ መጠቀም ነው፡፡ በወንዙ ላይ ደግሞ የሚመለከተው አካል ወደወንዙ ፍሳሽ ባያፈስ መልካም ነው፡፡ ይኼን ማሳሰቢያ ልሰጥ እፈልጋለሁ፡፡ አንድ ዜጋ ተጎዳ ማለት፣ ጉዳቱ የሁሉም ኢትዮጵያዊ ነው፡፡ ስለዚህ የሚመለከታቸው አካላት ነገ ለእኔ ነው ብለው አስበው ቢያስተካክሉ የሚል ሐሳብ አለኝ፡፡

ጥያቄ፡- ሌላ ያልተነሳና የሚጨምሩት ሐሳብ ካለዎት?

ምላሽ፡- የምጨምረው፣ ለወደፊት በጀት ቢኖር ወንዞች፣ ከወንዝ ወጥተው እንዳይፈሱ በግድብ ተስተካክሎ ወንዝን ማንኛውም ዜጋ እንዲጠቀምበት ወይም ጥቅም ላይ እንዲውል ቢደረግ ጥሩ ነው፡፡ ይኼው ነው የእኔ ማሳሰቢያ፡ ፡ ምክንያቱም ከልማቱ ጥቅም ይኖረዋል፡፡ ይኼ ሁሉ የሚባክን ውሃ በስርዓቱ ቢያዝ ጥሩ ነው፡፡ አሁን ፀሐይ ስለበዛ፣ የበጋ ዝናብ ስለሌለ ውሃ እየቀነሰ ነው፡፡ ስንዴ በውሃ ማምረት ይቻላል፤ ጤፍም ማምረት እየተጀመረ ነው፡፡ ወንዞች በሰፊው አገልግሎት ቢሰጡ ሀገርም ይለወጣል፤ ሰውም ይለወጣል፡፡

ጥያቄ፡- ጎርፍ ሲመጣ ቅድሚያ ማስጠንቀቂያ ይደርሳችኋል?

ምላሽ፡- አዎ፤ የለገዳዲ ከተማ ቀድሞ ያጠነቅቀናል፡፡ ከሀምሌ ወር ጀምሮ ተጠንቀቁ በወንዝ ዳርቻ እንዳትገኙ ይሉናል፡፡ የለገዳዲ ከተማ በስልክ ደውለው እንዲሁም በሚዲያ ያሳውቃሉ፡፡ ጎርፍ የሚያጠቃን ከብዙ አቅጣጫ ነው፡፡ ይህ ነው ከፍተኛ ችግር እየፈጠረ ያለው፡፡ ለወደፊት በወንዝ ዳርቻ መኖር በጣም ይከብዳል፡፡ ከተማው እየበዛ ነው፤ የውሃ ደለልም እየጨመረ ነው፡፡ ልክ ሰማይ ላይ ደመና ስናይ እኛ ጥንቃቄ እናደርጋለን፡፡

ጥያቄ፡- በቀበሌያችሁ ካሉ ማኅበራት ጋር መረጃ የመለዋወጥ ሁኔታችሁ ምን ይመስላል?

ምላሽ፡- እንደዋወላለን፤ እንረዳዳለን፡፡ እኛ ያለንን እቃ እናውሳቸዋለን፤ እና ያላቸውን እንዋሳለን፤ በአጠቃላይ ጥሩ ማኅበራዊ ኑሮ ነው የምንኖረው፡፡ ችግር፣ ስብሰባም ሆነ ጥሪ ሲኖር ይደርሱልናል፡፡ በሁሉም ነገር አብረን ነው የምንሳተፈው፡፡

ጥያቄ፡- ማኅበራቱ ምን ያህል ናቸው?

ምላሽ፡- እኛ ሃምሳ አምስት ነን፡፡ ሌላ ማኅበር ላይ ደግሞ ወደሰላሳ ናቸው፡፡ ማኅበራት ብዙ ነን፡፡ እዚሁ አካባቢ ያለን ወደአስር እንሆናለን፡፡ ሌላም ቦታ ማኅበር ሊኖር ይችላል፡፡

ጥያቄ፡- ማኅበራቱን እንዴት መሰረታችኋቸው?

ምላሽ፡- እኛ የተመሰረትነው በሥራ አጥ ነው፡፡ ከኤርትራ፣ ከትግራይ ተፈናቅለን መጥተን ነው፡፡ መተዳደሪያ ጡረታ የለም፡ ፡ በዚያን ጊዜ ተሃድሶ ፈንድ የሚባል ድርጅት በአዲስ አበባ ተቋቋመ፡፡ ስንዴ እርዳታ ለአንድ ዓመት ሰጠን፤ ከዚያ በኋላ በዚህ መሬት ተደራጅታችሁ ስሩ ብሎ ይኼን ሰጠን፡፡ ከዚያ ይኼው ወልደን፣ አሳድገን፣ አስመርቀን ሁሉ ሰላሳ ዓመት ኑረናል፡፡ ልጆቻችንም ወልደው ከብደው ይኖራሉ፡፡ ሰው የሚገናኘው በችግር ምክንያት ነው፡፡

ጥያቄ፡- መጨመር የሚፈልጉት ሐሳብ ካለ?

ምላሽ፡- ለወደፊቱ የሚያሰጋኝ ወንዞች እየተበከሉ ሲሄዱ ለአላርጂክ ያጋልጣሉ፡፡ እና ይኼ ጉዳይ በተለይ የቆዳ ፋብሪካ ላላቸው ሰዎች ትምህርት በሰፊው ተሰጥቷቸው ቢቀር መልካም ነው፡፡

አመሰግናለሁ!

C.15 Community interview 7 [English]

Question: How long have you lived in this area?

Response: Twenty-nine years, I was born here

Question: Where did your family live?

Response: My mother has lived here for at least 45 years.

Question: What kind of work does your family do?

Response: My father works in a company. My mother is also a businessman.

Question: According to your family, what was the use of water in this area like?

Response: We got drinking water recently. It has been at least seven years since we got piped water. Before that, we used the water of Akaki River for drinking as well. The past and the present are like heaven and earth. The condition of the river is not connected. A big difference has been seen in the last ten or fifteen years. The river is now very polluted. It also has dirt.

Question: When you were growing up here, how is the water change or land management described? How productive was the water being used?

Response: Although the water is not being used much, urban agriculture is being practiced on vegetables. Most of the people are using the water in an organized manner. But now, unlike before, the river water is starting to bring dirt, which is not suitable for the plants. It also shows burn marks on the vegetables.

Question: Did people swim around here when you were a child? Did you swim? What about fish production?

Response: We still swim. But now the water is dirty, so it's not like it used to be.

Question: Has there been any flood damage in this area?

Response: Our area is a high place so there is no flood. But there was flood damage in this area in 2011 E.C. But now it has decreased somewhat. Every time winter comes, there is a risk of flooding.

Question: Is there a situation of reducing water in summer?

Response: It is limited when used for irrigation. But it has not been said to have subsided much.

Question: How do you use water?

Response: We use tap water. We do not use river water for domestic purposes; but we use it for animal drinking.

Question: How many times a week does the tap water come?

Response: Water comes at six or seven o'clock at night. This happened recently. We fetch water at night. That is dangerous. It means that there is such a problem.

Question: What do you say is the most serious problem in the current water situation?

Response: It is a very serious problem because the water floods in winter. Water breaks for many reasons. It is not possible to know the reason uniformly.

Question: Do you see an exaggerated change in the water during the winter and summer months?

Response: There is a lack of rain. It was raining before. But now it rains only in winter.

Question: Do you think that due to the lack of water, water should reach us first from other areas?

Response: Yes, I think so. Water is mandatory.

Question: Is there a culture of helping each other when you face a water shortage or a problem in your area?

Response: To survive with the water problem, it is to go and fetch water separately from the place where it is found. We go four or five kilometers to fetch water by cart. But for washing clothes and drinking water for animals, we mostly take it from the river. Alternatively, there are those who boil the water and use it for cooking.

Question: Do you get early warning when a flood is coming? Do you have a different approach? How can you be aware of floods?

Response: Three years ago there were no precautions. The city of Legedadi would not tell us. Since we started working with the city three years ago, they have sites all over the place. We will be aware of the time of flood in those places, we will receive the information and we will receive the meteorological information. Not available now. But it was like that before. Mostly, the message is delivered through different media.

Question: How are you, as a local resident, solving the water problem?

Response: I create awareness for the community about floods. I will ask the relevant institutions in writing or in person to solve the water problem. But there is a problem with institutions. There are those who answer letters and those who do not.

Question: Is there anything you would like to add to the water issue?

Response: Not that I would add, especially when research work is often done on this river, no solution is given. When will the results of the research on water be used here? I think that the results of research in this area should work.

Thank you!

C.16 Community interview 7 [Amharic]

ጥያቄ፡- በዚህ አካባቢ ለምን ያህል ጊዜ ኖረዋል?

ምላሽ፡- ሀያ ዘጠኝ ዓመት፣ እዚሁ ነው የተወለድኩት

ጥያቄ፡- ቤተሰቦችህ የሚኖሩት የት ነበር?

ምላሽ፡- እናቴ ቢያንስ 45 ዓመት ያህል እዚሁ አካባቢ ኖራለች፡፡

ጥያቄ፡- ቤተሰብዎ በምን ሥራ ነው የሚተዳደሩት?

ምላሽ፡- አባቴ ድርጅት ውስጥ ነው የሚሰራው፤ እናቴ ደግሞ ነጋዴ ናት፡፡

ጥያቄ፡- ቤተሰቦችህ እንደነገሩህ፣ እዚህ አካባቢ የነበረው የውሃ አጠቃቀም ምን ይመስል ነበር?

ምላሽ፡- የመጠጥ ውሃ ያገኘነው አሁን በቅርቡ ነው፡፡ የቧንቧ ውሃ ካገኘን ቢያንስ ሰባት ዓመት ቢሆን ነው፡፡ ከዚያ በፊት ለመጠጥነት ጭምር የኢቃቂ ወንዝ ውሃን እንጠቀም ነበር፡፡ የበፊቱ እና ያሁኑ በጣም የማይገናኝ እንደሰማይና ምድር ነው፤ የወንዙ ሁኔታ አይገናኝም፡፡ ባለፉት አስርና አስራአምስት አመታት ውስጥ ትልቅ ልዩነት ታይቷል፡ : አሁን ላይ ወንዙ በጣም ተበክሏል፤ ቆሻሻም አለው፡፡

ጥያቄ፡- እዚህ ስታድግ ያየኸው የውሃ ለውጥ ወይም የመሬት አያያዝ እንዴት ይገለጻል? ውሃው ጥቅም ላይ ውሎ የነበረው ምርታማነትስ ምን ይመስላል?

ምላሽ፡- ውሃው ብዙ ጥቅም ላይ ባይውልም፣ አትክልት ላይ የከተማ ግብርና እየተሰራበት ነው፡፡ አብዛኛው ሰው ተደራጅቶ እየሰራ ውሃውን እየተጠቀመበት ነው፡፡ ነገር ግን አሁን ላይ የወንዙ ውሃ ከበፊቱ በተለየ ሁኔታ ቆሻሻ ማምጣት ሲጀምር ለአትክልቶቹም አይስማማም፡፡ በአትክልቶቹ ላይም የማቃጠል ምልክት ያሳያል፡፡

ጥያቄ፡- በልጅነት ጊዜ እዚህ አካባቢ ሰዎች ይዋኙ ነበር? እርስዎስ ይዋኙ ነበር? የዓሳ ምርትስ ነበር?

ምላሽ፡- አሁንም እንዋኛለን፡፡ ግን አሁን ውሃው ቆሻሻ ስለሆነ እንደድሮው አይደለም፡፡

ጥያቄ፡- እዚህ አካባቢ የጎርፍ ጉዳት ደርሶ ያውቃል?

ምላሽ፡- የእኛ አካባቢ ግን ከፍታ ያለው ቦታ በመሆኑ ጎርፍ የለም፡፡ ነገር ግን እዚህ አካባቢ 2011 ዓ.ም የጎርፍ ጉዳት ነበር፡ : አሁን ላይ ግን የተወሰነ ቀንሷል፡፡ ከረምት በመጣ ቁጥር የጎርፍ አደጋ አለ፡፡

ጥያቄ፡- በጋ ላይ ውሃ የመቀነስ ሁኔ አለ?

ምላሽ፡- የተወሰነ ነው ለመስኖ አገልግሎት ሲጠቀሙ የሚቀንሰው፤ ግን ብዙም ቀነሰ ባይባልም አለ፡፡

ጥያቄ፡- ውሃን እንዴት ነው የምትጠቀሙ?

ምላሽ፡- ከቧንቧ ነው ውሃ የምንጠቀመው፡፡ የወንዝ ውሃን ለቤት አገልግሎት አንጠቀምም፤ ለእንስሳት መጠጥ ግን እንጠቀመዋለን፡፡

ጥያቄ፡- የቧንቧ ውሃ በሳምንት በስንት ጊዜ ይመጣል?

ምላሽ፡- ማታ ስድስት ወይም ሰባት ሰዓት ነው ውሃ የምትመጣው፡፡ ይህ የሆነው ከቅርብ ጊዜ ወዲህ ነው፡፡ ሌሊት ነው ውሃ የምንቀዳው፤ ያም አደጋ አለው፡፡ የዚህን ያህል ችግር አለ ማለት ነው፡፡

ጥያቄ፡- አሁን ላይ ባለው የውሃ ሁኔታ በጣም አሳሳቢ ችግር ነው የሚሉት ምንድን ነው?

ምላሽ፡- ከረምት ላይ ውሃው ጎርፍ ስለሚገባበት በጣም አሳሳቢ ችግር ነው፡፡ በብዙ ምክንያት ውሃ ይቋረጣል፡፡ ምክንያቱንም ወጥ በሆነ መልኩ ማወቅ አይቻልም፡፡

ጥያቄ፡- በክረምትና በጋ ወራት ወቅት ውሃው ላይ የተጋነነ ለውጥ ታያላችሁ?

ምላሽ፡- የዝናብ እጥረት ያጋጥማል፡፡ በፊት ይዘንብ ነበር፤ አሁን ላይ ግን ክረምት ብቻ ጠብቆ ነው ዝናብ የሚጥለው፡፡

ጥያቄ፡- ካለው የውሃ እጥረት አኳያ ውሃ ከሌላው አካባቢ ቀድሞ ሊደርሰን ይገባል ብለው ያስባሉ?

ምላሽ፡- አዎ አስባለሁ፡፡ ውሃ ግዴታ ስለሚያስፈልግ ነው፡፡

ጥያቄ፡- በአካባቢያችሁ የውሃ እጥረት ወይም የጎርፍ ችግር ሲያጋጥማችሁ ርስበርስ የመረዳዳት ባህል አለ?

ምላሽ፡- የውሃን ችግር ለመቋቋም በተናጠል ውሃ ከተገኘበት ቦታ ሂዶ መቅዳት ነው፡፡ ውሃ ለማግኘት አራት ወይም አምስት ኪሎ ሜትር በመሄድ በጋሪ ነው የሚቀዳው፡፡ ልብስ ለማጠብ እና ለእንስሳት መጠጥ ግን በአብዛኛው ከወንዝ ነው የምንወስደው፡፡ በአማራጭነት ግን ውሃውን በማፍላት ለምግብ መስሪያ የሚጠቀሙም አሉ፡፡

ጥያቄ፡- ጎርፍ ሲመጣ ቅድሚያ ማስጠንቀቂያ ይደርሳችኋል? የተለየ አሰራር አላችሁ? እንዴት ነው ጎርፍ ልትጠነቀቁ የምትችሉት?

ምላሽ፡- ከሦስት ዓመት በፊት ጥንቃቄዎች አልነበሩም፤ የለገዳዲ ከተማም አይነግረንም ነበር፡፡ ከሦስት ዓመት ወዲህ ከተማው ጋር መስራት ከጀመርን ጀምሮ ሁሉም ቦታዎች ላይ ሳይቶች አሏቸው፡፡ እነዚያ ቦታዎች ላይ ጎርፍ የሚመጣበት ጊዜ ይነገርና፣ መረጃው ስለሚደርሰንና የሜትሮሎጂ መረጃ ስለሚደርሰን አንጠነቀቃለን፡፡ አሁን ላይ የለም፤ በፊት ግን እንደዛ ነበር፡፡ በአብዛኛው በተለያዩ ሚዲያዎችም መልዕክቱ ይደርሳል፡፡

ጥያቄ፡- እርስዎ እንደአንድ የአካባቢ ነዋሪ የውሃን ችግር በምን መልኩ እየቀረፉ ነው?

ምላሽ፡- በጎርፍ ዙሪያ ለማኅበረሰቡ ግንዛቤ እፈጥራለሁ፡፡ የውሃን ችግር ለመቅረፍ ለሚመለከታቸው ተቋማት በደብዳቤ ወይም በአካል በመቅረብ እጠይቃለሁ፡፡ ተቋማት ላይ ግን ችግር አለ፡፡ ደብዳቤ ቢጻፍም፣ ስልክ ቢደወልም መልስ የሚሰጡም የማይሰጡም አሉ፡፡

ጥያቄ፡- በውሃ ጉዳይ መጨመር የሚፈልጉት ሐሳብ ካለ?

ምላሽ፡- የምጨምረው ሐሳብ ሳይሆን፣ በተለይ በዚህ ወንዝ ላይ ብዙ ጊዜ የምርምር ስራ ሲሰራ የመፍትሄ ሐሳብ አይሰጥም፡ ፡ በውሃ ዙሪያ ላይ የሚሰራ ምርምር ውጤት ወደዚህ መጥቶ ሥራ ላይ የሚውለው መቼ ነው? እዚህ ቦታ ላይ የሚሰሩ የምርምር ውጤቶች መፍትሄያቸው ቢሰራበት የሚል ሐሳብ አለኝ፡፡

አመሰግናለሁ!

C.17 Community interview 8 [English]

Question: Why did you migrate or come to this area?

Response: I am a resident here.

Question: Where did you live before?

Response: I live here with my family.

Question: When living in this area, what are the general changes in the area's land condition, river, rain and water supply and use?

Response: Thank you. Many changes have been seen in the area as a result of a lot of work. For example, water scarcity occurs when the first rains do not fall. Quality water is not available. Second, the seedlings in the area will dry out. The water will decrease It's not like winter. The water level will decrease. Another difference is when it rains. First, it fills with water. Second, although water is colorless, the water shows something black. Thirdly, saplings grow in this area. When it rains, the flood brings various wastes, such as wood, plastic, sand, and pollutes them. Another is that the water level will increase. Therefore, the environment will behave differently at that time. But the community uses it to wash clothes with the water that is abundant in summer. They also use it to extract sand. These are the characteristics of the area during this three year period. The water is useful. But chemicals released from factories pollute it. This is the problem. But if the chemical was not released, we would drink the water. But occasionally they add chemicals to it. The water is getting dirty and the quality is getting polluted.

Question: Has there been a change in the amount of rain since before?

Response: Yes. There is a change in terms of rain. The present and the past have changed. The change is, firstly, the width of the river was not this much before, secondly, when the river is full, the width of the river is very narrow, so the water comes out of the river and reaches the community. Before, the water came out of the river and reached the people. But now the river is wide. Another thing is that there weren't many saplings around the river before. Before this, one Chinese and two Ethiopians who were working around the river to fix the river died.

Question: What is the water quality before and now?

Response: The quality is better now than before. In the past, when it rained and the flood came, the water smelled. But now the smell of the water has subsided. Of course, when the river expands, it will absorb the smell of the water, but it cannot be said that the water is clean or of good quality.

Question: Based on what you have observed before and now, how do you explain the difference between the amount of rain in summer and winter?

Response: The amount of rain is now fuller than before. But after the river widened, the water level decreased. The sound of the river is not heard much. The rain has now subsided. The amount of rain is decreasing every year. The rain is not the same as last year.

Question: Why do you use the water of the river before and now?

Response: They used to water seedlings. But now they leave it. In the past, they used the water of the river to bathe and wash clothes. But now the water has receded. All that is left is collecting firewood from the area and sand from the river. Due to the quality of the water, watering seedlings, bathing and washing clothes with the river water has decreased.

Question: What is the water supply and demand in this area?

Response: There is river water. But other tap water is very scarce. Currently, there is a severe water shortage in our area. We get water once a week in a year on Thursday. The people will stand in line all day to get water. But before, we used to get water every day.

Question: What is the quality of the water?

Response: The water is of poor quality. Especially when yet comes, the water tastes like dirt. It gets better and better later on.

Question: Do you think all areas of Addis Ababa have equal access to water?

Response: Not equally accessible. For example, a bono that uses water and has a tap in the house does not use it equally. About 100 to 200 people use bono water. They also queues to get water.

Question: Does the time when the water comes to the house and is released

to the house differ?

Response: It does not vary. It is equal.

Question: When you face a water shortage or flood problem in your area, is

there a solution that the community can take?

Response: First, when water is released, the community stores it in different containers. Second, when water is scarce, it goes searching. For example, I know that I can buy a jar for five birr and fetch water at Bajaj. When there is a shortage of water, the community buys water from distant places. Apart from this, even if there is a water shortage, the community does not share the water it has with others.

Question: If you have any other suggestions that have not been raised?

Response: Your research work is good, keep it up. I hope that the dirty water in this area will be turned into clean water with better technology and that it will be useful for me, the community, and the country and that there will be no water problems.

Thank you!

C.18 Community interview 8 [Amharic]

ጥያቄ፡- ወደዚህ አካባቢ የፈለሱት ወይም የመጡት ለምንድን ነው?

ምላሽ፡- እዚሁ ነዋሪ ነኝ፡፡

ጥያቄ፡- በፊት የሚኖሩት የት ነበር?

ምላሽ፡- እዚሁ ከቤተሰብ ጋር ነው የምኖረው፡፡

ጥያቄ፡- እዚህ አካባቢ ሲኖሩ አጠቃላይ ስለአካባቢው የመሬት ሁኔታ፣ ወንዝ፣ ዝናብ እንዲሁም የነበረው የውሃ አቅርቦት እና አጠቃቀም ያሉት ለውጦች ምን ምን ናቸው?

ምላሽ፡- አመሰግናለሁ፡፡ ብዙ ከመስራት የተነሳ አካባቢው ላይ ብዙ ለውጦች ታይተዋል፡፡ ለምሳሌ፣ አንደኛ ዝናብ ያልዘነበ ጊዜ የውሃ እጥረት ይከሰታል፡፡ ጥራት ያለው ውሃ አይገኝም፡፡ ሁለተኛ ደግሞ አካባቢው ላይ ያሉ ችግኞች ይደርቃሉ፡፡ ውሃው ይቀንሳል እንደከረምቱ ወቅት አይደለም፡፡ የውሃው መጠን ይቀንሳል፡፡ ሌላው ዝናብ ሲዘንብ ጊዜ ልዩነት አለው፡፡ አንደኛ ውሃ ይሞላል፡፡ ሁለተኛ ውሃ ቀለም ባይኖረውም ውሃው ጥቁር ነገር ያሳያል፡፡ ሦስተኛ ደግሞ እዚህ አካባቢ ላይ ችግኞች ይበቅላሉ፤ ዝናብ ሲጥል ጎርፍ የተለያዩ ቆሻሻዎችን ለምሳሌ፣ እንጨት፣ ፕላስቲክ፣ አሸዋ ይዞ በመምጣት ይበከላቸዋል፡፡ ሌላው ደግሞ የውሃ ከፍታ ይጨምራል፡ ፡ ስለዚህ በወቅቱ ሁኔታ አካባቢው የተለያየ ባህሪ ይታይበታል፡፡ ግን በብዛት በጋ ላይ በሚኖረው ውሃ ህብረተሰቡ ልብስ ለማጠብ ይጠቀምበታል፡፡ አሸዋ በማውጣትም ይጠቀሙበታል፡፡ በዚህ ሦስት ዓመት ውስጥ ያሉት የአካባቢው ባህሪያት እነዚህ ናቸው፡፡ ውሃው ጥቅም አለው፤ ግን ከፋብሪካ የሚለቀቁ ኬሚካሎች ይበክሉታል፡፡ ይኼ ነው ችግሩ፡፡ ኬሚካሉ ካልተለቀቀ ግን ውሃውን እንጠጣው ነበር፡፡ ነገር ግን አልፎ አልፎ ኬሚካል ይጨምሩበታል፡፡ ውሃው ቆሻሻ እየሆነ ጥራቱ እየተበከለ መጣ፡፡

ጥያቄ፡- ከበፊት ጀምሮ የዝናቡ መጠን ለውጥ አለው?

ምላሽ፡- አዎ፤ ከዝናቡ አንጻር ለውጥ አለ፡፡ አሁን እና የድሮው ለውጥ አለው፡፡ ለውጡ፣ አንደኛ የወንዙ ስፋት ይሄን ያህል አልነበረም በፊት፣ ሁለተኛ ወንዙ በጣም ሲሞላ የወንዙ መጠን ስፋት በጣም ጠባብ ስለሆነ ውሃው ከወንዙ ወጥቶ ወደሕጎብረተሰቡ ይደርሳል፡፡ በፊት ውሃው ከወንዝ ወጥቶ ወደሰዎች ይደርስ ነበር፤ አሁን ግን ወንዙ ሰፍቷል፡፡ ሌላው፣ በፊት በወንዙ አካባቢ የሚታዩት ችግኞች ብዙ አልነበሩም፡፡ ከዚህ በፊት ወንዙን ለማስተካከል ወንዙ አካባቢ ሥራ ሲሰሩ የነበሩ አንድ ቻይናዊና ሁለት ኢትዮጵያዊያን ህይዎታቸው አልፏል፡ ፡

ጥያቄ፡- በፊት እና አሁን ላይ የውሃ ጥራቱስ ምን ይመስላል?

ምላሽ፡- ጥራቱ ከድሮው አሁን ይሻላል፡፡ ድሮ ዝናብ ሲዘንብ እና ጎርፉ ሲመጣ ውሃው ሽታ ነበረው፡፡ አሁን ግን የውሃው ሽታ ቀንሷል፡፡ በርግጥ ወንዙ ሲሰፋ የውሃውን ሽታ አምቆ ይዞት ይሆናል እንጂ፣ ውሃው ንጹህ ነው ወይም ጥራት አለው ማለት አይቻልም፡፡

ጥያቄ፡- በፊት እና አሁን ላይ ካስተዋሉት ነገር ተነስተው የዝናብ መጠን በበጋ እና በክረምት ያለውን ልዩነት እንዴት ይገልጹታል?

ምላሽ፡- የዝናቡ መጠን ከድሮው አሁን ይሞላል፡፡ ግን ወንዙ ከሰፋ በኋላ የውሃው መጠን ቀንሷል፡፡ የወንዙ ድምጽም ብዙ አይሰማም፡፡ ዝናቡ አሁን ላይ ቀንሷል፡፡ በየዓመቱ የዝናቡ መጠን እየቀነሰ ነው የሚሄደው፡፡ የዝናቡ ሁኔታ አንደድሮው አይደለም፡፡

ጥያቄ፡- የወንዙን ውሃ በፊት እና አሁን ላይ ለምን ለምን አገልግሎት ይጠቀሙበታል?

ምላሽ፡- ድሮ ችግኝ ያጠጡበታል፤ አሁን ላይ ግን ትውታል፡፡ ሌላው ድሮ ገላን ለመታጠብ እና ልብስ ለማጠብ የወንዙን ውሃ ይጠቀሙበት ነበር፡፡ አሁን ላይ ግን ውሃው ቀንሷል፡፡ አሁን ላይ ያልቀነሰው ከአካባቢው ማገዶ እንጨት መልቀምና ከወንዙ አሸዋ ማውጣት ብቻ ነው፡፡ ከውሃው ጥራት የተነሳ አሁን ላይ በወንዙ ውሃ ችግኝ ማጠጣት፣ ገላ መታጠብና ልብስ ማጠብ ቀንሷል፡፡

ጥያቄ፡- እዚህ አካባቢ ያለው የውሃ አቅርቦት እና ፍላጎት ምን ይመስላል?

ምላሽ፡- የወንዝ ውሃ አለ፡፡ ሌላ የቧንቧ ውሃ ግን በጣም እጥረት አለ፡፡ አሁን ላይ እኛ አካባቢ ከፍተኛ የውሃ እጥረት አለ፤ በዓመት ውስጥ በሳምንት አንድ ጊዜ ሐሙስ ቀን ነው ውሃ የምናገኘው፡፡ ይሄንንም ሰው ቀኑን ሙሉ ተሰልፎ ነው የሚያገኘው፡፡ በፊት ግን በየቀኑ ነበር ውሃ የምናገኘው፡፡

ጥያቄ፡- የውሃው ጥራትስ ምን ይመስላል?

ምላሽ፡- ውሃው ጥራት የለውም፡፡ በተለይ ገና ሲመጣ ውሃው ጣዕሙ አፈር አፈር ይላል፡፡ በኋላ ላይ እየቆየ እየተሻለ ይሄዳል፡
:

ጥያቄ፡- በውሃ አጠቃቀም ሁሉም የአዲስ አበባ አካባቢ እኩል ተደራሽ ነው ብለው ያስባሉ?

ምላሽ፡- እኩል ተደራሽ አይደለም፡፡ ለምሳሌ፣ ቦኖ ውሃ የሚጠቀም እና ቤት ውስጥ ቧንቧ ያለው እኩል አይጠቀምም፡፡ ቢያስን ከመቶ እስከሁለት መቶ ሰው የቦኖ ውሃ ይጠቀማል፡፡ ውሃ ለማግኘትም ይሰለፋል፡፡

ጥያቄ፡- ውሃው ወደቤት የሚመጣበት እና ወደቦኖ የሚለቀቅበት ጊዜ ይለያያል?

ምላሽ፡- አይለያይም፤ እኩል ነው፡፡

ጥያቄ፡- በአካባቢያችሁ የውሃ እጥረት ወይም የጎርፍ ችግር ሲያጋጥማችሁ ማኅበረሰቡ የሚወስደው መፍትሄ አለ?

ምላሽ፡- አንደኛ፣ ውሃ ሲለቀቅ ጎብረተሰቡ በተለያየ ዕቃ ቀድቶ ያስቀምጣል፡፡ ሁለተኛ፣ ውሃ እጥረት ሲያጋጥም ፍለጋ ይሄዳል፡፡ ለምሳሌ፣ እኔ አንድ ጀሪካ በአምስት ብር ገዝቼ በበጃጅ ውሃ አምጥቼ አውቃለሁ፡፡ የውሃ እጥረት ሲያጋጥም ማኅበረሰቡ ከርቀት ቦታ ውሃ በመግዛት ያመጣል፡፡ ከዚህ ውጭ ውሃ እጥረት ቢያጋጥም ማህበረሰቡ ያገኘውን ውሃ ለሌላ አያጋራም፡፡

ጥያቄ፡- ሌላ ያልተነሳና የሚጨምሩት ሐሳብ ካለዎት?

ምላሽ፡- የምርምር ስራችሁ ጥሩ ነው ቀጥሉበት፡፡ እዘህ አካባቢ ያለው ቆሻሻ ውሃ በተሻለ ቴክኖሎጂ ወደንጹህነት ተቀይሮ ለእኔም፣ ለማኅበረሰቡም፣ ለሀገሪቱም ጠቃሚ እንዲሆንና የውሃ ችግር እንዳይኖር ተስፋ አደርጋለሁ፡፡

አመሰግናለሁ!

C.19 Community interview 9 [English]

Question: Since you are a resident of this area while living here, what are the general changes you have observed in the area's land condition, river, rainfall and water supply and use?

Response: The River has no width. It was like this before and it is like this now. There used to be a bridge. Now it's three.

Question: Is the width of the river the same before and after the construction of the bridges?

Response: Since they have moved the bridges away, they have done a little bit of narrowing now. The size inside is still not a crack before.

Question: Were the trees on the banks of the river the same before and now?

Response: They are not the same. Before, all the banks of the river were forest. They were not so stripped. But now the trees have been cut down while the bridge is being built. As you can see, the forest is stripped. It was not like this before. The tree was all the way to the river's edge. Before, there was a very dense tree in the area.

Question: Who cut down the trees?

Response: It is called the government. People around here don't touch trees; In fact, the local community used to go into the forest and cut wood. But now a guard has been assigned; It is not possible to go into the forest and collect wood.

Question: Did the river water grow vegetables?

Response: It was not long ago. Before there were trees, it was not suitable for planting or sowing. But now that the trees have been cut down and the area is a little wider, there is now more space for vegetable production than before.

Question: What is the water quality of the river before and now?

Response: The water was not polluted before. It is now polluted. At present, the water is polluted due to the discharge of sewage from many places. Before, it was for drainage, so the water did not flow. At present, the water is dirty, so the community does not use it for washing clothes. But they used it before. No one is using the water now. First, the water smells. Second, it's not clean.

Question: What is the condition of the rain?

Response: The rain is the same as before. This year is the same. It makes no difference in my opinion.

Question: What is the flood situation like?

Response: There is not much flood at present. Last year it did some damage. But this winter there is no flood. Since no water has been released from ‹‹Legedadi››, there is not much flooding. But before that there was a heavy flood. But this year's flood is much less than before.

Question: When you live in this area, what do you say is difficult about water?

Response: The water is nothing but the flood. It was the flood release that was a little troublesome. But now there is improvement. The water of the river is not used for washing clothes or for drinking, as various wastes are released, including from factories. It is used for sand extraction and vegetable cultivation.

Question: In addition to the river, what are the water problems in this area?

Response: Before, there was no tap water. But now, it doesn't much time. There is no too much problem with drinking water. We use tap water at home. All local communities also have plumbing.

Question: Do you get water supply every day?

Response: Yes. There is water. There is no problem with water supply, except for the occasional loss. If it is lost, it is one day a week. Beyond that there is water.

Question: Do you have any additional thoughts regarding water issues in the area?

Response: I have nothing different from what I have said so far. There is not much water supply problem in this area. A dam has been built around the river, so we are not afraid that floods will harm us. In any direction, there was a flood. But not now.

Question: Who built the flood protection for you?

Response: The dam was built after the community contributed money and money was collected from the community.

Question: If you have any other suggestions that have not been raised?

Response: In the past, some thieves used to steal materials used for the construction of the dam under the cover of trees. But after the trees have sprouted, there aren't many. Because the river fills with silt, it is often very difficult to measure the level of water entering the river.

Thank you!

C.20 Community interview 9 [Amharic]

ጥያቄ፡- እርስዎ እዚሁ አካባቢ ነዋሪ ነዎት፡፡ እዚህ አካባቢ ሲኖሩ አጠቃላይ ስለአካባቢው የመሬት ሁኔታ፣ ወንዝ፣ ዝናብ እንዲሁም የነበረው የውሃ አቅርቦት እና አጠቃቀም ላይ የተመለከቷቸው ለውጦች ምን ምን ናቸው?

ምላሽ፡- ወንዙ ስፋት የለውም፡፡ በፊትም እንደዚህ ነበር አሁንም አንደዚሁ ነው፡፡ ድሮ አንድ ድልድይ ነበር ያለው፤ አሁን ሦስት ሆኗል፡፡

ጥያቄ፡- የወንዙ ስፋት ድልድዮቹ ከመሰራታቸው በፊትና ከተሰሩ በኋላ አንድ ዓይነት ነው?

ምላሽ፡- ድልድዮችን አራርቀው ስለነበር የሰሩት ብዙም ባይሆን አሁን ላይ ትንሽ የመጥበብ ሁኔታ አለው፡፡ ወደውስጥ ያለው መጠን በፊትም አሁንም ስምጥ አይደለም፡፡

ጥያቄ፡- በወንዙ ዳርቻ ያሉት ዛፎች በፊትና አሁን አንድ ዓይነት ነበሩ?

ምላሽ፡- አንድ ዓይነት አይደሉም፡፡ በፊት ሁሉም የወንዙ ዳርቻ ደን ነበር፤ እንደዚህ አልተመናመነም ነበር፡፡ አሁን ግን ድልድዩ ሲሰራ ዛፎቹ ተቆርጠዋል፡፡ ደን የነበረውም ተመናምኗል ማለት ነው እንደምታየው፡፡ በፊት እንደዚህ አልነበረም፤ ዛፉ እስከወንዙ ጫፍ ድረስ ነበር፡፡ በፊት በአካባቢው በጣም ጥቅጥቅ ያለ ዛፍ ነበር፡፡

ጥያቄ፡- ማነው ዛፎችን የቆረጣቸው?

ምላሽ፡- *መንግሥት* ነው ይባላል፡፡ እዚህ አካባቢ ያለው ሰው ዛፎችን አይነካም፤ እንደውም የአካባቢው ማኅበረሰብ ወደጫካው ገብቶ አንጨት ይለቅም ነበር፡፡ አሁን ግን ጠባቂ ተመድቧል፤ ወደጫካው ውስጥ ገብቶ እንጨት መልቀም አይቻልም፡፡

ጥያቄ፡- በወንዙ ውሃ አትክልት ይለማ ነበር?

ምላሽ፡- ብዙ ባይሆንም በፊት ነበር፡፡ በፊት ዛፎቹ ስለነበሩ ለመትከልም፣ ለመዝራትም ምንም አይመችም ነበር፡፡ አሁን ግን ዛፎቹ ስለተቆረጡና ቦታው ትንሽ ሰፋ ስላለ ከበፊቱ አሁን ላይ ለአትክልት ማምረቻ ሰፋ ያለ ቦታ አለ፡፡

ጥያቄ፡- የወንዙ ውሃ ጥራት በፊት እና አሁን ላይ ምን ይመስላል?

ምላሽ፡- በፊት ውሃው እንደዚህ ድፍርስ አልነበረም፡፡ አሁን ላይ ነው የደፈረሰው፡፡ አሁን ላይ ከብዙ ቦታ ፍሳሽ ስለሚለቀቅ ውሃው ተበላሽቷል፡፡ በፊት ለፍሳሽ ቦይ ስለነበር ውሃው አይደፈርስም ነበር፡፡ አሁን ላይ ውሃው ቆሻሻ ስለሆነ ማኅበረሰቡ ለልብስ ማጠቢያነት አይጠቀሙትም፤ በፊት ግን ይጠቀሙት ነበር፡፡ አሁን ላይ ውሃውን የሚጠቀመው የለም፡፡ አንደኛ ውሃው ይሸታል፤ ሁለተኛ ንጹህ አይደለም፡፡

ጥያቄ፡- የዝናቡ ሁኔታስ ምን ይመስላል?

ምላሽ፡- ዝናቡ ድሮም ያው ነው፤ ዘንድሮም ያው ነው፡፡ በእኔ ዕይታ ልዩነት የለውም፡፡

ጥያቄ፡- የጎርፍ ሁኔታስ ምን ይመስላል?

ምላሽ፡- አሁን ላይ ጎርፍ ብዙ የለም፡፡ ባለፈው ዓመት የተወሰነ ጉዳት አድርሶ ነበር፡፡ በዘንድሮው ክረምት ግን ጎርፍ የለም፡፡ ከለገዳዲም ውሃ ስላልተለቀቀ ብዙም ጎርፍ የለም፡፡ በፊት ግን ጎርፍ በከፍተኛ ሁኔታ ነበር፡፡ ነገር ግን የዘንድሮው ጎርፍ ከበፊቱ በጣም የቀነሰ ነው፡፡

ጥያቄ፡- እዚህ አካባቢ ሲኖሩ በውሃ ጉዳይ አስቸጋሪ የሚሉት ነገር ምንድን ነው?

ምላሽ፡- ውሃው ጎርፍነቱ እንጂ ሌላ የሚያስቸግር ነገር የለውም፡፡ ጎርፍ የሚለቀቀው ነገር ነበር ትንሽ ያስቸግር የነበረው፡፡ አሁን ግን የመሻሻል ነገር አለ፡፡ የወንዙ ውሃ የፋብሪካዎችን ጨምሮ የተለያዩ ቆሻሻዎች ስለሚለቀቁበት ለልብስ

ማጠብም ሆነ ለመጠጥ አገልግሎት ላይ አይውልም፡፡ አሸዋ ለማውጣት እና ለአትክልት ልማት ነው አገልግሎት ላይ የሚውለው፡፡

ጥያቄ፡- እዚህ አካባቢ ከወንዙ በተጨማሪ የተመለከቱት የውሃ ችግር ምንድን ነው?

ምላሽ፡- በፊት የቧንቧ ውሃ ይጠፋ ነበር፡፡ አሁን ግን ብዙ ጊዜ አይጠፋም፡፡ ብዙም የሚጠጣ ውሃ ችግር የለም፡፡ ውሃ የምንጠቀመው በቤት ቧንቧ ነው፡፡ ሁሉም የአካባቢው ማኅበረሰብም የቧንቧ አላቸው፡፡

ጥያቄ፡- በየቀኑ የውሃ አቅርቦት ታገኛላችሁ?

ምላሽ፡- አዎ፤ አለ፡፡ አልፎ አልፎ ቢጠፋ እንጂ የውሃ አቅርቦት ችግር የለም፡፡ ቢጠፋ በሳምንት አንድ ቀን ነው፤ ከዚያ ውጪ ውሃ አለ፡፡

ጥያቄ፡- በአካባቢው የውሃ ጉዳይን በተመለከተ የሚናገሩት ተጨማሪ ሐሳብ አለዎት?

ምላሽ፡- እስካሁን ከተናገርኩት የተለየ ነገር የለኝም፡፡ እዚህ አካባቢ ብዙም የውሃ አቅርቦት ችግር የለም፡፡ በወንዙ ዙሪያም ግድብ ስለተሰራ ጎርፍ ጉዳት ያደርስብናል ብለን አንሰጋም፡፡ ወደየትኛውም አቅጣጫ በፊት ጎርፍ ይገባ ነበር፤ አሁን ላይ ግን አይገባም፡፡

ጥያቄ፡- ጎርፍ መከላከያውን ማን ነው የሰራላችሁ?

ምላሽ፡- ኅብረሰተቡ ብር አዋጥቶ፣ ከኅብረተሰቡ ብር ተሰብስቦ ነው ግድቡ የተሰራው፡፡

ጥያቄ፡- ሌላ ያልተነሳና የሚጨምሩት ሐሳብ ካለዎት?

ምላሽ፡- በፊት አንዳንድ ሌባ ሰዎች ዛፎችን ሸፋን አድርገው ለግድቡ መስሪያ አገልግሎት ላይ የሚውሉ ቁሳቁሶችን ይሰርቁ ነበር፡፡ ዛፎቹ ከተመነጠሩ በኋላ ግን ብዙም የሉም፡፡ ወንዙ ደለል ስለሚሞላ ብዙ ጊዜ የውሃ መጠኑን ወንዝ ገብቶ ለመለካት እጅግ አስቸጋሪ ነው፡፡

አመሰግናለሁ!

C.21 Community interview 10 [English]

Question: since you a resident of this area while living here, what are the general changes you have observed in the area's land condition, river, rainfall and water supply and use?

Response: The rainfall does not vary. The rain is the same as before. When it rains before, it rains. It is raining at the same rate as before. It is raining not far away. The month when the winter rains start varies from year to year. In the past, rains did not start like we do now. It was around April that the winter rains started. But now it's around February. It is different in this regard.

Question: What is the change in the use of the land?

Response: This is how the farmers work. But the river was not so high. They used to sow ‹‹Teff›› on it. But now in winter, nothing can be done because the water is overflowing. Cabbage, on the other hand, works twice as well until March. After that it will be terminated. Because the water will fill up and destroy what they have done.

Question: What kind of change has there been from before and now?

Response: The flood has now risen. Now the flood has increased. Also, the river, which used to be high and narrow, is now much deeper and wider. The land is being eaten away.

Question: Since when did the farmers stop producing ‹‹Teff›› ?

Response: Seven or eight years ago.

Question: When to plant cabbage? When will it be collected?

Response: It is sown around the middle of September and harvested three months later in January. The second round of production will arrive by June.

Question: What is the water quality of the river before and now?

Response: It's getting very dirty now. This is where we used to swim before. It was getting very dirty now. The water is contaminated with chemicals. If you touch the water to cross the river, it will cut your body.

Question: When did you stop swimming?

Response: We stopped swimming five years ago. Our reason is that the water is spoiled.

Question: When you live in this area, what do you say is difficult about water, especially floods?

Response: The flood problem is destroying the farmers' land. When there is a flood, it makes a farmer who used to produce twice a year to produce only once. The farmers are afraid of the flood and stop sowing. Floods are especially dangerous in March. It also threatens the farmers.

Question: Why does the community use the water of the river in this area?

Response: To grow vegetables and water cattle. They are not used for drinking. It is used for house building or work.

Question: Apart from the river water, tell us about the supply of drinking water in your area.

Response: We use drinking water from faraway places. There is an area called hot water. It is then fetched and presented being loaded on a donkey. The water is hot water. For example, if it is fetched in the morning, it will be cold by about seven o'clock in the afternoon. After that we use it for drinking. No other bono water. Bono water can be brought by cart if required. There are carts ready to fetch water. You can pay for them and import them. A jug of water costs twelve Birr.

Question: Do you fetch the water from the spring?

Response: Yes. It is hot water. We pay two Birr per jug (Jerika). We pay Birr to the water keeper employed by the water development. If we are caught drawing water or taking a shower from the spring without paying, the higher body will punish the guard. And the society is paying two birr.

Question: Do you have any additional thoughts regarding water issues in the area?

Response: There is no bono or piped potable water in the area. There is no health center. There is no youth center. Young people hang out in different places. We asked bono to make potable water for us. A well is said to be being dug; but it has been too long. It was two years ago.

Question: When the society is in trouble with water, what solution do you take?

Response: We fetch water every day. And when it's over, we'll fetch again. We fetch water with different water storing materials. In the past there was spring water. Everyone is recording for themselves.

Question: If there is a flood, what solution will you take in the summer of the community?

Response: When a flood occurs, the community works together to protect it. Everyone tries to prevent flooding by building a terrace or earth dam around their house. Nothing has been done to protect the remaining land from flooding. Every year during the winter months, the flood erodes the land. A scavenger machine will come and fill it with soil once. Floods in the home area damaged the roads, but not reach the home.

Question: If you have any other suggestions that have not been raised?

Response: There is no health center in this area; there is no road. Especially when winter comes, road issue is very difficult.

Thank you!

C.22 Community interview 10 [Amharic]

ጥያቄ፡- እርስዎ እዚሁ አካባቢ ነዋሪ ነዎት፡፡ እዚህ አካባቢ ሲኖሩ አጠቃላይ ስለአካባቢው የመሬት ሁኔታ፣ ወንዝ፣ ዝናብ እንዲሁም የነበረው የውሃ አቅርቦት እና አጠቃቀም ላይ የተመለከቷቸው ለውጦች ምን ምን ናቸው?

ምላሽ፡- ዝናቡ ብዙ የተራራቀ ለውጥ የለውም፡፡ ዝናቡ እንደበፊቱ ነው፡፡ በፊት በሚዘንብበት ወቅት ይዘንባል፡፡ እንደበፊቱ ተመጣጣኝ የሆነ ዝናብ ነው የሚዘንበው፡፡ ብዙም ያልተራራቀ ዝናብ ነው የሚዘን ነው፡፡ የክረምቱ ዝናብ የሚጀምርበት ወር ግን ከዓመት ዓመት ይለያያል፡፡ ድሮ ዝናብ አሁን ባለንበት ወቅት አይጀምርም ነበር፡፡ በፊት ሚያዝያ ወር አካባቢ ነበር የክረምቱ ዝናብ የሚጀምረው፤ አሁን ላይ ግን ወደየካቲት አካባቢ ነው፡፡ በዚህ ረገድ ልዩነት አለው፡፡

ጥያቄ፡- የመሬቱ አጠቃቀም ላይ ያለው ለውጥስ ምን ይመስላል?

ምላሽ፡- አርሶ አደሮቹ የሚሰሩት እንደዚሁ ነው፡፡ ነገር ግን ወንዙ የዚህን ያህል ከፍታ አልነበረውም፡፡ ድሮ ጤፍ ይዘሩበት ነበር፡፡ አሁን ክረምት ላይ ግን ውሃው ሞልቶ ስለሚፈስ ምንም ማድረግ አይቻልም፡፡ የጎመን አትክልት ግን እስከመጋቢት ወር ድረስ ሁለት ጊዜ የሚያደርስ ሰው ይሰራል፡፡ ከዚያ በኋላ ይቋረጣል፡፡ ምክንያቱም ውሃው ይሞላና የሰሩትን ስለሚያጠፋባቸው ነው፡፡

ጥያቄ፡- ጎርፍ ከድሮና ከአሁኑ ምን ዓይነት ለውጥ ነው ያለው?

ምላሽ፡- ጎርፉ አሁን ከፍ ብሏል፡፡ አሁን ላይ ጎርፉ ጨምሯል፡፡ በተጨማሪም ድር ከፍ ያለ እና ጠባብ የነበረው ወንዝ አሁን ግን በጣም ወደታች የገባ እና ሰፊ ሆኗል፡፡ መሬቱ በጣም እየተበላ ነው፡፡

ጥያቄ፡- አርሶ አደሮች የጤፍ ምርት ማምረት ያቆሙት ከመቼ ጀምሮ ነው?

ምላሽ፡- ከዛሬ ሰባት ወይም ስምንት ዓመት በፊት ነው፡፡

ጥያቄ፡- ጎመን መቼ ነው የሚዘራው? መቼስ ይሰበሰባል?

ምላሽ፡- መስከረም ወር ኢጋማሽ አካባቢ ይዘራና ከሦስት ወር በኋላ ጥር ላይ ይሰበሰባል፡፡ ሁለተኛው ዙር ምርት እስከሰኔ ወር ይደርሳል፡፡

ጥያቄ፡- የወንዙ ውሃ ጥራት በፊት እና አሁን ላይ ምን ይመስላል?

ምላሽ፡- አሁን ላይ በጣም እየቆሸሸ መጣ፡፡ በፊት እኛም እዚሁ ነው ውሃ ዋና የለመድነው፡፡ አሁን በጣም እየቆሸሸ መጣ፡፡ ውሃው በኬሚካል ተበክሏል፡፡ ወንዙን ለመሻገር ውሃውን ከነካኸው ሰውነትህን ይቆራርጠዋል፡፡

ጥያቄ፡- ውሃ ዋና ያቆማችሁት መቼ ነው?

ምላሽ፡- ከአምስት ዓመት በፊት ነው መዋኘት ያቆምነው፡፡ ምክንያታችንም ውሃው ስለተበላሸ ነው፡፡

ጥያቄ፡- እዚህ አካባቢ ሲኖሩ በውሃ ጉዳይ በተለይ በጎርፍ አስቸጋሪ የሚሉት ነገር ምንድን ነው?

ምላሽ፡- የጎርፍ ችግሩ፣ የአርሶ አደሩን መሬት እየቆረሰው መጣ፡፡ ጎርፍ ሲኖር በዓመት ሁለት ጊዜ ያመርት የነበረን ገበሬ አንድ ጊዜ ብቻ እንዲያመርት ያደርጋል፡፡ አርሶ አደሩም ጎርፉን ፈርቶ መዝራት ያቆማል፡፡ በተለይ መጋቢት ወር ላይ ጎርፍ ያሰጋል፡፡ አርሶ አደሩንም ያሰጋል፡፡

ጥያቄ፡- እዚህ አካባቢ የወንዙን ውሃ ማጎበረሰቡ ለምን ለምን አገልግሎት ይጠቀምበታል?

ምላሽ፡- አትክልትን ለማሳደግ እና ከብቶችን ውሃ ለማጠጣት ነው፡፡ ለመጠጥ አይጠቀሙም፡፡ ለቤት ግንባታ ወይም መስሪያ ግን አገልግሎት ላይ ይውላል፡፡

ጥያቄ፡- ከወንዙ ውሃ ውጪ በአካባቢያችሁ ከመጠጥ ውሃ አቅርቦት ጋር ስላለው ነገር ይግለጹልን፡፡

ምላሽ፡- የመጠጥ ውሃ ከሩቅ ቦታ ነው የምንጠቀመው፡፡ ፍል ውሃ የሚባል አካባቢ አለ፤ ከዚያ ተቀድቶ በአህያ እየተጫነ ነው የሚቀርበው፡፡ ውሃው ፍል ውሃ ነው፡፡ ለምሳሌ፣ ጧት ላይ ተቀድቶ ከመጣ ከቀኑ ወደሰባት ሰዓት አካባቢ ይቀዘቅዛል፡፡ ከዚያ በኋላ ለመጠጥ እንጠቀማለን፡፡ ሌላ የቦኖ ውሃ የለም፡፡ የቦኖ ውሃ ከተፈለገ በጋሪ ማምጣት ይቻላል፡፡ ውሃ ለመቅዳት የተዘጋጁ ጋሪዎች አሉ፡፡ ለእነሱ ብር ከፍለህ ማስመጣት ትችላለህ፡፡ አንድ ጀሪካ ውሃ የሚዛው አስራ ሁለት ብር ነው፡፡

ጥያቄ፡- ውሃውን ከምንጭ ነው የምትቀዱት?

ምላሽ፡- አዎ፤ ፍል ውሃ ነው፡፡ በአንድ ጀሪካ ሁለት ብር እንከፍላለን፡፡ በውሃ ልማት ለተቀጠረው ውሃ ጠባቂ ግለሰብ ነው ብር የምንከፍለው፡፡ ሳንከፍል ውሃ ብንቀዳ ወይም ከምንጩ ሻወር ስንወስድ ከተገኘ ከበላይ አካል በጥቢቃው ላይ ቅጣት ያስተላልፍበታል፡፡ እናም ጎብረተሰቡ ሁለት ብር እየከፈለ ይቀዳል፡፡

ጥያቄ፡- በአካባቢው የውሃ ጉዳይን በተመለከተ የሚናገሩት ተጨማሪ ሐሳብ አለዎት?

ምላሽ፡- በአካባቢው የቦኖም ሆነ የቧንቧ የመጠጥ ውሃ የለም፡፡ ጤና ኬላ የለም፡፡ የወጣቶች ማዕከል የለም፤ ወጣቶች አልባሌ ቦታ ነው የሚውሉት፡፡ የቦኖ መጠጥ ውሃ እንዲሰራልን አመልክተን ነበር፡፡ ጉድጓድ እየተቆፈረ ነው ተብሏል፤ ግን በጣም ቆይቷል፤ ከሁለት ዓመት በፊት የነበረ ነው፡፡

ጥያቄ፡- ጎብረተሰቡ በውሃ ሲቸገር ምን መፍትሔ ትወስዳላችሁ?

ምላሽ፡- በየቀኑ ውሃ እንቀዳለን፡፡ ሲያልቅ ደግሞ በድጋሜ እንቀዳለን፡፡ በተለያዩ የውሃ መቅጃ ቁሶች ውሃ እንቀዳለን፡፡ ድሮ የምንጭ ውሃ ነበር፡፡ ሁሉም ለየራሱ እየቀዳ ነው የሚጠቀመው፡፡

ጥያቄ፡- ጎርፍ ቢከሰት በማጎበረሰቡ በጋ ምን መፍትሄ ትወስዳላችሁ?

ምላሽ፡- ጎርፍ ሲከሰት ማጎበረሰቡ በመተባበር ይከላከላል፡፡ ሁሉም በየቤቱ አካባቢ እርከን ወይም የአፈር ግድብ እየሰራ ጎርፍን ለመከላከል ጥረት ያደርጋል፡፡ በተረፈ መሬቱን ከጎርፍ ለመከላከል የተደረገ ነገር የለም፡፡ በየዓመቱ ክረምት ወራት ላይ ጎርፉ መሬቱን ይሸረሽረዋል፡፡ ስካባተር ማሽን ይመጣና ለአንድ ጊዜ አፈር ይሞላዋል፡፡ የቤት አካባቢው ጎርፍ መንገድ ነው የሚጎዳው፤ ወደቤት አይደርስም፡፡

ጥያቄ፡- ሌላ ያልተነሳና የሚጨምሩት ሐሳብ ካለዎት?

ምላሽ፡- በዚህ አካባቢ ጤና ጣቢያ የለም፤ መንገድ የለም፡፡ በተለይ ክረምት ሲመጣ የመንገድ ጉዳይ እጅግ አስቸጋሪ ነው፡፡

አመሰግናለሁ!

C.23 Community interview 11 [English]

Question: What have been the water changes since you came to this area?

Response: Before there was a change, now the water has decreased a lot. There is no water. In winter, this area was covered with water. And his side was clothed with water. There is no water for three or four years now. Water is running low.

Question: Does the land use along the river have changed before and now?

Response: It is the same. It is the same. It is so. No tree is planted. Only two acacia trees have sprouted after I came here. It all happened before. Nothing new. When we lived around here, other people tell us that you are in danger of flooding. It was nothing. Still there is not.

Question: What does the water quality of the river look like before and now?

Response: Now it's muddy. It was good before. As soon as I came to this area, I used to prepare local drink ‹‹Tella/ጠላ›› by the river water and sell it. Now their bath is here. Washing their clothes is above. It just stayed there, dirty.

Question: How many years have you stopped using the river water?

Response: It will be about five years. We saw people bathing in it. We stopped there where there was garbage.

Question: Why do the communities use the river water now?

Response: They wash themselves. They wash their clothes. That dirt has covered the river.

Question: Does the nature of rain change in winter and summer?

Response: There is no rain like before. Especially for the last four years there has been no rain. It was raining heavily before.

Question: What is the flood situation like?

Response: It was before, but now there is no flood. Before, the flood was filling up to the opening of the bridge. It's been four, five years now.

Question: Where does the community get drinking water apart from the river?

Response: We are using it while shopping. Now that it's broken this week, there's running water in the homes of those who have piped it in. We are buying a jug for three birr and we are using it. Bono water is not available here. Bono water is far away. So there is a huge water problem. It is very unfortunate to have trouble with water, which is a national product. We can fetch water two days a week if we pay.

Question: What would you say is difficult about living here?

Response: Our problem is water and electricity.

Question: When there is a water problem in this area what will be the solution you taking?

Response: When we ask, they tell us that you are not a native of this area. However, we make dam and drink potable water in the river. This is the solution we have taken. We do this together. The drinking water is also available for everyone. The water is filtered through sand.

Question: If you have any other suggestions that have not been raised?

Response: Our pressing problem is water and electricity. We have no other problem.

Thank you!

C.24 Community interview 11 [Amharic]

ጥያቄ፡- እርስዎ ወደዚህ አካባቢ ከመጡ በኋላ የውሃ ለውጦች ምን ምን ናቸው?

ምላሽ፡- ለውጥ ነበረው በፊት አሁን ላይ ውሃ በጣም ቀንሷል፡፡ ውሃ የለም፡፡ ክረምት ላይ ይህ አካባቢ ሜዳው ሁሉ በውሃ ይሸፈን ነበር፡፡ ጎራውም ውሃ ይለብስ ነበር፡፡ አሁን ላይ ሦስት ዓመት አራት ዓመት ሊሆን ነው ውሃ የለም፡፡ ውሃ በጣም እየቀነሰ ነው፡፡

ጥያቄ፡- በወንዙ ዳርቻ ያለው የመሬት አጠቃቀም በፊት እና አሁን ላይ ለውጥ አለው?

ምላሽ፡- ያው ነው፡፡ ያው እንደዚሁ ነው፤ እንደዚሁ ነው፡፡ የተተከለም ዛፍ የለም፡፡ ሁለት የግራር ዛፎች ብቻ እኔ ወደዚህ አካባቢ ከመጣሁ በኋላ ነው በወፍ ዘራሽ የበቀሉት፡፡ ሁሉም በፊት የነበረ ነው፡፡ አዲስ ነገር የለም፡፡ እዚህ አካባቢ ስንኖር ሌሎች ሰዎች የጎርፍ አደጋ ላይ ናችሁ ይለን ነበር፡፡ ምንም አልነበረም፤ አሁንም የለም፡፡

ጥያቄ፡- የወንዙ የውሃ ጥራት በፊት እና አሁን ላይ ሲያዩት ምን ይመስላል?

ምላሽ፡- አሁን ድፍርስ ነው፡፡ በፊት ጥሩ ነበር፡፡ ወደዚህ አካባቢ እንደመጣሁ የወንዙን ውሃ ጠላ እየጠመቅኩ እሸጥበት ነበር፡፡ አሁን ገላቸውን መታጠቢያም እዚሁ ነው፡፡ ልብሳቸውን ማጠቢያም ከላይ ነው፡፡ በቃ በዚያው ቆሸሸ ቀረ፡፡

ጥያቄ፡- የወንዙን ውሃ መጠቀም ካቆማችሁ ስንት ዓመት ይሆናችኋል?

ምላሽ፡- አምስት ዓመት አካባቢ ይሆነናል፡፡ ሰዎች ሲታጠቡበት አየን፤ ቆሻሻም በዛበት በዚያው አቆምን፡፡

ጥያቄ፡- የአካባቢው ሰዎች አሁን ላይ የወንዙን ውሃ ለምን ለምን ይጠቀሙበታል?

ምላሽ፡- ገላቸውን ይታጠባሉ፡፡ ልብሳቸውን ያጥባሉ፡፡ ያ ቆሻሻ ወንዙን በክሎታል፡፡

ጥያቄ፡- በክረምት እና በበጋ የዝናቡ ባህሪ ይለወጣል?

ምላሽ፡- አሁን ላይ እንደድሮው ዝናብ የለም፡፡ በተለይ ያለፉትን አራት አመታት ዝናብ የለም፡፡ በፊት ከባድ ዝናብ ይጥል ነበር፡፡

ጥያቄ፡- የጎርፍ ሁኔታስ ምን ይመስላል?

ምላሽ፡- በፊት ነበር እንጂ፣ አሁን ላይ ጎርፍ የለም፡፡ በፊት የድልድዩ ቀዳዳ ድረስ ጎርፍ ይሞላ ነበር፡፡ አሁን አራት፣ አምስት ዓመት ሆኖታል፡፡

ጥያቄ፡- ማኅበረሰቡ ከወንዙ ውጪ ለመጠጥ ውሃ አገልግሎት የሚያገኘው ከየት ነው?

ምላሽ፡- እየዞርን እየገዛን ነው የምንጠቀመው፡፡ አሁን በዚህ ሳምንት ተበላሽቶ ነው እንጂ፣ ቧንቧ ውሃ ያስገቡ ሰዎች ቤት የቧንቧ ውሃ አለ፡፡ አንድ ጀሪካን ሶስት ብር እየገዛን ነው የምንጠቀመው፡፡ ቦኖ ውሃ ግን እዚህ አካባቢ የለም፡፡ የቦኖ ውሃ ሩቅ ቦታ ነው ያለው፡፡ ስለዚህ ከፍተኛ የውሃ ችግር አለ፡፡ የሀገር ምርት በሆነው ውሃ መቸገር እጅግ ያሳዝናል፡፡ ከፍለንም በሳምንት ሁለት ቀን ነው መቅዳት የምንችለው፡፡

ጥያቄ፡- እዚህ አካባቢ ሲኖሩ አስቸጋሪ የሚሉት ነገር ምንድን ነው?

ምላሽ፡- ችግራችን ውሃ እና መብራት ነው፡፡

ጥያቄ፡- እዚህ አካባቢ የውሃ ችግር ሲያጋጥም የሚወሰደው መፍትሄ ምንድን ነው?

ምላሽ፡- ስንጠይቅ የዚህ አካባቢ ተወላጅ አይደላችሁም ነው የሚሉን፡፡ ነገር ግን፣ ወንዙ ውስጥ ለመጠጥ የሚሆን ውሃ ገድበን እንጠጣለን፡፡ የወሰድነው መፍትሄ ይሄን ነው፡፡ ይሄን የምናደርገው በጋራ ነው፡፡ የመጠጥ ውሃው የሚያገለግለውም ለሁሉም ሰው ነው፡፡ ውሃው የሚጣራው በአሸዋ ነው፡፡

ጥያቄ፡- ሌላ ያልተነሳና የሚጨምሩት ሐሳብ ካለዎት?

ምላሽ፡- አንገብጋቢ ችግራችን ውሃ እና መብራት ነው፡፡ ሌላ ችግር የለንም፡፡

አመሰግናለሁ!

Appendix D. Visual data (observations)

Figure A3. Map showing locations and observation identification (ID) for each point of visual data collection

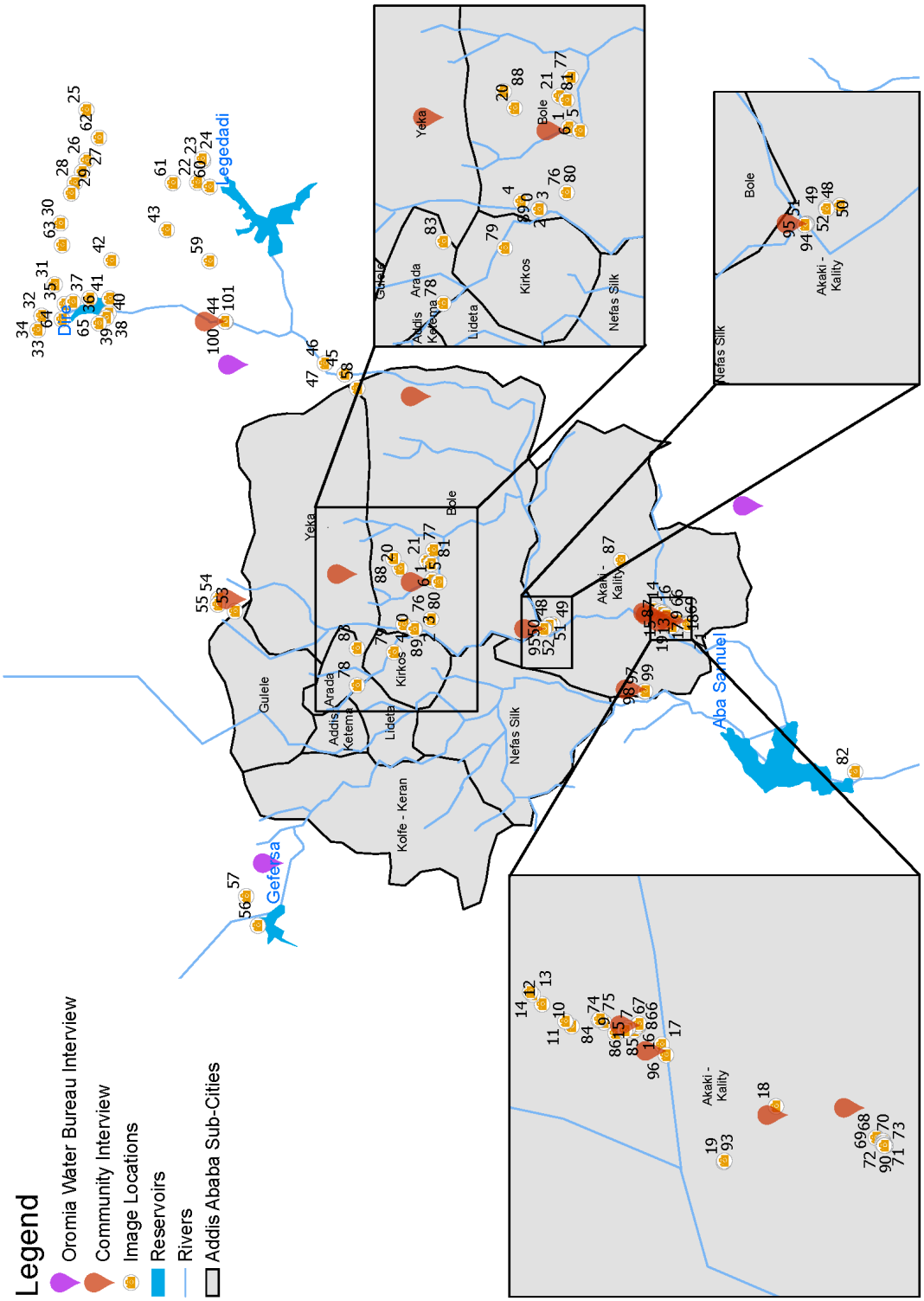
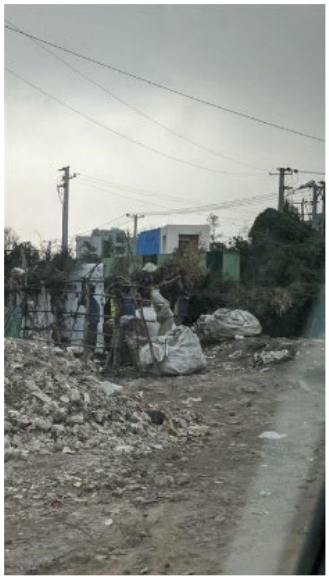
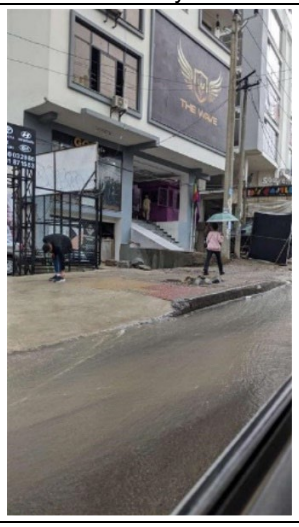
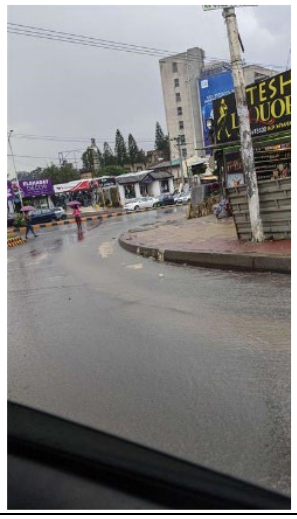
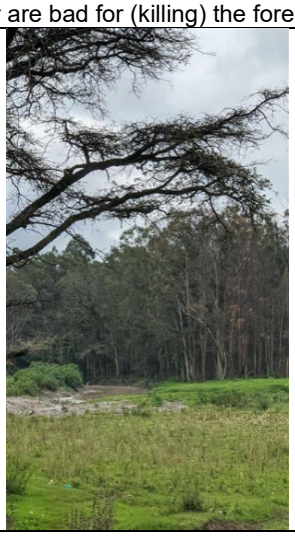


Table A1. Observation identification, creation date, description, location, and image

ID	Creation (Date)	Notes/description and photo(s)	x	y
4	6/30/2022	Not relevant to study.	38.77808	8.998876
5	07/02/2022	River pollution (dump site next to river) 	38.80177	8.989802
6	07/03/2022	River pollution (urban agriculture next to river)	38.77793	8.998985
7	07/03/2022	Not relevant to study.	38.77804	8.998998
8	07/06/2022	Urban runoff after heavy rainfall  	38.78021	9.004272
9	07/09/2022	Not relevant to study.	38.80204	8.990328
10	07/09/2022	Not relevant to study.	38.80105	8.987083

ID	Creation (Date)	Notes/description and photo(s)	x	y
11	07/10/2022	community use and sandmining 	38.78617	8.877546
12	07/10/2022	when the river flow increases it brings sand for mining 	38.78605	8.877721
13	07/10/2022	used to be a floodplain up to the school but the communities built embankment to stop flood 	38.78578	8.878698
14	07/10/2022	the houses here destroyed because of flooding (before community embankment) 	38.78612	8.880857

ID	Creation (Date)	Notes/description and photo(s)	x	y
15	07/10/2022	floods destroyed house in 2018	38.78637	8.881159
16	07/10/2022	the toxins in the river are bad for (killing) the forest 	38.78721	8.882302
17	07/10/2022	River banks (low flow)	38.78769	8.882766
18	07/10/2022	embankment and wall built by local authority (akaki locality)	38.78782	8.882879

ID	Creation (Date)	Notes/description and photo(s)	x	y
19	07/10/2022	Livestock drinking from same river as sandminers	38.78592	8.87779
20	07/10/2022	River flowing under the bridge - river was up to 10m 5 years ago	38.78621	8.877618
21	07/10/2022	first akaki bridge (too low) started to block akaki in 2018	38.78522	8.876439

ID	Creation (Date)	Notes/description and photo(s)	x	y
22	07/10/2022	highly irrigated area	38.78218	8.870827
23	07/10/2022	grazing area/sand mining not accessible because of flooding	38.77944	8.873381
24	07/11/2022	On-street handwashing taps	38.80768	9.006184

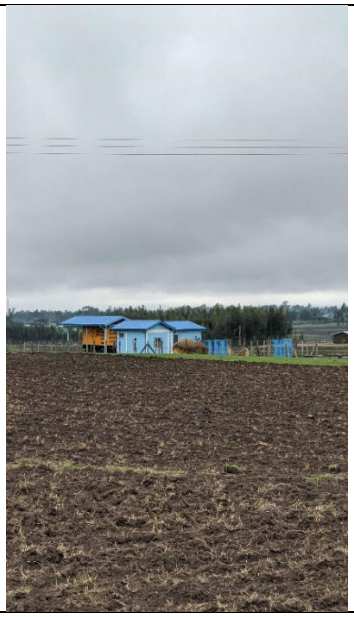
ID	Creation (Date)	Notes/description and photo(s)	x	y
25	07/11/2022	Not relevant to study.	38.81123	8.993093
26	7/14/2022	Legedadi catchment that feeds the reservoir	38.99738	9.105125
27	7/14/2022	Legedadi catchment (stone mining)	39.00804	9.10227
28	7/14/2022	well field mainly feeds Addis but on the way supplies some rural communities	39.00894	9.102686

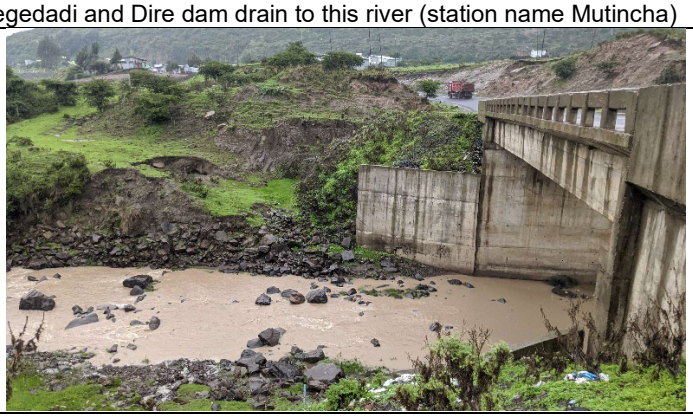
ID	Creation (Date)	Notes/description and photo(s)	x	y
29	7/14/2022	the Sendafa river goes to Legedadi. the last river in the Legedadi catchment before Dire. covers a large area compared to other rivers	39.03303	9.159304
30	7/14/2022	High surface runoff in rainy season	39.00818	9.159178

ID	Creation (Date)	Notes/description and photo(s)	x	y
31	7/14/2022	Rural land	39.00257	9.161364
32	7/14/2022	Turbid stream	38.99712	9.164966
33	7/14/2022	Turbid stream	38.99206	9.166735
34	7/14/2022	Not relevant to study.	38.97728	9.171942
35	7/14/2022	Not relevant to study.	38.94718	9.174771

ID	Creation (Date)	Notes/description and photo(s)	x	y
36	7/14/2022	first river that joins the Dire river	38.9318	9.181178
37	7/14/2022	second river that joins Dire river	38.92487	9.183076
38	7/14/2022	Not relevant to study.	38.92487	9.183076
39	7/14/2022	Not relevant to study.	38.93759	9.169828
40	7/14/2022	Dire reservoir	38.93865	9.165837
41	7/14/2022	Dire reservoir	38.94046	9.157713

ID	Creation (Date)	Notes/description and photo(s)	x	y
42	7/14/2022	water drawn from this tower goes Legedadi reservoir	38.93304	9.148506
43	7/14/2022	when level of Dire comes over - this fills and drains to akaki river	38.93078	9.149729
44	7/14/2022	Not relevant to study.	38.93086	9.149634
45	7/14/2022	flower farm (uses own groundwater)	38.94032	9.147915

ID	Creation (Date)	Notes/description and photo(s)	x	y
46	7/14/2022	groundwater collection for addis	38.95905	9.147083
47	7/14/2022	groundwater for local and addis 	38.97409	9.120039
48	7/14/2022	measurement site downstream of dire dam (Legedadi station is name)	38.92892	9.091354

ID	Creation (Date)	Notes/description and photo(s)	x	y
49	7/14/2022	Rural settlement on river bank	38.90318	9.033227
50	7/14/2022	Legedadi and Dire dam drain to this river (station name Mutincha) 	38.90851	9.042746
51	7/14/2022	teff fields in distance	38.90844	9.042903
52	7/14/2022	High flow (Akaki upstream)	38.7803	8.931623

ID	Creation (Date)	Notes/description and photo(s)	x	y
53	7/14/2022	Kebena outflow into Akaki	38.78007	8.933261
54	7/14/2022	bulbula station takes measurements here	38.77989	8.933236
55	7/14/2022	Kebena river (drains to akaki)	38.7781	8.935635

ID	Creation (Date)	Notes/description and photo(s)	x	y
56	7/15/2022	Visible pollution on river bank	38.7781	8.935573
57	7/15/2022	gully formation at top of big akaki catchment	38.78663	9.086675

ID	Creation (Date)	Notes/description and photo(s)	x	y
58	7/15/2022	rapid housing development (empty last year) land is cheap but illegal (money goes to kebele) 	38.79282	9.094657
59	7/15/2022	rapid urban development 	38.78992	9.095036
60	7/15/2022	Gefersa reservoir 	38.63213	9.075358
61	7/18/2022	Not relevant to study	38.64656	9.081083

ID	Creation (Date)	Notes/description and photo(s)	x	y
62	7/18/2022	Rural settlements on river bank	38.89617	9.027028
63	7/18/2022	Livestock grazing	38.95872	9.099111
64	7/18/2022	groundwater wellfield	38.99522	9.099111

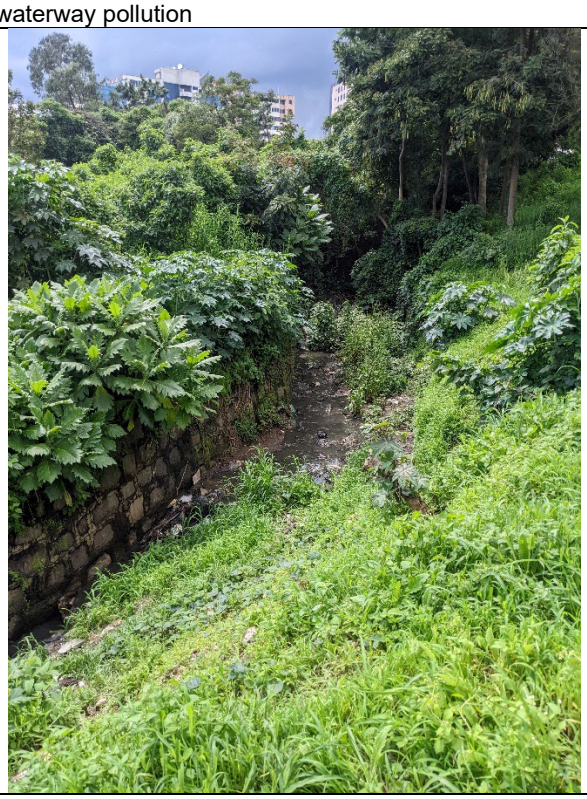
ID	Creation (Date)	Notes/description and photo(s)	x	y
65	7/18/2022	groundwater wellfield	38.99717	9.117111
66	7/18/2022	High surface runoff	39.01936	9.153167
67	7/18/2022	quarry activity	38.96658	9.171167

ID	Creation (Date)	Notes/description and photo(s)	x	y
68	7/18/2022	Not relevant to study	38.93008	9.171167
69	7/18/2022	Dire Reservoir	38.92811	9.153167
73	8/14/2022	Akaki river high level	38.78613	8.877598
74	8/15/2022	Akaki river level with bridge	38.78624	8.877552
75	8/15/2022	no flooding here (higher land) so better for irrigation	38.78064	8.865904

ID	Creation (Date)	Notes/description and photo(s)	x	y
76	8/15/2022	flooding here so not being farmed	38.78063	8.865923
77	8/15/2022	Not relevant to study	38.78047	8.865569
78	8/15/2022	flood plain	38.78036	8.865558
79	8/15/2022	River high level	38.78035	8.865601

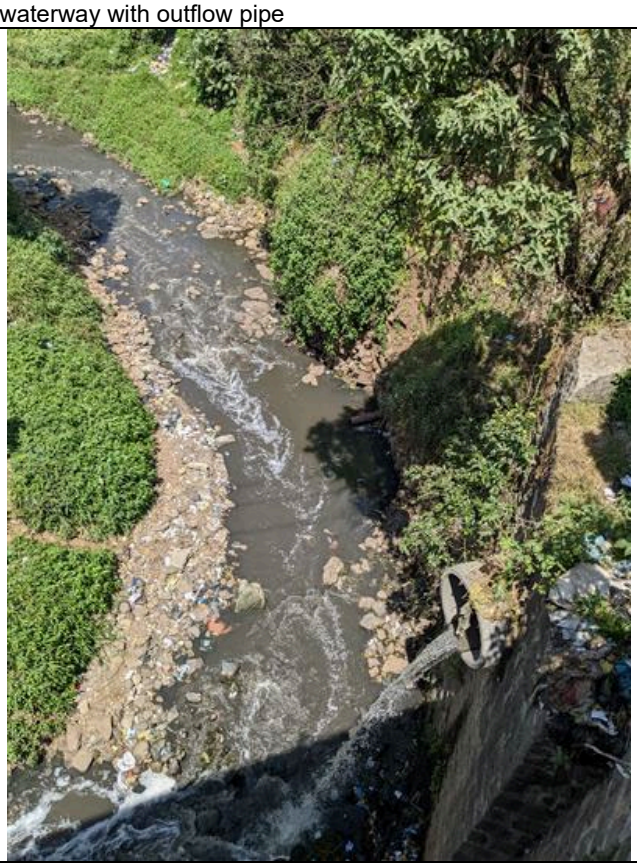
ID	Creation (Date)	Notes/description and photo(s)	x	y
80	8/15/2022	trees acting as a garbage barrier in flood plain	38.78035	8.865542
81	8/15/2022	recent flooding	38.78631	8.879272
82	8/15/2022	recent flooding	38.78643	8.879519

ID	Creation (Date)	Notes/description and photo(s)	x	y
83	8/15/2022	urban runoff during rainfall event	38.78283	8.991
84	8/15/2022	Urban runoff during rainfall event	38.81677	8.98977

ID	Creation (Date)	Notes/description and photo(s)	x	y
85	8/25/2022	urban waterway pollution 	38.75021	9.027025

ID	Creation (Date)	Notes/description and photo(s)	x	y
86	9/16/2022	Urban waterway (some pollution) 	38.76652	9.009008

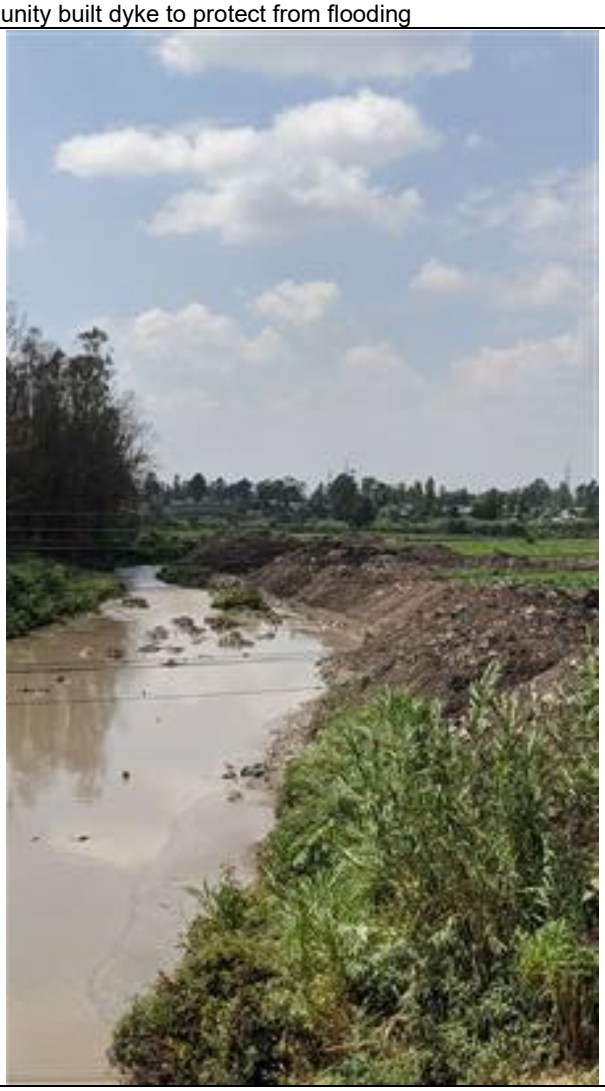
ID	Creation (Date)	Notes/description and photo(s)	x	y
87	9/16/2022	Not relevant to study	38.78283	8.990989
88	9/16/2022	water truck delivery (when water in the storage tank runs out) 	38.81	8.990989
89	11/29/2022	Aba Samuel Reservoir 	38.708	8.78386

ID	Creation (Date)	Notes/description and photo(s)	x	y
90	12/05/2022	City waterway with outflow pipe 	38.76846	9.027025
91	12/12/2022	Recent flooding	38.78647	8.879474
92	12/12/2022	Sand mining	38.78603	8.878099

ID	Creation (Date)	Notes/description and photo(s)	x	y
93	12/12/2022	cabbage patches 	38.78592	8.878232
94	12/12/2022	Heineken factory	38.81176	8.898138
95	1/13/2023	saw a woman dispose of her household waste into this waterway 	38.81259	9.009411
96	02/03/2023	Not relevant to study	38.77792	8.999046

ID	Creation (Date)	Notes/description and photo(s)	x	y
97	02/06/2023	River low flow	38.78025	8.865458
98	02/06/2023	stick for depth indication and to locate sand for mining	38.78026	8.865512
99	02/06/2023	Not relevant to study	38.78025	8.86551
100	02/06/2023	River low flow	38.77949	8.873356
101	03/05/2023	Kebena low flow	38.77805	8.935672

ID	Creation (Date)	Notes/description and photo(s)	x	y
102	03/05/2023	Kebena low flow (some built up rubbish from higher flows) 	38.77798	8.935842

ID	Creation (Date)	Notes/description and photo(s)	x	y
103	03/05/2023	community built dyke to protect from flooding 	38.78471	8.876224
104	03/05/2023	Irrigation next to river plus visible waster left from higher river levels	38.74755	8.886693

ID	Creation (Date)	Notes/description and photo(s)	x	y
105	03/05/2023	Livestock and irrigation next to river	38.74734	8.886679
106	03/05/2023	Legedadi river (low flow)	38.74756	8.886406

ID	Creation (Date)	Notes/description and photo(s)	x	y
107	03/05/2023	Legedadi river (visible pollution) 	38.92896	9.091304
108	03/05/2023	Condominium sites on outskirts of Addis Ababa (East) 	38.92908	9.091631

Appendix E. Addis Ababa Water and Sewerage Authority workshop proceedings

E.1 Questionnaire responses

- Q1 Job Title
- Q2 Role Description
- Q3 What do you understand is included by the term "water security"?
- Q4 What do you think is the most urgent issue (or issues) for water challenges in Addis?
- Q5 How do you think water issues in Addis are linked to issues beyond the city boundaries?
- Q6 Any other general comments on water security from your perspective?

Table A2. Questionnaire responses from AAWSA, OWEB, and other regional stakeholders

ID	Date	Responses		
AAPDC1	**27/01/2023**	Q1A: Civil infrastructure implementation follow up and regulation expert at Addis Ababa Planning and Development Commission / Head of department of management at Lunar International College.	-	Q3A: The term water security from my point of view included: the fulfilment of the need for water including (households, industries, etc…) without restriction. It also implies the reserve which will be needed in case of emergency (if we have water security there will be no shortage in case of emergency).
		Q4A: Lack of planning ahead. Political instability. Poor design of distribution networks. Poor management of current water sources. Rapid population growth. Lack of recycling mechanisms.	Q5A: Every living things need water somehow, if there is shortage in one region it is obvious people will migrate from that region to other regions where water is available which will affect the other regions with water. So the problem will be shared (it is beyond regional boundaries). As human being we need to focus more on "blue ocean strategy" there is enough resources available we just need to focus on finding new ways to extract our resources and make them available to peoples in need (water is not limited resource since 97% of our world	-

			is filled with water, so if we look at the bigger picture water issues are all our problems not regional).	
AASTU1	**27/01/2023**	Q1A: PhD student at Addis Ababa Science and Technology University	-	Q3A: Water security is increasingly used to explore the multiple challenges associated with physical and human pressure on water resources management. It assists to comprehensively understand the interaction between water and human. Water security leads to identify XX XX areas and the monitor change in water system for acceptable water quality and quantity.
		Q4A: Monitoring and proper management. Increasing supply to fill the gaps of water supply. Awareness creation for management.	Q5A: Thinking water issues beyond basin or regional boundaries because of water transfers from one basin to the next basin as well as outside region. So thinking the water systems as whole used to protect basin; use water properly. XX sustainability of water resource system for deliveries and beneficiaries within and outside the basin.	
AAWSA1	**28/07/2022**	Q1A: Heavy waterline installation maintenance and distribution process leader. Water Production and distribution department.	Q2A: Distribute and control the water supply main transmission and distribution water network.	Q3A: Securing the source and the catchment of the water supply source. Securing sustainable and sufficient water for the Addis Ababa city customer for our case of example.
		Q4A: Scarcity of water is the most critical issue and challenge. The next one is non-revenue water.	Q5A: Because most of or almost all source of the water sources for Addis come from the boundary city around Addis and it has its own administrative, need and other socio politics issues.	-
AAWSA10	**27/01/2023**	Q1A: Water spray?	-	Q3A: 1. If every community is aware that water is scarce and works hard to take care and monitor its own around water dams or reservoirs. 2. From the point of view of health, it should be protected and monitored so

				that it is not harmed by water contamination
		Q4A: 1, It should be done to have a water supply equal to or greater than the number of inhabitants, both internationally and nationally. 2. In terms of urgent matters, I think that the development is very fast in the center of the country, so if they use treated (distributed) water for industry, hotels, factories, etc., instead of using water that is filtered from sewage, or if they can use non-potable water that is dug for iron and fluoride.	Q5A: 1. Watershed issues should be jointly resolved and monitored by the water supplier's institution and the office of the Ministry of Water. 2. The issue of regional boundaries should be addressed properly as it is not a matter of the political system of the country and is not solved only by institutions.	Q6A: 1. To maintain water safety: (1.1) Strengthening the protection that is being done now, for example, monitoring every dam, reservoir, pressure point; (1.2) In order to protect water safety more, the community should understand the benefits and harms of water and take ownership of it.
AAWSA2	**28/07/2022**	-	-	Q3A: I understand water security is use the water resource in equitable way and efficiently use with the consideration of the next generation.
		Q4A: Not effective distribution of drinking water for all the need. Water quality during transportation. Water loss.	Q5A: The source of the water body is not found in Addis most of them.	-
AAWSA3	**28/07/2022**	Q1A: Non-revenue water sub process leader.	Q2A: Identifying NRW ratio and implement reduction mechanisms.	Q3A: Save water for distribution system and protection water from any contamination.
		Q4A: Source limitations, Non-revenue water, resource limitation, water distribution network damages.	Q5A: The sources are out of the city boundaries so the concerning institution working with cooperation.	-
AAWSA4	**28/07/2022**	Q1A: Water quality expert. Water quality control case team.	Q2A: Testing and monitoring of potable water from source to tap.	Q3A: There are different water security challenge in Addis Ababa city. One of the main problem is the broken pipeline found on different parts of the city. These pipelines are cause the main water pollutions problem in Addis.

		Q4A: Urgent issues in Addis Ababa city is the shortage of potable water. Water scarcity and flooding is the main problem in the city. Water distribution (water supply system) issue is one of the main challenge because of the geographical location, power distribution etc.	Q5A: The potable water sources are out side Addis Ababa city, due to this problem AAWSA can not manage by it self to provide water for Addis Ababa city. As we know AAWSA have two mandates the other one is discharge and treating waste water in appropriate manner. Also AAWSA integrate the surrounding Oromia special zones to achieve in the objective.	-
AAWSA5	**28/07/2022**	Q1A: Head of laboratory. Wastewater quality control.	-	Q3A: Water is a vital role for every human being and living things. In my understanding about water security - access to all drinking safe water.
		Q4A: The city is urbanized unpredictably and rapid population growth because of this the gap in water supply and demand is the most urgent issue.	Q5A: Almost all water sources are located outside the city. Therefore to insure the water sources we have to link near city's around the city.	-
AAWSA6	**28/07/2022**	Q1A: Ground water case manager.	-	Q3A: Water security in the term it has different definition and mean. So water security mean protect from different water contamination and also water is limited resource: to use properly protect over abstract/ the mean that mean lead by example.
		Q4A: Unbalance demand with supply, leakage problem (it has acknowledged), illegal connection those three .. Challenge in Addis water supply.	Q5A: Addis it must be linked to the bound-city because the source of water comes from the far from the city. So by together shares .. With people to the people. Addis an closely linked with beyond the city boundary.	-
AAWSA7	**28/07/2022**	Q1A: Plan and budget leader.	Q2A: Preparing long, short, and medium term plan and allocate the necessary budget. In addition follow and mentor the plan and budget attained properly.	Q3A: Water security is all about attaining/gaining the basic need, i.e., water, to society and those in need in sustainable manner. In addition water security is developing water sources for those in need in sustainable manner.

		Q4A: Supply shortage of water companies to the demand, water quality problem, big loss of water, environmental degradation in water source areas, institutional efficiency problem, shortages of budget/ the necessary resources.	Q5A: Water issues linked beyond the city boundaries because most of the water sources the city gain outside the boundary. This implies its necessary to work jointly with these areas in a win-win approach.	-
AAWSA8	**28/07/2022**	-	-	-
		Q4A: Unbalance between water demand and water supply of AAWSA for Addis. Reduction of physical loss specially which are due to hydraulic structure. Urgent issues: shifting from ground water sources to surface (sustainability); resource (i.e., for construction of dams); minimizing NRW loss (i.e., commercial loss and physical loss).	-	-
AAWSA9	**27/01/2023**	Q1A: Sub process owner water distribution	-	Q3A: As water is a finite resource, we should save it and use it. As it is the earth, we have to find a solution for the city in a way that suits it, and we have to find a sustainable solution - Not learning to raise awareness - Lack of water
		Q4A: Because we are facing a shortage of clean water/drinking water/ in our city in the country?? Finding a solution and raising awareness of how to use the produced water - It is useful to have a common understanding of water by making it a common benefit with international watershed countries - This is a challenge because the system is not fixed - Facilitation if economic shortages are solved and dams are built	Q5A: Doing teaching work with equal mutual benefit - Creating awareness - It is necessary to facilitate the use of policies by revising them - Since the basins are outside our city, facilitating the possibility of using them inside	Q6A: Since well water / surface water / water are exhaustible resources, work to create awareness to use drinking water only for drinking and cooking. - Owning wells dug in different places - Making our systems accessible to those who are old and inaccessible - Reduction of wasted water

ACEWM1	**27/01/2023**	Q1A: Student affairs officer.	-	Q3A: I think 'water security' is about the management of water for appropriate usage so that it can be currently used appropriately so that the future generation also can use the resource for various purpose: drinking, cleaning, energy, irrigation etc., without shortage.
		Q4A: Water shortage, lack of skilled manpower, lack of goverannce, lack of appropriate infrastructure, lack of energy.	Q5A: Water politics is one of the problem that harness the development of poor countries like Ethiopia. It is always the agenda of the lower stream countries that are established along the Nile basin.	Q6A: Creation of awareness, I believe, is important to address issues related to water security. The creative awareness should also go along with action that enhances the security.
AwRBA1	**19/10/2022**	Q1A: Ecohydrology and water quality desk. Senior water resource monitoring expert, monitoring the resources In the basin Awash.	-	Q3A: Water security mean securing the limitted resource for any intended uses sustainably.
		Q4A: For me water quality is a pressing issue which affect the resources qualatitavely as well as quantitavely. So, water quality is the most urgent issue.	Q5A: I think it is a key indicator for social, economical, and development good. That is why, which is beyond the local issue.	Q6A: Water security is a very important for human health and sustainability. So, securing water secure or protectors human for better livelihood and development as well.
ECDSW1	**27/01/2023**	Q1A: Executive officer of civil informatics process.	Q2A: Lead, plan and organize the process as well as coach, check and review the works/services provided by the process.	Q3A: From my point of view water security mean to secure water / to ensure water availability and sustainability.

		Q4A: Water challenges locally: water sources for some part of the country, water quality, lack of integrated water management (i.e., not only engineering solutions but also other aspects such as social, economic to legal issues shall be incorporated while managing water), lack of information/data to preform study/research or decision, lack/loosen water policy, regulations, standards and law, lack of attention by decision makers, few research engagements, etc. climate change will be a threat both for locally and internally.	Q5A: Because the boundary of water (surface water and groundwater) resources is beyond basin or region. Thus, anything related to water management, security, monitoring, etc. which are water issues pass over basin or regional boundaries.	Q6A: Water security or ensuring sustainable water resource will not be an easy task. Since water touches various disciplines and has different stakeholders. Implementing water resource management considering various disciplines (perspectives) and different stakeholders will enhance water security.
MoWIE1	**21/10/2022**	Q1A: Ecohydrologist of: Ecohydrology and water quality desk. Role: to understand nature-based solutions for water issues.	-	Q3A: Water security: the issues of water access in terms of quantity and quality.
		Q4A: Locally: water pollution, contamination to undertake agricultural production including irrigation, drinking water for animals and humans as well. Nationally: accessing requires amount of water for irrigation and drinking water at all levels.	Q5A: The issues of Awash basin is beyond one region, becomes issues of Addis Ababa, Oromia, and Afar region state. Because Akaki Kality river is highly exposed to pollution/contamination with heavy metal and other agro and industries bases chemicals. Besides there is also the biologically contaminanted water released to the system will disturb the whole ecosystem.	Q6A: Water security is highly … in the central part of Ethiopia because the area is highly populates and demand a high amount of water in quantity. Thus, the existing water Akaki river demands to manage and support to the community.
OSZ1_Legetafo	**13/10/2022**	Q1A: Manager at Tato Water Utility	-	Q3A: Water availability. Water quality (for drinking purposes). Water resources protection.
		Q4A: Water to not come from a bottle. High price of water. Migration from the city (Addis). Contamination of water sources (pollution).	Q5A: Using different basins. Water supply (groundwater and rainfall) being in different places. Available water	Q6A: We need more technology in spring development and water technologies.

			(gorundwater and rainfall) is not connected to regions and cities.	
OSZ2_Burayu	**18/10/2022**	Q1A: Water supply distribution management team leader (Burayu)	-	Q3A: Clean [water] for society and livestock (for the benefit of society).
		Q4A: Supply and demand balance. Resource [water] scarcity. Lack of [water] quality.	Q5A: Lack of coordination (from stubborness?). Migration from one region to another (many people come for increased security).	-
OSZ3_Gelan	**20/10/2022**	Q1A: Gelan town technical department director	-	Q3A: Usage of borehole exist at gelan. Many industries exist in the city of gelan which might affect the borehole. Water availability.
		Q4A: Water quality. Contamination effect. Water availability. The increase of public interest.	Q5A: For the city's pleasure (benefit). When you walk past the city it smells (bad).	-
SH1	**27/01/2023**	-	-	Q3A: Water security is a complextion to define clearly, however it can be defined in XXX. Water security is a reliable access to water to sufficient quantity and quality. Also water security can be described as a nexus between availability and use of water.
		Q4A: Climate related problem. Water source depletion. Population increase.	-	-
SH10	**27/01/2023**	Q1A: Ecosystem and biodiversity researcher (environmentalist).	-	Q3A: Water security is defined as the security of water for community or residence. Security means water supplly with meeting WHO water per capita in daily basis. Every household get the WHO standard water per day. Every boday secured in water supply based on the standard.
		Q4A: Water challenges in Addis Ababa are: management system, water leakage, infrastructure, budget shortage, urbanization, high population growth, capacity (skill).	Q5A: Water issues are linked beyond the boundary of a certain city or region. Because surface water is flowing starting somewhere and goes to follow the slope of the geographical space (landscape). Whether it is out or in the region. If it is get any problem at any time	Q6A: Water is life. It is security for humanbeing or other animals is essential.

			that affacts the supply. Also the groundwater recharged anywhere or upper slope and flows the lower slope. Therefore, water issue has linkage with outside the boundary.	
SH2	**27/01/2023**	-	-	Q3A: Water security is managing water related risk for health. Managing availability of reliable water.
		-	-	-
SH3	**27/01/2023**	Q1A: Senior water supply engineer.	Q2A: Study, design and constructs supervisions to water supply projects.	Q3A: The capacity of a population to safeguard sustainable access to adequate quantities of acceptable water quality for sustaining livelihoods, human well-being, socio-economic etc.
		Q4A: Lack of meeting demand (rapid population growth) supply and demand don't balance. High water loss. Poor watershed management.	Q5A: Water issues to be cross-sectoral - there should be a policy brief every sector to include in their agenda. Advocacy and awareness creation on water demand management using media, influential people, school clubs	Q6A: Water security should be a top priority of the government. Researchers and organisations working on the water sector should support the issue with evidence.
SH4	**27/01/2023**	Q1A: Director of training centre.	-	Q3A: Water scarcity. Lack of fresh water to meet standard water demand. The mismatch between water demand and availability. Challenges of water supply; water loss, groundwater ownership not clearly defined, less awareness, no groundwater policy in Ethiopia, un match of demand and supply, no alternative water supply expect solutions and section.
		Q4A: Rapid increase of the population. Changing in using standard of people. Changing in consumption pattern. Climate change. Drought, flood. Deforestation.	Q5A: Source: water XX one area, user (consumer) is at an other place e.g. Water sources for Addis Ababa is from Oromia, regional state, XX is the source problem. Finance: to build a	Q6A: Build/develop water supply facility by own financial capacity.

		Expansion of agriculture. Urbanisation. Water pollution. Lack of proper management natural resources including water resources.	dam/infrastructure source of fund is from donors which is affects by different political or economical parameters from other countries.	
SH5	**27/01/2023**	-	-	Q3A: Water security means water after treatment, to use properly by any means, water use for any pollutions, water to control by water rules and duty, and water have on Ethiopia or in XX to have guidelines for water protection.
		Q4A: In locally: There is no benefit for any developing water project, it is separate the water rule and political rule, it study by the penetration. Nationally: water infrastructure, collection, distributions and treatment, water business, law, and finance, water scarcity are challenges.	Q5A: Both regional boundaries first fail to mean to them by the project. Cooperation among country sharing water basin is to control difficult to historic resilient and to increase the utilization of water.	-
SH6	**27/01/2023**	Q1A: Water distribution for maintenance unit and sub-process head.	-	Q3A: The importance of water usage policy in the country (especially Addis Ababa city). Groundwater regulations and rule (for use of groundwater).
		Q4A: Reducing the water use if urban. Consistent surface water treatment plant. Give awareness to the people about the treated water usage. Replace the old pipe which installed or laying with the city.	-	Q6A: Give awareness for the cycling waters or special com. With industries etc. use manage of water.
SH7	**27/01/2023**	Q1A: Senior project engineer (infrastructure).	Q2A: Managing and coordinating projects and stakeholders.	Q3A: Providing adequate and sustainable water supply to the users. Environmental friendly water usage. Demand management and reduction the misuse of the water supply through different mechanisms. Water security means security in all the social, political, economical aspects of a population livelihood.

		Q4A: Scarcity of water supply due to the rapid growth (expansions) od the urban population. Change in natural environment (deforestation) which leads to depletion of the groundwater. Wastage and poor management of water resources. Policies and regulation on water management and supply (feasible one).	Q5A: Because the water resources are not bound by basin and regional boundaries and they are interconnected these make the water issues are the issues everyone should take into account that it is the matter of everyone's need/basic necessity. In additional, the water resources for instance river basins may be trans-boundary and connects between regions. Therefore, the water issue arising out of the misuse of this kind of river may impact all the regions /basins along the stream.	Q6A: Water resources shall be properly managed. Other affecting factors which makes the water supply is below the demand amount; shall be well tackled. The depletion of groundwater and the misuse of the abstracted water needs a regulation or policies to avoid these problems and recharge/replenish the groundwater system.
SH8	**27/01/2023**	-	-	Q3A: Water security includes sufficient water demand and supply for beneficiaries. Includes water management and demand management, service management and usage.
		Q4A: Locally the most urgent issue production of sufficient water sources. Operation cost coverage. Reduction of unaccounted water (NRW). Proper management of water sources. Sufficiently managing water systems. Awareness creation for beneficiaries. Water quality management. Nationally: water source management policy creation.	Q5A: It is linked to basin because any water source groundwater or surface water developed around basin so it is lightly linked to basin to get sufficient water sources reached to demand planned. Linked to regional boundaries because most the time water supply for cities are for apart from the cities and coming crossing mainly administrations, these administration are the parts of regions so it is big issues to take into account regional benefits to properly managing water developed for cities.	Q6A: Health security, family planning security, property security, XXX security, food security, environmental security, human resources security, harmonization security.
SH9	**27/01/2023**	Q1A: Medium water network installation and water distribution sub-process head.	-	Q3A: Protecting water for sustainable socioeconomical development, protection water from disaster, management of aquifer rechargability.

		Q4A: Water policy for self supply of cities. Expantion of XXX and ends to reduction rechargeability of groundwater. Poor watershed / catchement management. Ignoring / not considering utility space roadside.	Q5A: If poor watershed management exists or unbalance of groundwater extraction of no management aquifer rechageability.	Q6A: Water policy (surface and ground), watershed management (strong institutions), water extraction depend source we have (guided by police).

E.2 AAWSA workshop presentation

Workshop Overview

Day 1	Day 2
• Completion of Form 1	• Workshop 3: Scale and boundaries
• Introduction presentations from AAWSA and GCRF Hub	• End Session: Discussion and feedback
• Workshop 1: Water problems	• Completion of Form 2
• Workshop 2: Impacts and causes	• Debrief and Follow on
• Debrief	

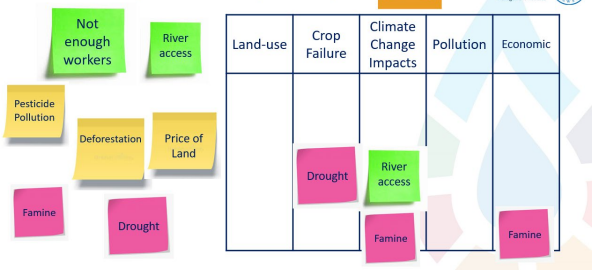
Workshop 1: Water Problems

What is a 'water problem'?

Workshop 1: Activity Instructions

- 15 minutes: Individual writing of local/regional water problems from your perspective. 1 problem for 1 sticky note.
  - Red – The issue is severe/urgent/deadly
  - Yellow – The issue is persistent and can vary in severity
  - Green – The issue is inconvenient but not dangerous
- 1 hour: Group problem collection, sharing, and categorising. Collect and share your water problems. Group them into themes (more than one theme can have the same problem and more problems can be added at any time).

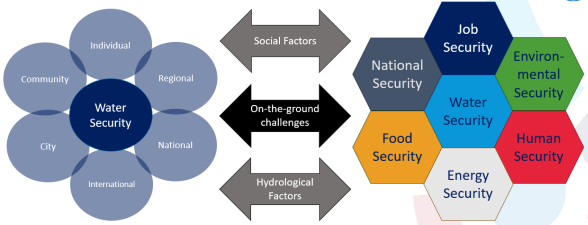
Workshop 1: Activity Example



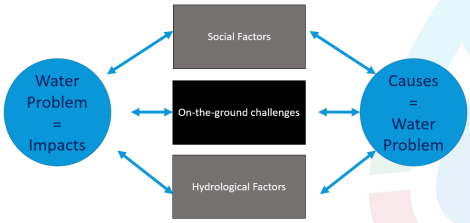
Workshop 1: Activity Prompts

- What water problems do you work with in your role?
- What water problems do you come across more frequently than others?
- What water problems do you often face whilst conducting your activities in the field?
- What water problems do you experience personally when going about your day-to-day activities?
- What water problems do you know exist, but might not directly interact with?
- **What water problems do you come across that are related to water but not supply and demand?**
- What water problems appear at different scales (over time, over different areas,)?

Hybrid Water Security



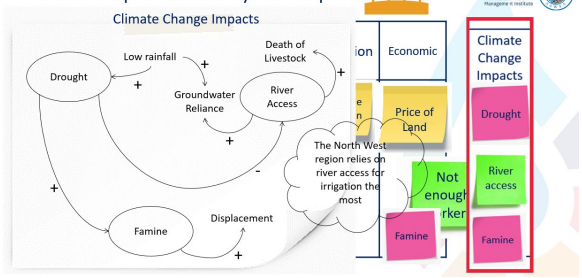
Workshop 2: Impacts and Causes



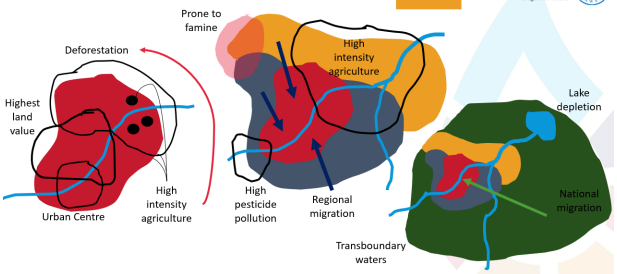
Workshop 2: Activity Instructions

- Groups from the previous session remain.
- 1 paper per theme.
- Expand problems into impacts, causes, and components.
- These do not have to be confined to Addis or be be purely physical/hydrological.
- Draw this by writing the single water problem in a circle and drawing connected lines to causes and impacts. (+) indicates it adds to or is added to by the component, a (-) indicates it reduces or is reduced by the component.
- Use the sticky notes to add comments where a (+) or (-) isn't appropriate but there is some important information.

Workshop 2: Activity Example



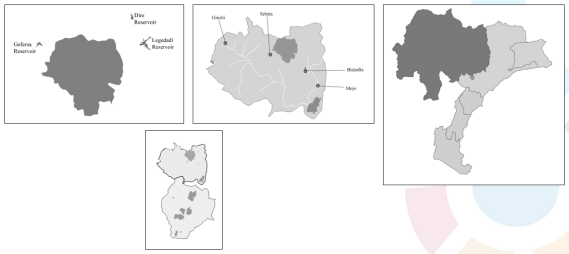
Workshop 3: Activity Example



Workshop 2: Activity Prompts

- What do you think causes this problem? Is it an individual thing or a combination of things?
- What sources, characteristics, responsible bodies, management actors, do these water problems have?
- What would/could/does worsen these problems?
- What environment(s) do these problems exist in?
- What causes variations in these problems (e.g., seasonality, level of urbanisation).
- Who 'owns' these problems?

Workshop 3: Scales and Boundaries



Scales and Boundaries

Mini activity: What is your work boundary?

Your responsibilities based on mandates, working areas, influence, decision making, infrastructure, people you work with

Workshop 3: Activity Prompts

- Where are many causes creating multiple water problems?
- Where do different environments or themes of water problems overlap (physical and decision-making environments i.e., institutional mandates)?
- Where and how do stakeholders interact with common water problems?
- How are boundaries determined – how and by whom?
- Where are multiple scales linked by a water problem?

Workshop 3: Activity Instructions

- 2 groups from yesterday.
- Various maps of different scales.
- On these maps, we will draw where the water problems, elements and causes take place or exist.
- Interconnections should be shown where appropriate using arrows. Colour code for relative importance (using traffic light system).
- Use the A1 sheets of water problems. Use the diagrams of impacts and causes.

E.3 AAWSA workshop notes

Part 1

GROUP 1

(i) source allocation (catchment, produce, urban); (ii) management; (iii) network

- More discussion on water governance issues, related to institutional/political issues e.g. boundaries - relationship between AAWSA + OSZ; also flooding: as affects both qual and quant - but some disagreement as view that AAWSA not principal stakeholder in addressing; strong agreement that supply/demand gap the biggest issue in current moment; lack of alternate water source for non-domestic use an issue contributing to low supply; non-replacement of old pipes hard to trace as issue because only flares up when issue is severe i.e. leak/burst - imbalance between pressure and pipe capacity; lack of automation institutionally in AAWSA means some of these issues are not flagged in advance; management issues: GW over abstraction, currently no system for deliberate ('artificial') recharging; deterioration of both surf and GW increasingly problematic

GROUP 2

n.b. mainly management-level): (i) resource; (ii) policy; (iii) social; (iv) environmental; (v) technology; (vi) coordination; (vii) economic

- Main disagreements were around the severity of each problem (group members first listed issues individually then collated into categories)
- Some did not want to list certain problems because they are sensitive/political/institutional and so may have PE implications: some suggest that AAWSA doing best with limited resources; others flagged that there remain many issues - ended up falling into two categories of inst' issue: (i) technology; (ii) power
- Discussion around outsourcing management / privatisation as solutions to inst'l problems: but others flagged that this could cost jobs - 'even your own'
- Some AAWSA staff members are working much more closely with issues felt on ground: and so have better understanding of socioeconomic issues
- Categorisation: some wanted to do so according to the practicalities of the work done day to day, others in terms of the type of problems people came into contact with
- One person wanted to call a colleague at one stage to ask them specifically what their (sub)department dealt with / was unclear
- Sense that some of the issues discussed were perhaps management problems (relating to individuals/mgmt styles) - but these were disguised in discussion by reference to specific department titles and their dysfunctions

- Infrastructure damage was identified with lack of knowledge amongst neighbourhoods/communities - responsibility therefore identified with those seen as doing 'social work'
- In general, problems with network/infra/social/etc associated with departments that *should* be dealing with that issue, not necessarily in line with the source of those issues themselves

Part 2

GROUP 1

- Deliberation on governance (the group first talked of institutional resource management) issues (socioeconomic/enviro/inst factors)
- Econ impact of WR dev't - creates employment for certain community groups
- Healthy discussion and debate amongst participants, each taking into account the others perspective
- Groundwater use: including private wells - some attribute strong causality to this in overabstraction ('overutilisation')
- Administrative boundaries by far the biggest perceived issue in governance: insofar as certain problems are not addressed because they are always seen to be in some other department's remit

GROUP 2

- A lot of procedural deliberation in this group
- Selecting main themes to discuss was controversial; eventually consensus was to decide an inclusive overarching theme (the most inclusive one)
- Understanding what causes what was derived from list of issues/factors from WS1
- Rationing water seen as major issue: how to connect with 'good governance'
- Coordination btwn agencies (external to AAWSA) that affect performance of AAWSA
    - Capacity of individual institutions a major factor in this: where capacity low in one institution, can lead to another institution taking on more responsibility/agency themselves [[example?]]
- Unwillingness to discuss non-water issues - some encouragement from MD/AH to incorporate these
- Very linear thought process initially; again MD/AH helped nudge towards more systemic thinking

- Of interest: AAWSA receives by far largest share of budget from AA city administration yet challenges still persist
- Coordination between City Planning/AAWSA/Road Agency is there - but the implementation of this cooperation is a major challenge: they plan together, but then perhaps each indiv. agency does not allocate budget
- Seemed there was some sense that the new palace was drawing some prioritisation; AA hilltop areas also receive priority
- Coordination with power authority: AAWSA gave 6 vehicles

Part 3

GROUP 1

- Absence of IWRM planning the biggest issue identified (all agreed that this is central prob)
- Secondarily, absence of bulk supply for Addis + Oromia SZ surrounding
- AAWSA builds non-water infra in OSZ for communities (schools/clinics/etc - and provides water to them - e.g. around Gerbi [ER: note new dam building there])
- AAWSA-OSZ joint board established 3y ago: makes decisions on infra constructions; but limited capacity for effective implementation
- Within AA, sector offices come together in a joint planning directorate - [no mention of actual concrete actions taken by this unit]
- Capacity gap between planning and implementation commonly identified
- AAWSA sees hydrological zone as its unit for boundaries of service, but gov't uses geographic/political boundaries

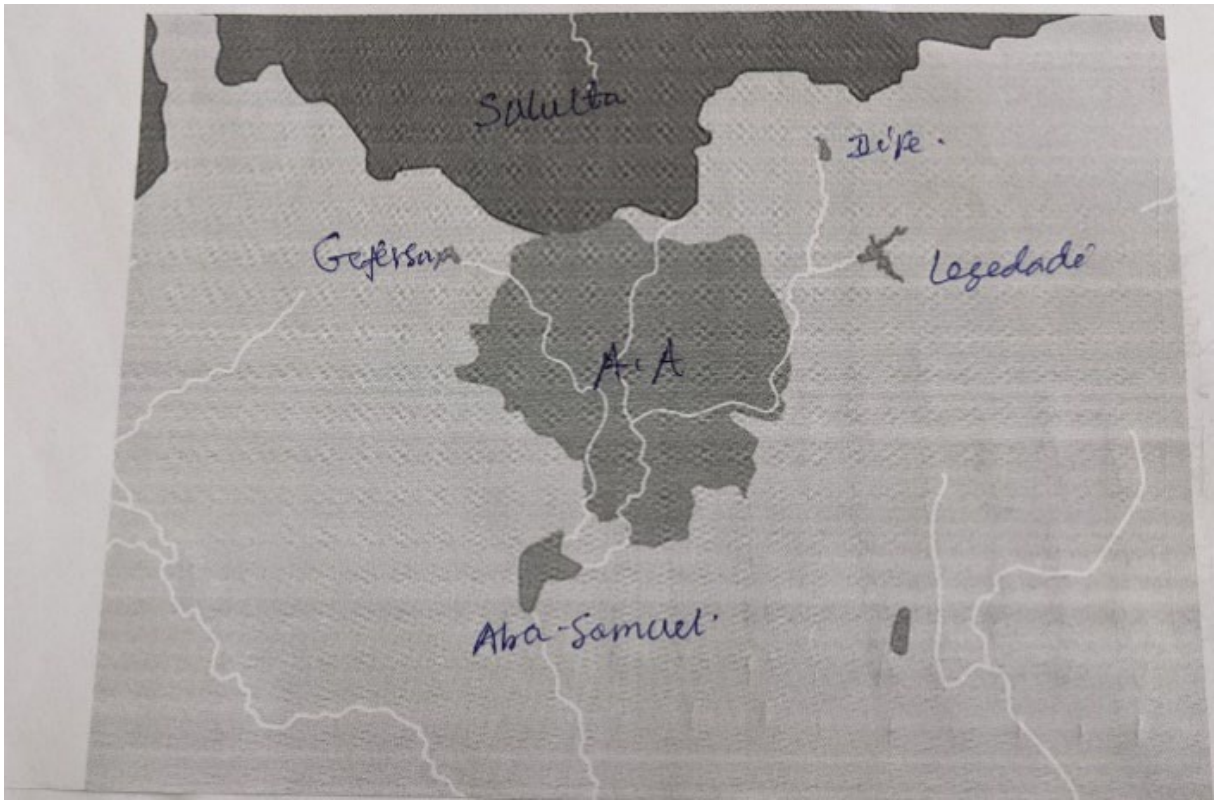
GROUP 2

- Clear that boundary-setting is a very complex process. Group struggled to plot several issues / responses to PP prompts at one time - 'hotspot areas' with multiple + severe probs
- Reverted back to causes instead of problems themselves; although this was not limited to any particular geographic area (discussion extended to outskirts of Awash basin, remittances as source of revenue)
- Linear/iterative understanding of problem elaboration/persistence
- Lack of FX identified as hard barrier to infra development (hence remittance discussion)

- Early on, discussion was very much limited to bounds of AAWSA's geographical unit in AA, but by the end was effectively global (i.e. remittances from diaspora)
- Periphery of AA v fuzzy: AAWSA involved with service provision in OSZ very regularly (in all directions from AA admin boundary)
- East + west peripheries show the largest demand/supply gap (see map): Koyifitche + Ayat Arafsa hotspots for non-connected households
- Power interruption has greatest impact on wellfield abstraction: affects up to 70% of all AA supply (less of an issue for pocket wells inside the city; power interruption is less severe in the centre but outside the interruptions can last a long time)
- Old + central parts of city suffer the most from WQ problems - pop'n density + v. old pipes - since downstream WS came online, need for pressurisation greater: pressure on old pipes/damage
- Water rationing severe in W part of AA: Shiro Meda e.g.
- Gulele SC most affected by aged pipes
- Migration: focussed on 5 main roads of AA, i.e. migration on daily/event basis ('official figure' is 5k arrive to AA daily, 3k leave + 2k stay); population settlement/growth remains distributed at peripheries - also where challenges exist for AAWSA to supply water
- Industrial Zones: another stress on water, outside AA but competes for GW with AAWSA; uses same aq; also WW disposal incr. Pressure on WW treat plants (which are only ever designed for dom. Waste but ind. Waste ends up there too - confirmed by ATH testing work at WWTP inflows)
- Power supply sources stretch very far geographically from AA: can be as far away as L. Tana - so this stretches 'boundaries' very very far - in terms of
- implications for power interruptions / abstraction
- Budget distribution: was prompted by MD/ATH but the sense was this was too sensitive for discussion in this arena: but understood that is a relevant effect. International loans mentioned - thus again increases boundaries massively - to international scale again

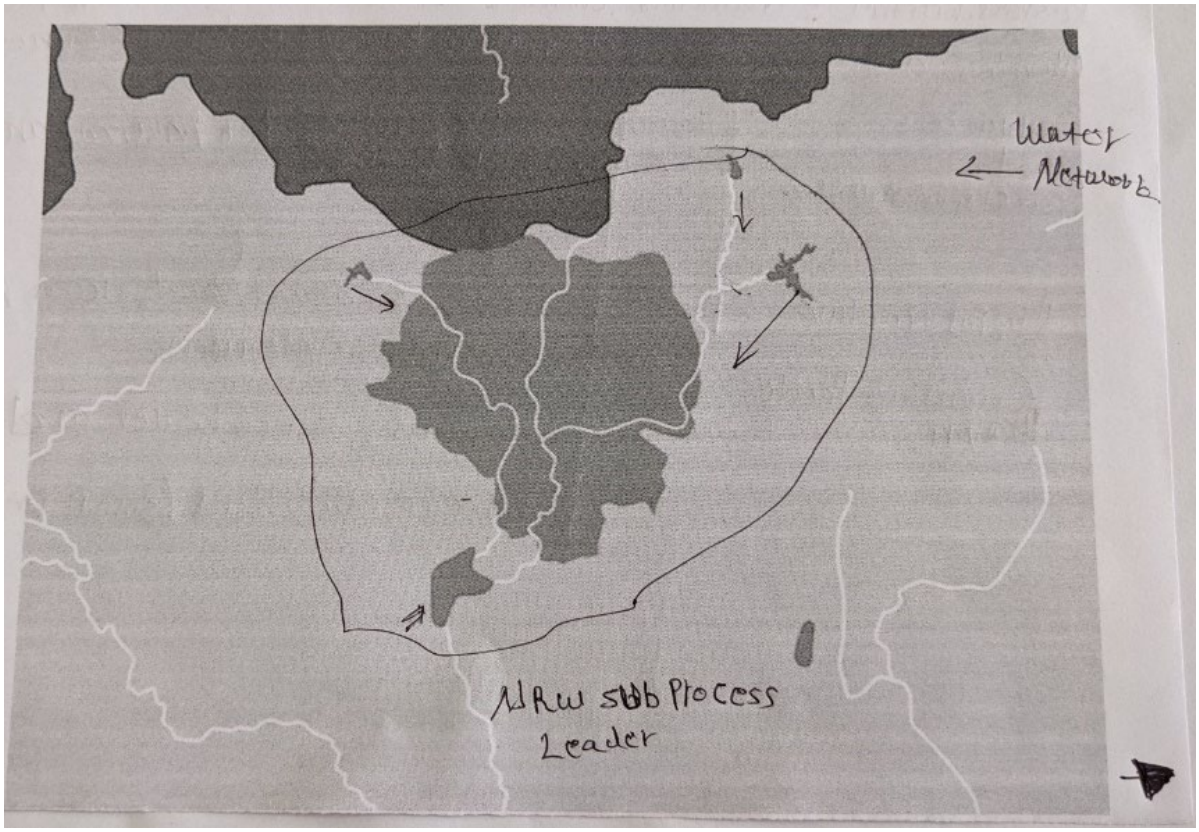
E.4 AAWSA individual boundaries and descriptions

Figure A4. Boundaries for Water Quality Control Head



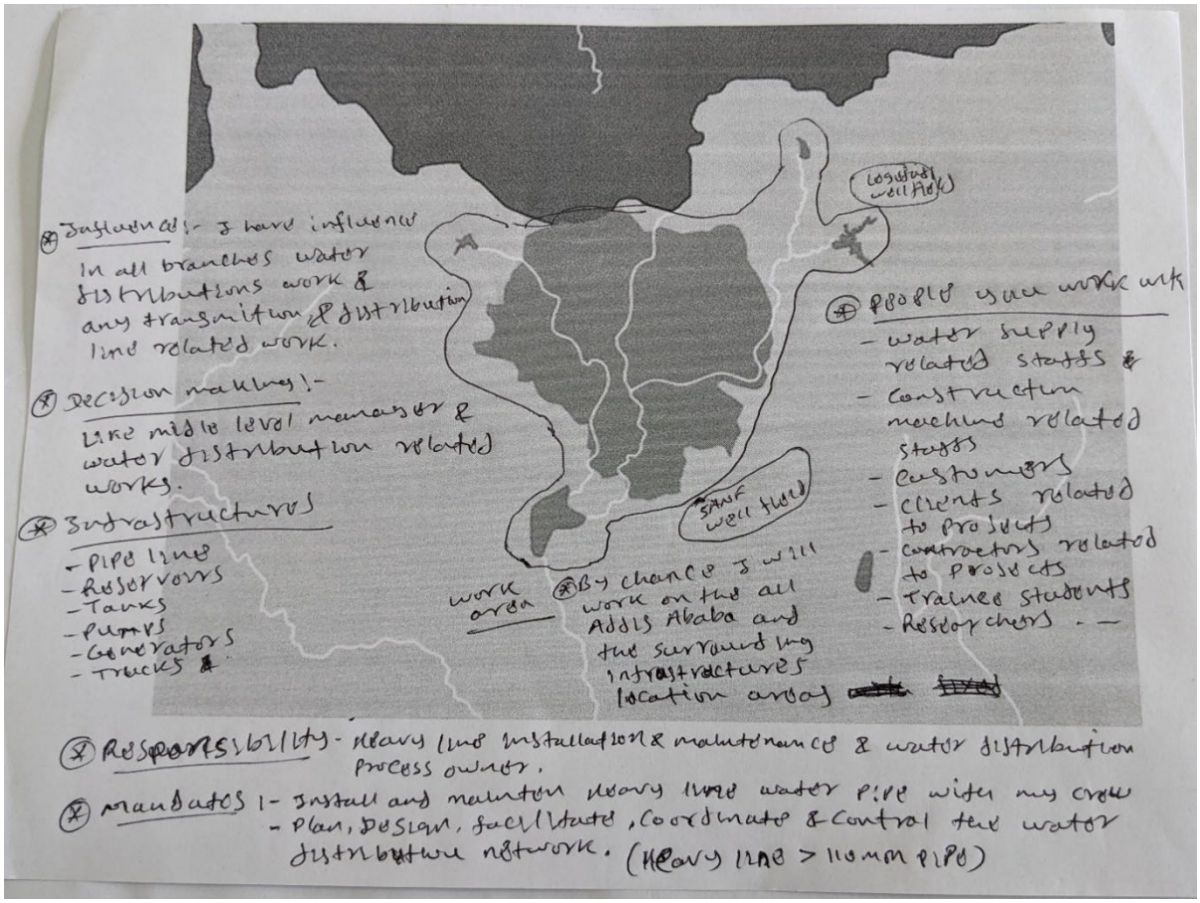
Text on the reverse reads: “Water source/working areas: Finfine Zuria special zone, Wolmera Woreda, Bereh Woreda, Sululta Woreda, Nuelo Woreda, Akaki Woreda, Sebeta and Alemsenu town, Gelan town, Sululta town, Legedadi-legetafo town, Sendafa town, Addis Ababa city. Water supply boundaries: Sululta town, Burayou town, Sebeta town, Alemgenena town, Sendafa town and surrounding areas, Legedadi-legetafo town, Dire town and surrounding areas, Gelan town and surrounding areas, Addis Ababa city. Decision making boundaries: Addis ababa city administration, Oromiya regional state administration, Finfine Zuria special zone administration, Bereh Woreda administration, Suluta Woreda adminisatrtion, Wolmera Woreda administration, Akaki Woreda administration, Sebeta Hallas Woreda administration.”

Figure A5. Boundaries for NRW Sub-Process Leader



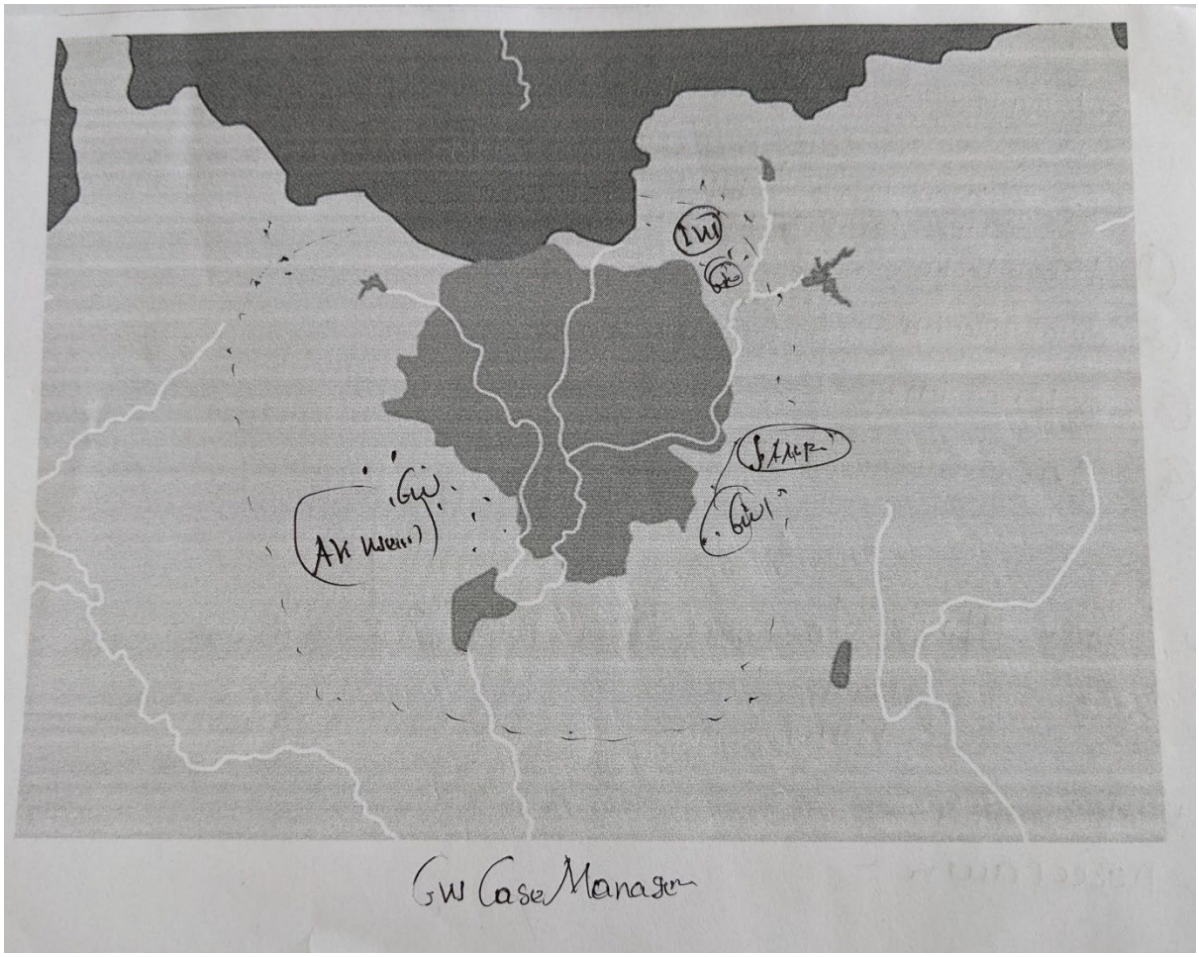
Text on the reverse reads: “Responsibilities: identifying, controlling and set reduction measure for NRW. Working area: all in addis ababa boundaries and water sources area. Influence and decision making: identifying and controlling both physical and commercial losses. Infrastructure: 1 dam, intake, treatment plant, access road and distribution network. Consulting people: customers, stakeholder and micro assositions (small enterprise).”

Figure A6. Boundaries for Supply Pipe Installation Planner



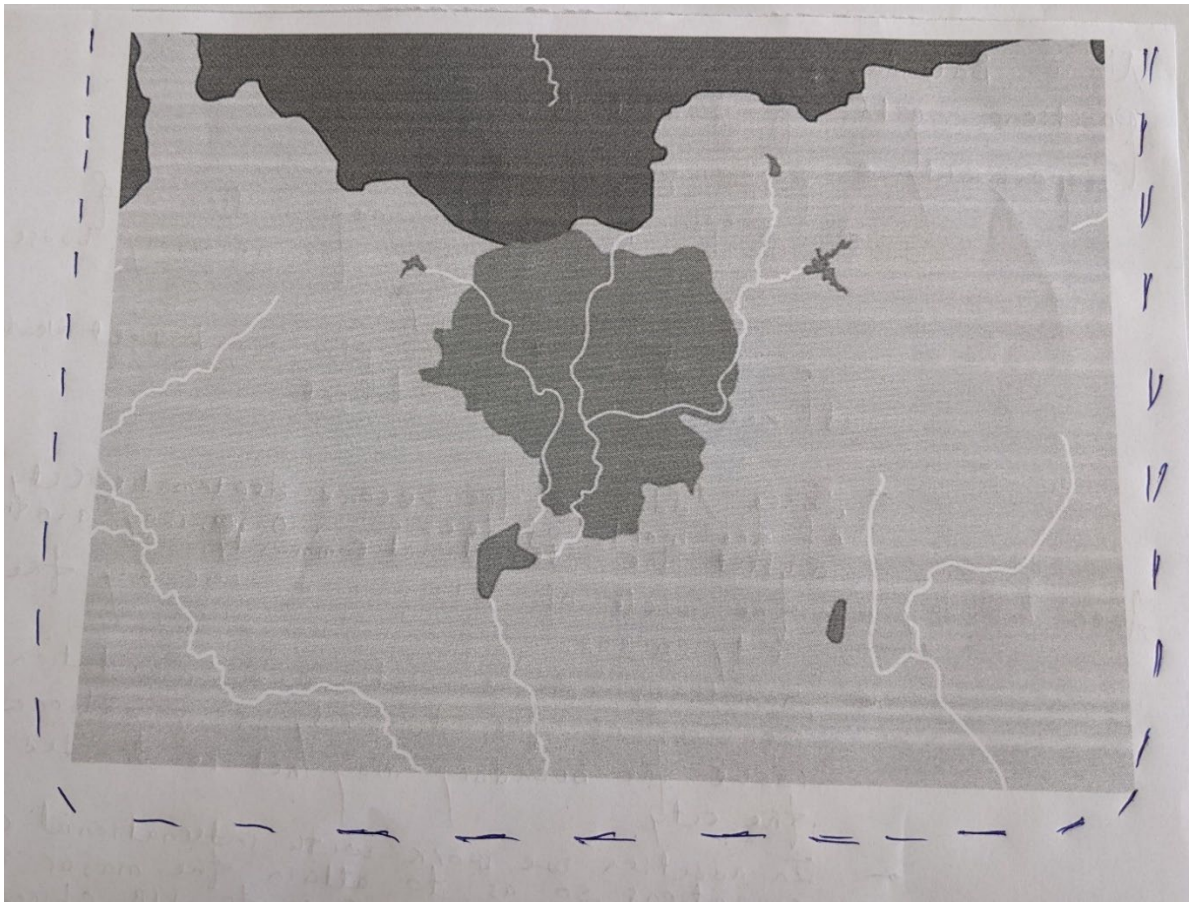
Text reads [anti-clockwise]: “Influence: I have influence in all branches water distributions work and any transmition and distribution line related work. Decision making: Like middle level manager and water distribution related works. Infrastructures: Pipelines, reservoirs, tanks, pumps, conerators, trucks. Responsibility: Heavy line installation and maintenance and water distribution process owner. Mandates: Install and maintain heavy line water pipe with my crew. Plan, design, facilitate, coordinate and control the water distributions network (heavy line > 110mm pipe). Work area: By chance I will work on the all Addis Ababa and the surrounding infrastructures location areas. People you work with: Water supply related staffs, construction machine related staffs, customers, clients related to products, contractors related to products, trainee students, researchers.”

Figure A7. Boundaries for Groundwater Case Manager



Text on the reverse reads: “1) collect daily production data, 2) Identify daily production data problem, 3) Measure water table, 4) Decide pump position. * emergency praple, *tlactron. Cause at Water: Imbanitation, deterastation, migration, industrialisation. Supply utility to rural area (people – decision making) water, light. Job opportunity, project awn.”

Figure A8. Boundaries for Planning and Budget Head



Text on the reverse reads: “Responsibility: preparing long term, medium term, and short term plan and the necessary budget for the authority. Follow and monitor the plan and budget weather it meets the intended target. Since Addis is the second diplomatic city of the world of decision in one way or another affect the international community. Area boundary: the whole of Addis and near by city areas, sometimes since water and sanitation services of the authority is a national issue the boundary may not be limited to the city. In addition we work with international organisations so as to attain the major goals of the organisation. E.g., the WB, Chinese EXIM Bank, the like …”

Figure A9. Boundaries for Water Quality Expert

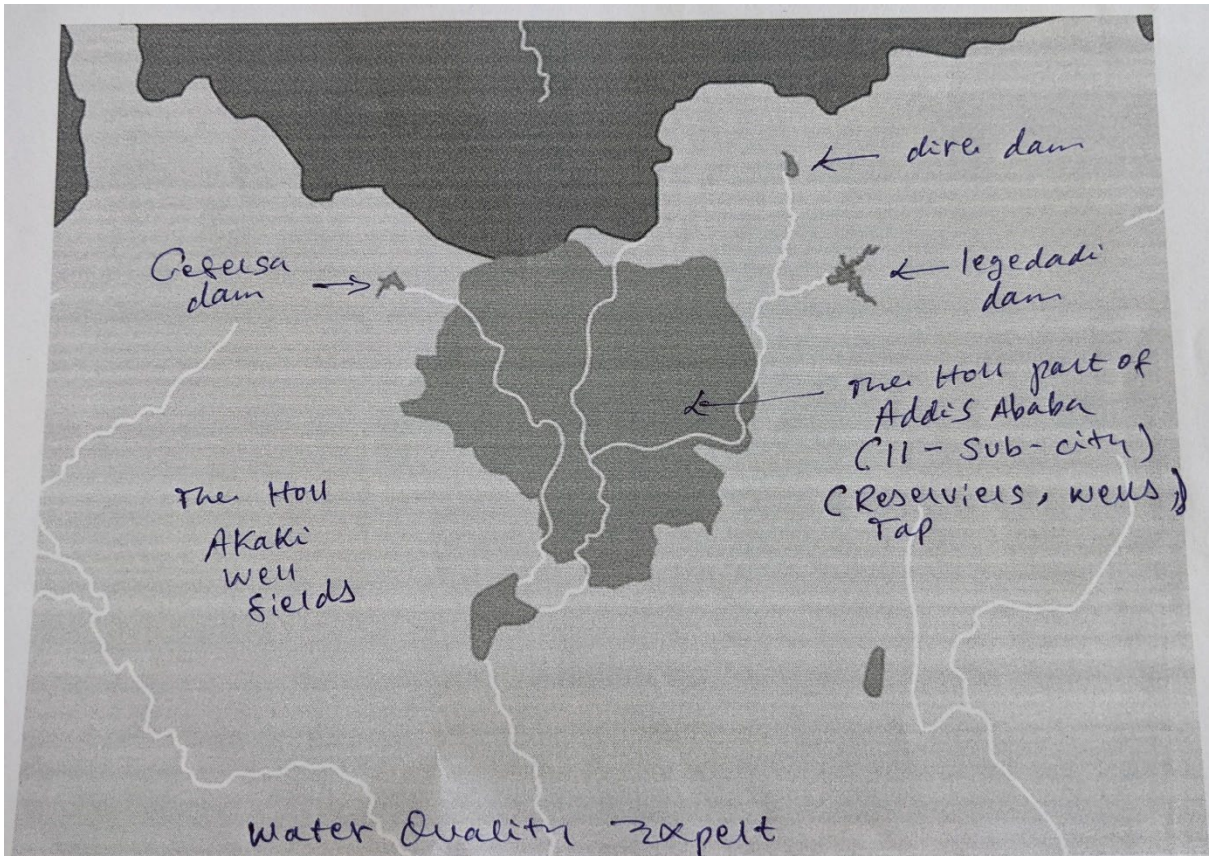
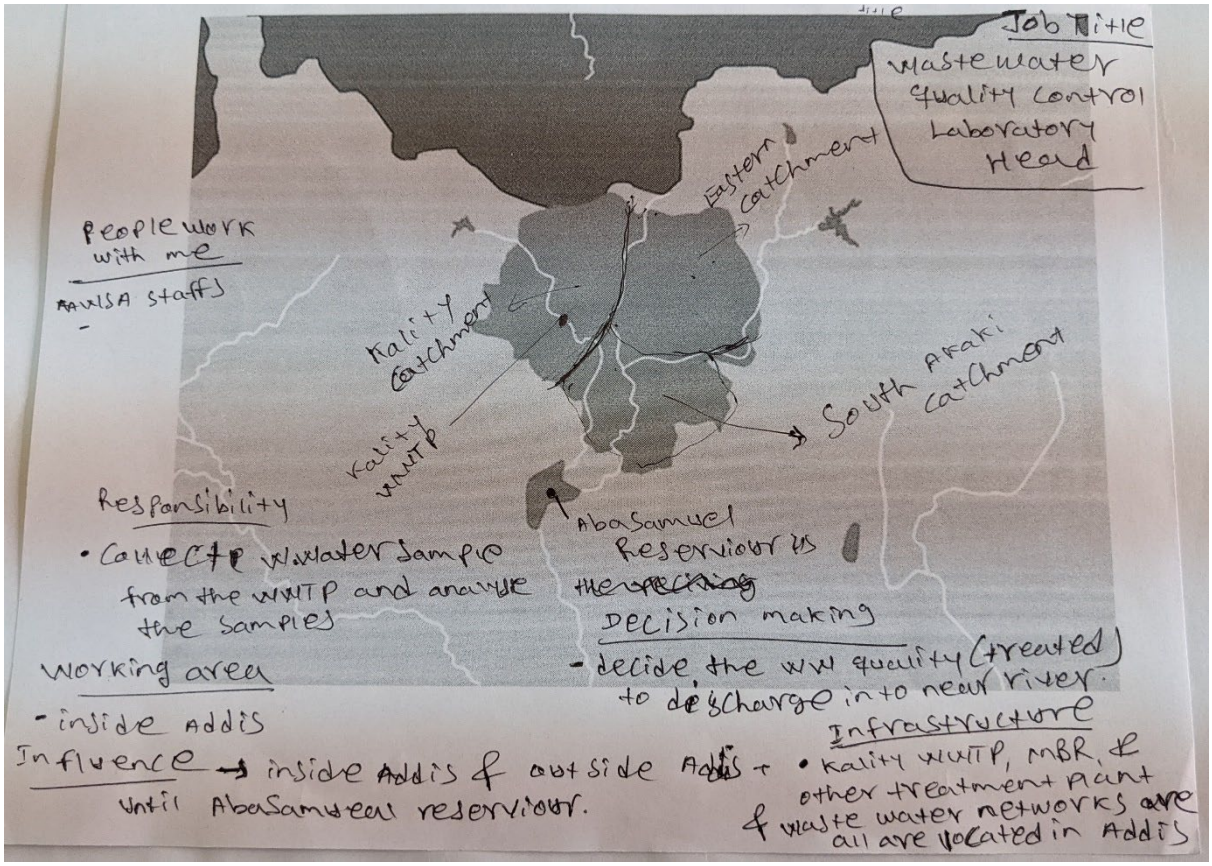


Figure A10. Boundaries for Wastewater Quality Control Laboratory Head



Text reads [anti-clockwise]: People work with me: AAWSA staffs. Responsibility: Collect W.Water sample from the WWTP and analyse the samples. Working area: inside Addis. Influence: inside addis and outside addis and until AbaSamueal reservoir. Decision making: decide the WW quality (treated) to discharge into near river. Infrastructure: Kality WWTP, MBR and other treatment point and waste water networks area all are located in Addis."

Figure A11. Boundaries of a Sewer Connection Line Planner

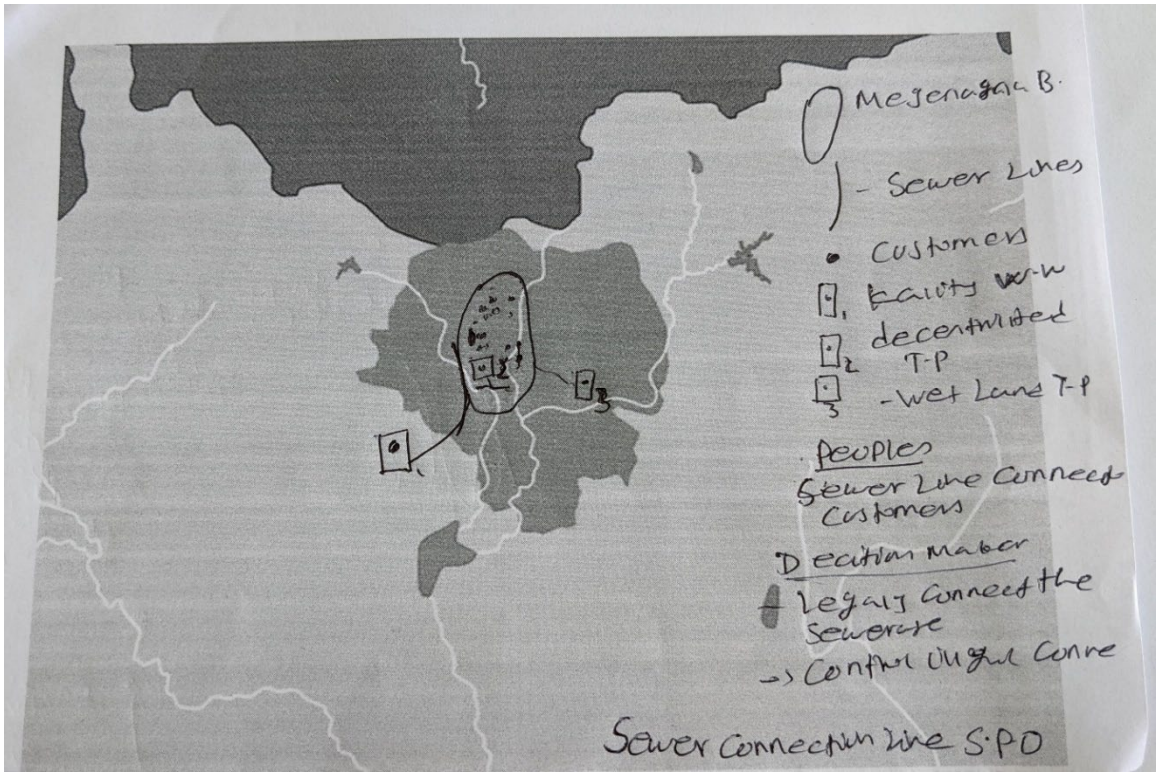
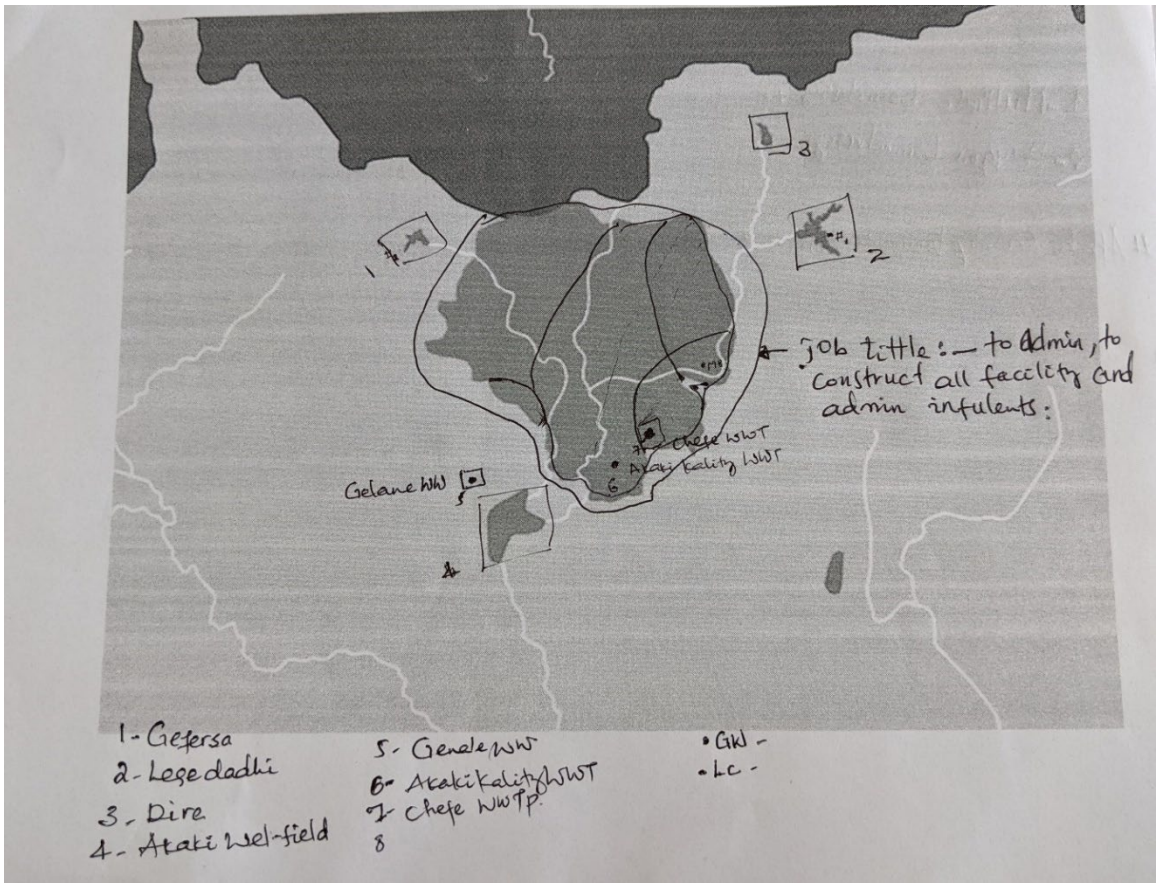


Figure A12. Boundaries of a Wastewater Planner



Appendix F. Oromia Water Bureau key informant interviews

F.1 OWEB interview guide

Introduction to research

This research looks at understanding water issues across the Akaki catchment and beyond.

I am interviewing key informants, citizens, and relevant authorities, ministries, and organizations. This is to help understand how water issues are caused and what the causes and impacts are from different perspectives.

This interview will be no more than 1 hour, and it will be semi-structured. This means there are topics of discussion, but it is mostly directed by you, the participant. Audio will be recorded.

There are three parts to the interview: (i) an initial survey; (ii) water issue discussion based on boundaries; (iii) water issue discussion based on your role, knowledge, and experience.

I will be using the answers as data to build a picture of water issues in the Akaki basin and beyond and provide recommended governance solutions. Even though we are recording the audio, the discussion we have will be completely anonymous and you will not be identifiable in any recounts of the interview.

I will share any relevant findings with you, with your permission, once my research is concluded. But I will need to take your contact details. These will not be shared with anyone else without your permission.

You are allowed to stop the interview at any time and your responses will not be used.

Do you have any questions?

If you would like to proceed, could you please sign the consent form.

Opening

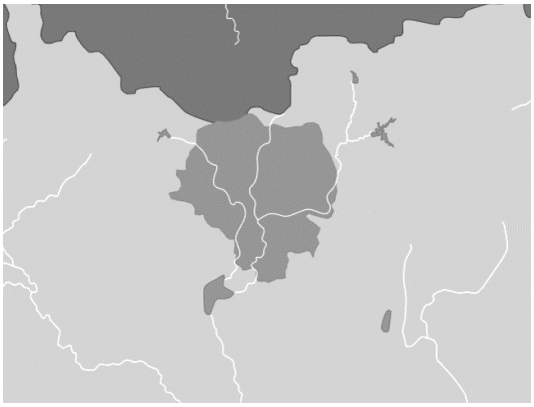
- ☐ Thank the participants for taking their time to help with this research
- ☐ Introduce the research using the interview brief

- [ ] Ask if they have any questions about the interview brief or the research
- [ ] Ask them to sign to the consent form
- [ ] Ask them if they have any questions about the consent form
- [ ] Repeat that they can withdraw from the interview at any time and the responses will not be used
- [ ] Repeat that their responses will remain anonymous
- [ ] Say that the interview and recording will now begin.

Interview Guide

- What water problems do you work with in your role?
- What water problems do you come across more frequently than others?
- What differences do you observe in terms of water problems at different scales (over time, and over different areas)?
- What do you think causes this problem? Is it an individual thing or a combination of things?
- What sources, characteristics, responsible bodies, management actors, does this water problem have?
- What would/could/does worsen these problems?
- What environment(s) do these problems exist in? e.g., specific areas, types of areas
- What causes variations in these problems (e.g., seasonality, level of urbanisation).
- Who is responsible for this problems?
- Where and how do stakeholders interact with common water problems?
- How are boundaries determined – how and by whom?

Use the diagrams below to explore the dynamic and geographical relationships between answers to the questions above.



Role and Knowledge

For this topic, we are exploring the specific role and knowledge of the key informant in relation to water security. This involves their perspective of water security and priorities in relation to their work as well as any specific guidelines/mandates they operate within that they believe is related to water security.

- What is your perspective of water security?
    - What does it mean to you?
    - What water security priorities are there in your work?
- Do you work within any frameworks, guidelines, or mandates that specifically focus on water security?

Supply and demand challenges

For this topic, we are trying to understand the various uses of water (demand) and the various issues with supply (quality, quantity, access etc.). It is important to try and get an insight into scales of severity (e.g., how bad something is, how urgent something is, how important something is) as well as a perspective of how/if these things have changed over time.

Some question prompts if needed:

- What is your biggest concern for water?
    - Drinking water supply?
    - Reduction in quality?
    - Flooding?

    - Rainfall variability?
    - Explore these between rainy season and dry season
- Explore how water is obtained for different purposes and if that has been different over time
- When do you feel most and least concerned about water? Quantity, quality, availability, extreme events?
- Have you noticed a reduction in water availability since working here?
    - Explore quantity, quality, and access
- How do you personally respond to water issues in your working role?

Closing

- [ ] Raise awareness that the interview is coming to an end
- [ ] Ask if there is anything that hasn't been mentioned that they feel is important
- [ ] Ask them if they have any questions for you
- [ ] Thank them again for taking part
- [ ] Tell them that you will let them know how their responses are used if they wish

F.2 OWEB key informant interview transcripts

F.2.1 Key informant 1 (Lege-tafo Lege-dadi)

Question: What is the role of water in your opinion? What problems do you think about water in your work?

Response: It's said that water is life. From animate to inanimate there is nothing that water cannot touch. It is especially important for human beings. Then the problem of water: one is scarcity. It is second, quality. The third is accessibility. There is a lack of space even to provide water cover. In general, these are the problems.

Question: What water problems are you working on?

Response: What we are doing is: First, digging water wells. There is a shortage of water. We dig a well. In addition, we dig wells and lay lines through projects, begging, and loans. Then water line expansion works. The other one will be delivered to every home by communal water point for the community. It is the problems that live in the middle that are difficult. Especially shortage of water. Again the capital for waterworks is huge. Digging wells, laying lines, widening etc. for water development. These are the visible problems.

Question: Are there any problems you have encountered in your efforts to solve the water problem?

Response: The problems we faced: The first is to stay away from the water source on the asphalt road. Most of the springs around here have wells that are five or six meters deep. But the water wells we use should be 100 meters, 200 meters to 500 and 600 meters deep wells. Second, Addis Ababa city water has many wells in this area. And because of uses this, it causes the other water sources to dry up.

Question: How do you describe the water problems on a scale level?

Response: Most of the water in this area is piped from underground. Because of this, there will be no quality problem. But when we do, when lines break, when we don't work properly, the water gets dirty. Even when the water reaches the house, there is a situation where the water becomes dirty because people do not wash the water taps

they use. Other than that, the problem is mostly with the cover. About 68% of water supply coverage has been achieved.

Question: What do you think is the cause of water problems?

Response: The water problem: One is climate change. It is the biggest problem. Second, the fact that the city of Addis Ababa has many deep wells used for water in this area has had its impact. For example, people around the city use spring water for animals, to wash, etc. they use Thus the source has dried up. This is a man-made problem. Another problem is lack of technology. For example, we do not have a laboratory to determine the health of the water; we take a water sample and analyze it once a year. So, the water can get dirty at any time. The water lines were also laid out by experience, not based on GPS. We have asked for someone to contact them in the event of a breakdown. These problems are generally lack of resources and lack of use of technology. For example, when water comes out of a well into a tank, it needs a meter; but we don't have any calculations that do this. I think there are problems here as well.

Question: Are there any bodies that you think should take responsibility for the problems you have raised so far regarding water supply and quality ?

Response: Yes. For example, through cleaning, the society must maintain its cleanliness. In addition, the community must protect the water sources in the area. I think this is the problem of society. I think that the other thing is the problem of the bodies working on the water. For example, when Addis Ababa took water from here and the source dried up, it should not have been silent. Water supply to the community has recently started here. So I think this is a big problem. I think it is better if the society in Addis Ababa and here use water together. I think there is also a policy problem. For example, when one entity benefits, it should also benefit the community of that area. Of course, there have been recent improvements; but waterworks are not a quick fix. It takes a long time. In our country, the project takes five to six years. So this is a problem with the government. There will be problems that the city administration will solve by itself. Another type of migration (rural to urban migration) causes cities to become unsustainable or disadvantaged. With water supply and quality, this problem

has become negative and unexpected. It makes the problem worse. Source avoidance is another aggravating problem. In general, I think these problems are exacerbated.

Question: How do you describe the problem of water from the environment?

Response: There is a problem of not taking care of land outside the city. There is cutting down of trees and soil erosion and landslides. This is not well maintained. Besides, the rivers in the city are heavily polluted. There is no type of garbage that cannot be thrown away. I think this is the biggest cause of environmental pollution, water pollution or quality problems. We don't have much industry here (Legetafo). But garbage from every house is polluting the rivers.

Question: What problems are there in the city's water due to the change of seasons?

Response: During the winter, due to floods, unexpected water enters the village and people's houses. This flood causes various damages. Even if it does not destroy human life, it destroys property. In summer, there is a problem of water drying up. It used to rain in April. But this year it started in June. As a result, there is a disturbance in the rainy season.

Question: Is there a party that you think is responsible for the problems that occur in the water?

Response: First government is responsible. Therefore, the issue of water should be managed through policy. Government bodies must implement what is in the policy. I think the society should be aware and participate. The people, including us, must play their part in the water problem.

Question: Where and how do you think the different stakeholders can discuss to solve the water problem?

Response: Most of the discussions are done through the Ministry of Water. Then the discussion can be carried out from the Ministry of Water to the region, from the region to the zones. For example, we often discuss directly with Addis Ababa water and Sewerage Authority (AAWSA). But what should have happened was if the life of its own framework was carried out through the region and the regions worked together with us. We only ask for it when we are in trouble, but not for the normal life of our own discussion guide.

Question: Who and how are the borders of the water region determined?

Response: There are urban and rural boundaries in the Oromia region. But we have not divided the water border yet; we provide water. We are not limited by borders. But our line with Addis Ababa is not different. In terms of water supply, there are rural districts and kebeles outside the city, Tafo, and Sandafa regions. We will make water available to these places. We give. However, there is still a shortage of water due to the large population in the areas.

Question: Where do you think there is a water quality problem in your city?

Response: There is a dry water source on the side of Sandafa. But there is no water quality problem in this city; Water quality problems can be caused by contact after community extraction. But the main problem is shortage of water.

Question: Is there any problem you have noticed in the Addis Ababa zone regarding water?

Response: Addis Ababa is improving now. But before, they used to take water without giving a drop of water. This is a big problem. Most of the people around here raise animals. Water is pumped by hand. And they were having a hard time. But now they have started to provide some water supply to Addis Ababa zone. It's getting better. I think they should do more in the future.

Question: What do you think is the biggest problem that you have noticed in water supply and demand?

Response: My biggest concern is the problem of water shortage. Water scarcity comes first from failure. Second is the overuse of groundwater. Addis Ababa uses up to one hundred liters per second. Thus, there is a very intensive exploitation of water use. This type of water exploitation may one day dry it up. The area is plain. A dam cannot be built. So this concerns me. Apart from that, climate change, environmental concerns have their own impact. I think the more environmentally conscious we are, the more water resources we have to conserve. Groundwater may dry up; this is the biggest concern and concern. We have not been able to solve the problem of water shortage quickly because the water project takes a lot of money and time. As additional

water projects are delayed, existing water resources may dry up. Also, this is a big concern.

Question: How would you describe the issue of water quality?

Response: At the current level, there is no problem of the quality of the ground water decreasing. The quality is guaranteed. There is no reduction.

Question: Are there differences in rainfall patterns in this area?

Response: Yes. This area sometimes gets heavy snowfall especially in winter. Sometimes there are heavy floods. Sometimes there is a drought and it seems like the whole winter is gone. In general, the variability of the rainfall pattern is observed. But since this area is mountainous, there is no severe lack of rain. But first, when a large population settles in the area, the water that should enter the ground is channeled into the river through a dug canal. This affects the groundwater. Second, the plastic wastes that are often dumped in the area affect groundwater as they prevent water from seeping into the ground. Another big problem is the poor maintenance of the upper watershed. All of these have an impact on the ground water.

Question: Is there a time when you think we have a very serious water problem?

Response: We have a serious problem when the devices that make water accessible fail. It is especially difficult when the water pump burns out. The item is not available on the market; if it can be repaired, it will not be repaired quickly because there are few experts. In addition to not finding the goods on the market to buy new, there is a dollar problem. As a result, the water pump burned and lasted for more than twenty days. Therefore, people who get water from the pumped line will not get water for at least a month. Most of our water supplies are already unreserved; we have a direct water line. So we don't have a backup in case of a crash.

Question: Will the water supply tend to decrease?

Response: Yes. There is a decreasing trend as there are dry wells and rivers.

Question: Are there any different guidelines and frameworks that you use in the work you do on water supply, quality and safety?

Response: We don't use anything. We just give it away.

Question: Is there a work framework that you think is good for the quality and success of the work you do or work in the field of water protection?

Response: First, if we know our lines well, it would be good to have a complete mapping of which milliliters are in which places. Apart from this, if we know where water reaches, where it does not reach, it is good if we know the quality of the water until it reaches the society from the ground. Apart from this, it is good if our water service delivery system is improved.

Question: Do you have any additional ideas that we have not mentioned or would like to express regarding the points we have raised so far, that is, water problems and safety?

Response: This city does not have a place to dump solid or liquid waste. This is a significant contributor to water poisoning and pollution. Another water basin in the city is also a big problem in causing damage to the ground water.

Question: Finally, if you have any questions you would like to ask the researcher?

Response: What is the benefit of your research? I want to ask that question.

Researcher's Response: I believe that by sharing the final findings of my research with you and other stakeholders (especially the administrative department), I will create inputs of recommendation to solve problems.

F.2.2 Key informant 2 (Burayu)

Question: What kind of water problems do you think there will be in the area where you work?

Response: One problem is supply-side. Second, there are some industries in this city (Burayu), although not many. These industries cause water pollution. But mainly there is a problem of population size and water supply imbalance in the city. If the city has the capacity, there is a problem of using the capacity, developing it and delivering it to the society. Another problem is that we do not supply water properly and there is a huge problem of Electric power outage. On the other hand as the city is expanding, the increase in population will cause severe water shortages.

Question: What are the water problems that occur more often than other problems?

Response: One of the most frequent water problems is the power outage. The second problem is the expansion of the city. Burayu city is very close to Addis Ababa, so many people leave here and go to Addis Ababa to work. Therefore, as the population of the city increases, water consumption increases. This is the biggest problem of water scarcity.

Question: Are there any differences in water problems that have been observed or noticed in terms of environment?

Response: In this area the underground water quantity is very low. We have a dry well here on a kebele called Guji. Because of this, we plan to dig another well. The previous borehole is about one hundred and thirty meters. But now we are studying to dig another borehole up to 400 meters away. Another problem that I have seen in a different way is that there are various constructions (house building work) going on in the area's waterways, whether illegally or otherwise, to expand the city. Therefore, it is very difficult to maintain or repair the lines when they fail in construction sites.

Question: What do you think causes water problems?

Response: The first cause is population growth. Others are climate change in the environment and misuse of our water resources.

Question: Are there any bodies that you think should take responsibility for the problems you have raised so far regarding water supply and quality?

Response: I don't know who is responsible for the overpopulation problem. Perhaps it can be addressed through policy at the national level. I think the other solution is to be able to create awareness.

Question: How do you describe the conditions that can aggravate the problems caused by water?

Response: First, there is the security issue. If there is no peace in the suburbs of the city, people are likely to migrate to the city. This exacerbates the water problem. Second, if population growth continues, it will make the problem worse. The work of building houses and expanding the city will make the problem worse. Another problem is the spread of desertification.

Question: Who do you think could be responsible for the worsening water problems?

Response: The first office to blame in this case is the water utility. They should not stand by while construction is being carried out on the existing waterway. They must ask, fight and stop. It should also be controlled. Second, the government must also fulfill its responsibilities.

Question: Where and how do the different stakeholders discuss to solve the water problem?

Response: The problem first comes from village, Kebele. We have regular meetings not only on water issues but also on other issues. We will also talk about water there. When there are various problems related to water and other issues, the city mayor's office gathers the people and discusses them every Wednesday. Incidentally, the mayor of the city is also the chairman of the Water Development Board. Any problem of the society will be presented and discussed. When there is a problem with water, the community gives information by calling or directly in person; and also asks a question. Another, we open a Telegram group on social media and connect with certain people who will give us information if there are problems with water. This is how we access and exchange information.

Question: What do you think is the biggest issue that you have noticed in Burayu city regarding water supply and demand?

Response: We said there is a shortage of water in our city. But also not supporting and using technology to make available water fairly accessible is the biggest issue. We have twenty ground water and one spring for a total of twenty one water resources. Not supporting these with technology is a big deal because it doesn't allow you to identify what is wrong with them.

Question: How do you describe the issue of water quality?

Response: There is also a serious problem in terms of water quality. First, there is no organized water quality testing laboratory; Water quality is not regularly monitored. What is being done now is the work of delivering water, not providing it with quality and standard. Therefore, this gap has caused serious problems in water quality. As the population of the city (Burayu) is more than five hundred thousand, the standard of the city is first rank. And according to science, a person should get at least eighty liters of water a day. This did not happen because the water supply was insufficient. Also, it is not of consistent quality. For this reason, the main issues are: firstly, the water supply is low, secondly, it is not supported by technology, and thirdly, the quality is not verified by the laboratory.

Question: Do you have any problems related to water due to floods?

Response: Although there is no particular flood in this area, in winter, flood silt is deposited in the area where there are water wells. At that time, if we have a breakdown, we will not be able to enter the vehicle for repair work. We face this problem. For example, two wells were covered with flood silt and we used another way to enter and repair.

Question: Are there any differences in the problems caused by the lack of rainfall in this area?

Response: It's been about six months since I came here. Since I came here, I don't have the information about the seasonality of rainfall. But the rain situation is not much different from Addis Ababa. Of course there is a problem with the groundwater. However, an objective study is needed to determine whether we have used the

groundwater more than it should or because of climate change. But as it is, the water well, which was used for many years, has dried up. This means that the city probably had more water in the past than it does now. I came here recently so I don't know more. But as people say, winter started late this year.

Question: Have you experienced a decrease in groundwater?

Response: Some have reduced water levels. There could be many reasons. First, because the well is washed. The other is that there may be a decrease or even loss of water due to drying up due to various reasons. The existing wells are dug to a depth of five hundred and four meters. We have completed the study to dig a four hundred and fifty meter deep well and it is in our hands. Seven other wells are recommended to be drilled at a depth of 500 meters. In total, we are preparing to drill eight more wells.

Question: What do you think is water security for you?

Response: Humans are naturally adaptable to disease and climate; they also learn a lot. For example, one gets used to living in a desert; Even if it goes to a very snowy place, it will get used to living. He also gets used to drinking clean well water. He also gets used to drinking tap water. As it should be, water security is inseparable from its supply. But we are getting used to it and we are just giving it water. So people get used to that. However, the issue of water safety is also set in law and regulations. We are also responsible by law. For example, if there is an epidemic, it will spread. We do not separate water safety from life; it is very much needed. But the reality is that we are living by adaptation. This is all about.

Question: What do you think is the water priority?

Response: Our first priority in Burayu City is water supply. The second is to keep the water clean.

Question: In Burayu City, do you have a framework for the work you do or water work?

Response: We are working on job change improvements with a strong focus on water quality. The issue has been included in the law and decree for strict monitoring. In the Oromia region, the work structure of the water service has brought the

framework down. What used to be done in the past is being guided by a framework. With this, a higher body will come and take a laboratory sample to confirm the quality of the water. A work structure has been organized to monitor the quality of water regularly. Due to financial difficulties to support this work with technology, we wrote a proposal and gave it to a non-governmental organization. We are trying to follow the work structure to make the water supply and quality equal for the left eye and the right eye.

Question: Do you have any additional ideas that we haven't mentioned or would like to express about the points we've covered so far, namely around water problems and security?

Response: I think there is something that has not been raised in relation to awareness and capacity building. Most waterworks are done by professionals. Such as Water supply, water quality etc. Here is a professional. From this point of view, it is good to see the gap and what should be done there? It would be a good resource to check things out. It is good if systematic support is given to the human resources by different bodies. On our side, we are working together with non-governmental foreign organizations on water issues. For example, in collaboration with a foreign (I think it's from the Netherlands) non-governmental organization called "Vitens Evidence", we completed the construction of a 3.4 km water line. We are looking for someone to support us in the next lab setup. In this regard Netherland is a country that has better experience. In addition, we have asked for support to provide us with various water meter equipment and training in water development work. We are making an effort by asking another party to support us through technology support.

Question: Finally, is there anything else you would like to add?

Response: No, there is not.

F.2.3 Key informant 3 (Gelan)

Question: How long have you been working here at Gelan?

Response: I started working at this place since 2005 E.c as an ordinary technician.

Question: What are the water problems in the area where you work?

Response: There is limited capacity in our office to dig wells and benefit the society. Our job is to take care of our water resources and deliver them to the people. From two liters per second to thirteen liters per second, we supply about four thousand cubic meters per day to the city's (Gelan) water service. According to the data of three years ago, the population of the city is seventy-eight thousand. But now the population will be more than one hundred thousand. The flow of people entering our city for various purposes (factory workers, residents building or bought home etc.) also puts additional pressure on water consumption. Our water development work has been stopped since 2010. We do not have any newly built or dug wells. There are also water projects that have been started. We may not be able to make the existing water resources accessible to the society in appropriate conditions due to power cuts. In our four kebeles, our employees work hard outside of regular working hours. When the community faces a water problem, they call our office. We will immediately communicate with the workers and deliver water to the community.

Question: What are the water problems that occur more often than other problems?

Response: yes; One, the most frequent water problems are caused by power outages. The electricity situation is not a lack of power, but because the electricity poles are old and worn out, every time there is rain and wind, there is a problem of power cuts. Since water and electricity are connected, when the electricity goes out, the water pump goes out with it. Second, because we operate water pumps for long hours, there is a risk of burnout. Buying and repairing will be another problem.

Question: Which of the frequent problems with water is the highest?

Response: It is a problem caused by power outages. But now the problem is being solved in some way. But the power outage situation was a big problem before.

Question: What do you think causes water problems?

Response: It is difficult to say that it is. Problems are interrelated. For example, when we announce to the electricity company to solve the problem of electricity, they give Response s like, "We don't have employees, employees can't work outside of work time because they don't get paid outside of working hours, and the office can't order because there is no one to take the responsibility of risks". Due to this everyone is pushing things away.

Question: Do you think there is a body other than electricity that should be responsible for water problems?

Response: In our office, the awareness of water is not that well developed even by the upper body. At some point, there are things that are done passionately for political gain. Then there is the slowdown. Then the pressure will be on the water development office here. As you know, water development projects require a large budget. To do this, it needs to invite many stakeholders. They are often non-professionals who come for job placement or support. This adds to the problem as it is another challenge in itself.

Question: Have you ever faced the problem of environmental pollution in this area?

Response: We have never met (pollution) before. But fluids from factories are very high. Their color and smell are very strong. But we will go and notify them immediately and it will disappear within two days and then come back another day and release the discolored discharge. It also harms the farmers' animals. Many companies (especially Chinese companies) have been harassing us by laying sewage lines on our water lines. But now an order has come from the higher authority and the problems are being solved by discussing.

Question: Have you ever faced unexpected rains related to the season in the city, and did it cause any problems?

Response: No, there isn't.

Question: Where and how do you discuss with different stakeholders to solve the water problem?

Response: We do not have the experience of discussing with each other. But we are planning to run awareness programs in the future. We are working together with the

mayor of the city to solve the problems. In this way, we have made them use communal water in one kebele.

Question: When water-related problems arise, are you the ones who solve them?

Response: Yes, we solve our problem by ourselves. We solve it with our own staff and our own office. The Oromia Water Office will send us a machine and a driver. We have our own staff so we do it with our own staff workers.

Question: How deep are your boreholes/wells?

Response: They are between 158 and 500 meters deep.

Question: How would you describe the issue of drinking water supply in your city?

Response: There is no line that did not reach water in the area where our city is located. At communal water, house to house, we have made water accessible to every house.

Question: How would you describe the quality of drinking water in your city?

Response: Since we don't have our own lab, we flush our water tanks every three months. We have four water storage tanks; we wash these regularly (every three months). The water comes from the well and then into the storage tanks. It is then distributed directly to the community. Therefore, we wash our water storage tanks every three months, whether they are dirty or not. Whether we repair water lines or not, we flush with chlorine. And when we see something out of the ordinary, we sample it and show it. Another one is Addis Ababa University, they come every three months and take a sample from each water well (in Afan Oromo we call it "Kurmana"). Again, we will take a sample from a community that we say we have doubts about; they send us.

Question: Have you ever had a flood related to your well?

Response: No, there isn't. We have never experienced anything like this. There is no harm that bad. It's simple.

Question: Are there any problems by rains you have faced due to the change of seasons?

Response: In winter, there is not that much water consumption except for drinking and some other things. But in summer, it uses more water. Animals, people, and for washing clothes use the water provided by us. Therefore, there will be more pressure on our work. Water scarcity may also occur.

Question: Which do you think is more of a problem than water supply and quality?

Response: In terms of water coverage or supply, only one of the eight wells we have so far has declined. It is about 12 meters down from 120 meters. This is not that much of a problem. This is the only one we have had, no problems with other wells. Our biggest problem is the imbalance between the flow of people and the amount of water we supply.

Question: In the city of Gelan, do you have a work framework that allows you to facilitate your work on the work you do or the water work?

Response: Not even that much. For example, we have a lab problem. But we are in the process of hiring our own experts to solve the problems. We are working with various governmental and non-governmental stakeholders to solve our problems.

Question: Do you have any additional ideas that we have not mentioned or would like to express regarding the points we have raised so far, that is, water problems and safety?

Response: It would be good if the society works together for the common benefit of water development service, out of the spirit of ``what do I have to do with it?'' In addition, it would be good if a policy was designed and put into operation to ensure that the areas that are sources of water resources have access to water first.

Question: Finally, I have a forgotten question. You told us that power outages are largely a problem. Does this problem happen to all (all 8) water wells or does it only cover specific areas?

Response: The problem is for all. Most of the work, including ours, is not supported by science and technology, so even if it works, it will quickly deteriorate.

Question: According to the information we got from Burayu city, they told us that the Oromia zone has prepared a working framework to support water quality through

testing and to plan for water safety. Is this not the case for you? Because of we see it as a good thing.

Response: Maybe because each job has a department, for other department may have arrived. But I don't have this information. We often try to work together with different offices. But the change of officials in each office will cause the work that has been started to be left unfinished.

Appendix G. Regional water security perspectives and priorities: the Awash River Basin Organisations

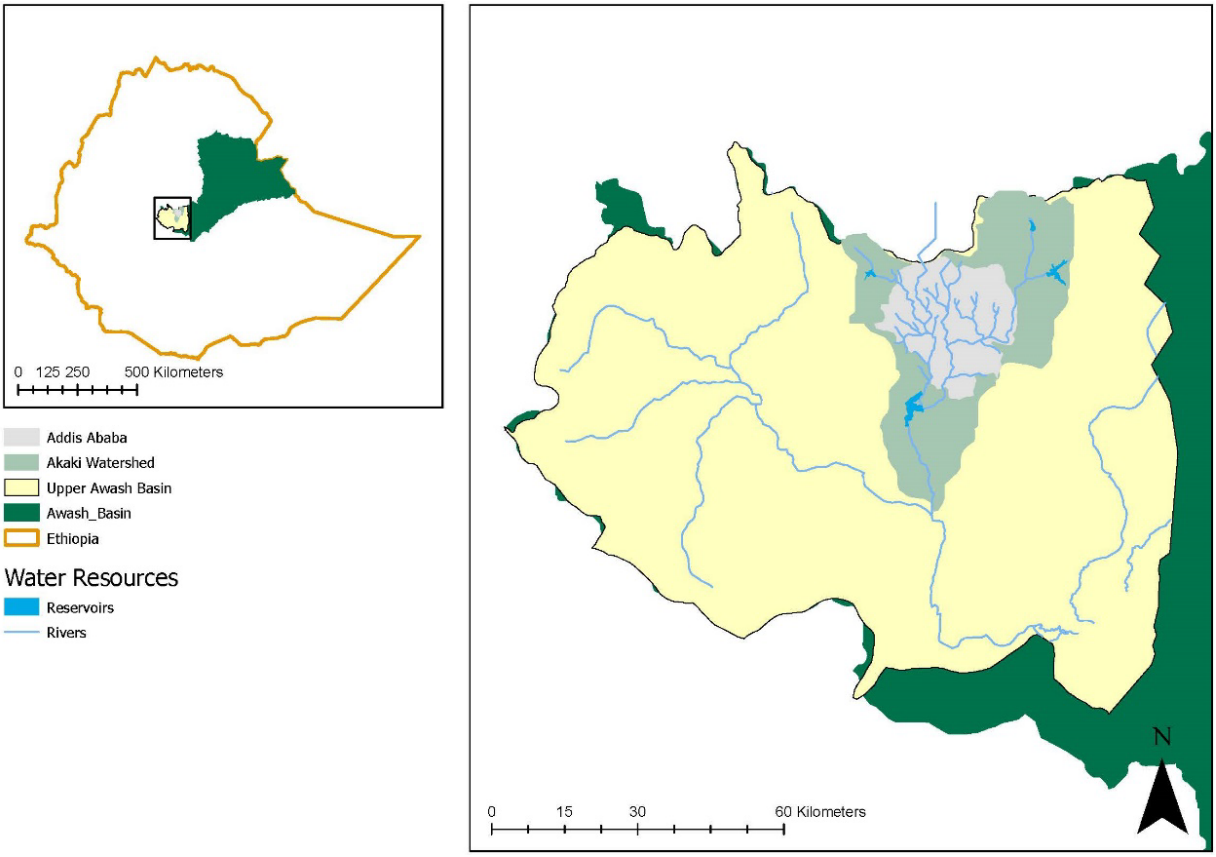
River basin organisations (RBOs) exist as an alternative regional water resources management body that operates within the hydrological – basin – boundary rather than administrative boundaries. RBOs include River Basin High Councils (BHCs) and River Basin Authorities[1] (RBAs). RBAs are accountable to their respective BHC (Proclamation No. 534/2007, Article 10), and both BHCs and RBAs are accountable to regulations set by the Council of Ministers and to MoWE (Proclamation No. 534/2007, Articles 5, 10, and 21).

The establishment of RBOs were a response to the Ethiopian Water Resources Management Policy (EWRMP) (MoWR, 1999) and Water Resources Management (WRM) Proclamation (FDRE, 2000), both of which emphasised the need to develop integrated water resources management (IWRM) plans and strategies at basin level (Tekle, 2019). RBOs are worth mentioning as part of the water resources management actors that influence water security priorities and perspectives in and around Addis Ababa, but they are not a main focus of this research[2]. Additionally, and as discussed in this chapter, their effectiveness as an authoritative body and hence their influence on water management in Addis Ababa is questionable. This chapter will therefore briefly outline the role, mandates, and influence of the RBOs that shape water security in the Awash basin, in which Addis Abba resides (see Figure A13), and are relevant for answering this thesis' research questions.

[1] A River Basin Authority being the secretariat of the respective River Basin High Council (Proclamation No. 534/2007, Article 8).

[2] The actors of interest in this research are those that operate within administrative boundaries, such as local communities (Chapter 6), utilities (Chapter 7), and ministries (Chapter 9).

Figure A13. Location of Addis Ababa in the Upper Awash basin



G.1 Establishment of the Awash River Basin Organisations

The 2007 River Basin Councils and Authorities (RBCA) Proclamation (No. 534/2007) (FDRE, 2007) brought the roles and responsibilities of RBOs into law, stating that the Council of Ministers must establish BHCs and RBAs for each of the 12 river basins[3] of Ethiopia (Article 3:1). According to the RBCA Proclamation, both BHCs and RBAs have the powers, duties, and overall objectives of promoting and monitoring 'the integrated water resources management process in the river basins falling under their jurisdictions with a view to using of the basins water resources for the socioeconomic welfare of the people in an equitable and participatory manner, and without compromising the sustainability of the aquatic ecosystems' (Proclamation No. 534/2007, Article 4). Some notable water security priorities for all RBOs could be inferred from definitions, expectations, priorities, and perspectives in the RBCA Proclamation. Namely, that water security would be a product of sufficient water quantity and quality (RBCA Proclamation No. 534/2007, Article 2:5, Article 2:7, Article 16:2), water security is central to Ethiopia's socioeconomic development (RBCA Proclamation No. 534/2007, Article 2:4, Article 4), and water security is impacted by the country's economic growth that has caused 'a correlative increase in water uses with quantitative as well as qualitative impacts' (RBCA Proclamation No. 534/2007).

The establishment of the Awash RBOs, with the Awash River Basin being one of Ethiopia's 12 river basins and the basin in which Addis Ababa resides (see Figure 86), was legally recognised under the Awash Basin High Council and Authority Establishment Council of Minister Regulation (No. 156/2008). Many of the powers and duties of the Awash RBOs (particularly the Awash RBA) defined in this Regulation, however, came from the preceding Awash Basin Agency[4] (as demonstrated in Figure A14). Although, the objectives of the Awash Basin Agency were not transferred to the subsequent Awash RBOs (see Table A3), demonstrating a shift towards IWRM as a central priority[5] of water resources management across

[3] The Abbay, the Aisha, the Awash, the Bara-Akaba, the Danakil, the Genale-Dawa, the Mereb, the Ogaden, the Oma-Ghibe, the Tekezem the Rift Valley Lakes, and the Wabi-Shebelle Basins (Proclamation No. 534/2007, Article 2:1).

[4] Established under the Awash Basin Water Resources Administration Agency Establishment Proclamation No. 129/1998 (FDRE, 1998).

[5] The focal shift and priority of an overarching Awash basin organisation towards IWRM was likely a result of multilateral initiatives, such as the Millennium Development Goals, and better access to

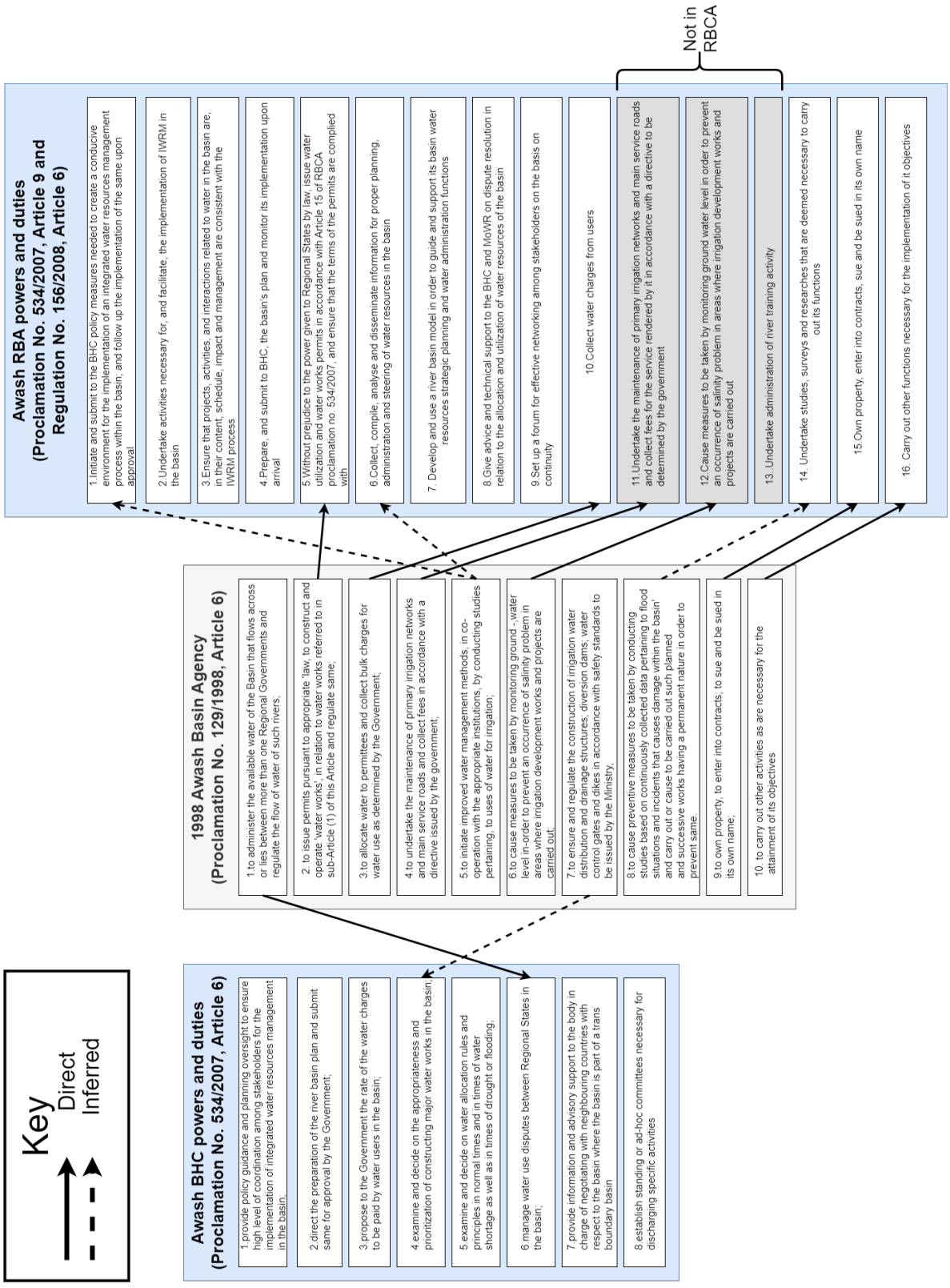
Ethiopia. It can be observed that in the creation of the Awash RBOs, one water security dimension was lost in the translation of powers and duties from the Awash Basin Agency to the new RBOs; the priority of water for irrigation development held by the preceding Awash Basin Agency was replaced with IWRM-focused initiatives based on resource management rather than utilisation (demonstrated in Table A3 and Figure A14).

Table A3. Comparisons of objectives of the Awash basin water management organisations over time

1998 Awash Basin Agency (Proclamation No. 129/1998)	2007 RBCA (Proclamation No. 534/2007)	2008 Awash BHC and RBA (Regulation No. 156/2008)
'To… coordinate administer allocate regulate …the utilization of the surface water resources of the [Awash] Basin.' (Article 5)	'To… promote monitor …the IWRM process in the river basins falling under their jurisdictions with a view to using of the basins' water resources for the socioeconomic welfare of the people in an equitable and participatory manner, and without compromising the sustainability of the aquatic ecosystems.' (Article 4)	To… promote monitor …the implementation of IWRM process in an equitable and participatory manner in the Awash basin.' (Article 3)

funding opportunities (from the World Bank, UN agencies, and other donors, for example) (Hailu et al., 1970; Giordano & Shah, 2014).

Figure A14.Powers and duties of Awash River Basin Organisations (basin high council (BHC) and river basin authority (RBA)) transferred from the preceding Awash Basin Agency



G.2 The 2017 Awash Basin Strategic Plans

As part of the Awash RBA's mandates, they must also produce allocation plans, basin studies and reports, research, and other strategies for water resources management (Regulation No 156/2008, Article 6:4, 6:14) within the guidelines of the EWRMP (Awash Basin Authority, 2017d). Consequently, in 2017, six eight-year strategic plans were published based on Water Allocation, Water Quality, Watershed Management, Flood and Drought Management, Basin Information Management and Communication, and Stakeholder Engagement. Notably some water security priorities for the Awash RBA can be inferred by the chosen focus areas of the six reports reflected in the titles and content. The strategic plans largely reflect the pursuit of water security through physical water (i.e., more water means more water secure), absence of water-related threats, and the obtainment of scientific and social knowledge about the water environment. The overarching visions and goals of each strategic plan (see Table A4) reflect these core water security themes, but also demonstrate the significant link between water and economic (at individual, regional, and national levels) security in the Awash basin; utilisation of water resources for unlocking the basin's economic potential being a key motivator for seeking water security.

Table A4. Visions and Goals of the Six Awash Basin Water Strategic Plans (Awash Basin Authority, 2017d, 2017e, 2017f, 2017a, 2017b, 2017c)

Strategic Plan	Vision	Goal
Water Allocation	'To realize integrated, equitable, efficient and sustainable water resources development and transparent management system for social, economic and environmental uses in Awash River Basin.'	'…to provide water for the full coverage of the domestic, livestock, environmental and industrial water demand in the basin and forecasted irrigation water demand with sustainable, equitable and rationally manner...'
Water Quality	'To see a model basin in which the surface and ground water shall have acceptable quality for intended purpose.'	'…to make the water quality of the basin suitable for intended use and improve its aquatic ecosystem by 2017 EC… In sub basins where the river is utilized for drinking purpose the water safety guarantee level will be raised continuously. Ground water pollution will be strictly controlled. The river water of Awash will be favourable for aquatic life. The water ecological environment […] will be considerably improved.'

Integrated Participatory Watershed Management	'To see environmentally sustainable, socially impartial and economically sound Awash River basin in which integrated watershed management implemented with full human and capital resource, as well as involvement of all basin stakeholders is guaranteed by 2017 EC.'	'…to improve income and watershed ecosystem that contributes for the enhancement of livelihoods of different communities in Awash Basin.'
Flood and Drought Management	'To realize the capacity to withstand the adverse impact of drought and flood hazards that occurs at Awash River Basin by 2017 EC.'	'…to control hazardous flood waters and use it for the mitigating hazards of drought in the Awash River Basin.'
Basin Information Management and Communication	'Realizing an integrated, standardized Basin Information Management and Communication System which brings effective Information & knowledge-based sustainable water resources development and management.'	'Develop and implement basin information system for planning, research, development and management of basin's water resource; Develop and implement appropriate, effective and basin wide Water resources Information communication system'
Stakeholders Management	'To see a highly satisfied, skilled and effectively role-played stakeholders.'	'..to bring integrated participation and empowerment of multi-stakeholders for sustainable river basin management.'

In order for the Awash RBA to execute its mandates to implement IWRM, facilitate IWRM activities, and in general create an environment that enables the IWRM 'process' in the Awash basin (Regulation No. 156/2008, Article 6:1, 2, 3), the Awash River Basin was split into six managerial sections. This was done by the Awash RBA and MoWE based on hydrological, administrative, economic, and social boundaries, one of which is the Upper Awash Basin (Key Informant Interview (AwRBA), 2022; Oosterloo, 2016; Awash Basin Authority, 2017d). Further investigation of the six Awash Basin Strategic Plans disclose detailed action plans for the Upper Awash (also known as Upstream Koka) area that contains Addis Ababa and the surrounding OSZ. Many of these build on fundamentals of national legislation such as the FDRE Constitution (1995), the EWRMP, the Environmental Policy of Ethiopia (EPE), the WRM Proclamation (No.197/2000), the WRM Regulation (No. 115/2005), the RBCA Proclamation (No. 534/2007), the Conservation Strategy of Ethiopia (CSE), the Rural Land Administration and Land Use Proclamation (No. 456/2005), and Regional Conservation Strategies. In this sense, it becomes apparent that the Awash RBA largely enacts and reflects Government, not Regional, water security priorities and perspectives for the Awash Basin.

G.2.1 Water security themes

The strategic plans of Water Allocation, Water Quality, and Flood and Drought Management all share relatively similar water security perspectives; contributing to improving water security through largely physical action. For example, the Water Allocation Plan's nine strategic development points[6] are largely based around the pursuit of physical water security in the storage, efficiency, and development of water resources (Awash Basin Authority, 2017d). Additionally, initiatives to improve water security in the Water Quality Plan are related to the construction of treatment works, and the Flood and Drought Management Plan lists largely infrastructure-based solutions with flood control measures being hard engineering solutions (Awash Basin Authority, 2017e, 2017a).

The other strategic plans, along with some initiatives in the Water Quality Plan and Flood and Drought Management Plan, take a different water security perspective for the Awash Basin. The Basin Information Management and Communication (BIMC) Plan and the Stakeholder Engagement Plan in particular demonstrate a link between improving water security with the capability to know about the physical and social water security environment. For example, the BIMC Plan places data and communication as crucial to water resources initiatives, with the detailed action plan focussing on generating and organising more data (Awash Basin Authority, 2017b). This is in line with the Watershed Management Plan and Water Quality Plan, both of which place large emphasis on collecting and analysing more data through assessing the physical characteristics of the basin and improving and testing/sampling, respectively.

Stakeholders are also frequently mentioned in the six strategic plans. Notably, the Stakeholders Management Plan centres itself around improving interconnectivity, participation, and empowerment of stakeholders in the Awash Basin (Awash Basin Authority, 2017c). Other strategic plans (such as the Watershed Management Plan and the BIMC Plan) also mention the roles of participation, communication, and

[6] The water allocation plan lists nine strategic development points for the Awash basin: managing conflicts; water resource development; full capacity water storage in existing reservoirs; development of surface and ground water sources; improvement of water use efficiency; the establishment of a water use administration system; capacity development; and research and technology innovation (Awash Basin Authority, 2017d).

capacity amongst stakeholders for improved water resources management. This does not, however, appear to based on understanding different water security perspectives or needs, but appears to be centred on creating awareness (of and amongst stakeholders), information dissemination, and consultation/participation in an activities seemingly being a very top-down pursuit of water security. Even so, these plans do not make it clear how the stakeholders in the Awash Basin would be organised and coordinated and there is no suggested framework for facilitating this. In fact, whilst the Stakeholders Management Plan explicitly points out that the current institutional structure ‘lacks appropriate linkage mechanisms for the coordination of stakeholders’ and lacks ‘institutional stability and flexibility to increase participation of stakeholders’ (Awash Basin Authority, 2017c), it does not provide any specific solutions to this.

The last significant aspect of the six strategic plans are the listed ‘action owners’ and ‘collaborators’ in the detailed action plans for the Upper Awash. Whilst the Stakeholders Management Plan calls for participation and ownership amongst ‘all people, groups and organizations that could affect or be affected by the project or activities [including] Federal, Regional and Local governments, civil society organizations, water users and the general public’ (Awash Basin Authority, 2017c), the listed action owners and collaborators do not reflect this breadth. Action owners are predominantly the Awash RBA, MoWE, some other ministries (such as the Ministry of Environment, Forest, and Climate Change), and Regional Bureaus. Collaborators are often other ministries, city administrations, research institutions, and NGOs. There is a general lack of Addis Ababa authorities as action owners or collaborators across all detailed action plans for the Upper Awash. For example, despite Addis Ababa accounting for 38% of the water demand for this planning area (Awash Basin Authority, 2017d), the detailed action plan for the Water Allocation Plan only mentions water allocation activities to be implemented in the Oromia Region. Hence, many ‘action owners’ and ‘collaborators’ are either MoWE, the Awash RBA, or Oromia ministries and Water Bureaus. The Watershed Management

Plan is the only strategic plan[7] that specifically names an Addis Ababa action owner – the Addis Ababa Rivers and Riverside Development Project Office (AARRDPO).

[7] AAWSA is listed as a stakeholder in the Stakeholders Management Plan but not in the detailed action plan.

G.3 Cooperation and coordination between Regional Water Bureaus and River Basin Organisations

The Awash Basin crosses multiple Regional and City states (Afar, Amhara, Oromia, Somali, SNNP, Addis Ababa City Administration, and Dire Dawa City Administration) (Awash Basin Authority, 2017d). As part of the Federal Government's vision for water resources management, Regional States *should* cooperate with RBOs (RBCA Proclamation No. 534/2007, Article 19) and have 'the responsibility to integrate [and] merge the basin wide strategic activities and issues with their regional development plan' (Awash Basin Authority, 2017d). In reality, however, Regional Bureaus/Agencies have no mandate to cooperate or coordinate with RBOs. For the Awash Basin, the autonomous nature of the water resources utilisation of regions and city administrations (namely Addis Ababa) that make up the administrative areas within the Basin allow them to operate in an independent and uncoordinated manner. The Addis Ababa City Government Executive and Municipal Service Organs Reestablishment Proclamation No. 35/2012 (The City Government of Addis Ababa, 2012), for example, lists no mandate for AAWSA to align and communicate its activities with the Awash RBOs.

Issues of cooperation and coordination between RBOs and Regional States could be mainly ascribed to a general confusion around who has the higher authority as well as the presence of overlapping mandates; Regional States and RBOs were given similar powers and responsibilities by MoWE (as delegated under Proclamation No.197/2000, Article 7 and 8) with a lack of clarity on who has the higher authority when it comes to water resources management, making conflicts of interest common (Awash Basin Authority, 2018). Based on the EWRMP, Regional States appear to have a bigger say than RBOs in the coordination of water resources management activities with the Federal Government (e.g., meteorological and hydrological monitoring, irrigation development, and water allocation) (MoWR, 1999). The 2001 Water Sector Strategy and 2020 Ten-Year development Plan further confirm this by reinforcing that water resources development and utilisation is ultimately guided by Federal and Regional Government objectives as well as development plans 'based on objective realities of each Regional States and local administrations' (MoWR, 2001, sec.4.1.1; PDCE, 2020). Conversely, the RBCA Proclamation gives power to

RBOs over the Regional Sates, in that BHCs have the power to resolve trans-state water resources disputes (Proclamation No. 534/2007, Article 6:6). However, this power is also given to MoWE in the WRM proclamation (Proclamation No. 197/2000 Article 18:d), and to a generic 'supervising body'[8] in the WRM regulations (Regulation No. 115/2005 Article 2:7) (FDRE, 2005). Furthermore, the 2020 Draft National Water Policy suggests that the Federal Government intend to give more power to RBOs, equipping them with 'the capacity to take strategic decisions for planning… to carry out watershed development activities… monitor water pollution and coordinate protection measures, organize stakeholder fora, and ensure implementation of policy and regulation' as well as strengthening their capacity in water allocation and apportionment (MoWIE, 2020).

An additional dynamic between the Awash RBOs and the Regional States is the variety of powerful stakeholders in the Awash basin. The Awash basin is often described as one of Ethiopia's most economically significant, utilised, and industrialised basins (Hailu et al., 2018; Oosterloo, 2016; Awash Basin Authority, 2017d; Tekle, 2019) and, as a result, is home to many industries, pastoral, agro-pastoral, farmer-cultivator, agri-business, urban, industrial, communities, situations and interests (e.g., large state-owned sugarcane irrigation schemes, foreign investment in horticulture, textile, leather and steel manufacturers, small holder farmers etc) (Oosterloo, 2016; Awash Basin Authority, 2018). This means that there is vested national and regional economic interest in the basin, creating an environment full of powerful stakeholders, especially in the Upper Awash where diplomatic and political significance in Addis Ababa has joined with high irrigation, manufacturing, and export potential in the surrounding areas. This combined with the lack of authority, coordination, cooperation, and enforcement between Regional States and RBOs, has therefore created exploitable loopholes in water resources management and regulation in the Upper Awash area. For example, the overlapping mandate to monitor wastewater discharge and water abstraction has led to loopholes for responsible wastewater discharge (Key Informant Interview (AwRBA), 2022), the

[8] Defined as 'the Ministry of Water Resources or any organ delegated by the Ministry' (Regulation No. 115/2005 Article 2:7).

lack of enforcement and political commitment to water management over economic development facilitating this situation (Key Informant Interview (AwRBA), 2022).

G.4 Conclusions

It could be argued that the current functioning of the Awash RBOs has created a rift in regional water resources management where disparities between management units (basin vs. administrative) has led to a less coordinated approach to water resources management; breeding overlapping mandates, repeated research, and lack of coordinated enforcement between Federal and Regional water resources governance.

It becomes clear from the establishment, research, and activities of the Awash RBOs, that this organisation is shaped by the water security perspectives and priorities of the Federal Government over the Regional States that sit within the local basin unit. Hence, RBOs enact the water security/management vision of the Federal state. This is perhaps due to the Awash RBOs being intended to adopt some of MoWE's devolved roles and responsibilities, and hence sitting closer to this level of governance than the Regional States. However, whilst the Awash RBOs were envisioned as the next governance level of water resources management responsibilities delegated by MoWE, their power to enforce and regulate appears questionable. With the Awash basin being the most utilised and industrialised river basin in Ethiopia, the lack of power combined with the vested national and international economic dependency on the industries that exist in this basin, means that the ability for the Awash RBA to enforce permit regulations (for water utilisation and wastewater discharge, for example) appears to have left it as a middleman between the Federal Governments' economic water security interest and the water security interests of the Regional States and local communities.

Without the political commitment and power to enforce and regulate, it is hard to find proof for successes in improving, or fostering, IWRM in the Awash basin since the conception of the Awash RBOs. Additionally, given that the main mandate of the RBOs is to promote and facilitate IWRM, it is hard to see how it is possible for this to be implemented effectively in the Awash Basin without the involvement of actors within Addis Ababa. For the Upper Awash area, AAWSA, for example, are not mentioned as action owners or collaborators in any of the strategic plans. In fact, there is a general lack of Addis Ababa stakeholders in the action owners and collaborators across all plans. As a result, the Awash RBOs influence over Regional

Water Bureaus and Agencies in the Addis Ababa area appears minimal if any, and there is a general lack of evidence that Awash RBO plans have improved water management in this area at all.

G.5 References

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Appendix H. Awash River Basin Authority key informant interview transcript

[beginning of recorded interview]

Interviewer:

I will quickly introduce my research to you and then we can do the first part [of the interview] here. So my research is looking at understanding water issues across the Akaki catchment and beyond. I'm interviewing key informants, citizens, relevant authorities, ministries, organisations - to help understand how water issues in this area are caused and what the causes and impacts are from different perspectives.

The interview here will be no more than one hour, and it will be, as I said before semi-structured, so a discussion. It is mostly directed by things you say, and this kind of thing. And, as I said, it will be recorded with your permission.

So, yeah, there are, there are three parts: this initial survey and then two kind of topics of discussion based on these issues. And I will be using these answers along with other interviews to build a picture of water issues and in this area and beyond and match these with local policy and things like this.

Even though we are recording, the discussion is completely anonymous. So no one will be able to be identified in recounts of the interview. And if you have given me your details, I will share any relevant findings with you when my research is concluded, but I won't show your details with anybody else without your you permission.

And then just to reiterate, you are allowed to stop the interview at any time if you feel uncomfortable or anything like this. So before we start, do you have any questions for me about the interview?

Key informant:

No no.

Interviewer:

It’s all good?

(KI 1 nods)

Okay, so this [the initial survey] will maybe take five minutes, there are three questions and the answers can just be bullet points, very brief. And if you have any questions about the questions on here, just let me know. Feel free to use this desk if it is easier, it might be easier for you? Or even this one if you want to. So then, yeah, when you are finished, we will start the discussion.

[KI 1 fills out the initial survey]

Key informant:

I think I have finished.

Interviewer:

Perfect, thank you so much.

Okay.

Are you happy over there?

Key informant:

Yes, I am happy. Don’t worry.

Interviewer:

I just want you to be comfortable.

Okay, so now we're going to have a discussion about the idea of water security and the challenges for around the Akaki catchment. But also wider than this. The impacts, for example, to the upper Awash and things like this.

So first, I think we can talk about supply and demand challenges and your knowledge of these. So, in terms of water security, I'm interested to know what you would say your biggest concern for water is - both personally and then in your job, in your role.

Key informant:

Ok thanks. Thanks for this question.

I think, as you mentioned earlier, you know, the basin Awash is highly utilised basin.

And it is also, you know, the well-developed basin, there are a lot of activities are carried out on this basin. Including, you know, there are a lot of industries are situated in the upstream catchment of Awash and, you know, also if you consider the population also, one sixth of, you know, our population lives in this basin.

So the basin is, you know, highly intensive agriculture has been occurred. So that's why as a ministry of water and energy, and also as a basin authority, we are categorised the basin into six groups or six, you know, managerial sections and the one is, you know, the upstream catchment. Which we call it, you know, the water quality team area and mostly the ministries have also, you know the basin authorities, they have been working to minimise, especially the water security issue. Because for instance, if you see the Adama town, they directly abstract the water from the river for, you know, for domestic use and including Madhara and Awash Sebat, you know, they are highly dependent on the river water. And that's why we are working to improve the water quality of the basin.

Yes, I mentioned earlier, there are also really high agricultural areas and that's why, you know, the water security is a big issue for the basin of Awash in terms of water quality also, in terms of water quantity. There is a high scarcity in the middle of the basin. If you see in the Madhara area, there are three sugar factories. There are highly water consumers. And that's why, you know, especially if you see, you know, the dry season, there is a security issue, will be a big issue. If you see in the rainy time, the flood issue is a big issue. So, you know, the the year the water quality is also a big issue. So securing water is it's a main challenge for us, you know, the water quality. You know, when we, when we protect the water, we can secure.

Because if you have enough water, I mean, we don't have enough water in fact, and this water is polluted, so we minimise existing pressure. So, security is a big issue for us for our sustainability and also for our development. However, we will try to, you know, prioritise water for domestic use first. Because as I mentioned earlier, more than 5,000 people in Adama, they are belonging river water of Awash. And downstream there are also the Madhara community, the Awash community, and there are also pastoral community, they are directly using the river water for, you know, domestic purpose.

However, we are trying to manage the, you know, the water that we have in our hand by allocating for different purposes based on, you know, the, as I mentioned, the priority of water. First, we will try to allocate for domestic use and then we will try to allocate for agricultural purposes. Especially we are using the Koka dam not only for generating hydroelectricity, but we are using still for allocation of water.

So, I think water quality and water security, in fact water security, it's our main issue.

Interviewer:

For water quality?

Key informant:

For water quality.

Interviewer:

So, talking about water quality a bit more. In terms of sources of impacts to water quality, what would you say are the main sources of pollution? Whether that is industrial or domestic, or…? What would you say the main sources for pollution in this area?

Key informant:

Yeah, so I mentioned, you know, almost 70 or 65… over 65% of our industries are in upstream…

Interviewer:

Yeah.

Key informant:

...catchments. This industry, they do not have, you know, well constructed treatment plant. And, you know, we are also poor at monitoring and evaluating and enforcing the law of the environment and there's also other issues like, you know, when you discuss with the industry owners, they say you know currency is a big issue for them. You know, they need to buy chemical, they need to buy accessories. So, regarding the treatment issue or you know, as a basin authority, no as national body, we are not happy. But we need their products. Especially if you see the tanneries this is, you

know, our, you know, the key source of dollar, we export and, you know, the tanneries result to Europe and Asia.

So, mainly we are focusing on not monitoring them properly because if you see the industries there are a lot of enrolment in there. That's why the pollution is high, it's not hidden for the government also. They know it…

Interviewer:

Of course.

Key informant:

…but still, we have been trying to monitor industry quarterly and also monthly, they have been putting recommendation for them to improve their treatment plant to, you know, the wastewater management. But still, you know, industrial pollution is the main source of pollution, for the degradation of the water in the basin.

In addition to this, you know, as I mentioned, there is a lot of peoples are located in the upstream catchment. Our, you know, the sewerage infrastructure is poor and we have only one sewerage treatment system that located in Akaki, which is not efficient. And it's not effectively collected, you know, the whole discharges from the town, that's why which is also another issue. Anyways, you know, urban wastes and also industrial waste, are the major concern for the deteriorations of the river water.

Interviewer:

And obviously that has, in terms of the pollution both from industry and from the towns and the sewerage, a large downstream impact as well.

Of course, for the communities downstream in the in the Awash area - is that very noticeable? The downstream impacts would you say?

Key informant:

Yes it is..

Interviewer:

Extremely noticeable?

Key informant:

…extremely noticeable. You know if you talk with the community in my ongoing research you know they are developing spots on their skins. You know, there is a development of salinity on the lands and there is, you know, high they said there is an increase in fungus or land.

So, this is you know that really associated with, you know, the contact of you know, untreated wastewater. Even they are not healthy, they don't know. They are regularly they are going to the medical centre, you know, at the centre but they don't know because as you know you know this heavy metals impact is not direct. It's difficult to know their impacts directly. It takes two decades or three decades. That's why. Yeah, definitely the impact is so noticeable.

Interviewer:

Okay and then also going back to quantity as well. You mentioned obviously water quality impacts to water security, but also quantity, and you mentioned places like Adama relying on river water. But the dependencies, can you tell me more about their variation, whether that's seasonal, does it change for the dependency? Whether geographically? Just a bit more about water quantity security issues.

Key informant:

Yeah, sure, you know, the distribution of the water depend on the climate related issue.

There is uneven distribution as well. The basin, you know, if you see downstream, they have high scarcity starting from January to June really. You know, the river course holds very little water. So that's a big issue. However, if you see that the Adama and the Madhara Awash water supply, especially in the middle part of Awash, for instance, I had discussed with the treatment plant director of the Adama water supply. They are challenging seasonally. In the rainy season the, you know, the turbidity is a big issue for them. There is high water availability but, you know, treating or removing, you know, suspended materials for them is very difficult. When you compare in the dry season. There is, you know, algae in the growth of algae, you know, monthly, they release more than 70,000 Ethiopian Birr for treatment only. It is

before two months ago, I had discussed with her and she said, you know, they need to stop this river water and they trying to go to the groundwater because of, you know, the treatment related fee. I mean, you know, treatment budget. So, in fact, in the in the dry, in the dry time in the dry season, the treatment issue basically depend on removal of heavy metal related, and removal of algae related issue. They have been trying to remove the order of the water but still because of the presence of algae, the water has, I mean, the water has order. This is, you know, the challenge for them. And there is also, you know, in the dry season, there is a scarcity of water.

They know because, you know, the river is almost and, you know, it's not sufficient and that's why we are trying to allocate water considering the, you know, the remaining months. That's why you know, scarcity of, you know, providing water is also the very difficult for them.

Interviewer:

So, because of the expensive treatment of surface water, you mentioned they were, considering relying more on groundwater?

Key informant:

Sure.

Interviewer:

Is that quite an active thing happening now? Moving to groundwater, or is it more of a future; If this continues to be expensive, this is what we will do?

Key informant:

I think they have being commissioned this issue for, they have got I think money from the UN and IMF I don't know they have the they found the grant money and they have been commissioned the lines are related issue. So, I think in the next two and three years, they have been shifting from surface to groundwater.

Interviewer:

Okay and this is also a very largely shared aquifer, no? The groundwater in the upper Awash, the aquifer is very shared by many industries using the groundwater, many

communities using groundwater, Addis using the same aquifer. Do you think this creates quite noticeable, I don't know, ‘competition’ I suppose is the right word?

Key informant:

I'm not sure. But you know how also hit on the groundwater quality, as you mentioned. For instance, if you see that there have been trying to extract this water from the Mojo area, so this mojo area is in highly you know, full of groundwater, studies show that have enough ground water. But you know if you see the industries most of industries also rely on this area. For instance, over 14 tanneries are located in mojo town. There are also the textile industries, there are also, you know, floriculture industries. They do not have, you know, enough treatment plant. If you see the floricultures they discharge on, I think lagan, so called the Lagan area.

For me, I don't know, there is no still an indicator for the pollution of groundwater, but it might be challenge for the next. First because most of industries discharge even on land without constructed lagan.

Interviewer:

Okay. Okay. So, in the role that you work in specifically, how do you personally respond to issues of water security?

Key informant:

Yes, you know, if you see this question there are, you know, structural arrangement as you know, in all governmental organisations and this issue are highly noticeable with expert. But, higher officials there are not worrying about this. In fact, they know definitely, they know the pollution of, you know, the area as I said earlier, because of several reasons, still, they are not working.

We have, you know, relatively good policies in environmentals, you know, water policy, still working, but they enforce. In the case of enforcement, the government are not politically committed to, you know, involve in the water management. That's why I had discussed with experts, there is also one project we call it the blue green project which is funded by XX authority. And this organisation, I mean, this non-governmental organisation has been trying to incorporate industries, I mean organisations that are responsible on water sectors, like ministry of water, Awash

basin authority, environmental protection authority, Oromia water and energy bureau, Madhara water and energy bureau. These five organisations are working on the same area to minimise even budget related issues. They are worrying or mandated to control this environment and also in water. Still, they have been trying to show the load of the pollution for their heads, but you know, for that if you see on the other side I don't know. The they are not commited. That's why the pollution becomes serious.

Interviewer:

Of course. And so with the corporation between various different organisations working in the same area in Awash, do you notice that - for example with things like pollution - that the coordination makes it more of a difficult issue to address?

Key informant:

Oh, yeah, you know, if you, if you review the mandates, which gives the same issue for several organisation to monitor it. So we have been trying to minimise budgets and also, you know, budget related issue to monitor it. That's why this NGO provide some amount of money to work together and they have been trying to monitor and to analyse, you know, the collected sample and they have also informed the result to local authorities and also for the industries as well.

But the main challenge is, you know, it is not connectivity of monitoring, or you know sampling. It needs you know maybe you know the governmental influence.

Interviewer:

And enforcement as you mentioned before?

Key informant:

Enforcement, yes.

Interviewer:

Yeah. Of course, of course.

And do you notice these issues in the Awash basin? I suppose, do you notice issues moving between nearby basins weather into the Awash or out of the Awash? For

example, to the CRV basin the surrounding basins. Do you notice the issues moving between these basins?

Key informant:

I'm not sure this question. You know, each basins have their own, you know, what, we call it… boundary, and they have also their own force.

I mean, you know, their own organisations and that's why the relationships between basin with basin is not highly considered and in terms of expert level. But, as ministry of water and they have responsible to monitor the whole country, that's why experts are moving to Nile basin. They are monitoring the water quality of the basin in the Nile, and similarly, in the maybe in the next or quarterly, they try to move to in the Rift valley basin and Awash basin, and Wabi-Shello and so on. But the basins itself they have their own resource in the resource the quality experts, environmental specialists, and they have their own labs almost, you know, many lab. So they have been trying collect the water samples in they analyse in their lab and they I think inform the, you know, the rule that are for the ministry of water or database. In terms of Awash basin, it is mainly focused even it is noticed by environment protection authority, because the community highly vulnerable for the problem and Awash even there have been working there are a lot of studies were carried out to protect it. But still, as I mentioned because of, you know, the lack of enforcement or another issue still, the problem is exist.

Interviewer:

Yeah, of course. As a, I guess a visual guide here I have a small picture here of this is Addis, and this is a Koka, Legedadi, Gefersa, Dire and the Akaki rivers running through here. And here, I have upper Awash. Here I have the upper Awash with some of the big towns labelled on here. So like Mojo, Bishoftu etc, Addis is here. Also, this is Aba Samuel. Yeah.

And I just wondered from some of the things we have been talking about (and this is some of the major rivers including the Awash)…

Key informant:

Tributary rivers?

Interviewer:

Sorry, yes, yes.

…From the things we have been talking about and your knowledge if you would draw on these maps with me to show where you think the main problems are? Whether you want to draw like a point to say, like this specific area, or you want to draw like a big boundary to say in this big area.

Key informant:

Okay so like reach or catchment?

Interviewer:

Yeah. So, yeah, on this one, which is it's obviously smaller. And this one here.

Key informant:

Okay.

[Interviewer presents physical copies of Figure 1 and 2 for key informant to use as discussion prompts]

Figure 1. Addis Ababa and Surrounding Reservoirs and Rivers.

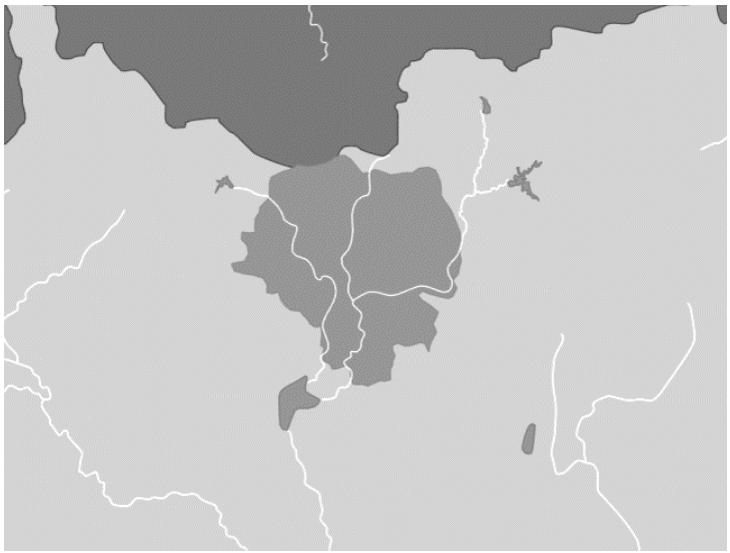
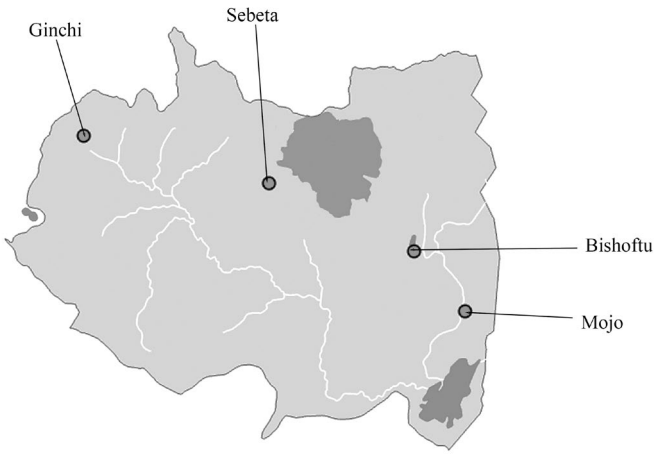


Figure 2. Upper Awash Basin with Major Towns, Tributaries, and Koka Dam



Key informant:

I think this is relatively.

Interviewer:

Sorry?

Key informant:

It is relative, relatively. Because you know this this area is highly polluted area based on the severity degree. Which one is highly severe? So, I think if you see this Ginchi, this is a relatively, you know, a baseline area. There is low agriculture. Only agriculturals. So this is, you know, it's baseline area for us. We call it this is a baseline station. Even we have one station at the Ginchi area at bridge. We call it that is a baseline station. We compare the iteration of the water quality with respect to the baseline so for this one.

Okay. So if you see the Sebeta, this is also, you know, this here is also the polluted area. There are industries, but in fact, let us stop, this is middle or medium or moderately polluted area. Bishoftu and Mojo this is in this area is severe area. Severely, polluted. That are a lot of industries. More than 14 tanneries are here. Almost three textile industries. There are a lot of more than five flower farming and then almost five slaughterhouses.

So, this is, you know, this is very polluted catchment, or you know town. Similarly, if you compare Addis Ababa it is also equally severely polluted with Mojo. There are a lot of tanneries. Even in Addis we have six tanning industries near to Haile government area there are six tanning. There are you know social institutes or business institutes that are hotels, medical centres and that's why this is also, you know, highly polluted area, highly polluted area. But if you see the polluting is high, but the vulnerability of the community is downstream of the town. Like, you know, in the Akaki near to Aba Samuel area. This is this is near Aba Samuel there are agricultural lands they are, you know, the farmers are pumping this river water for urban agriculture. So, they are not using this water for domestic use totally, but they have contact with this polluted water.

You know, as I mentioned, there is high skin dryness is become noticed by the community. So, this area is the polluted area because of polluted water, but mainly, which we has been seen in agriculture sector, they use this water for agriculture uses and there's, you know, the community the haves they say that even their cows their milk production has been decreasing because of the polluted water. The livestocks were using the river water and because of the pollution, even they said that their livestocks are, you know - what we call it hair removing – the hairs become removed without any…. So this is, you know, highly polluted area. This is the Akaki catchment, because this is Akaki catchment before entering the river Akaki into Aba Samuel there are you know high urban agriculture based on this polluted water. So this is because of the polluted water but when we come to this one we think, I don't know, we have been trying to collected samples from Bishoftu Galan but still we don't have enough information about, you know, the severity of …

…even there are two industrial parks now between Gelan and Bishoftu, but the severity is not still not noticeable even by the community. The drainage is, you know, far from the community. And that's why maybe. But if you see the Mojo town, even the Mojo is highly polluted. It's not only water. Even at the air, pollution is a big issue because and the gases are released into the air. Like sulfide, ammonia. That's why highly noticed by the community, even by people's who live in the town, but also by, you know, the downstream users of the river.

As I mentioned, the discharge, the user discharge for urban agriculture and the that's why, you know, their land has showing salinity and there is an increase in, you know, fungus related insects, you know herbicides that's why high this area is also highly polluted are.

Figure 3. Map output from session

Interviewer:

Okay great thanks. Okay thank you.

So going back to water security as the bigger picture and I know some of this you will have answered in here (the survey) but I want to I guess understand more about your perspective of water security and what you think formed this perspective. So do you think it's your work, education, where you live, and maybe even the media? and because of this the priorities that you think there are for a water security? Do you think these are different from your work to maybe the priorities you have as an individual?

Key informant:

I think this is an interesting addition. In fact, still we are poor in advocating this problem. If you see our medias in social media or you know, the governmental medias like TVs and so on, they are not talking about or promoting about the challenge for our community. That's the big issue still.

I know when I was young HIV was a big issue for Ethiopia. And, you know, if you see the media's pictures, all are talking about, you know, and that's severity or the problem of HIV and that's why people are more aware and have been trying to save them from this challenge, or from this endemic disease.

So now we need to look at this issue nationality. You know, we will try to has a big sustainability issue to know the community very well and also to know industries are responsible to the their discharges and also to be accountable the government institutions, you know, for their tasks and mandates, given by the proclamation. So we need to advocate strongly to improve the water security issue in Ethiopia.

I think for me in and also for experts who are working on the water sector, we are worried about the security of water in our country, but you know, the officials and the politicians, they have their own concern. Maybe that gap it's makes difficult to secure this water bodies in Ethiopia. However, we need to communicate and also to work this highly with higher officials. Still, there is a gap, you know, there is a, the bridges, you know, it's not working to communicate the academic communities with, you know, the governmental community. So that's why there are a lot of works carried out by researchers for international for Ethiopian researchers but still which is not applied.

And other issue is engagement of community. You know, the community is not highly engaged in monitoring planning activities related to the wastewater management or water security. They're highly vulnerable. They don't have a channel to communicate with government. Even with local governments. They don't have, you know, a channel to communicate with industry owners. So, we need to aware the community and we need to organise communities in the form of associations to secure the water bodies.

As you know, this is I think my opinion secure the water bodies, secure water bodies in Ethiopia.

Interviewer:

In terms of your work, are there any specific frameworks or guidelines or mandates that specifically focused on water security? That specifically mention water security?

Key informant:

Not yet. Not yet.

Interviewer:

Do you think they'll…

Key informant:

They have policy for you know I mean we have regulations and mandates also policy in wastewater and there is also policies in wastewater related issues but still is is not also in place in all regions. Even you know, awareing policies regulations also a

challenge. At the high levels they know the policy they know in the regulation they know know the guidelines when you go to the local authorities or even authorities levels then they even local authorities they don’t know well about the mandates and the tasks given for them. That's why making the creating awareness also is a big issue. Policies are designed and also ratified in Addis but when you go to regional level they are not well noticed or well accepted.

Interviewer:

Do you think there will be a there will be something that specifically points to keeping water security?

Key informant:

Still we are trying to secure waters by securing water quality. So still as I mentioned we are trying to secure the water quality of our water bodies we will try to partly secure the existing waters. If we deteriorate, the water we have in hand we will lose this water. So that's why, as I mentioned, we have because of lack of securing this river water or surface water some towns like Adama totally Awash, they are not using the river water, they are totally shifted to the ground water. So we need to secure our water resources for our sustainable development basically the water quality, the basin.

Interviewer:

Okay, so I think we are coming to the end of the discussion, but before we finish, I just wanted to ask: I know that water quality, of course is a priority issue, but if you were to create a recommendation for water security for your area, what would be your main points? Including water quality obviously.

Key informant:

Yeah. For us usually as an ecohydrology and water quality directive. We are still working to know the deterioration level of water. We have a mandate only to collect samples and to analyse it and also to know the level of pollution and deprivation level of the waters in the basin.

But in order to secure the water resources there are a lot of activities. Even if you see in the climate in the climate directory, they have been trying to, you know, to afford this higher afforestation in Ethiopia. That is one of, you know, the big concern for our government, to secure water in the whole basin. And also, we have been trying to, to build one or two dams in the lower Awash area. As I mentioned earlier, there is a lot of challenges directly or indirectly related to water security. We have high flood because of lack of dams, we lose this water and this water directly join to Lake Abay that's the boundary of Djibouti and Ethiopia. If we have a lot of dams, we need to have, you know, enough waters. So we try to secure this water. So still there are development plan to build two or three of dams in Awash basin and also we have also trying to more afforestation activity to change the climates of the basins and have been trying to secure the water pollution by enforcing by using incentives to industries.

Interviewer:

Is there anything that hasn't been mentioned that you feel is important to mention… related to water security?

Key informant:

Yeah related to water security for me, as I said as I mentioned earlier, if it is possible, we need to have as one sectorial entity. We don't have you know water security entities mostly we are trying to secure our water bodies, as I mentioned, by protecting our water quality or by, you know, by afforestation activities and so on. So, we need to have one sector with a water security sector. If it is possible in the form of head office or in the form of desks - one is this one but another one is still the water security issue is not well known by even higher officials.

We need to write book as issues. We need to have meetings also webinars. This is very important to our water security of the problem. I mean, the severity of the problem of water security related issues in Ethiopia. So still there is a, you know, positive a green light from especially from, you know, Europeans from especially from and from the UK side still, I know there are a lot of government organisations have been trying work in this area. For instance, if you see the water and land resource centre and they are higher related with Newcastle. And also, there is one GCRF

project. They still, they are trying to secure water by in that side there is the oxford team and this team also trying to reach the security issue still here in IWMI but it's not enough. Still we need to have higher advocacy, training, seminars also you know still I don't know we don't have also the higher you know PhD candidates relate to water security issue. So we need to have training also PhD courses to conserve it.

Interviewer:

That's very interesting. Thank you very much.

And unless you have any questions for me then I have no more questions for you.

Key informant:

I don’t have questions for you. If I have, I will contact you with email.

Interviewer:

Please do that. Please do.

[End of recorded interview]

Appendix I. Ministry of Water and Energy key informant interview transcript

Interviewer:

Perfect. Thank you. Okay, so now we will move on to the spoken part I suppose. So, as I said before, we are trying to think about issues of water security, the interview is semi structured which means that there are some prompts, but it's mainly more of an open discussion and it means that there are some topics I would like to cover, but it'll be mostly directed by our discussion and things we talk about. So, I suppose, a good starting point is to talk about your biggest concern for water in your role here. But also, as I suppose a citizen... as a starting point.

Key informant:

So, what I can start? You just make it brief. What is expected to start?

Interviewer:

So just talk about your biggest concerns for water. I suppose related to your work and your knowledge.

Key informant:

Ok. About water?

Interviewer:

Yeah.

Key informant:

Anything water?

Interviewer:

Yeah.

Key informant:

Ok. Hmmmm… as we know water is the life. Quality [of] water is life of life. We just commonly say this kind of speaking for all who are not that much aware for water issues. So when we see water, water is not simply accessed for any demands

without any difference. As we know water is given for peoples as natural resource but it's not… finite resource, it’s a finite resource.

Once we use in the mis aspect we lose it. So, needs to manage properly and also needs to reuse if it is managed properly. So, when we come to Ethiopia, we have more than 12 basins, among them 9 of the river basins are wet and have much amount of water especially the surface water and demand is much concern. Particularly, the overuse of the resources. There is not that much legal practices to not to permit peoples who are using without having a permit so needs such kind of practices here and there. So, when we talk about water we have to see its importance and significance for all living things. So from that aspect, we may have detail assessments whether it is accessed or not, this is the first issues. If it is accessed, how it is managed. So, the issue of access and the issue of management is the primary for any any anybody who is interest in the whole, anybody who is interested to work on that aspect to work on the water aspect. So, I say water is very important resource for all of us. Think of it and do water policy.

Interviewer:

So, in terms of you mentioning water obviously being a finite resource, you mentioned management issues of quantity and also issues of quality. Can you talk a bit more about those specifically with examples?

So for example, quality issues for water in your work, quantity issues for water in your work and management issues for what in your work.

Key informant:

Ok. Particularly for our for especially if you take it as you know, as institutions, our institutions is the ministry of water and energy. So this ministry has mandate to investigate the resources in quantity as well as in quality. After having [assessed] the potential needs to allocate this resource [water] properly. Then, needs management. So, for me, the ministry is working what is expected but not that much as per requirements. So, when we raise the issue of water quality especially it needs different peoples attentions particularly in central part of the country particularly the Awash basin – highly populated area, highly industrialised area, highly urbanised

area – so this area is clear as it produce much amount of pollutants or contaminants to the basin. So, production of such amount of pollutants and contaminants to the basin means contaminating the water resources so once the water is contaminated or polluted the resources needs further treatment or any management aspects. So, the quality issues start from the upper part of the basins what we say the upper catchment of the Awash basin meaning start from Addis Ababa city is one of the upper catchment elements but it starts from Ginchi which is in the upper catchment of the Awash. The water emerges rom that. Here, the issue of quality is much a concern for everybody's.

Interviewer:

Can you give me some specific examples about quality issues in the upper Awash basin?

Key informant:

Yeah. We have we have a lot of industries here in Addis Ababa. Particularly in Akaki surroundings. You can get, you know, leather industry. You can get textile industry. You can take, you know, soap and related industries and there are different industries that are located downstream of Addis Ababa and that industries produce the city of Desawar and that's industries produce number of contaminants which is untreated water.

So once we give the permit to use the water, but they produce the water without treatment. That is an issues that we may investigate. What is the level of that contamination? May need some investigates whether the level is permissible or not. But for our sake of communication, we can mention some elements that I had experience about that. You know, we had different exposures of now having reviewed the documents related to the Akaki. Basin pollution aspect and there was, you know, events that show the rivers indicate whether they're polluted or not. So from out past experience the river, especially the Akaki river – there are two rivers, the little and the big rivers the big Akaki rivers – two rivers are highly contaminated with such industries, as well as the human domestic pollution as well. So, you know, the studies the reviews showed that if you check the sediment water quality even the soil quality you get significant amount of metal contaminations even there is one

study that shows the organic chlorine contaminants in the water as well as in the fish so this shows the resource is now highly polluted or misused. So that is an example for us the discuss on the issues. If you want that, I can share the document on that and you can see how much the problem is.

Interviewer:

So we've talked a lot about quality but you also mentioned quantity in terms of overuse but also I was wondering about, in terms of quantity, issues such as drought and flooding as well. Do you come across these in your work because as well?

Key informant:

Yeah. The event of flooding, you know, is not that much new for us, especially in Addis. The flooding is very, very critical for the communities. You have informations peoples were exposed to the flood events and even we lost some peoples because of flooding. This may be the issue of all the result of urbanisation because, you know, as we know when the city is built, the is clear to produce the flood. Even the quality of infrastructure that we have in Addis is not that much in protecting the floods. When you look, you know, different directions of Addis the road infrastructures are not that much when constructed to protect the flood event. So, as we know, as we, as we have the landscapes, you know, from the upper catchments behind Addis (Entoto) to Akaki is 1,000 metre differences between. So this slope difference create much amount of flood.

So this flood hammers the communities, especially who are more vulnerable to this – especially living in the riverside of the areas between the little as well as the large Akaki river. So we have much events on this aspects.

Regarding the droughts in case we may not clearly sense the drought is happening but as we now look there is difference in the water, the rain, times times has been difference. So that may indicate the drought is coming, if you check, especially in the summer season or dry season, particularly April March April June, the temperature of the city is completely different than the past 5/10 years back. So that indicate that there's is drought exercising for the community or for the area. So that is also an indicator for these events [drought].

In case the quantity, we may interlock the groundwater. We have groundwater, potentials, and surface water potentials. By the way that's Addis Ababa city community uses two sources: the surface water as well as the groundwater. If you check, if you have the chance to see, the quality strength of the surface water of the Addis Ababa water there is a change before 10/20years back that water quality or turbidity or some parameter of water quality had better quality than current. So, you can go to the Addis Ababa city water and sanitation office, and you can access whether the quality is decreasing or not. That leads to not to access as much amount of water that related to the issue of quantity as well. And also, be when you go to the groundwater we are now also challenged, the issue of potential the issue of groundwater. Because the groundwater as well is contaminating and some of the wells are not now functional because of the dryness so that's the issue of quantity. So, in general, the Addis Ababa catchment, or Upper Awash Basin is now challenged by two events: the flood as well as the drought.

Interviewer:

And you also mentioned overuse. Who do you think is responsible for overuse of water?

Key informant:

Overuse. When we say overuse, the issue of equity in our water policy the water has to be used based on the principles. As whether it is equity or not. And all peoples have equal chances to use the water. But in Addis what you look is some investments some peoples have special interest to use the water than others. so, in case they may pass some legal requirements, but they are using more than they are expected to use. Even the permit that they get may use some amount of water – through drilling or whatever – but they use more that that. That is also overuse. The other is if you see the community you know you receive the water and you use then when you release that water has to be under permissible limit of water quality criteria's. But the people's release the water without treating that mean using the water in overuse aspect.

So, when we see say overuse it can be expressed in different terms. From misuse aspect of the water and also using more than having the legal permit of the water. That is the practice what we now look in Addis.

Interviewer:

So you mentioned the idea of equity in water allocation. Would you say that.. How unequal would you say the access was to water in Addis? [asked to repeat] How unequal, do you think the water, accesses or how equal do you think it is? In Addis, around Addis, in Upper Awash.

Key informant:

Yeah. You know, if the government gets potential or ability access the water for all and based on the service if the government follows the pollution-pay principle this may prevent a problems. The other way, if the government takes all assignments, accessing the water to any demands for investment, for drinking, for all, for even irrigations. If the government do, does this aspect of assignment is properly, such good issues, may be solved. This is one thing that we have to set markly.

The other aspect in case issue of equity or the access. Maybe happened because of, unaccess of water in the city. The city is not now fulfilling the requirement of the communities, you can take me, I am not getting water properly as our ten years plan says you know. The city especially ranked one 100 litre per capita is required per day but we get you know, per week. So, this is you know the problems that me or you may also come across the problems. I don't know where you live or where you have the locations may be different. Around somewhere in the Arat Kilo or somewhere which is the area is suitable for accessing you may not be seeing the problem. But the other areas, especially in the downstream and between the east and west wings peoples are not getting required amount of waters. That may also be related to this. Also when we say water it may not be the drinking water, irrigable water is also required. So in Ethiopia, particularly here in Addis, irrigable water is not that much access to the communities. We use the drinking water for both: for house consumption as well as for our plants or whatever we want to have. That may be also the issue of the water security

Interviewer:

Okay. So talking about these problems that we have mentioned. Here, I have two maps. I have this one here which I'm sure you're recognised as Addis, Aba Samuel, and then the three reservoirs and the Akaki rivers running through. Here I have the upper Awash, which I'm also sure you are familiar with, and I put on here Ginchi, Sebeta, Bishoftu, Mojo, this is Koka, and this is Addis Ababa. Here are some major tributaries also. So, using some of the problems that we have discussed but also other ones that might come to mind and I wonder if we can draw these on the map in terms of… and they can be either areas that are very specific or you can say in this kind of general space this is happening.

So issues related to quality, quantity, access in different areas. Then you can draw on these maps. is

[Interviewer presents physical copies of Figure 1 and 2 for key informant to use as discussion prompts.]

Figure 1. Addis Ababa and Surrounding Reservoirs and Rivers.

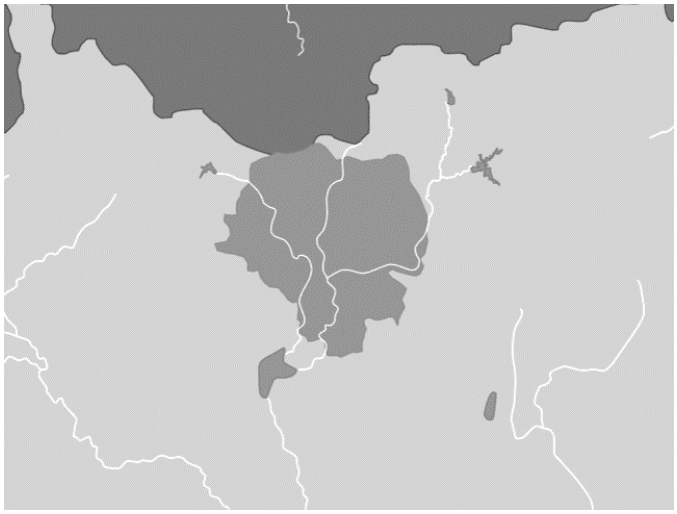
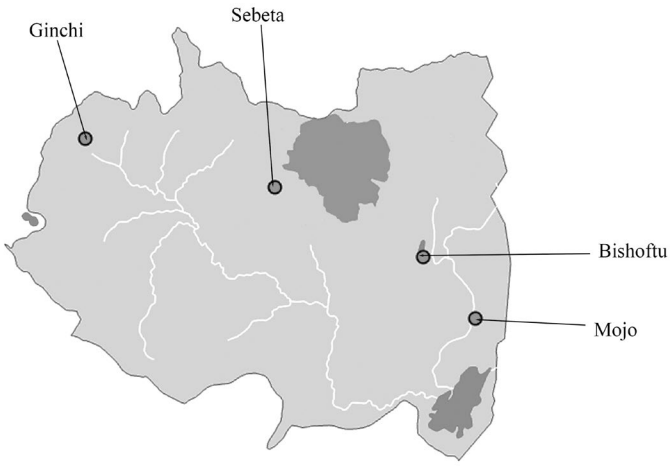


Figure 2. Upper Awash Basin with Major Towns, Tributaries, and Koka Dam



Key informant:

This is Ginchi. Of course, this, this is a lot of the better quality [water] than the others, because it is forested area.

These are more of forested areas. In case when it comes to Addis. Addis normally if you show the two rivers. Small Akaki and large Akaki maybe this is better to draw some checkpoints.

That means is little Akaki, this is bigger Akaki or large Akaki. This is from the middle of the city, this is Addis Ababa. This is the dam or reservoir of the Addis reservoir. This is Dire. This is Gefersa. I had some same opportunities to look these areas from upper catchment of Dire to here. And I have also some information about it the Gefersa side. So I now locate some points whether they produce or they just discharge some significant amount of contaminants to this rivers. So, when you go to here, this is agriculture area. The upper catchment of the Dire is more of agricultural area. This one is the upper catchment of the Dire, and is purely agricultural area and land degradation. So, filtration of water is the issue of here. So there is gully and other land degradation aspects in this catchment.

When you go to this one, there are locations of some cities and the eastern part of the Dire. Here there is some cities some Oromia cities are around here. As well there is also some cities also here. This cities directly discharge their own urban wastes into this river and this receives all this all this contaminated waters and goes to the dam. And this dam is challenging, you know, sedimentation issue.

So, this dam is now challenging from different pressures. Sedimentation is one of the pressure, contamination especially domestic waste. And some also, you know, do you know quera or what you call slaughterhouse, you know that is also one slaughterhouse which is legally established around here. And this is also an issue for this. All this by the way some of the water goes to the dam and the other water, which is highly polluted, comes to this. This is the city of the, the middle city part, and had much pressure from both sides from this and this from west and east part of this river. And this has different tributary rivers that feed it, there are more than three or four or five major rivers that feed to this. And, finally, the two come across below to the Bullabulla. Here the load is urban waste, much urban waste discharges to this. The city, as you see, all this hospitals here hospitals here. Domestic. There are different pollution producing agents. All different agents are here. So these all wastes go to here and all the wastes around here. There's also what you call the industries, industrial wastes are here. By the way there are non-industries we may not actually locate that industries but you can get this access from industry ministry that will give you the location of the industries that are located in Addis. That may create good information for you and to allocate on this map maybe will be more information for you.

Then this is Akaki river, big Akaki river. Here, here, here, here, here, here, here, around here as well, there industries. Particularly leather and textile they are much pollution producing agents. Leather, textile, and also soap. By the way you may Google and also see. And plastic factories are there. And these industries produce much amount of waste.

There was one, my friend Joseph. Have you got him? Yes, he was undertaking survey urban waste management aspects and he may also have some important information about this locations and as well important information concerning this, so you can also contact that one.

So this all pollutions, all these pollutants go to the river and here these are, by the way these are irrigable lands. All this contaminated water go to this irrigable land and give services for irrigation. This as well gives irrigation services. Even the cattles, animals, all animals, get their water demand from here before it enter to the Aba Samuel.

And also, you know, this maybe be inside. So once Aba Samuel goes to this and meets somewhere far from this Aba Samuel, all these wastes are the main challenge of the Awash basin and go to Koka.

So they meet maybe here Bishoftu and Mojo are this may be relatively better catchment because Bishoftu here, by the way Bishoftu this area is wellfield area of Bishoftu this means the groundwater potential of Bishoftu is around here. So there may be a groundwater interconnection this catchment with this catchment but still our survey showed that this water is a little bit better than this one. We recommended to use Bishoftu much of their demand from this area, this Shimbea Meda wellfield area. Bishoftu gets its water supply from this.

The north part of Bishoftu means this one. This and this may have connection. But still we say this water is better than the other. So this is groundwater potential and has much, here there is mountain. So maybe the connection maybe the connection differ. This mountain water goes to this one and this come to around here and goes to this one so maybe the connection not that much expected. So this is something what I have.

In case Mojo, there is Mojo leather factories. There are 2,3,4 factories around Mojo. They pollute the water above and below or upper stream and below stream so you get, you know, leather industry. By the way there is one farm around here. There is one farm, which is flower farm. This flower farm is an issue for the Bishoftu as well as the basin the sub-basin of Mojo. Because it is now expanding and there is high waste there is waste expected from this and released to this mojo river. So, this also an issue that is, and the leather industry also an issue, the two cities also is an issue for this basin. So significant amount of contamination was go to this basin and effect this ecosystems that we have.

And we go to Koka. By the way Koka has significant amount of water hyacinth. This water hyacinth it emerges from Aba Samuel. History shows that primarily in Ethiopia water hyacinth came to here area for ornamental purpose and this extended to here and covers a much amount of area of the reservoir. This reservoir is now treated by water hyacinth. Although the water hyacinth is good for removal of contaminations, the water security issues is high because it consumes 7 fold of the natural

evapotranspiration. So there is much concern for water securities. In case you consider one thematic are of your investigations. It is something we are no looking for. When it comes to the western side of the Awash basin, what we call North west, north west or north east this is the Akaki Kality Akaki river. This is the main river route of Awash. I don’t know whether is your concern, whether Kality or the whole basins I don’t know. But your concern is only focused on this Addis Ababa Akaki river we can talk more about that around here or if your concern is at basin scale we can talk more general information about the basin and sub-basin as well.

So this is, this is the Addis Ababa city that that generates as much amount of pollutants or contaminants to the river. And this river is highly contaminated than other sub-basins. Expected this rivers is now dead river. So if it's dead river, what is expected now? So the issue of water is much. So water security issues much issues are critical to investigate, so the irrigation aspect or anything related to this maybe your concern and investigate further. Focussing on different thematic.

Interviewer:

So, the last part, the last few questions or discussion I want to have and is about water security priorities in your work and also if within your work there are any frameworks or guidelines or mandates that specifically focus or mention water security.

Key informant:

For our ministry and we have policy. Water policy. And we have also strategy. And we have also different guidelines. Those guidelines may not be directly linked to water security. But directly addresses the issue of water securities. Of course, when we say water security, we have to argue the definitions. For me, the security is the issue of the water quality and water quantity. So, if it is the issue of the two, the quantity and the quality, the legal frame focuses on conserving the resource and accessing the resource to the communities. So to solve this such important problems there are different legal frameworks that the government tries to on us come on board and legalise for usage. So, I don't know, your clear enquiry, but the ministry always updates it's legal frameworks.

So which area of legal issues, that's more better for you to discuss?

Interviewer:

Just, I suppose, what you think is related to the most to what security in terms of the frameworks you operate in.

Key informant:

Of course, it's general question. So to solve the issue of water security we have different strategies. By the way, as a country or as a nation, as well as I had to mentioned the basins, we have the basins, we have more than twelve basins, among them, some of the basins, the basins are highly highly overly used or demand much attentions of government and some of the river basins may need, you know, to bring them to the non-access areas. So there are different legal box to limit that kind of thing this. But for you, in case I only tell you some points of the legal things because some of things may not be a lot for me to tell you much about them. But for some regarding the pollution control aspect, regarding water permit aspect, we have legals that enforces people to have permit before they use. That is one kind of legal frames to solve the issue of water securities and also there is pollution control strategies. And we have, by the way, from one aspect which helps to address water securities that is water hyacinth control strategy framework is already appealed to a committee and anyone can use that aspect and that directly solves the issues of the water security. Once you practice this policy and strategy frames may clearly address the issue of the water quality and quantity. That’s the one thing that we have in case the strategy is clear and anyone can access even the policy is also there. This is the thing that we have. And also with the monitoring aspect the pollution control aspect tells us to follow up and monitor our water resources without there is normally you can see you know the hydrological sections the watershed sections and the water resource sections. We have, in the ministry, three departments or three pillars: 1) the water resource pillar 2) the water and sanitation pillar 3) the energy department. So we now we are not discussing the water resource pillars these water resource pillars have also different sections. Among them, hydrology, watershed or IWRM, water resources management, and transboundary issues, and other. The informatics aspects. So this has, you know, a kind of what you call proclamations that the sector

is established and got its roles to practise in the national level. So this the framework, this all framework lead to solve the problem of water issues. In case if you need much clarification you can list out that and I can respond on that aspect.

Interviewer:

Okay so we're coming to the end now, I just wanted to firstly ask if there is anything related to water security that hasn't been mentioned that you feel is important or if you have any questions for me as well?

Key informant:

For you? As general the water security issue is very critical for the country because, you know, to facilitated the development aspects even, you know, you know, to save the nations the issue of water is very critical. So the government is now trying to work it's roles or related to that. So there's a scientific community including you and me as well show the gaps. Which gap is demands priority? Particularly the central water potential areas including Awash basin, Akaki Kality, Akaki river basin or sub-basin. Because it needs options how to manage so I expect you to show us what kind of solutions or what kind of strategies the government shall implement or work in terms of the security or related to that. And also linking between, you know Addis Ababa there is also one channel that we have part of that. We have one group that always concerns and discuss and also created platform that platform maybe the input for this water security issues.

So if we just solve the problems of a Addis Ababa water supply issues, we are clearly also solving the water security issues of the upstream of the basins. So, you are required to show some indicative strategies how to link the government activities with the water supply authorities. And other experience from other countries in case from Europe, or Asian countries that may help African countries to solve issues of water security. Always people asked to say about the water security, they say water security is more of, you know, the issue of drought or only, you know, not accessing the water whether it's quality or not, that's not an issue. So in case for me the security is quantity as well as quality is very determinant. So for the central part of the country is critical issues.

Interviewer:

Great. Well unless you have any more questions I don't have any more for you. So..

Key informant:

If you have any clarity especially to have detail notes or informations about water security in case you may write down your issues included I can just write some points related to that. Because this time might not be much enough for us and finalise all that requires.

Interviewer:

I will keep in touch. Thank you very much. I'm going to stop the recording now.

[End of recorded interview]