ADDIS ABABA UNIVERSITY

COLLEGE OF DEVELOPMENT STUDIES

CENTRE FOR ENVIRONMENT AND DEVELOPMENT

Analysis of Irrigation Water Governance and Institutions in the Central Rift Valley Sub-Basin, Ethiopia

A Dissertation Submitted in the Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy in Development Studies (Environment and Development)

by

Endalew Jibat Gemede

September, 2024

Addis Ababa, Ethiopia

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Supervisors

Feyera Senbeta (Prof.), Department of Biological Sciences, Faculty of Sciences, Botswana University of Agriculture and Natural Resources, Gaborone 0027, Botswana

Tesfaye Zeleke (Ph.D., Associate Professor), Addis Ababa University, Dean of College of Development studies

Fitsum Hagos (PhD), International Water Management Institute (IWMI- Ethiopia)

September, 2024

Addis Ababa, Ethiopia

Dissertation Approval

Addis Ababa University

School of Graduate Studies

This is to certify that the dissertation prepared by Endalew Jibat Gemede entitled "**Analysis of Irrigation Water Governance and Institutions in the Central Rift Valley Sub-Basin, Ethiopia**" and submitted in fulfillment of the requirement for the Degree of Doctor of Philosophy (Environment and Development Studies) compiles with the regulations of the University and meets the accepted standards with respect to originality and quality.

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External Examiner	Signature	Date
_____	_____	_____
Internal Examiner	Signature	Date
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Declaration

I, the undersigned, declare that this is my original work, has never been presented in this or any other University, and that all the resources and materials used for the dissertation have been dully acknowledged.

Name: Endalew Jibat Gemede
Signature: _____
Date: _____
Place: Addis Ababa
Data of submission: _____

This dissertation has been submitted for examination with my approval as University supervisor.
Main supervisor's name:
Signature: _____
Date: _____

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Abbreviation and Acronyms

BDA	Basin Development Authority
CAR	Capability, Accountability and Responsiveness
CE	Choice Experiment
CIT	Contextual Interaction Theory
CPR	Common Pool Resources
CRV	Central Rift Valley
CVM	Contingent Valuation Method
DCE	Discrete Choice Experiment
FDRE	Federal Democratic Republic of Ethiopia
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GIRDC	Generation Integrated Rural Development Consultants
GWP	Global Water Partnership
IAD	Institutional Analysis and Development
IWRM	Integrated Water Resources Management
IWUAs	Irrigation Water Users Associations
KII	Key Informants Interview
MNL	Multinomial Logit Model
MoWR	Ministry of Water Resources
NGOs	Nongovernmental Organizations
OECD	Organizations for Economic Cooperation and Development
RUM	Random Utility Model
RVBA	Rift Valley Basin Authority
SIWI	Stockholm International Water Institute (SIWI)
SNA	Social Network Analysis
SNNPR	Southern, Nations, Nationalities and People's Region
SPSS	Statistical Package for the Social Sciences
STATA	Statistics and Data
TAP	Transparency, Accountability and Participatory
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme (UNDP),
WEB	Water and Energy Bureau
WSDP	Water Sector Development Program
WTP	Willingness to Pay

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List of Original Papers

This Dissertation is organized based on the following five peer-reviewed and published articles.

Paper 1: Understanding Water Governance in the Central Rift Valley of Ethiopia: Governance Framework, Coherence and Practices, Environmental Management (Springer), https://doi.org/10.1007/s00267-024-01966-6

Paper 2: Assessment of Water Governance Practices in the Central Rift Valley of Ethiopia: Transparency, Accountability and Participation**,** Water and Environmental Sustainability (WES), https://doi.org/10.52293/WES.4.2.4051

Paper 3: The role and interplay of institutions in water governance in the Central Rift Valley of Ethiopia, *F1000Research (Taylor and Francis)* 2024, 12:1434 (https://doi.org/10.12688/f1000research.138939.2)

Paper 4: Analysis of Stakeholders' Interaction and Power Dynamics in Water Governance in the Central Rift Valley, Ethiopia, present environment and sustainable development (under review).

Paper 5: Farmers' Willingness to Pay for Irrigation Water: Opportunities and Challenges for Implementation of Water Charge Policy in the Central Rift Valley, Ethiopia (Manuscript is prepared for journal submission).

General Abstract

Water governance requires multi-sectoral stakeholders' participation and appropriate policies, laws, and regulations. The Central Rift Valley (CRV), the study area possesses water resources such as major lakes (Ziway/Dembel, Langano, and Abiyata) and major rivers (Katar, Meki, and Bulbula). These water sources are sources for livestock and ecosystem services, industry, and agricultural irrigation. Although these water resources are vital for the local community and wider areas, these resources are endangered due to an imbalance in human-water interaction. This study aimed to examine the water governance framework, governance practices, role of water institutions, stakeholders' interaction and power dynamics, and irrigation water service fees in the CRV sub-basin of Ethiopia. The study employed both quantitative and qualitative approaches. For qualitative data, key informant interviews, focus group discussions, and content analysis were used. A thematic approach was employed to analyze qualitative data using NVivo software packages. For quantitative data, a household survey was administered to collect data from 302 HHs. A mixed logit Model was used to analyze choice experiment survey data (willingness to pay). STATA software packages were used for quantitative data organization and analysis. The results indicate that water-related policies, regulations, and strategies were enacted and implemented in the country. However, the water policy and related regulations were not supported by enforcement mechanisms such as detailed standards, guidelines, and procedures. Water allocation and apportionment were not practiced. This study results shown that both formal and informal institutions were involved in irrigation water governance, and contributed to community awareness creation, irrigation water distribution, and conflict resolution at a local level in the study area. Regarding stakeholders, different types of stakeholders including government, community-based associations, NGOs, development partners, private companies, and individual farmers were involved in water governance aspects. However, the power of these stakeholders was imbalanced; federal and regional government organizations dominated in decision-making processes, and stakeholders at federal and regional levels and development partners had more power in terms of human resources capacity, resource generation, knowledge creation, and information accessibility compared to local level stakeholders. Regarding farmers' willingness to pay (WTP), the result of the Mixed Logit

indicates that the mean WTP for improved irrigation water attributes (intensity, frequency, and water quality) showed positive and significant. This implies irrigator farmers have positive attitudes toward the implementation of irrigation water charge policy to make trade-offs by non-monetary attributes. On the other hand, the cost of irrigation water pump using petrol was observed as a major challenge to irrigation water fee policy. In conclusion, the state of irrigation water governance is poor in the CRV sub-basin of Ethiopia. Both formal and informal institutions were not harmonized and interlinked to shape the behavior and practices of irrigation water users in the study area. Hence, emphasis should be given to revisiting water governance policy and its enforcements, institutional roles and responsibilities, stakeholders' interaction platforms, and non-monetary attributes of water and cost-effective water lifting technologies to improve water governance and sustainable water use in the CRV sub-basin of Ethiopia.

Key terms: Central Rift Valley, Ethiopia, Institutions, power dynamics, Water Governance, Willingness-to-pay, stakeholder

Chapter One: General Introduction

1.1. Background

Water governance is a system that makes water management more effective, accountable and participatory through formal and informal institutions involvement (UNDESA 2003). As stated by Pahl-Wostl and Knieper (2011) water governance is the ways in which actors interact at different levels and how that interaction is guided by various sets of rules, be it by the formal or informal. Graham et al. (2003) sees water governance as a system of frameworks where the associated agreements, procedures, conventions, and policies operate in coordination. According to Lautze et al. (2011) the governance concept consists of three core aspects: the processes of decision-making; the processes of institutionalization (including mechanisms, systems and traditions); and the processes and institutions of decision-making that involve multiple actors. Water governance embraces the range of political, social, economic and administrative systems that develop and manage water resources and the delivery of water services at different levels (Rogers & Hall 2003; Rauschmayer et al. 2009). In other words, it is the set of systems that control decision-making with regard to water resource development and management.

Water governance, or our collective decisions and choices indicate about the use and management of water, emerges through institutions (Gallaher and Heikkila 2014) where institutions are understood as the "rules of the game" and the interested stakeholders as the actors, allowing assessments to be undertaken to understand how the different stakeholders interact, the power dynamics between them and how they influence policies (UNDP 2013). Institutional arrangements can include enforced formal laws governing individual behavior, public and private organizational arrangements, as well as informal norms and standards shared among communities (Heikkila 2004; Agyenim 2011). Institutions may establish organizations and organizations frequently create, implement, or administer institutions (Tortajada 2010b; Gallaher and Heikkila 2014).

Making a distinction between water management and water governance is important, where the former aims to improve outcomes or goals directly while the latter seeks to define what good outcomes are and align management practices with those goals. Water governance provides the

framework for deciding on and undertaking management activities (Pahl-Wostl 2009). Governance is observed as a prerequisite for improving water management (Lautze et al. 2011). Water management is the activities to analyze and monitor resources along with measures developed and implemented to keep the resources within a desirable condition, and water governance as a social function that helps regulate the management of water resources services along with providing guidance towards a desirable state (Pahl-Wostl 2009).

Water management is the whole set of technical, institutional, managerial, legal, operational activities required to plan, develop, operate and manage water resources (Savenije 1996). Water management can be considered as a process including all activities of planning, design, construction and operation of water resources systems. Water resource management has become increasingly a global challenge since the 1970s because of the conflicts flaring up from the protracted social inequalities; the inefficiency, ineffectiveness, and inefficacy characteristic of water governance have been among the prevailing challenges in many regions in the world (Castro 2007). Over extraction and pollution of water has significantly affected the environment, and as a result over 60 percent of ecosystem services being degraded or used unsustainably (Kammeyer et al. 2020). This degradation estimated to cost an annual loss of USD $3-5 trillion in natural capital (Ranger et al. 2023). By 2025, water withdrawal for most uses (domestic, industry, and agriculture) is projected to increase at least by 50%, which will limit irrigation water withdrawal that in turn constrain food production (Rosegrant et al. 2002).

Lack of effective water governance is one of the factors contributing to inadequate water resource management (UNDP 2016; Jiménez et al. 2020). Organizations for Economic Cooperation and Development (OECD) highlighted that water resources management had been ineffective due to governance gaps in policy, administration, coordination, funding, information, and accountability (OECD 2011).

Empirical evidence shows that water governance is vital for sustainable water management and uses. For instance, Bakker and Morinville (2013) argued that water governance is critical to water security and to the long-term sustainability of the Earth's freshwater systems. It is also mentioned that water governance is helpful in terms of enabling better flow of information and knowledge to enhance stakeholder participation (Turner et al. 2009); and can greatly contribute

to the design and implementation of robust public policies, targeting measurable objectives in predetermined time-schedules at the appropriate scale (OECD 2015). Although water governance is vital in sustainable water resources management and uses, the concept received attention in the literature and development endeavors in the recent decades (Jacobi et al. 2014).

Institutions are the laws, policies, and organizational arrangements that communities devise to permit, forbid, or require certain human behavior (Crawford and Ostrom 1995). Institutional arrangements include enforced formal laws while informal institutions refer to socially shared rules such as social or cultural norms, standards which are not written down and reflect local people's attitudes (Heikkila 2004; Pahl-Wostl 2009). Water institutions have broad components such as water law, water policy and water administration with their constituent institutional aspects (Saleth & Dinar 2004; Gain and Schwab 2012).

For sustainable water governance, multi-stakeholder collaborations and interactions that facilitate the sharing and integration of diverse sources and types of knowledge are very important (Medema et al. 2017). Stakeholders' collaborative processes and repeated interactions, which build trust and strong network ties, are crucial to improve water governance through knowledge co-creation between different stakeholders (Berkes 2009; Bodin and Crona 2009). In this aspect, identifying the key stakeholders and analyzing their interactions and power relations are essential through institutional coordination (horizontal and vertical) as it enhances participation, partnerships, dialogue, conflict resolution and consensus building among multiple stakeholders (Mayers 2005; Nikitina et al. 2009).

It is also important to consider instruments that enable efficient allocation and use of water to improve water governance. In irrigation development, policy designers have adopted strategies such as price setting, decentralizing irrigation water governance and improving water rights linking with the preferences of local governance items (Johnson et al. 2004; Veettil et al. 2011). Failure to consider the users preferences, might cause irrigation systems to rely heavily on subsidization and increasing pressures on the fiscal resources (Lankford et al. 2016). On the other hand, considering users' preferences has the opportunity to enable farmers to value water and maintain the system for a long term (Ribeiro and Johnson 2018; Ren et al. 2018). It also needs in-depth and contextually rich data (Torjatada 2010a), which is missing in countries like

Ethiopia that describe the structure of governance organizations and institutions across space and time.

The Central Rift Valley (CRV) of Ethiopia, the study area, is endowed with diverse water resources such as lakes and rivers. Although water resources in CRV are vital for the livelihood of the local community and for ecosystem services for wider areas (Vilalta 2010; Etissa et al. 2014; Hailu et al. 2018), these resources are endangered due to imbalance of human-water interaction (Vilalta 2010; Pascual-Ferrer and Candela 2015; Lemi 2019). For instance, increasing irrigation water abstraction and investment at upstream (Vilalta 2010), competition of water uses for domestic purposes, agricultural activities, livestock production, and mismanagement of irrigation practices have been threatened the sustainability of water resources in the CRV (Pascual-Ferrer and Candela 2015; Lemi 2019). Therefore, this dissertation intended to examine water governance focusing on water governance framework and practices, water governance principles, role of formal and informal institutions, stakeholders' interaction and power dynamics, and water users' preferences regarding to local water governance and irrigation water (service) fees in the CRV, Ethiopia.

1.2. Statement of the problem

Water resources in the CRV have a great role in the livelihood of the local community for food production, income generation and support of biodiversity, e.g. fish harvesting, agricultural irrigation and home for different bird species (Vilalta 2010; Pascual-Ferrer et al. 2014; Elias et al. 2019). However, water resources in CRV are being degraded by anthropogenic factors such as overexploitation, increase pollution and unsustainable water uses for irrigation purpose and for industry (Vilalta 2010; Lemi 2019). For instance, unsustainable irrigation and water abstraction caused Lake Ziway to drop and reduce the water area between 1986 – 2000 periods (Goshime et al. 2019); Lake Abiyata has lost lake height between 1985 and 2006 (Seyoum et al. 2015); and coverage of water bodies was declined by 2.6% between 1985 and 2015 due to expansion of irrigation farms (Elias et al. 2019).

Hengsdijk et al. (2016) stated that the CRV of Ethiopia faces different forms of environmental degradation because of uncontrolled economic development and poor short-term needs for survival. Another finding also reported that the Ethiopian CRV sub-basin is already a degraded

basin from an environmental point of view as ecosystems are endangered due to human activities, and proposed shift in water governance (Pascual-Ferrer et al. 2014). A study carried out by Etissa et al. (2014) in the CRV mentioned a lack of participatory processes in farm irrigation practices is evident in the area.

Evidence of studies also shows the quality and volume of water resources were declined in the CRV. For instance, study conducted by Feleke et al. (2019) mentioned that water resources in the CRV degraded because of the expansion of irrigation agriculture, and inefficient irrigation water utilization. Other evidence shows that the Meki catchment of CRV sub-basin is experiencing irrigation expansion and water scarcity challenges (Taye et al. 2022). In addition, Goshime et al. (2021) warn the rapidly increasing competition for water in the area might cause a substantial decrease in water (water scarcity) and an unmet water demand for long-term and sustainable developments. Berhanu and Bisrat (2020) also advised that the continued abstraction of water from Lake Ziway and its main tributary rivers for irrigation water demand might soon exceed the supply unless sound decision taken.

The causes of these problems are associated with water governance and institutional flaws as previous works reported (e.g., Agyenim 2011; UNDP 2013; Gallaher and Heikkila 2014; Dechasa et al. 2020; Jiménez et al. 2020). Overlooking the current situation of irrigation water governance and practices in CRV sub-basin as is, might lead to water resource degradation and endanger the livelihood of the local community and the wider ecosystem services.

Several studies (for instance, Arsano 2010; Deneke 2012; Dessie et al. 2019) have been conducted related to water governance in Ethiopia. Dessie et al. (2019) conducted study on ‘Trends and actors of local water governance of Borkena River in Ethiopia’ blamed the households and institutions around the river for the depletion of the river water. A study by Arsano (2010) on governance in Ethiopia, particularly in Amhara, Tigray and Afar found out persist challenges in terms of Capability, Accountability and Responsiveness (CAR). The report on Textile Industry water use in Ethiopia indicates that water sector faced higher water pollution risks, and mentioned that weak enforcement of existing regulations attributed to the problem at hand (Sima and Restiani 2018). Another study conducted on institutional change in water

governance showed that the existing water governance is characterized by centralized control of resources and dominance of federal actors, and poorly coordinated (Deneke 2012).

A study conducted focusing on collaboration of stakeholders in governing water supply in the urban context in Wolkite and Addis Ababa Towns reports that there were weak collaboration among stakeholders, and the governance arrangement was dominated by a few sectors (Bues and Theesfeld 2012; Mersha et al. 2016; Woldesenbet 2020; Woldesenbet and Kebede 2021). This implies imbalanced power makes local actors vulnerable to overriding their decision making and resources uses. Adela et al. (2019) also reported that the existing small-irrigation scheme governance attributed to water scarcity in Ethiopia.

Another study conducted by Guni (2013) in CRV focusing on institutional analysis of irrigation agencies found that irrigation water management institutions perform far below expectations, and the current institutions are not unable to handle broader issues. Geleta et al. (2022) also conducted a study in CRV (Katar Sub-basin) on 'polycentric irrigation water governance, focusing on irrigation water users' associations (IWUAs) service delivery', and reported that significant numbers of irrigators were dissatisfied with IWUAs' water allocation services.

In many water governance literatures, aspects such as frameworks, institutions, stakeholders, and community involvement and participation were analyzed as the major components of governance. However, in most of the studies conducted so far in CRV, water governance framework and practices, the patterns of governance principles, interplays of formal and informal institutions, stakeholders' interaction and power dynamics, farmers' willingness to pay for irrigation water (service) fees were not addressed in a comprehensive manner. In addition, the underlying institutions and organizations involved in water governance need analytical scrutiny, and in-depth and contextually rich data across space and time (Torjatada 2010a), which is lacking in Ethiopia. Therefore, this dissertation intended to examine irrigation water governance and institutional aspects in the CRV, Ethiopia. The study was designed to answer a hierarchy question of *How can water governance and institutions in CRV, Ethiopia, successfully enhance the management and sustainable use of water resources?* To address this question, the study set a number of research objectives as follows.

1.3. Objectives of the Study

1.3.1. General Objective

The general objective of the study aimed at analyze water governance practices, institutions, key stakeholders' involvement and farmers' preferences for irrigation fees payment to improve water governance and sustainable water use in the Central Rift Valley, Ethiopia.

1.3.2. Specific Objectives

The study addressed following specific objectives:

1. To examine irrigation water governance framework, practices, and the patterns of transparency, accountability and participation in study area;
2. To analyze the role and interplay of institutions in the irrigation water governance;
3. To analyze stakeholders' interaction and power dynamics involving in the irrigation water governance;
4. To investigate farmers' willingness to pay for improved irrigation water in the study area.

1.4. Research questions

This study answered the following research questions:

1. What are water irrigation governance framework, practices and the patterns of transparency, accountability and participation in water supply in the CRV sub-basin?
2. How institutions are influencing the behavior of irrigators in the study area?
3. How are the stakeholders' dynamics influencing water decision in the CRV sub-basin?
4. What are the preferences and WTP of farmers' for improved irrigation water in the study area?

1.5. The scope and limitations of the study

Water governance and institutions could embrace several issues. Hence, this study is delimited, conceptually, to water governance and institutions focusing on water governance qualities, role of formal and informal institutions, stakeholders' interaction and power dynamics, and preferences of households on water governance and fees for accessing irrigation water in CRV, Ethiopia. Spatially, the study was delimited to water resources of the CRV of Ethiopia, particularly; Lakes of Ziway/Dembel, Langano and Abijata, and Rivers of Katar, Meki and

Bulbula and their tributaries. Although the study was delimited to these areas, for the stakeholders' analysis, the role of formal and informal institutions and water governance principles relevant data were generated from different organizations at Federal, Basin, Regional, Zonal, Woreda and Kebele levels; from public, NGOs, water development partners, research and academic institutions. The household survey data was generated from six Kebeles of three Districts in the CRV. The study employed both qualitative and quantitative method. On the other hand, the study has the following limitations. Improved water governance was not covered in this study due to short time, and inconveniences of COVID-19 and security issues in the areas during field data collection. Satellite image using GIS was not employed to collect data, particularly, to identify the physical stress of water resources because of inconveniences to transect walk to delineate as a result of time constraints and security issues. Moreover, valuation of irrigation water was not computed because of the scope of the study was focused to test the farmers' willingness towards irrigation charge policy by identifying the positive and negative sign of attributes' coefficients.

1.6. Theoretical and conceptual backgrounds of water governance and institutions

1.6.1. Theoretical backgrounds

Institutional theory, which stresses the importance of formal and informal norms and rules to make effective governance of natural resources, is one of the prominent theories related to water governance and institutions (Ostrom 2010). Specifically, the theory's "design principles" are considered important because they enable to increase the capacity for adaptive decision-making and facilitate the appearance of self-organization at smaller scales (Ostrom 2011). According to this theory, self-organizing agents can modify rules-in-use, procedures, and technical methods to deal with changing ecological conditions and address major management issues.

In the theory of self-governance, which confirmed the practical effectiveness of autonomous governance of public affairs could be more efficient through small-scale social contracts. The theory offers a new way of guiding change in how the public sector is managed and it is like a shining star that directs the instantly recognizable clarity of societal shared governance (Vallury et al. 2022).

Collective action increases the beneficial outcomes, so individuals are motivated to make a set of rules (to minimize the effect of independent action), and therefore form an institution (Cave et al. 2013). For individuals to conform to their own rules, the authors suggest establishing trust and a sense of community to create consistent commitment through motivation for monitoring and sanctioning activities rather than using external force. The main concept is that individuals will be more likely to create and conserve the commons when they have credible and reliable information, crucially when they have an opportunity to decide the rules of the game (Forsyth and Johnson 2014).

In this theory essence, Ostrom (2005) believes that in the context of effective governance of small communal resources, the community members are capable of using various methods to improve their understanding and communication that enable them to build social interaction, mutual trust, and respect. The view of this theory goes with the community institutions such as IWUAs, customs, and traditional water resources governance practices in our case in the CRV, Ethiopia. In IWUAs, rules or local agreements were drafted with the community members, and used for irrigation water allocations, schedule management, fee collection, and sanction of non-compliance.

Another theory related to the governance and institutional aspects reviewed in this study is Contextual Interaction Theory (CIT). The theory provides an analytical framework that helps to assess whether a policy transfer contributes to or damages conditions for successful water management and helps to understand the internal processes that occur once the governance actors have decided to move forward to the implementation of the chosen policy (Bressers and de Boer 2013). After a policy transfer is in principle accepted, like water management based at the river basin scale or stakeholder participation, it will be confronted with an existing governance regime (de Boer 2012). CIT places the characteristics of the actors (motivations, power, and resources) involved in the policy process at the center of the analysis and provides a framework within which the influences of the external context can be understood. Through a more detailed understanding, one can draw lessons related to effective policy transfer in water governance (Bressers 2007; de Boer and Bressers 2011; Owens & Bressers 2013).

The theory (CIT) focuses on whether the promulgated policy is practically implemented or not and evaluates the policy goals practically. This theory aligns with the current study regarding the water governance framework and the role of formal institutions in water governance in the CRV, Ethiopia. The concept of the theory was also used in identifying water actors' involvement in decision-making processes and the power dynamics of actors.

Other theories associated with the governance and institutional aspects used in this study are the Theory of Value, which states individuals derive utility from characteristics or attributes of a good (Lancaster 1966); and Random Utility Theory that states the utility has deterministic and probabilistic components (McFadden 1974). According to these theories, individuals gain utility from the attributes of goods or services. In the current study, farmers' willingness to pay for irrigation water service attributes was estimated from the trade-offs of non-monetary attributes such as irrigation frequency, irrigation intensity, and irrigation water quality. Hence, these theories benefited the study in conceptual framework development and the analysis parts of the study.

1.6.2. Water governance approaches/frameworks

There are various approaches or frameworks used in water resources governance and institutions. For instance, the Institutional Analysis and Development (IAD) framework (Ostrom 2011), the OECD water governance framework, the concept of 'polycentric systems', and the Transparency, Accountability, and Participation (TAP) framework (Biad et al. 2015) were considered in this study.

Institutional Analysis and Development (IAD) (Ostrom 2011) was considered in this paper. Ostrom (2005) used different terms, but the key term used for the whole work is "common-pool resource"; and she defined common pool resource as a natural or man-made resource system that is sufficiently large as to make it costly (but not impossible) to exclude potential beneficiaries from obtaining benefits from its use. To make clear the process she used terms such as resource systems and system units. Resource systems are best thought of as stock variables that are capable of producing a maximum quantity of a flow variable without harming the stock or the resource system itself whereas system units are what individuals appropriate or use from

resource systems (Stoker 2019). The institution is seen as "sets of working rules that are used to determine who is eligible to make decisions in some arena, what actions are allowed or constrained, what aggregation rules will be used, what procedures must be followed, and what information must or must not be provided (Ostrom 2005).

Ostrom (2005) observes that several solutions exist to cope with many different problems, for instance, the role of private agents (users of Common Pool Resources) in sharing the usage of resources and the emerging costs by setting up their system of rules so that they can overcome the threat of resource exploitation, which might indicate water users association and irrigation water users, in our case. Whaley (2018) has discussed interdependence, independent action, and collective action in solving common pool resource utilization, which is aligned with the need for resource governance at different scales, using effective institutional rules and societal and individual morals.

An institutional framework identifies the major types of structural variables that are present to some extent in all institutional arrangements, but whose values differ from one type of institutional arrangement to another (Whaley 2018). The IAD framework is thus a multi-tier conceptual map. A key part of the framework is the identification of an action situation, which was termed as an “action situation” that can be utilized to describe, analyze, predict, and explain behavior within institutional arrangements; and the resulting patterns of interactions and outcomes, and evaluating these outcomes (Ostrom 2010). A common set of variables used to describe the structure of an action situation includes (i) the set of actors, (ii) the specific positions to be filled by participants, (iii) the set of allowable actions and their linkage to outcomes, (iv) the potential outcomes that are linked to individual sequences of actions, (v) the level of control each participant has over choice, (vi) the information available to participants about the structure of the action situation, and (vii) the costs and benefits, which serve as incentives and deterrents assigned to actions and outcomes (Ostrom 2011).

TAP framework helps to assess the core pillars of water integrity, focuses on strengthening transparency, accountability, and participation in a utility’s operations, and ensures compliance with internal rules and regulations (Biad et al. 2015). TAP also enables demonstrable democratic principles, rule of law, information sharing, and respect for gender capacity, and precludes

secrecy in transactions about water supply (Louviere et al. 2015). The assessment of TAP within the water sector focuses on measuring: the effectiveness of existing systems and processes to make information open and public; the functioning of compliance and oversight mechanisms, both internal and external; and the level of participation of citizens/end-users in decision-making processes (Jacobson et al. 2013).

Another framework used in resource governance is the concept of 'polycentric systems', which was also written by Ostrom (2010) that is characterized by multiple governing authorities at differing scales rather than a mono-centric unit'. Polycentric analysis has the benefit of incorporating a wide variety of formal/informal and state/non-state actors whose power to decide different resource governance outcomes (Ostrom 2010).

Polycentrism implies the involvement of multiple actors at multiple scales; hence, a second innovative aspect of a water security approach is the emphasis on multi-level governance processes such as multi-stakeholder watershed management platforms (Bakker and Morinville 2013). In many explanations, polycentric governance implies that nongovernmental, particularly community actors play a more significant role in environmental management (Gunningham 2009). Multi-level governance negotiated, non-hierarchical interactions between institutions at the transnational, national, regional, and local levels, including relationships between governance processes at these different levels (Peters and Pierre 2001).

Many practitioners have welcomed multi-level governance, although they express their concern regarding 'scalar failures', which refers to a situation in which a lack of coordination between scales might weaken water governance institutions and undermine efficient and effective water management (Batterbury and Fernando 2006; Moss and Newig 2010). For the current study, the concept of polycentric governance was seen positively in supporting the role of IWUAs and informal institutions in improving irrigation water governance in the CRV sub-basin. Geleta et al. (2022) also reported that polycentric irrigation water governance can play a great role in alleviating the consequences of unregulated irrigation water use in Katar sub-basin, Ethiopia.

1.6.3. Types/Models of Governance

Governance processes take place at the interface between state, market and civil society and may take various forms (Pahl-Wostl 2015). There could be different forms or modes of governance. These forms of governance may differ in terms of the kind of actors involved and their roles, and in terms of the nature and logic of interactions. Depending on the governance challenge, a particular governance mode or a combination of modes may be most effective in addressing the challenge (Pahl-Wostl 2015).

Kooiman (2003) tried to distinguish three governance modes: self, co-governance, and hierarchical governance which differ mainly in the role of governmental and non-governmental actors. Hierarchical governance refers to the classical mode of governmental top-down control; whereas self-governance refers to situations in which actors take care of themselves, outside the realm of governmental control. Co-governance refers to organized forms of governance interaction where different actors (public and private) coordinate and communicate to deal with the issues at stake without a central governing actor (Kooiman 2003).

Other governance modes which depend on the dimensions of the degree of formality of institutions and the role of state versus non-state actors include hierarchies, markets and networks (Pahl-Wostl 2009). In hierarchies, regulatory processes are based on formal institutions and governmental actors play the dominant role while markets are based on a combination of formal (i.e. property rights) and informal institutions and non-state actors dominate. Networks are largely governed by informal institutions and both state and non-state actors may participate even though the latter are generally in the majority (Treib et al. 2007).

1.6.4. Definition of Relevant Concepts

Based on different contexts, terms may have multiple definitions or meanings. Therefore, explanation and conceptualization of key terms can help to clarify the way they are used in this study.

Water governance: Water governance is the set of rules, practices, and processes through which decisions for the management of water resources and services are taken and implemented, and decision-makers are held accountable (OECD 2015). In this study, water governance is defined

as the policies, rules, and regulations enacted to manage water resources, institutions established to operate and implement the policies, stakeholders' involvement, implementation of water governance principles, and the preferences of farmers to take part in contribution of water resources protection and conservation for sustainable use.

Governance quality: quality of governance in this study is observed as the extent of water laws, regulations, institutions and enforcements at all levels and scales are coherent, and capable of enhancing the efficiency of water resources management and sustainable use in the country/CRV. Governance quality includes sufficient involvement of actors, different levels and scales, more instruments of policy and organizations sharing responsibilities for implementations (de Boer 2012). It is also the implication of substantial interaction in the policy network, coordination of responsibilities and resources within the implementing organization for the application of policy and clear responsibilities for local level implementers.

Governance principles: the term governance embraces broad concepts and ideas that are widely practiced. The core principles of governance include participation; equity, non-discrimination and inclusiveness; gender equality; rules-based; transparency; and accountability and responsiveness (UNDP 2013; OECD 2015). In this paper, governance principles are conceptualized as the accountability mechanisms in implementing water policies, strategies, roles and responsibilities; participation of key stakeholders in water related decision making processes and implementation; and transparency of irrigation water allocation and distribution, transparency of financial transfer and uses.

Formal institutions: formal institutions are laws, policies, regulations, i.e., rules and prescriptions that forbid and permit together with the expected outcomes and sanctions associated with deviation (Agrawal and Gibson 1999; Muller et al. 2017). Accordingly, in this study formal institutions include federal and regional constitutions, laws, regulations, directives and local government laws regarding water resources; the activities, procedures and operations sanctioned by state agencies and officials regarding water resources; rules that are authoritatively passed to govern water resources and to shape relationship between stakeholders and the resources.

Informal institutions: The phrase 'informal institutions' may indicate different meanings at a particular time and depending on the context. The widely used definition of 'informal institutions' is given by Helmke and Levitsky (2003) which define informal institutions as the socially shared rules, usually unwritten, that are created, communicated, and enforced outside of officially sanctioned channels. In this study, informal institutions are conceptualized as social and cultural norms, non-state sanctioned regulations, systems enforced by local people, and traditional practices of water resources governance and uses.

Institutional analysis: Institutional analysis indicates how institutions i.e., structures and mechanisms of social order and cooperation governing the behavior of two or more individuals behave and function according to both empirical rules (informal rules in use and norms) and also theoretical rules (Ostrom 2011). Institutional analysis also includes how individuals and groups construct institutions, how institutions function in practice and the effects of institutions on each other, on individuals, on societies and on the communities at the large. It focused on a systematic study of people's collective behavior; and it indicates how government agencies implement policies.

1.7. Review of Literature

1.7.1. Review of relevant concepts

1.7.1.1. Water Governance

Water governance comprises all social, political, economic and administrative organizations and institutions, as well as their relationships to water resources development and management (UNDP 2013; Tortajada 2010a). Different authors have understood water governance based on the contexts of social, cultural, political and environmental prevailing in specific areas. For instance, Özerol et al. (2018) stated water governance as "the social function that regulates development and management of water resources and provisions of water services at different levels for society and guides the resources towards a desirable state and away from an undesirable state". In the governance arena, decisions should be coherent with a broad set of principles leading to a more progressive and efficient and equitable management of water resources (Torjatada 2010a). Involving users of water in the governance of the resource make the participation more meaningful because local stakeholders may be more familiar with the

peculiarities of local economic, social, cultural and environmental situations (Torjatada 2010a); and users involved may help to accept the regulations as appropriate and consistent with their values and interests and more willing to comply with them (Kooiman 2003).

Water governance also embraces value-related issues such as responsibility, accountability, transparency, equity and fairness. Jiménez · 2020 (2020) describes water governance as a combination of functions, performed with certain attributes, to achieve one or more desired outcomes, and all shaped by the values and aspirations of individuals and organizations. Good water governance qualities can be proposed as: openness and transparency, broad participation, rule of law (predictability), and ethics, including integrity (control of corruption) (Lautze et al. 2011; Ribeiro and Johnson 2018).

On the other hand, governance concerns the function and interplay of institutions in the broadest sense including social networks and markets as well as state institutions. It is important to recognize that while institutions of governance may operate according to formal rules and procedures, outcomes are also shaped by informal norms, rules and expectations (Plummer and Slaymaker 2007). Good or improved water governance has three main components (Biad et al. 2015): (i) Policy, regulatory, and legislative frameworks that protect water resources and create an enabling environment for ecological sustainability and effective service delivery; (ii) Institutions that manage and use natural, financial, and human resources in a responsible and efficient manner; and (iii) Decision-making mechanisms that achieve responsible use of political power, and facilitate the participation of stakeholders in a transparent and accountable manner.

Governance processes take place at the interface between state, market and civil society and may take various forms (Pahl-Wostl 2015). There could be different forms or modes of governance. These forms of governance may differ in terms of the kind of actors involved and their roles, and in terms of the nature and logic of interactions. Depending on the governance challenge, a particular governance mode or a combination of modes may be most effective in addressing the challenge (Pahl-Wostl 2015).

Kooiman (2003) tried to distinguish three governance modes: self, co-governance, and hierarchical governance which differ mainly in the role of governmental and non-governmental

actors. Hierarchical governance refers to the classical mode of governmental top-down control; whereas self-governance refers to situations in which actors take care of themselves, outside the realm of governmental control. Co-governance refers to organized forms of governance interaction where different actors (public and non-public) coordinate and communicate to deal with the issues at stake without a central governing actor (Kooiman et al. 2008).

Other governance modes which depend on the dimensions of the degree of formality of institutions and the role of state versus non-state actors include hierarchies, markets and networks (Pahl-Wostl 2009). In hierarchies, regulatory processes are based on formal institutions and governmental actors play the dominant role while markets are based on a combination of formal (i.e. property rights) and informal institutions and non-state actors dominate. Networks are largely governed by informal institutions and both state and non-state actors may participate even though the latter are generally in the majority (Treib et al. 2007).

1.7.1.2. Governance frameworks

The successful implementation of a policy is heavily dependent on the context from which it came and that to which it is transferred (Bressers and de Boer 2013). Structural contexts that have influences on specific contexts in water governance include levels and scales, networks and actors, perspectives and goal ambitions, strategies and instruments, responsibilities and resources for implementation, and property and use rights (Bressers and de Boer 2013).

Coherence means when more than one layer of government is dealing with the same natural resource and when the activities of these layers of government are recognized as mutually dependent and influencing each other's effects (Bunch et al. 2011; de Boer 2012). Likewise if more than one scale is relevant the interaction effects between those scales should be considered. Coherence implies when more than one actor (stakeholder) is involved in the policy, which indicates the existence of substantial degree of interaction in the policy network (de Boer 2012). In addition, coherence implies the alignment of laws, rules, procedures, indicators, roles and responsibilities across all levels and scales, and actors' consensual network relations working on water and irrigation development. Sustainable governance of water resources requires the incorporation of water goals into the various policies that affect or are affected by the water system of all partners involved (de Boer and Bressers 2011).

Coherence of water governance organized around ecologically meaningful scales when aligned with institutional coherence is quite important (Heikkila 2004; Bunch et al. 2011). It is also argued that small or fragmented institutions governing water resources lack both the ability for comprehensive resource planning and the ability to address problems that cross state and local boundaries (Lopez-Gunn and Jarvis 2009). Institutional scales need to align with hydrological and ecological scales as it enables the integrated management of land and water uses, and their effects on upstream-downstream dynamics (Plummer 2011). It also helps to resolve problems such as inefficient uses of resources, negative environmental externalities, and social inequalities; and provides scientifically-based prioritization of management activities (Benson and Jordan 2010; Plummer 2011; Cohen and Bakker 2014). Managing water at the appropriate scale(s) within integrated basin governance systems is suggested to reflect local conditions and foster coordination between the different scales, to promote long-term sustainable objectives, and to enhance multi-level co-operation among users and stakeholders (OECD 2015).

Another important aspect in a broader water governance perspective is flexibility. It is the decentralization of power that is supported by upper levels of government, empowering rather than controlling relations, and trust across all levels (de Boer 2012). It also includes supporting solutions from local, responsibilities and pooling resources for integrative implementation, the use of strategies and instruments from public policies and private properties rights and creates ways to achieve the intended goals based on the context.

Similarly, governance principles inbuilt in the policy and strategies are vital for improved water governance. Despite the fact that a lot of research has been carried out on water governance, the principles of water governance was developed recently by OECD in 2015, which has twelve principles on water governance (OECD 2015). The principles intend to contribute to tangible and outcome-oriented public policies, based on three mutually reinforcing and complementary dimensions of water governance: effectiveness, efficiency, and trust and engagement (Keller and Hartmann 2019).

Water governance embraces value-related principles such as responsibility, public participation, accountability, transparency, equity and fairness (Tortajada 2010a; Adhikari and Tarkowski 2013). These principles are among the major principles of good governance identified by the

World Bank and UNDP (Kaufmann 2020). Participation implies the meaningful and active involvement of a broad range of stakeholders, including vulnerable or marginalized groups in decision making processes (Jiménez et al. 2020). Participation also refers to equity between and among the various interest groups and stakeholders with fair and impartial processes of decision making (Biad et al. 2015).

Transparency refers to the openness and public access to information so that citizens can understand the decision-making processes that affect them, and are knowledgeable about the standards to expect from public officials (UNDP and SIWI 2011). Transparency requires governments, companies, organizations and individuals to facilitate all means for citizens to understand the decisions that may affect them; and it requires the information to be usable through open data, that is accurate, available, complete, conformant, consistent, credible, relevant and timely (Das et al. 2016).

Accountability is the requirement for powerful actors to accept responsibility and answer for their actions (Nuesiri 2016). Accountability could be vertical when characterized by a hierarchical principal-agent relationship, and horizontal where there is no hierarchically superior or diagonal and inclusive of citizen initiatives to hold powerful actors accountable (Karar 2017). When vertical, horizontal and diagonal accountability practices are primarily civil society or citizen driven, they are referred to as social accountability (Nuesiri 2016). The Human Rights framework identifies three essential principles for building accountability which include: responsibility (defining roles and responsibilities in service delivery and enabling coordination between different stakeholders), answerability (by providing reasoned justifications and explanation for their actions and decisions to those they affect), and enforceability (by providing monitoring, supporting and enforcing compliance for the use of corrective and remedial action where necessary) such as sanctions for corrupt behavior (Jiménez et al. 2020).

1.7.1.3. The role and arrangements of water institutions

It is recognized that institutions can play a key role in shaping how Common Pool Resources users coordinate their actions to solve supply and demand problems (Heikkila 2004). In general, institutions are the laws, policies, and organizational arrangements that communities devise to permit, forbid, or require certain human behavior (Crawford and Ostrom 1995). Institutional

arrangements include enforced formal laws, informal norms and standards shared among communities that govern individual behavior, public and private organizational arrangements (Heikkila 2004).

Formal institutions are linked to the official channels of governmental bureaucracies and can be enforced by legal procedures, while informal institutions refer to socially shared rules such as social or cultural norms which are not written down and reflect local people's attitudes (Pahl-Wostl 2009). Institutions, formal or informal are shared, enforced and long-lived (Helmke and Levitsky 2003; Hassenforder and Barone 2019).

Saleth and Dinar (2004) analyzed water institutions using a two-stage analytical approach. These were done by breaking the water institution down in terms of its three broad institutional components: water law, water policy and water administration. At the second level, each of these institutional components is broken down further to identify their constituent institutional aspects: the water law component law-related institutional aspects; the water policy component policy-related institutional aspects; and the water administration component include the administration-related institutional aspects (Gain and Schwab 2012). In practice, many stakeholders such as water users associations, NGOs and local communities build on local knowledge and networks lack support, funds, institutional and technical capacities or lack membership to significantly contribute to the management of water resources (Torjatada 2010a).

1.7.1.4. Stakeholders' power and dynamics in water governance

In national and international environmental policy, the need to understand who is affected by the decisions and actions taken, and who has the power to influence the outcome of the decision is becoming recognized by decision makers (Stein et al. 2011). Stakeholder power is the extent to which stakeholders are able to persuade or coerce others into making decisions, and follow certain courses of action (Mayers 2005). Although this is a vital first step, stakeholders are often identified and selected on an ad hoc basis, rather than considering them as vital actors for sustainability. Undermining stakeholders and their interaction has the potential to marginalize important groups, bias results and jeopardize long-term viability and support for the process (Reed et al. 2009). This study suggests that making an inventory of those who could have a role in decision-making, gauging their importance through their level of influence and their interest

for a particular outcome, mapping the relationships between the actors, and understanding their potential for developing alliances are vital (Reed et al. 2009).

Stakeholder analysis in natural resource management such as water bodies has often focused on inclusivity, to empower marginal groups, such as women, those without access to well established social networks, the under-privileged, or the socially disadvantaged, and those who are not easily accessible (Johnson et al. 2004; Keller and Hartmann 2019). Stakeholder analysis is also vital to be aware of the diverse range of potentially conflicting stakeholder interests (Prell et al., 2007).

The distribution of power, capacity and resources is generally imbalanced (Suhardiman et al. 2017). Failure to recognize the power imbalances can result in some stakeholders dominating others and less powerful stakeholders being abused, overruled or excluded (Eriksson et al. 2015). The power balance requires key actors to have mutual respect and trust. It is argued that natural resource governance such as water bodies typically deals with conflicting interests of various stakeholders as they use the same resources for different purposes.

Sustainable governance of water resources relies on processes of multi-stakeholder collaborations and interactions that facilitate the sharing and integration of diverse sources and types of knowledge (Medema et al. 2017). It is essential to facilitate collaborative processes and repeated interactions that build trust and strong network ties, which is a crucial condition for successful knowledge co-creation that provides more insight into the properties of relationships between different stakeholders within a collaborative network (Berkes 2009; Bodin and Crona 2009; Medema et al. 2014).

Therefore, to improve water governance and water resources management, it is vital to understand the different perspectives and power of the actors involved. Identifying the key stakeholders and analyzing their interactions and power relations are essential to improve the governance of water resources. Stakeholder interaction within river basins becomes a powerful tool in good water governance through institutional coordination (horizontal and vertical) between various government bodies. It enables participation, partnerships, dialogue, conflict resolution and consensus building among multiple stakeholders (Nikitina et al. 2009). The

existing different degrees of power to control decisions among stakeholders have effects on policies and institutions (Mayers 2005).

1.7.1.5. Preferences of water users and water pricing in irrigation water services

Some researchers advocate water pricing as policy and economic instruments arguing that it enhances efficient use of water (Speelman et al. 2009). However, failure to collect appropriate fees from irrigation farmers for the use of the irrigation network leads to poor water delivery, low productivity, low incomes, inadequate cost recovery and maintenance effects (Burton et al. 2020). Efficient allocation of water through water pricing requires getting the right pricing, because it is sensitive to social, physical, institutional and political settings (Johnson 2004; Veettil et al. 2011).

To improve the efficiency of water allocation and use, policy designers have adopted strategies such as price setting, decentralizing irrigation water governance and improving water rights (Veettil et al. 2011). Since farmers live in a micro-environment, within a particular type of irrigation water governance and institutional framework and with different cropping systems, the linkages between price setting and local governance items are of the utmost importance (Veettil et al. 2011). In irrigation water pricing, considering farmers' preferences is vital for proper policy intervention because farmers might value the irrigation water attributes in a different way at different price levels.

1.7.2. Empirical literature

1.7.2.1. Frameworks of governing water

The modes of water governance depend on the particular nature and history of a country, including its territorial configuration, governmental structure, local customs and constraints on access to water (Bruch et al. 2007). Several countries are characterized by a centralized national system for water management. For instance, in countries such as Tunisia, Syria and Jordan there are lesser extent of provisions within their laws that delegate water management responsibilities from the centralized government to lower levels of government, committees and Water User Associations (Bruch et al. 2007).

On the other hand, in countries like India, water is constitutionally a state subject; therefore, state governments are responsible for governing water within their boundaries with technical and financial support from the federal government (Ahmed and Araral 2019). Morocco and Yemen have the most decentralized legal frameworks of water governance (Bruch et al. 2007). In Morocco, each Basin Agency is an autonomous organization, managed by a Board of Directors composed of local authorities, various sector representatives, water users, local councils and ethnic group representatives. Regarding the ownership of water, in countries such as Tunisia, Palestine, Morocco, Syria and Algeria the state has a legal obligation to hold the ownership of water in trust for the benefit of citizens (Bruch et al. 2007).

In Ethiopia, the Federal Democratic Republic of Ethiopia (FDRE) constitution 1995 Art 40(3) asserts that every Ethiopian has the right to access to water, and the owners of water resources are the peoples of Ethiopia. Following these constitutional grants, different legal frameworks have been established in the country. For instance, Water Resources Management Policy and Water Sector Strategy were developed in 1999 and 2001 respectively. The main objectives of water policy were: to promote the coordination of water resources management activities between the Federal and Regional Governments, to encourage the establishment of water resources management institutions and the participation of user communities in water resources management, decentralized water resources management from regional to the lowest administrative structure (FDRE 1999). The policy also promotes and recognizes the hydrologic boundary or "basin" as the fundamental planning unit and water resources management domain.

Besides the policy, the National Water Strategy of Ethiopia (FDRE 2001) was developed with the main objective of translating the national water resources management policy into action. The overall goal of the Water Resources Strategy is to enhance and promote all national efforts towards the efficient, equitable and optimum utilization of the available water resources of Ethiopia for significant socio-economic development on a sustainable basis. Irrigation Development Strategy is one of the four sub-strategies, and it dealt with issues, among others, such as: research and development; stakeholders' participation; gender mainstreaming; environment and health standards; capacity building; institutional aspects; and social aspects.

The policy has also recognized irrigation as an integral part of the water sector and consequently develops irrigation within the domain and framework of overall water resources management.

The federal government, regional states, Zones, District and Kebele administration were involved in water resources management according to the government structure of Ethiopia. The Federal government has a mandate to formulate policy, strategy, plan, and to determine and administer the utilization of the water of rivers and lakes linking two or more states or crossing the boundaries of the national territorial jurisdiction. Regional States have the mandate to administer land and other natural resources in accordance with Federal laws, unless the federal government delegates its mandate to regional states. In addition, regions have mandates to determine the use and administration of water resources that do not link with other regional states though it is argued as leading to fragmentation by some authors (Imeru Tamrat 2008). The Ministry of Water and Energy is responsible for policy, strategy and plan development and undertake overall supervision of water resources management.

The federal government has also established the Basin Development Authority by Regulation No. 441/2018, with the overall objective to implement integrated water resources management, sustainable development administration and utilization of water resources at a basin level in an equitable and participatory manner (FDRE 2018). The major duties and responsibilities given to this authority includes to conduct policy studies, develop basin master plans, work collaboratively with regional states and other organs, and provide capacity building advice. With respect to Rift Valley, there is established Rift Valley Lakes Basin Authority, with the main objective to promote and monitor the implementation of integrated water resources management process in an equitable and participatory manner in the Rift Valley Lakes Basin. There are also organizations established in all Regional States which include: Water Resources Bureau, Irrigation Development Agency, Agriculture and Rural Development Bureau, Environment Protection Authority and at regional, zonal and Woreda level to coordinate, manage, monitor and implement water policies and strategies.

Several studies were conducted regarding legal frameworks and institutional arrangements of water governance in Ethiopia, and different findings were reported. For instance, an assessment of local land and water institutions in the Blue Nile by Hagos et al. (2011) found that though

there were efforts to improve institutional arrangements, the sector was challenged by high frequency of overlapping and conflicting roles and responsibilities among organizations, poor inter-sectoral collaboration, and frequent restructuring and reorganization over the last few years. Another study conducted by Haileslassie et al. (2016) focusing on institutions for irrigation water management in Ethiopia reported that there is unfair water distribution within the schemes and inefficient water uses in Ethiopia.

Moreover, a study undertaken by Duguma (2017) focusing on governing irrigation water found that there are less flexibility on policies, strategies and plans as go from lower tiers to upper, i.e. from Woreda to Regional and National levels of administration; however coherence among stakeholders is better at higher level than at local level. Hailu et al. (2017) conducted a study in Awash Basin of Ethiopia, and reported that water institutions are overwhelmingly more rhetoric than action oriented. The study report of policy analysis of water for productive use among smallholder irrigation in Ethiopia, indicates that the policies and strategies relevant to Ethiopia's productive water use lack concrete instruction and institutional stabilities, and suffering from sector fragmentations at all levels from the community up to federal (Tesfaye and Seleshi 2014). In addition, undertaking reforms in the water sector (both at Federal and Regional levels) have resulted in poor coordination and deterred the actual implementation of the strategies.

In the Ethiopian context, different efforts have been made to develop water policies and regulations to manage water resources in the country (Jibat et al. 2024). In addition, community-based integrated watershed development (Gebregziabher et al. 2016), preparation of guidelines for the establishment and management of multi-stakeholder platforms (Kassa et al. 2024), establishing Basin Development Office (FDRE 2018), adaptive water resources management initiatives (Mosello et al. 2015), Green Legacy Initiative (Beyene and Shumetie 2023), etc were the efforts and initiatives the country committed. For instance, the Federal Democratic Republic of Ethiopia (FDRE) formulated Ethiopian Water Resources Management Policy in 1999, Ethiopian Water Resources Management Proclamation in 2000, and Ethiopian Water Sector Strategy in 2001. In addition, the FDRE designed and implemented the Water Sector Development Program (WSDP) and Water Governance Program for Integrated Water Resource Management in the different River Basins (FDRE 1999; FDRE 2000; FDRE 2002). The overall

goal of these efforts is to achieve efficient, equitable and optimum utilization of water resources for significant socioeconomic development on a sustainable basis.

However, the intended goal was not attained due to deficiencies related to water governance, water resources management and institutional flaws (Jibat et al. 2024). For instance, water institutions had rapidly changing losing coherence and lack coordinated interplay among water organizations (Hailu et al. 2018); lack of gender equity (Moriarty et al. 2008); less collaboration and networking among stakeholders (Duguma 2017); weak institutional linkages and lack of clear responsibility in water governance at various levels (Dessie et al. 2019); and lack of accountability and responsiveness in ensuring equity (Arsano et al. 2010).

Moreover, management of the existing water infrastructures such as irrigation systems are dominated by traditional practices and lack scientific knowledge to improve efficiency (Ayana et al. 2015). There are also deficiencies in irrigation management which include over irrigation, poor drainage, salinity and alkalinity in the irrigated areas of the country (Michael and Awulachew 2007; Zelalem 2010). These deficiencies resulted in degradation of soil fertility, reducing land and water productivity in Ethiopia. Driving factors that resulted in such deficiencies are population increase and their demands, urbanization, and development needs in agriculture and industry leads to increased demand for water in Ethiopia (Ayana et al. 2015).

1.7.2.2. Institutions and attributes of water governance

Previous studies indicate that both formal and informal institutions have contributed to natural resources management. For instance, a study conducted in Sub-Saharan Africa revealed that informal institutions have contributed more than formal ones for sustainable Common Pool Resources (CPR) management though joint decision-making, enabling exclusion at low cost for CPR users, acknowledge the local knowledge of the community and using locally agreed sanctions (Yami et al. 2009). The study also suggests emphasizing on enhancing the effectiveness of both formal and informal institutions by interlinking the values of these institutions. Another study conducted on governance of water supply service in Mexican communities suggested the recognition of both formal and informal water institutions and updating laws, rules and regulations to operate and enforce them at municipal and at community

level based on local reality (Tinoco 2012). There is also evidence that in many cases where some informal institutions gradually become part of formal counterparts and some formal institutions take informal forms in governing resources such as water (Nhundu et al. 2015).

Strong institutions which are governed, planned and financed adequately are therefore vital for good and sound water governance (Tortajada 2010b). Akamani (2016) indicated that an institutional failure is caused due to inadequate consideration of the human dimensions and its failure to prioritize the need for learning uncertainty and adapting to change. Jacobi et al. (2014) identified that major challenges related to water institutions include lack of integrated planning of water use, the poor coordination of the main stakeholders, and the need for management instruments that may fit local conditions better.

In Ethiopia, the fundamental principles that guide the equitable, sustainable and efficient development, utilization, conservation and protection of water resources of Ethiopia are emanated from the policy of water resources management of the country (FDRE 1999). The major principles of water resources management included in Ethiopian Water Resources Management Policy are: decentralized water resources development and management, participatory governance approach, integrated and comprehensive management of water resources, management systems in reliability and sustainability norms, ensure the participation of all stakeholders and user communities, and promote compatible and integrated water resources management with other natural resources as well as river basin development plans (FDRE 1999).

Regarding to irrigation water management, the policy advocates development and enhancement of small scale irrigated agriculture; environmentally sound basis as well as development of sustainable, and promotion of water use efficiency; promote decentralization and users-based-management of irrigation systems; support and enhance traditional irrigation schemes by improving water abstraction and water use efficiency; prevention and mitigation of degradation of irrigated water; establish water allocation and priority setting criteria based on harmonization of social equity, economic efficiency and environmental sustainability requirements (FDRE 1999).

In terms of water supply institutional aspects, the Federal government has formulated different rules, regulations, enforcements, and institutional arrangements to achieve the goal of enhancing and promoting all national efforts towards the efficient, equitable and optimum utilization of the available Water Resources of Ethiopia for significant socioeconomic development on a sustainable basis. For instance, Ethiopian WRM Proclamation 197/2000, WRM Regulations No.115/2005, Basin Development Authority Regulation No. 441/2018, and Water Development Commission Regulation No. 442/2018 and Irrigation Development Commission Regulation No. 444/2011 can be mentioned.

These rules and regulations are promoting the allocation and apportionment of water, based on comprehensive and integrated plans and optimum allocation principles that incorporate efficiency of use, equity of access, and sustainability of the available water resources of Ethiopia in order to achieve significant socioeconomic development on a sustainable basis (Arsano et al. 2010). The Water Resources Management Policy of the country was also intended to promote and enhance traditional and localized water harvesting techniques in view of the advantages provided by the schemes' dependence on local resources and indigenous skills (FDRE 1999).

There were various studies have been undertaken regarding water institutions in the last ten years in Ethiopia. For instance, Hailu et al. (2017) conducted a study focusing on water institutions in the Awash basin of Ethiopia, and reported that institutions had rapidly been changing lacking coherence and duties and powers of institutions are mostly centralized. The study has also indicated that water policy did not properly cascade down to the lower level, and customary water institutions are undermined. Another study conducted on institutions for irrigation water management in Ethiopia revealed that visible progresses are observed in creating an institutional framework for improved water management in Ethiopia though there are cases where informal institutions substitute formal institutions, pointing to dysfunctionality of formal institutions (Haileslassie et al. 2016).

1.7.2.3. Stakeholders' engagement in governing water

Engagement is emphasized as a prerequisite to successful water governance along with process and structure requirements (Akhmouch and Clavreul 2016). Experiences in water allocation

reforms in Canada, South Africa, the United States, as well as in England and Wales have shown that stakeholder engagement processes can be valuable to gain a deeper understanding of the preferences of different water users (OECD 2015). A Case Study of Lake Ontario and the St. Lawrence River Regulation, using "Shared Vision Planning" approach to resolve conflicts in efforts to develop a new water regulation plan revealed that the approach succeeded when stakeholders perceived that they had something to gain from collaboration (Megdal et al. 2017).

In Ethiopia, the water resources management policy of the country recognizes the identification of the relevant stakeholders from the beginning in any water resources undertakings and creates conducive situations for their involvement in the different water resources management activities (FDRE 1999). The policy also encourages discussions and consultations amongst the various stakeholders, the development of partnership among key stakeholders, and private sector participation. To understand the state of water governance, conducting stakeholder analysis is essential to capture their opinions, interests and concerns to improve water resources management and water use in a sustainable manner.

Studies have been conducted so far in Ethiopia regarding the role of stakeholders and participation reported different findings. For instance, a study conducted focusing on stakeholder analysis of the Koga Irrigation and Watershed Management Project finds that stakeholders have conflicting interests and views about the project regarding the economic benefits and social impacts of the project (Gebre et al. 2008). The authors reported that stakeholder' engagements, particularly on advanced planning and preparatory stages, were weak. A study conducted on stakeholders' arena in the Awash River Basin found that the stakeholders are not acting synergistically, poor coordination and fragmented, power asymmetry among them and constrained effective participation, which lead to hinder the efforts to tackle the anthropogenic and natural factors affecting water security in the basin (Hailu et al. 2017).

Moreover, stakeholders' participation is mostly taken as information provision, lesser extent consultation, and active involvement (e.g. in the planning process) is not yet present in Ethiopia, even though there are stakeholder meetings and public platforms where water issues are discussed (Oosterloo 2015). One of the challenges of irrigation practices in Ethiopia is lack of

community involvement, and lack of consultation in scheme planning, construction and implementation of irrigation development (Haile 2015).

1.7.2.4. Users' preferences in water pricing and governance

The linkages between price setting and local governance issues are of the utmost importance concern in water governance (Veettil et al. 2011). In irrigation water pricing, considering farmers' preferences is vital for proper policy intervention because farmers might value the irrigation water attributes in a different way at different price levels. For instance, a study conducted in Krishna River basin in India focusing on price sensitivity preferences for water-pricing methods shows that farmers preferred volumetric pricing at higher price levels and quota pricing at low price levels (Veettil et al. 2011; Parween et al. 2021).

A study conducted by Salman et al. (2008) revealed that there is relative success of participatory irrigation in Jordan partly because of making adjustments related to the willingness of stakeholders in the course of implementation. One of the shortcomings of previous works are failure to understanding the specific preferences of farmers about how they will be charged for water, and the composition (farmers preferences and engagement) in the local institutions that would administer irrigation water supply and management, which is a common problem in most developing countries (Burton et al. 2020).

As a result of failure to consider the users' preferences, in many developing countries, irrigation systems rely heavily on subsidization from the state while increasing pressures on the fiscal resources (Lankford et al. 2016); where users preferences are considered, many farmers with access to surface water irrigation expend large sums of money to secure groundwater points to the value of water and to maintain the system for a long term (Ren et al. 2018).

It is suggested that taking consideration of users' preferences into water pricing is vital because it helps as policy and economic instruments to enhance efficient use of water (Speelman et al. 2009; Ayana et al. 2015). The irrigation water policy of Ethiopia also promotes all pricing systems and mechanisms should be geared towards conservation, protection and efficient use of water as well as promote equity of access. The policy encourages tariff setting shall be site specific, depending on the particulars of the project, location, the users, the cost and other

characteristics of the schemes (FDRE 1999). Regarding governance dimension, the policy promotes meaningful participation of individual farmers in all phases of the planning, studies, implementation and operation and maintenance of small, medium and large scale irrigation farms, and fairness and transparency in the governance of irrigated agriculture. It also asserts that willingness to pay by users of water systems is a powerful drive for financial sustainability of water resources systems, and willingness to pay shall be promoted by instituting fairness in water systems, promoting transparency and communications.

In Ethiopia, irrigation water pricing is attempted to be practiced in Awash River Basin. Ethiopian water management proclamation enacted in 2005 (Procl. number 115/2005) also legalized and encouraged charging water use. CRV is currently one of the sub-basins where irrigation activities by individual farmers are largely practiced. Hence, studying farmers' preferences regarding local water governance and irrigation water service fees can benefit decision makers by providing information for better water decision and water policy intervention in terms of water use in CRV, Ethiopia.

A study conducted focusing on farmers' perception regarding sedimentation management in small-scale irrigation schemes of Ketar and Arata-Chufa (farmer-led irrigation schemes) in Ethiopia, indicates that farmers use their local knowledge, own technique and informal institutions to mobilize and engage huge amounts of labor for intensive sediment cleaning campaigns (Gurmu et al. 2019). For a problem related to lack of regular maintenance and rehabilitation on Koga irrigation project in the Mecha district, Amhara region, a result of study suggested farmer's contribution for recovering the cost burden for management, maintenance and operation of the irrigation system by assessing farmer's willingness to pay (Alemayehu 2014). The result of a study undertaken using Contingent Valuation Method (CVM) to identify farmer's willingness to pay (WTP) for irrigation water use in Agarfa District of Oromia Region, estimated to 4018.02 Birr per hectare per year per household, which shows the importance of user's participation in decision making to contribute for the sustainability and effectiveness of irrigation water use (Birhane and Endrias 2016). In addition, demographic and socio-economic factors such as education level, family size, irrigable land size, total annual income, access to credit and experience in irrigated farming have significant effect on households' WTP for the

improvement of irrigation water use (Alemayehu 2014; Ayana et al. 2015; Birhane and Endrias 2016; Ejeta et al. 2019).

Beside the willingness to pay water fees, it is also imperative to address the perspectives of users regarding water governance aspects to ensure the sustainability of water uses. Burton et al. (2020) suggests an approach that directly seeks farmers input in the first instance, rather than reverting to a top-down approach where local preferences are ignored. In this regard, just collecting irrigation water fees may not ensure the improvements of water governance unless backed up with appropriate management. For instance, a study conducted on irrigation water pricing in Awash River Basin of Ethiopia indicates that the current collection of water irrigation services in the basin has been serving more to enable the Awash Basin Authority exist without significant contribution to the improvements of the water management, failing to consider water governance dimension (Ayana et al. 2015). Hence, it is vital to conduct the study of irrigation water users' preferences by categorizing them into two sub-themes (preferences of irrigation water service fee and local water governance).

In general, different efforts have been made to develop water policies and regulations to manage water resources in the country. In addition, community-based integrated watershed development, preparation of guidelines for the establishment and management of multi-stakeholder platforms, establishing Basin Development Office, adaptive water resources management initiatives, Green Legacy Initiative, etc were the efforts and initiatives the country committed to improve water resources governance. For instance, the Federal Democratic Republic of Ethiopia (FDRE) formulated Ethiopian Water Resources Management Policy in 1999, Ethiopian Water Resources Management Proclamation in 2000, and Ethiopian Water Sector Strategy in 2001. In addition, the FDRE designed and implemented the Water Sector Development Program (WSDP) and Water Governance Program for Integrated Water Resource Management in the different River Basins (FDRE 1999; FDRE 2000; FDRE 2002). The overall goal of these efforts is to achieve efficient, equitable and optimum utilization of water resources for significant socioeconomic development on a sustainable basis.

However, the intended goal was not attained due to deficiencies related to water governance, water resources management and institutional flaws (Jibat et al. 2024). For instance, water

institutions had rapidly changing losing coherence and lack coordinated interplay among water organizations (Hailu et al. 2018); lack of gender equity (Moriarty et al. 2008); less collaboration and networking among stakeholders (Duguma 2017); weak institutional linkages and lack of clear responsibility in water governance at various levels (Dessie et al. 2019); and lack of accountability and responsiveness in ensuring equity (Arsano et al. 2010). The management of the existing water infrastructures such as irrigation systems are dominated by traditional practices and lack scientific knowledge to improve efficiency (Ayana et al. 2015). There are also deficiencies in irrigation management which include over irrigation, poor drainage, salinity and alkalinity in the irrigated areas of the country (Michael and Awulachew 2007; Zelalem 2010). These deficiencies resulted in degradation of soil fertility, reducing land and water productivity in Ethiopia. Driving factors that resulted in such deficiencies are population increase and their demands, urbanization, and development needs in agriculture and industry leads to increased demand for water in Ethiopia (Ayana et al. 2015).

1.7.3. Conceptual framework

A study builds a conceptual framework which serves as a sketch out of the theoretical and empirical literature reviewed on the major components of the study to guide the overall of the study. Hence, the conceptualization of the key components of this study was underpinned by the previous concepts and theoretical frameworks. The conceptual framework was also taking into account empirical evidence of scholarly works in order to holistically capture the study objectives. It attempted to capture the possible connections among governance framework and practices of irrigation water resources, stakeholders' interaction and dynamics, water institutions, water users' preferences related to the attributes of irrigation water use.

To deal with the analysis of water governance and institutions water resource uses in the study area was taken as initial component. Following this the framework of governing water resources and its practices at various levels was considered as it determines the policy coherences and its implementation. Understanding the governance practices is vital to implement the policy as it influences specific contexts in water governance such as levels and scales, actors' networks, and strategies and instruments (Bressers and de Boer 2013). In this regard, water governance

framework and practices, and the patterns of as transparency, accountability and participation in irrigation water supply were taken to analyze water governance in the study area.

Another main component considered in this dissertation was the interaction among the key stakeholders. Conducting stakeholder analysis helps for inclusiveness of marginal groups such as women, the under-privileged, and those who are not easily accessible (Johnson et al. 2004; Keller & Hartmann 2019). Stakeholder analysis is also vital to be aware of the diverse range of potentially conflicting stakeholder interests (Prell et al. 2007). The other important theme for this study is the role of formal and informal institutions. Institutions can play a key role in shaping how Common Pool Resources users coordinate their actions to solve supply and demand problems, and govern individual behavior, public and private organizational arrangements (Crawford and Ostrom 1995; Heikkila 2004).

Institutional theory was considered in this conceptual framework development. The view of this theory starts from resource use, and emphasis on the need of rules to determine how to allocate the available resources, which are illegible to use, and etc. This view goes with the community institutions such as IWUAs, customs, and traditional water resources governance practices (self-governance) in this study. The idea of Contextual Interaction Theory (CIT), which focuses on evaluating the implementation of the promulgated policy and its goals, was used in this study. CIT aligns with the current study regarding the implementation of water management policy of Ethiopia, water governance framework, the role of formal institutions in water governance. The concept of the theory was also used in identifying water actors' involvement in decision-making processes and the power dynamics of stakeholders. This dissertation also used the Theory of Value (Lancaster 1966) and Random Utility Theory (McFadden 1974) to build the conceptual framework related to variables of irrigation water attributes and farmers' WTP for improved irrigation water in the CRV sub-basin, Ethiopia.

Another key component of the study is the preferences of users and willingness to pay irrigation water (service) fees. The economic values of irrigation water to the local communities are associated with the governance of water resources in the study area. In irrigation water pricing, considering farmers' preferences is vital for proper policy intervention because farmers might

value the irrigation water attributes in a different way at different price levels (Veettil et al. 2011; Weik and Larson 2012; Burton et al. 2020).

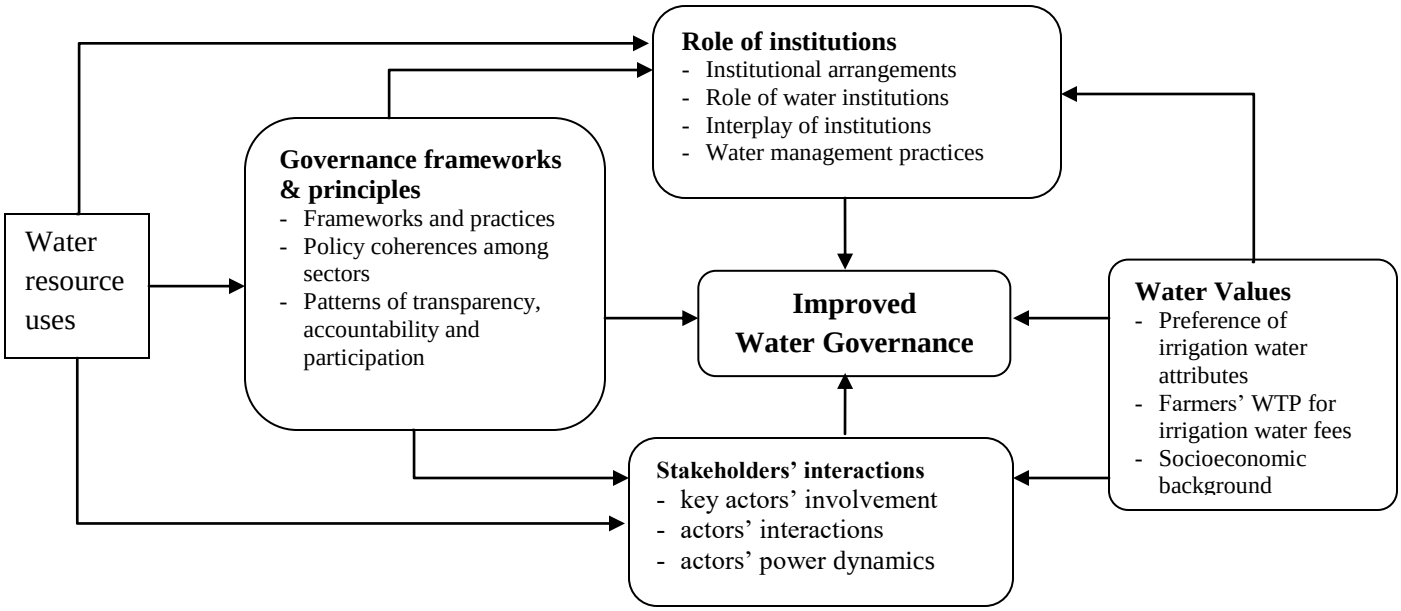


Figure 1.1. Conceptual framework of the study (own development based on readings, 2021)

The study builds a conceptual framework which frames water governance as the interaction of policy framework of governing water, key actors interactions and dynamics, role of formal and informal institutions, and users' preferences which integrate the themes to guide the study. The conceptual framework attempted to capture the possible connections or relations among these components (see Figure 1.1).

1.8. Methodology

1.8.1. Description of the study area

The Ethiopian Central Rift Valley (CRV) is part of African Great Rift Valley system and located between 38°00'to 39°30' east longitude and 7°00'to 8°30' north latitude. The altitude of the CRV ranges from 1500 m above sea level at the lowest parts of the valley up to 4000m at the eastern escarpment (Pascual-Ferrer and Candela 2015). The climate is humid to sub-humid in the highlands and semiarid in the rift valley; and the mean annual temperature is around 15°C in the highlands and 20°C in the valley (Ayenew 2002). The rainfall in the CRV is highly erratic and very high rainfall intensity and extreme spatial and temporal variability. The average annual rainfall ranges from 650 mm in the rift floor to 1150 mm in the adjacent highlands (Ayenew

2002). CRV is located in the administrative regions of Oromia and the Central Ethiopia Region, covering an area of approximately 10,000 km2. The population living in the CRV is estimated to be around 2.6 million people, based on the census of 2007, which was 1.9, and projecting with the current population growth rate of 2.57% of the country.

Economic activities and water resources

The majority of the population is dependent on subsistence farming, and the area is noted for low agricultural productivity and small landholding size (Vilalta 2010). Agricultural production and its related activities are the main source of economy in the area. About 67% of the CRV's Gross Domestic Product (GDP) is from agricultural sector, which includes crops, livestock, fisheries and forestry (Pascual-Ferrer and Candela 2015), while industry and service sectors account for 10% and 23% respectively. The predominant farming system is the mixed rain-fed production system consisting of crops and livestock. The major cereal crops grown include wheat, maize, barley and teff (Hengsdijk and Jansen 2006). The main livestock reared include cattle, sheep and goat (in decreasing order) and donkeys, mules and horses are commonly kept for transportation (Vilalta 2010).

Food insecurity is the major issue in the study area and a significant proportion of the population relies on relief assistance from external agencies; and access to health and education facilities is limited, and there are few opportunities to engage in income generating activities (GIRDC and FDRE 2009). During disaster and stress period, farmers and pastoralists have developed several survival strategies such as the culture of sharing, seasonal out-migration in search of wage employment, engagement in other off-farm activities, leasing out of farmland, and selling assets like livestock and household items (Vilalta 2010).

CRV has three large lakes (Dembel/Ziway, Langano, Abiyata), and three major rivers, i.e. Bulbula, Meki and Katar (Pascual-Ferrer and Candela 2015). Lake Ziway is an open lake and receives most of its water from two major tributaries, Meki and Ketar Rivers, originating from East and West highlands respectively and drain to the Lake. Lake Ziway is connected to the terminal Lake Abiyata via the Bulbula River (Vilalta 2010). The lake is home to many endemic birds, wild animals, and also serves as sources of commercial fish farming (Ayenew and Legesse

2007). Lake Langano is fed by rivers from the highlands on eastern side of the Rift Valley. Because of its terminal position in the drainage area and its shallow depth, Lake Abiyata is more sensitive to changes in the basin, especially susceptible to any diversion of Feeder Rivers; for instance, irrigation projects along the Meki and Katar Rivers and water abstraction directly from Lake Ziway for irrigation and domestic consumption (Vilalta 2010). The main source of irrigation water is from surface water (44% is by river diversion and 31% from Lake Dembel/Ziway), and 25% is used groundwater through wells (Pascual-Ferrer and Candela 2015).

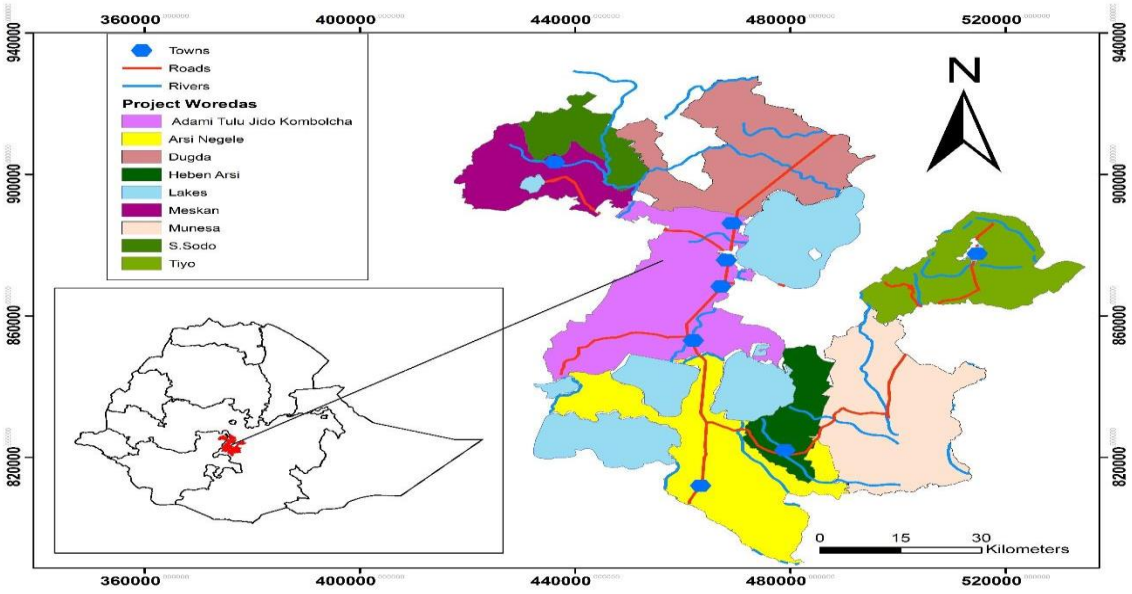


Figure 1. 2: Location Map of the Study Area (Developed, 2020)

The study area covered 3 districts which include: Dugda, Adami Tulu Jiddo Kombolcha, and East Meskan. The first two districts are located in Oromia Regional State while the remaining one is located in the Central Ethiopia Region. From the selected districts, households were selected from 6 kebeles (two kebeles from each district) for the study.

1.8.2. Water resources state and challenges in the CRV sub-basin

The CRV sub-basin includes major rivers such as Meki and Bulbula, major lakes such as Ziway, Abiyata, Langano and Shalla (Vilalta 2010). The sub-basin has an annual renewable surface water potential of 1065 MCM (million cubic meters), and 953 MCM available groundwater for abstraction (WLRC 2023). Although water resources in CRV are vital for the livelihood of the

local community and for ecosystem services for wider areas, these resources are degraded and endangered due to human-environment interaction (Vilalta 2010; Pascual-Ferrer and Candela 2015; Lemi 2019). For instance, increasing water abstraction for irrigation activities and investment at upstream (Vilalta 2010), competition of water uses for domestic purposes, agricultural activities, livestock production and ecosystem services, overexploitation, increase pollution and unsustainable water uses for irrigation purpose and for industry, and mismanagement of irrigation practices have threatened the sustainability of water resources in the CRV (Pascual-Ferrer and Candela 2015; Lemi 2019). Water quality deterioration in the CRV sub-basin is also growing, and many concerned actors were worrying its adverse effects for human and livestock health, the long-term health of farmlands, and the environment at large (Amare et al. 2023).

1.8.3. Rationale for the selection of the study site

Available water resources in the CRV sub-basin are sources of water uses for domestic purpose, for livestock and ecosystem services, for industry, and for agricultural irrigation (Vilalta 2010; Etissa et al. 2014; Hailu et al. 2020). However, these water bodies have been changed due to the influence of anthropogenic activities and climatic variations, which have significant impacts on ecosystems, human communities, and water availability (Ayalew et al. 2024).

Research evidence also indicate that climate change/variability and environmental degradation have increased in the central Rift Valley, Ethiopia and impacted the social vulnerability of people inhabiting that ecosystem (Mekonnen et al. 2019). The Need for economic development and climate change has been increased in the CRV, Ethiopia (Mekuria et al. 2024). Economic activity such as irrigation is expanding, and water scarcity is facing the upper catchment of CRV (Taye et al. 2022). In the last four decades, land use and land cover changes have happened in the middle catchment of the CRV due to factors such as population growth, drought, and social instability (Ariti et al. 2015). The competition for water is rapidly increasing in the CRV sub-basin due to the combined effect of various water resource developments (Goshime et al. 2021). Overall, these dynamics influence water resources governance over the horizon. In addition, large number of people also depending on water based livelihood in the area (Pascual-Ferrer et al. 2014; Elias et al. 2019). Leaving the current situation of water stress in CRV might lead to

unsustainable irrigation water services, and harm the livelihood of the local community and the wider ecosystem services. All these reasons initiated to select the study area for the current study.

1.8.4. Research design and approach

1.8.4.1. Research paradigm

Research methodology embraces the intersection of philosophy, strategies of inquiry, and specific methods (Creswell 2009). Methodological debates were undergoing regarding which research approach- quantitative or qualitative- is good help in understanding contexts and realities (Daniel 2016). Ontology and epistemology are major philosophical concepts playing out in shaping research approaches of quantitative and qualitative (Creswell 2009). Quantitative methodology is concerned with attempts to quantify social phenomena and collect and analyze numerical data, whereas qualitative methodology is more concerned with understanding the meaning of social phenomena (Fekede Tuli 2010).

It is argued that no one research methodology is better or worse than the other, what is critical is the selection of the appropriate research methodology for an inquiry at hand (Cohen et al. 2000). It is also argued that there is no single, absolutely correct methodology to social science research; rather methodologies are the different ways of looking at the world (Neuman 2003). There is still debate and no consensus about how to conceptualize the actual undertaking of research (Creswell 2009). It was argued that the use of quantitative and qualitative approaches in combination provides a better understanding of research problems.

This dissertation employed a mixed method approach for generating and analyzing data. The philosophical underpinning for mixed methods approach is pragmatism (Creswell 2009). A pragmatic approach provides a basis for reorienting the field of social science research methodology, and the great strength of this pragmatic approach is its emphasis on the connection between epistemological concerns about the nature of the knowledge that we produce and technical concerns about the methods that we use to generate that knowledge (Morgan 2007).

Pragmatism applies to mixed methods research in that it believes in an external world independent of the mind as well as that lodged in the mind. It does not see the world as an

absolute unity, and truth is what works at the time, for a particular research problem under study. In a similar way, mixed methods researchers look to different methods for generating and analyzing data rather than fixing to only one way (either quantitative or qualitative). For the mixed methods researcher, pragmatism opens the door to multiple methods, different worldviews, and different forms of data collection and analysis, and help researchers look to many approaches for collecting and analyzing data rather than subscribing to only one way, e.g., quantitative or qualitative (Creswell and Creswell 2018).

1.8.4.2. Research approach

This study employed mixed research approach. The rationales of using mixed approach in this study include: (1) the research questions need both quantitative and qualitative data; (2) the combination of qualitative and quantitative approaches provides a more complete understanding of a research problem (Creswell 2014); (3) quantitative and qualitative data overcome the weaknesses (gaps) of each form of data type and triangulate from different data sources (Groves et al. 2004). Triangulation method, which is using different sources of data and methods, was used to increase the credibility (trustworthiness and how believable a study is) and validity (the extent to which a study accurately reflects or evaluates the concepts or ideas being investigated) of research findings (Noble and Heale 2019).

This study employed survey design which collected information in an organized and methodical manner about the characteristics of interest from some or all units of a population using well-defined concepts, methods and procedures (Franklin and Walker 2003). The survey design which was employed in this study is exploratory sequential mixed methods. In this approach the researcher first begins with a qualitative research phase and explores the views of participants, policy makers, office holders, in the water sector, various stakeholders and groups. The information from qualitative data was used to enrich quantitative instruments. This was useful to build an instrument that best fits the sample under study, or to specify variables that need to go into a follow-up quantitative study (Creswell 2014).

1.8.5. Population, sampling and sample size determination

The study used quantitative data for stakeholder analysis, and for farmer's willingness to pay for irrigation water service. To conduct stakeholder analysis data was collected through semi-

structured interviews and questionnaires. To analyze farmer's willingness to pay for irrigation water, a household survey was conducted using a discrete choice experiment. The aim of the experiment was to elicit the farmer's preferences for different attributes of irrigation water service. The "payment" choice experiment for pre-testing was established with five attributes. A pre-test of the experiments were conducted with participants in the study location, and fine-tuned the study design. On the basis of the findings in the pilot test, adjustments were done for the final survey, and an extensive survey was administered in the study area.

The target population of this study includes farmers (irrigators) participating in irrigation activities either registered under Water Users Associations (WUAs) or not, but using irrigation schemes in the CRV. The sampling frame included individual farmers or households who are economically active (from age 18-64), and who were engaged in cultivating crop/vegetable/fruit, and livestock production. The target study area included 3 districts and 6 kebeles, those have long term irrigation experiences. This study employed multi-stage sampling technique. All districts in the CRV were categorized in to three catchments (upper, middle and lower). From each of the catchment, a district was selected using simple random sampling method. Two kebeles were selected from each district purposively focusing on long term experiences and potential irrigation practices to get sufficient data. Accordingly, East Meskan, Dugda and Adami Tullu Jiddo Kombolcha (ATJK) districts were selected from upper, middle and lower catchments respectively.

The selected sample districts have also additional benefits: i) the selected districts are located in two different administrative Regions (in Oromia Regional State and in Central Ethiopia Region) that help to observe institutional alignments at different levels; and ii) it helps to observe water governance in river system, lake system and groundwater. The result of such perspectives may have additional benefits for policy interventions.

Table 1.1.: Sample and sampling technique

Stage	Category of districts			Methods used
	Upper catchment	**Middle catchment**	**Lower catchment**	
1st stage (identifying target population)	1. Tiyo, 2. Munessa 3. East Meskan 4. S/sodo	1. Dugda 2. Arsi Negelle 3. Heben Arsi	1. Adami Tulu J/K	Clustering
2nd stage (selection of sample Districts)	East Meskan	Dugda	Adami Tulu J/K	Random sampling
3rd stage (selection of sample kebeles)	1. Enseno Husme 2. Dobena gola	1. Shubi gamo 2. Bekele Giris	1. Abune Germama 2. Golba Aluto	Purposive (long term irrigation experience)
4th stage (selection of farmers)	Farmer household	Farmer household	Farmer household	Random sampling

Source: Own proposal (2020)

Sample size and power calculations help determine if a study is feasible based on a priori assumptions about the study results and available resources (Schmidt et al. 2018). The minimum power for any study is considered to be 80%, and increasing power level above 80% increases the validity of the sample (Assele et al. 2023). Effect size of 0.35 and power 0.85 were used to increase the sample size and its validity. The standard equation is as follows.

$$n = \left[\frac{\left(z\frac{\alpha}{2} + z\beta\right)}{d^2}\right] \quad \ldots\ldots\ldots\ldots (1)$$

Where n = sample size, Zα/2 is the e critical value of the standard normal distribution at α/2 (for a 5% significance level, Zα/2 = 1.96), Z_β is the critical value for power for 80% power, **d** is the effect size.

Accordingly, the sample size for survey data was determined by power calculation using computer assisted G*Power software (Serdar et al. 2021) by entering effect size d = 0.35, α err prob (alpha) = 0.05, and power (1-β err prob) = 0.85 inputs. Accordingly, the G*Power software produced a total sample size of 296.

1.8.6. Quantitative Data Collection

The study used quantitative data for stakeholder analysis, and for farmer's willingness to pay for irrigation water service. To conduct stakeholder analysis data was collected through semi-

structured interview and questionnaire. To analyze farmer's willingness to pay for irrigation water household survey was conducted using a discrete choice experiment. The aim of the experiment was to elicit the farmer's preferences for different attributes of irrigation water service. The "payment" choice experiment for pre-testing was established with five attributes. A pre-test of the experiments were conducted with participants in the study location, and fine-tuned the study design. On the basis of the findings in pilot test, adjustments were done for the final survey, and an extensive survey was administered in the study area.

1.8.7. Qualitative data collection methods

Qualitative data are mostly non-numerical and usually descriptive or nominal in nature and qualitative questions are open-ended (Kabir 2016). Qualitative methods of data collection include focus groups discussions and interviews, and the approach is good for further exploring the effects and unintended consequences of a phenomenon. Qualitative data collection in this research used open-ended and semi-structured protocols. Instruments such as interview guides, FGD guides and checklists for observation and document review were used in this study. The qualitative data were gathered from relevant participants both from the study area and beyond. Accordingly, government officials and officers of water sectors from federal and two regional States, district water sectors, Irrigation Water Users Associations (IWUAs), households (farmers), private companies, water development partners, NGOs, and individual researchers were participated.

Key Informant Interview

For qualitative data collection, key informants (who are believed that best help the study by providing first-hand information) were purposively selected from Ministry of Water and Energy, Ministry of Agriculture, Basin Development Authority, Federal Environmental Protection Authority, Rift Valley Basin Development Office, and respective Regional Bureaus and District Offices of Oromia Regional State and SNNP Region, farmers/irrigators, youths, women, Sher-Ethiopia, local Kebele leaders, Development Partners and NGOs, and researchers. The data was collected using face-to-face interviews with key informants, and 36 key informants participated. These interviews involved semi-structured and generally open-ended questions to elicit views and opinions from the participants.

Focus Group Discussion

Focus group discussion (FGD) is one of the most popular qualitative research methods, and it is a structured discussion used to obtain in-depth information (qualitative data-insight) from a group of people about a particular topic (Omar 2018). It is a discussion guided by the moderator/facilitator according to the prepared interview guidelines. The aim of FGD is to study a topic in-depth and intensively. FGD is a group discussion of eight to twelve participants with guidance from a facilitator, which discusses a certain topic among participants (Cardno 2017). In this study, participants who have a common understanding regarding water governance and institutions, and using water for irrigation and livestock drinking were selected from the study area. The focus group discussions were held with six to eight participants in four group discussions.

Content analysis

Content analysis is a systematic procedure for reviewing or evaluating documents (both printed and electronic), computer-based and internet-transmitted material (Bowen 2009). Like other analytical methods, content analysis requires that data will be examined and interpreted in order to elicit meaning, gain understanding, and develop empirical knowledge. For this study, documents containing text (words) that have been recorded without a researcher's intervention was collected for the analysis. These documents include Ethiopian Constitution, water policies and strategies, proclamations, regulations, manuals, directives, articles, and official reports. Content analysis was mainly used in objective one and objective two. Thematic points were identified and coded before conducting analysis. Qualitative data collected through KII, and FGD were transcribed and organized under major thematic areas of the study. A separate ID was given to each interviewee, and each file was documented. Transcribed data and policy documents were organized, and imported into NVivo 11 software for coding and analysis purposes. Nvivo software package was used for mapping of the pattern of keywords and ideas, grouping keywords, categorize into themes and sub-themes. All the imported data were carefully read and coded under each of the major themes and sub-themes.

1.8.8. Method of analysis

To address water governance framework, policy coherence and water allocation practices in the study area, national water management policies and strategies, rules, and alignments at different

levels and scales were analyzed. Structural contexts that have influences on specific contexts in water governance, organizations that were involved and shared responsibilities, coordination among these organizations, and types of interaction at various levels of governance structures in water governance were analyzed using thematic approach.

To assess transparency, accountability and participation (TAP) in irrigation water supply, various indicators were assessed. TAP framework was employed to assess the practices of water governance principles in service provision. The assessment was focused on measuring the effectiveness of existing systems and processes to make information open and public, the functioning of compliance and oversight mechanisms, and the level of participation of citizens/end-users in water decision-making processes. The analysis was done qualitatively using a thematic approach.

The role and interlink of water institutions in water governance were qualitatively analyzed under two themes. The first theme being the linkage of institutions across different scales (Federal, Basin, Regional, and Woreda); and the second theme is how two types of institutions (formal and informal institutions) are integrated to play their roles to improve water resources governance in CRV. Under the former theme, the study explored the linkages of institutional design features across multiple scales or boundaries. In the second theme, the study investigated the extent of integration between formal and informal institutions to improve water resources governance. The analysis was carried out using NVivo 11 software and interpreted carefully to draw conclusions and policy implications.

Stakeholder analysis was undertaken using standard network measurements, which include degree centrality, closeness centrality, betweenness centrality and eigenvector centrality (Freeman et al. 1979). The analysis embraced three steps: identifying stakeholders, categorizing stakeholders and investigating the relationships between and among stakeholders (Reed et al. 2009). Social Network Analysis (makes use of matrices to organize data on the relational ties linking stakeholders together) was used to analyze collaboration and power relations among stakeholders, and the influence of stakeholders on water management or use decisions. Data were collected through semi-structured interview and questionnaire. The data set was analyzed using the software UCINET 6.0 (Borgatti et al. 2002).

Discrete Choice Experiments (DCE) was employed to analyze farmers' irrigation water willingness to pay in the study area. Choice experiments were selected because of its robust experimental designs, statistical efficiency, and multidimensionality (Louvier et al. 2015). Respondents were presented with alternatives with various attributes and levels of these attributes, for which they indicate their most preferences. Five attributes were selected from which three of them have three levels, two have two levels and one has four levels. The respondents' socioeconomic and demographic characteristics were used as explanatory variables to investigate heterogeneity in preferences. The analysis of farmers' WTP for improved irrigation water employed STATA and SPSS software packages for data organization, management and analysis.

1.8.9. Validity and reliability of the data

The validity of the survey tool (choice experiment) was checked by conducting pilot-study taking 20 participants from the study location. It was checked that the design of the choice experiment was converged. The "payment" choice experiment for pre-testing was established with five attributes such as: irrigation water (service) fee, irrigation intensity, irrigation frequency, irrigation water quality and readiness to share water for downstream users. On the basis of the findings in pilot test, the codes were carefully changed to the attribute levels in the choice cards (scenarios) for the final survey.

To test the reliability of the collected data, the model fitness of the quantitative survey was assessed using the Chi-square statistics. Accordingly, the P-value was less than 0.05, which proves significant relationships between dependent and independent variables. The value of Nagelkerke was also 0.963, which is significant. The result implies that the dependent variable was explained 96.3% by the independent variables.

1.8.10. Ethical approval and consent

The ethical clearance letter of this study No/0035/2023 was given by the institutional review board of the College of Development Studies at Addis Ababa University, Ethiopia. The proposal for the research was reviewed and approved by the committee of the institutional review board.

Written informed consent was also obtained from participants. During data collection, participants were informed that the data was for the PhD dissertation, and could be published.

1.8.11. Organization of the paper

There are six chapters in the dissertation. The first chapter focuses on the introductory section, which includes the background, problem statement, objectives, and study scope. This chapter also included a brief review of the literature.

The second chapter addresses the study's first objective: analyzing water governance framework, coherences, and the patterns of transparency, accountability and participation in irrigation water governance in the CRV sub-basin. Water resources management policies, strategies, rules and regulations, water allocations, actors' engagement in water resources governance were discussed in this chapter.

Chapter three analyzes the role of formal and informal institutions and their interplay, and the management of irrigation water in the CRV sub-basin of Ethiopia. In this chapter, the role of public institutions, role of IWUAs, role of development partners and NGOs, and contributions of informal institutions in water governance were discussed.

The fourth chapter analyzes the stakeholders' interactions and power dynamics in water resources governance in the CRV of Ethiopia. The types of stakeholders involved in the governance of water resources, their interaction and power dynamics in terms of human resources capacity, knowledge generation, access to information.

The fifth chapter analyzes the farmers' WTP for improved irrigation water services in the CRV sub-basin of Ethiopia. In this chapter, irrigation water attributes such as irrigation frequency, intensity, water quality, sharing irrigation water for the downstream users, and their preferences in contributing water resources conservation were discussed.

The last chapter (six) is synthesis chapter. Under this chapter the overall of the study, major findings, general conclusion, recommendations, future research areas, and contributions of the study in terms of empirical, methodological, conceptual and theoretical were discussed. In addition, the relationships between the specific objectives (major variables/components) were precisely discussed.

Chapter Two: Analysis of water governance framework, coherence, and the patterns of transparency, accountability and participation in the Central Rift Valley sub-basin, Ethiopia

Abstract

Water governance requires multi-sectoral participation beyond the state; and appropriate laws, policies, regulations, and institutions. A good water policy, a critical and integral instrument of water governance, guides water use schemes and ensures equitable water distribution among users. Although the Ethiopian Central Rift Valley (CRV) possesses water resources such as rivers and lakes, these resources are currently under severe threats owing to an imbalance in human-water interactions. This study examined water resources governance framework, policy coherence, actors' engagement and transparency, accountability, and participation in irrigation water supply in the study area. Key informant interviews (KII), focused group discussions, and document reviews were used to gather data for the study. The NVivo 11 program was used to organize, code, and analyze the data. Water resources management policy mechanisms were not fully put in place. Lack of coherence in water policy implementation, absence of clear roles and responsibilities of stakeholders, absence of transparency and accountability in irrigation water service delivery, and lack of meaningful participation of key actors in water governance decision-making were observed. Hence, reforms related to policy coherence and enforcement, stakeholder engagement, water distribution strategies, and the implementation of water governance principles must be given adequate emphasis.

Keywords: **Water Resources, Irrigation, governance, Governance principles, Stakeholders Engagement, Central Rift Valley**

2.1. Introduction

Appropriate natural resource governance is the foundation for sustained economic growth, ecological integrity and social welfare (Bruch et al. 2007). Water governance demands multi-sector participation beyond the state, including the private sector, civic society and the public in general (Tortajada 2010a; Adhikari and Tarkowski 2013). Water governance includes the strategy, which means maintaining a balance between ends, ways, and means; identifying objectives, the resources, and methods available for meeting such objectives to implement water policies and plans (Özerol et al. 2018; Van Assche et al. 2020). It also embraces, in addition to rules, regulations, and institutions, value-related elements such as responsibility, public participation, accountability, transparency, equity, and fairness (Tortajada 2010a; Adhikari and Tarkowski 2013).

For the sustainable use of water resources, appropriate laws, policies, regulations, and institutions need to be developed and put in place (Bruch et al. 2007). Water laws are the collection of rules and guidelines that control behavior and are enforced through social institutions; whereas a policy is a purposeful system of principles and the main component in water governance to guide decisions and avoid conflicts and help to achieve rational outcomes and equitable allocation of water (Saleth and Dinar 2004; Grigg 2016; Pintor and Dizon 2019).

Successful policy implementation depends on the structural context and coherence (Bressers and de Boer 2013). Coherence of water governance organized around ecologically meaningful scales aligned with institutional coherence is important (Heikkila 2004; Bunch et al. 2011). This enables the integrated management of land and water uses and their effects on upstream-downstream dynamics (Plummer 2011). It also helps to resolve problems such as inefficient uses of resources, and social inequalities, provides scientifically-based prioritization of management activities, and enables efficient allocation and use of water (Benson and Jordan 2010; Veettil et al. 2011; Plummer 2011; Cohen and Bakker 2014; Wehn et al. 2018).

In addition, improved water governance implies that water resources are managed and services provided in an equitable, transparent, and participatory manner with appropriate accountability mechanisms and in accordance with human rights standards (Biad et al. 2015). Good water governance can also be proposed as openness and transparency, broad participation, rule of law

(predictability), and ethics, including integrity (control of corruption) (Lautze et al. 2011; Ribeiro and Johnson 2018). Hence, improved water governance includes the participation of stakeholders in a transparent and accountable way in the decision-making mechanisms that achieve sustainable water uses.

In the governance arena, decisions should be coherent with a broad set of principles leading to a more progressive efficient, and equitable management of water resources (Torjatada 2010a), because involving users of water in the governance of the resource makes the participation more meaningful. Users involved may help to accept the regulations as appropriate and consistent with their values and interests and be more willing to comply with them (Kooiman 2003). In addition, local stakeholders may be more familiar with the peculiarities of local economic, social, cultural, and environmental situations (Torjatada 2010a).

In this paper, governance is conceptualized as the accountability mechanisms in implementing water policies, strategies, roles, and responsibilities; participation as key stakeholder involvement in water-related decision-making processes and implementation; and transparency as a process of publicizing water-related data and information, irrigation water allocation and distribution, means of financial transfers and uses.

There are different water governance policy frameworks implemented based on contexts and objectives. Integrated Water Resource Management (IWRM), which promotes coordinated management actions regarding environmental sustainability, is one of the most long-standing and adopted in many countries (Powell et al. 2017; Grafton et al. 2019). The Institutional Analysis and Development (IAD) Framework (Ostrom 2005; Meinzen-Dick 2007; Ostrom 2015) is also a widely used in common-pool resources governance, and the framework provides a means of describing and linking resource systems, governance systems, resource units, users, interactions, outcomes, and related ecosystems. The transparency, accountability, and participation (TAP) Framework is another approach that focuses on measuring the functioning of compliance and oversight mechanisms and the level of transparency, accountability in service provision, and participation of end-users in decision-making processes (Jacobson et al. 2013). Another emerging dominant water governance paradigm is the framework developed and endorsed by the Organization for Economic Co-operation and Development (OECD) countries, which is based on

12 principles embedded around effectiveness, efficiency, trust, and engagement that involve a diagnosis and the development of an action plan to resolve the implementation (OECD 2015; Karar 2017; Akhmouch et al. 2018; Grafton et al. 2019). This study employed mainly the OECD and TAP concepts because the major components of the study such as water governance principles, stakeholders' engagement, water allocation, and policy coherence were appropriately addressed by OECD and TAP governance frameworks.

Ethiopia in general, and Central Rift Valley (CRV) in particular is endowed with both surface and groundwater resources (Berhanu et al. 2014). These water resources are sources for livestock drinking, fishery, municipality, industry, crop food production, tourism, and home for biodiversity (Vilalta 2010; Etissa et al. 2014; Pascual-Ferrer et al. 2014; Elias et al. 2019; Hailu et al. 2020). They are, however, under severe pressure due to an imbalance between human-water interactions in recent times (Pascual-Ferrer et al. 2014; Lemi 2019). These caused Lake Ziway to drop by 0.36m and reduce the water level from 442 to 424 km2, which declined by 18 km2 between the 1986 – 2000 periods, and decreased by 0.5m since 2002 (Goshime et al. 2019). Lake Abijata has lost about 6.5m in total lake height between 1985 and 2006, of which 4.5m has been attributed due to human causes (Seyoum et al. 2015); and coverage of water bodies declined by 1.13% between 1985 and 2015 due to expansion of irrigation farms (Elias et al. 2019).

The causes of such problems are associated with water governance and institutional flaws related to policy enforcement, regulations, accountability, and limitation of engagement/participation of stakeholders (Agyenim 2011; UNDP 2013; Gallaher and Heikkila 2014; Jiménez et al. 2020). Ethiopia drafted various water resources management regulations such as the Environmental Policy of Ethiopia (FDRE 1997) and the Ethiopian Water Resources Management Regulations (FDRE 2005). However, evidence from key informants and focus group discussants revealed that these water rules and regulations were not appropriately implemented.

Recently the study area is experiencing extensive irrigation activities, which may lead to the loss of freshwater and unsustainable water services and endanger the sustainability of livelihood of the local community and the ecosystem services. Ethiopia launched large-scale irrigation wheat campaigns in the country, to which environmentalists warned of its negative environmental

impacts including water resources. Hence, this study aimed to explore and understand the state of water governance in the CRV of Ethiopia, governance framework, coherence, and implementation of governance principles, and to indicate future policy implications.

Conceptual framework

The Constitution of Ethiopia, water resources management regulation, and water management policy were taken as a first step and an essential component in understanding water governance. Water policy and regulations are essential elements under the water governance legal framework. Establishing policy coherence for development helps to understand trade-offs and co-benefits within and between policy sectors (Koff et al. 2020). The quality of existing water policy, rules, and regulations may affect policy coherences within water sectors, water allocation and permission systems, and engagement of water actors.

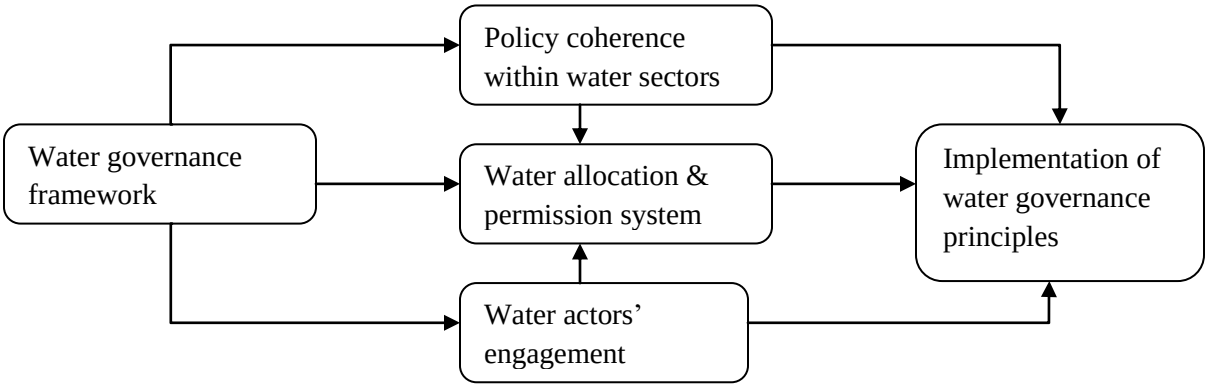


Fig.2.1. Conceptual Framework of the study (own development based on reading, 2021)

All the components have implications on the state water resources and the implementation of water governance principles, particularly on transparency, accountability, and participation. The diagram (Figure1), conceptual framework, indicates the relationship between these major study components.

2.2. Research approach and data collection methods

This study employed a qualitative research approach that includes key informants' interviews, focus group discussion, observation, and review of policy documents and literature. The study involved various government tiers from federal, regional, district, and Kebele (the smallest administrative unit in the country) levels. A total of 36 key informants were purposely drawn from development partners, NGOs, researchers, fishery associations, Irrigation Water Users

Associations (IWUAs), and private company representatives based on their knowledge and experiences. The data was collected from the highlands (East Meskan District) and the Valley (Adami Tulu Jiddo Kombolcha and Dugda Districts). Participants of key informants and FGD (farmers) were purposely selected from the members of Irrigation Water User Associations based on their long experience in irrigation activities with the support of the District Agriculture Offices and IWUAs committee to obtain relevant information.

In addition to key informants' interviews, 4 focus group discussions were undertaken (a total of 28 participants participated) with farmers who had long experiences in irrigation activities. From a total of 29 key informants, 9 were selected from the highlands (East Meskan District), and 20 were from the Valley (Adami Tullu Jiddo Kombolcha and Dugda Districts). The rest key informants were from federal and regional institutions. The data was collected through face-to-face personal interviews and focus group discussions.

2.3. Data organization and method of analysis

Qualitative data collected through KII and FGD were transcribed and organized under major thematic areas of the study. A separate ID was given to each interviewee, and each file was documented. The transcribed data and extracts from the policy documents were organized and imported into NVivo 11 software for coding and analysis. Nvivo software package enables mapping of the pattern of keywords and ideas - classifying of keywords and ideas, grouping keywords, themes, and sub-themes, managing data and ideas, reporting and organizing thematic representation of the data, and facilitating accurate and transparent data analysis process (Zamawe 2015; Dollah et al. 2017). Following this procedure, all the imported data were carefully read and coded under the major themes and sub-themes, and analysis was carried out accordingly.

2.4. Results and Discussion

2.4.1. Results

Water governance framework

Water resources in the CRV are common-pool resources – that is nobody is excluded from using the resources. This study revealed the existence of rules and regulations for water resources management and uses developed at national and regional levels in Ethiopia. For such resources,

certain rules that indicate the way the resources shared, the quantity allowed for each user, the rights and obligations of the users were promulgated in Ethiopia. These include various water policies, rules, and regulations such as the Environmental Policy of Ethiopia (FDRE 1997) and Proclamation (FDRE 2000), Regulation (FDRE 2005), and other related policy and strategy documents.

However, this study revealed that these rules and regulations were not yet cascaded to the lower-level implementers and end-users. The study's key informants stated that there is a lack of clearly defined rules, regulations, and procedures at lower administrative units that could help the effective implementation of the policy. For instance, this study revealed that the lack of clear guidelines regarding the extent of water abstraction for irrigation has resulted in the inefficiency of water resource uses via high abstraction and wastage.

The study found that the current situation of irrigation water uses in the study area is characterized by grabbing the available water resources by all irrigation water users, i.e., smallholder farmers, and medium and large scale agricultural investments with less attention to their effect owing to the absence of clear rules, regulations, and directives related to water distribution among water users. The information collected indicates that clear directives and detailed standards were lacking in efforts in water resources management practices. Although water policy and strategy formulated at the national level capture essential components such as water allocation and apportionment, and its implementation is poor.

The data showed that lower-level policy implementers and local water users, particularly irrigation water users, were not aware of the essence of the existing water policy. In the study area, sufficient community consultations were not undertaken. A key informant (KI-1) mentioned that water policy implementation lacks in-depth evaluation and local community consultation. Irrigation water users of local community members had no adequate awareness and understanding of the sustainability of water resources. However, they have shown high interest in exploiting the available water resources to meet current production needs. For instance, crop water requirements should be designed and implemented based on crop types and land size (Ewaid et al. 2019). However, this awareness and practice were lacking in the irrigation schemes in the CRV of Ethiopia. In the study area, crop water requirement was not practiced, due to a

lack of knowledge. Evidence indicates that traditional irrigation practices such as furrow irrigation have exposed water resources to evaporation and wastage of water resources on the field.

The absence (weak) of clear rules, regulations, and directives of water resources management at lower levels in the CRV resulted in deteriorating water quality and decreasing the depth of lakes and volume of rivers flows, which was attributed to farming closer to the Lake mouth. One key informant (CR-38) among the fishery association illustrates buffer zone deterioration as: "*Surrounding forest and grasses are cleaned and the Lake is left without protection like the human tooth is protected by the lip, water bodies are protected by surrounding trees and grasses. All these are removed by deforestation and irrigation expansion in the area, which is affecting water bodies*." The informant also called respective organizations to give their attention to develop buffer zones and protect the lakes and rivers from further degradation in the area.

Moreover, the data collected for the study showed that lower-level policy implementers and local water users did not understand the existing water resources policy. Community consultations and awareness-creation activities were not undertaken in the area on water-related matters. Another key informant (KI-5) mentioned that even organizational leaders and managers were not aware of water resources stress in the study area, and they were unable to bring the agendas to the front.

The roles and responsibilities of each organization were not clearly identified and some of them have engaged in similar activities in the study area. For instance, KI-13 mentioned:

> "*The responsible body for water governance is not clearly identified, or the roles and responsibilities of actors are not known. Different sectors such as agriculture/irrigation, water and energy office and environment protection authority office are working on water resources. However, their responsibilities are not demarcated and lack clear directives and guidelines. Institutional linkages were missed, and only activities are cascaded from higher levels without clear directives."*

Policy Coherence within Water Sectors

The Constitution of Ethiopia asserts that the trans-regional water resources should be administered under the federal government (FDRE 1995). It also granted regional governments to manage natural resources in their administrative jurisdiction. The National Water Resources Management Policy of Ethiopia (FDRE 1999) also promotes the enhancement of linkages and partnerships between the federal and regional governments for efficient, sustainable, and equitable water resources management. However, the federal water resources management policy or respective federal organization (potentially the Ministry of Water and Energy), didn't identify water resources linking two or more regions, or are supposed to be managed under the federal government.

In addition, the roles of regional governments in water resources that could be administered by the federal government were not clearly stated. This indicates mandate overlap or lack of clarity among water sectors regarding water resources management. KI-5 had to say:

> *"There is conflict on managing water resources, issuing water use permits, and collecting water fees between Oromia Region Water and Energy Bureau and Rift Valley Basin Development Office (RVBDO) on Lake Dembel. Oromia Water Bureau is claiming that managing water resources in the region are constitutionally granted to the region and RVBDO is also claiming a mandate on the same issue."*

Ethiopian water resources management policy encourages basin-based and hydrological boundaries as a planning unit to implement Integrated Water Resources Management (FDRE 1999). However, administrative and hydrological boundaries are not aligned in the CRV through multiple sets of users operating at different scales. For instance, the Meki River originates from Guraghe Highlands in the SNNP region and flows to Lake Dembel/Ziway through the Dugda District of the Oromia region. From December to April/May, the Meki River usually stops flowing to the middle/downstream (Dugda District); however, the upstream community (in East Meskan District) uses the river for irrigation during the same season. On the other hand, farmers in Dugda District severely lack water for irrigation. Consequently, as informants mentioned, during these periods' irrigators in Dugda District took different alternative measures such as being employed as labor workers in irrigation activities elsewhere and using groundwater by establishing wheels to meet their livelihood.

This fact requires effective vertical and horizontal integration to improve water governance and its use. However, such integration was missed in the CRV. Even though the upstream and downstream Districts were using the Meki River, they were not coordinated to conserve water resources, and sustainably use the available water resources. Limited consultation between the adjacent Districts of Dugda and East Meskan to use the Meki River and to address unfair water allocation and distribution contributed to the prevailing problem. This situation was exacerbated by increasing investment and deforestation at upstream and competition for water uses for different purposes (Vilalta 2010; Pascual-Ferrer and Candela 2015).

On the other hand, information obtained from fishery communities organized on Lake Dembel shows a decrease and deterioration of fish types and qualities in recent years due to water pollution, erosion, degradation of the buffer zone, and other related factors. One of the key informants stated:

> *"Some fish species disappeared from the Lake; illegal fish harvesting is expanding, and buffer zones and wetlands were changed to cultivation. I urge the concerned body to protect the Lake from degradation, particularly by protecting buffer zones and wetland areas surrounding the Lake and reforestation at the upstream level."*

The informant also addressed that these factors resulted in degrading the aquatic lives, decreasing communities' income, and endangering their livelihoods. Teklu et al. (2019) also reported similar findings that the deterioration of water quality and quantities contributed to the decline of fish production in Lake Dembel/Ziway. Similarly, the over-abstraction of water resources in upper and middle catchments has affected livestock production at a lower catchment which is becoming a serious challenge as participants of FGD from Golba Aluto Kebele raised the concern. These limitations were associated to the absence of policy coherence among water sectors at various scales and levels.

Water Actors Engagement

There are various actors engaged in water resources governance in the CRV. These water actors include government organizations (both federal and regional States), community water user associations, individual water users (farmers and private companies), development organizations, and NGOs. These actors have been involved in different aspects of water resource development, its management, and its uses. For instance, Irrigation Water User Associations (IWUAs) have engaged in water resources governance and uses in the CRV of Ethiopia. Participants from community representatives (KI-28) mentioned that members of the IWUAs have engaged in water governance in scheme maintenance activities (in-kind contributions such as developing and maintaining irrigation canals, participating in soil and water conservation activities, and managing irrigation schedules, among others), and contributing money for irrigation infrastructure development or new equipment purchase. The committee members also monitor any misuse of irrigation water, maintaining damaged pipes, maintaining leakage, and controlling and following up the pipes and canals from damage.

Efforts were also exerted to engage various community groups including disabled, women, poor people, elders, and youths in the governance and uses of water resources in the CRV of Ethiopia. One of the community representatives (CR-31) stated "*The disadvantaged groups were engaged in water resources governance by labor contribution."* The participants added that some of the IWUAs had tried to engage disadvantaged groups by facilitating credit from farmers' unions and exempting cash contribution payments such as electric consumption and tractor services until harvest season for poor people in Golba Aluto Kebele.

Similarly, elders were also engaged in conflict resolution by arranging favorable schedules during water shortages at the lower catchment due to the upper catchment's high abstraction. For instance, one of the community representatives (KI-28) mentioned:

> "*Two years ago public grievances were outbreak following Bulbula River stopped to flow to the lower catchment because of high abstraction at upper catchment for irrigation. The elders consulted with upper catchment irrigators and other concerned bodies, and arranged irrigation schedules at night and livestock drinking at day time.*"

Even though respective regulatory organizations rarely engage all relevant water actors, data gathered from key informants (e.g., KI-24 and KI-26) revealed that development partners and NGOs such as Farm Africa, International Water Management Institute, SOS Sahel Ethiopia, Sustainable Environment and Development Agency, and Population and Health Consortium Ethiopia have been contributing to address natural resources degradation including water resources in the CRV. Wetland International is working on watershed management, buffer zone development, and wetland management in Guraghe and Arsi Tiyo highlands. Besides using water, farmers were involved in water governance due irrigation scheme management such as irrigation schedule, labor contribution in terrace development and planting trees, and developing enclosure to protect the environment. However, all programs by the actors were not systematically coordinated and capitalized on benefits from stakeholders' engagement.

Stakeholder engagement provides the opportunity for those interested or 'have stake' to participate in decision-making and implementation processes (OECD 2015). However, water actors in the CRV lacked an integrated plan, were systematically less coordinated, and missed the opportunity of collaboratively operating the available logistic, financial and human resources that enable better performance on water governance improvement. Participants of the focus group discussion (FGD4) mentioned that engagement in water governance was not inclusive. For instance, community representatives, development partners, NGOs, individual investors, fishery associations, hotels and restaurants, and other private companies were not adequately involved. The main reasons for these limitations emanated from the failure to engage and coordinate all relevant water actors and the inability to establish a common platform. As a result, fragmented efforts were the common feature of actors' engagement in water resources governance in the CRV.

Evidence from this study indicates that the actors' engagement was not inclusive and holistic to enhance water governance and development in the CRV of Ethiopia. Key informant (KI-27) expressed that:

> *"The community members may contribute a lot if they understand the issue and are fully engaged. For instance, stream flow gauging are important to know the water supply, do irrigation and construct dams. Unless the community protects,*

the SIM card, telemetrics, and solar panel could be stolen. If stakeholders are engaged and the community agrees with water allocation and related issues, the community could protect all the apparatus installed. Making rules and regulations alone is not sufficient, consensus and full engagements of key actors are important to implement water rules and regulations."

Data obtained showed that the majority of actors were not coordinated. One of the participants (KI-9) stated:

"*Government sectors at the District level were not actively coordinating the actors to address water stress and resource degradation. There were no consistent efforts and actions from government organizations about the water resources stress in the study area. Implementing water rules and regulations, conducting monitoring and evaluation were missed*."

The informant also added that some private companies and investors are influential. However, they were not engaged meaningfully in the water resources governance system and practices.

Moreover, water users in the CRV were not collaboratively working on water resources management and soil and water conservation activities that can balance the environmental degradation. For instance, KI-23 mentioned that:

"*Even though the surrounding kebeles were beneficial from the Lake Dembel/Ziway, they were not significantly contributing to the conservation of the water resources and other natural resources available in the area. The lack of collaboration among kebeles and within the district's sectors was boldly visible. Committees were organized at the District level from different sectors; however, the efforts were not systematically and institutionally coordinated because every sector was running independently to accomplish its activities.*"

According to the informant's argument, the lack of an integrated plan and action among the actors was among the limitations in water governance in the CRV of Ethiopia.

Water Allocation and Permit System

Water allocation systems consist of a combination of policies, laws, and mechanisms to manage the risk of shortage, and to help allocate resources among competing uses (OECD 2015).

Countries allocate water resources to different sectors based on specific basin-level contexts. Ethiopia recognized basic-human and livestock needs as the highest priority in the water allocation plan, followed by environment and socio-economic development (FDRE 1999). The policy aimed to establish water allocation and priority-setting criteria based on social equity, economic efficiency, and environmental sustainability requirements (FDRE 1999; FDRE 2001). Notwithstanding the Policy, water allocation between upstream and downstream and between water uses (domestic, agriculture, industry, and environment) have not been practiced in the CRV. There were no detailed directives or guidelines that help to allocate water resources among various water uses, and between upper and lower catchments. Key informants, for instance (KI-27), mentioned that "*The earlier focus was on development (technical) aspects of water management, not on its governance issues such as how water resources allocation and distribution could be carried out.*" Measuring the amount of abstracted water, the balance of the annual inflow and outflow, and the data of allocated water for irrigation and other services were missed.

Regarding water permits, the Ethiopian Water Management Regulation (FDRE 2005) asserts that any person who uses water resources shall hold a permit. However, these practices were lacking in the CRV. One of the key informants (KI-3) stated, "*The absence of clear guidelines and directives that could enhance the implementation of the policy has contributed to the limitation*." Small-scale irrigation practices by farmers use both surface and groundwater resources without holding permits. The practices in the CRV indicate that any individual farmer, who has a pilot of land and is financially capable of pumping, can use an unlimited quantity of water for irrigation. These practices affected the available water resources and exposed the resources to mismanagement and over-exploitation. The process of a permit system for smallholder farmers was assumed to be implemented through the Irrigation Water Users Association (IWUAs); however, they were not well organized and capacitated to handle the responsibility.

The National Water Resources Management Policy of Ethiopia (FDRE 2000) promotes irrigation water fees depending on the quantity of water abstracted. However, there is a gap related to its implementation. There were no directives, guidelines or mechanisms that could enforce irrigation water payment per quantity of water abstracted. Similarly, the national policy

documents underscore the importance of developing appropriate cost recovery mechanisms based on users' payment capacities; however, the implementation of recovering whatever costs were lagging in the study area.

2.4.1.1. Patterns of transparency, accountability and participation

The term governance embraces broad concepts and ideas that are widely practiced. The core principles of governance include participation; equity, non-discrimination and inclusiveness; gender equality; rules-based; transparency; and accountability and responsiveness (UNDP 2013; OECD 2015). In this paper, governance principles are conceptualized as the accountability mechanisms in implementing water policies, strategies, roles, and responsibilities; participation as key stakeholder involvement in water-related decision-making processes and implementation; and transparency as a process of publicizing water-related data and information, irrigation water allocation and distribution, means of financial transfers and uses.

To assess whether water governance addresses issues of transparency, accountability, participation, and equity in the Central Rift Valley (CRV) of Ethiopia, the TAP framework (transparency, accountability, and participation) was employed. TAP framework was selected because of the following benefits in water governance assessments. TAP framework helps to assess the core pillars of water integrity, which is critical for improved governance in managing water resources and providing water services to citizens; and the water TAP approach focuses on strengthening transparency, accountability, and participation in a utility's operations and ensuring compliance with internal rules and regulations (Biad et al. 2015). TAP also enables demonstrable democratic principles, rule of law, information sharing, and respect for gender capacity, and precludes secrecy in transactions pertaining to water supply (Louka 2008). The assessment of TAP within the water sector focuses on measuring: the effectiveness of existing systems and processes to make information open and public; the functioning of compliance and oversight mechanisms, both internal and external; and the level of participation of citizens/end-users in decision-making processes (Jacobson et al. 2013).

The CRV sub-basin, Ethiopia, over-abstraction of water resources, unsustainable and unprotected water use practices, pollution, and degradation of buffer zones and wetlands were reported (Jibat et al. 2023). The causes of such problems might be also associated with water

governance flaws related to transparency, accountability, and participation of stakeholders (UNDP 2013; Jiménez et al. 2020). In this study, the patters of transparency, accountability, and participation in irrigation water governance were presented and discussed in the next sub-section.

Transparency in water governance

Transparency refers to openness and public access to information so that citizens understand the decision-making processes that affect them, and know the standards to expect from public officials (UNDP-SIWI 2011). Several efforts were exerted to ensure transparency in water governance and water service delivery in the CRV of Ethiopia. For instance, one of the key informants (KI-16) mentioned that "*Public institutions have attempted to ensure transparency in water governance uses through Irrigation Water User Associations (IWUAs) regulation.*" Accordingly, every one of the community members who had a pilot of land in the compound of the irrigation site was voluntarily invited to be registered and organized in IWUAs.

In addition, the procedures and mechanisms of registration in IWUAs, the responsibilities and rights of IWUAs members, and how the members use water for irrigation were transparent for all. According to the idea of a key informant (KI-15), this was supported by awareness creation activities done by IWUAs organizer agencies. The informant (KI-15) added that following these efforts, the majority of farmers were registered in IWUAs and engaged in water aspects and uses in the study area. In a similar manner, a key informant (KI-16) stated that "*Public institutions have attempted to ensure transparency in private companies by enforcing them to disclose information about the quantity of water abstracted, and wastewater discharged to water bodies*."

Although various measures have been taken to ensure transparency in irrigation water supply, there was a lack of a mechanism and systematic approach that helps water actors get information about the volume and quality of water available for various uses in the study area. One of the key informants (KI-27) mentioned that:

> "*Water sectors were not providing relevant information for relevant actors about water resource conditions and availability, protection and conservation planning, and the role of each actor in improving water governance. Relevant and essential data and information on water resources were not collected, organized, and*

accessible for decision-making in the study area. Information-sharing practices that enable water users to make informed decisions regarding their irrigation activities during different irrigation seasons were lacking."

The informant also added that awareness creation efforts exerted to improve understanding of the community were weak, and the roles and responsibilities of water actors were not clearly identified.

Similarly, evidence from the study revealed that some of the water users who were engaged in irrigation activities, particularly in the floriculture industry, were not cooperative enough to disclose information about the quantity of water they abstract, the types of chemicals they use, and the way they discharge wastewater. For instance, one of the key informants (KI-11) stated that:

"*The types and quantities of agrochemicals used in irrigation farming were not transparent. Some private companies such as Sheer-Ethiopia and other industries have no willingness to show the process of production, the process of waste treatment, the types of chemical they use, the volume of water they use, and other related data and information*."

The informant (KI-24) added that the lack of community awareness about their right to access relevant information, and the limited capacity of lower-level regulating bodies were attributed to hindering transparency practices in water governance in the CRV of Ethiopia. In addition to private companies, some Cooperative Farmers Union members were complaining that some of the committees' decisions were not transparent. For instance, a key informant (KI-14) mentioned that "*The committee took credit from Cooperative Farmers Union and made payment for electric consumption bills, undertook maintenance of canals and pumps, etc without the knowledge of members.*" These actions of the committee have created distrust among some members of the Cooperative Farmers' Union in the study area, particularly in the Dugda District.

Accountability in water governance

Accountability refers to sets of controls, counterweights, and modes of supervision that make officials and institutions answerable for their actions and ensure that sanctions are applied

against poor performance, illegal acts, and abuses of power (Karar 2017). Accountability is also a requirement for powerful actors to accept responsibility (Nuesiri 2016). The government of Ethiopia adopted various water policies and regulations to improve water resources governance in the country (FDRE 1995; FDRE 2005). These policy documents promote the development of appropriate institutional structures as well as decentralization to the lowest level of governance for better and more efficient management of water resources. Various public institutions were also established with mandates, which make the institutions answerable for their actions and performance, and to play their roles in the implementation of these policies and regulations.

However, in the CRV of Ethiopia, the roles and responsibilities of actors were inconsistent in water governance practices, which resulted in failure to ensure accountability in the study area. For instance, one of the key informants (KI-21) mentioned that:

> "*Regulatory agencies failed to exercise their mandates, roles, and responsibilities in terms of regulating and controlling malpractices. Detailed standards, guidelines, or manuals that protect wastewater discharging into water bodies are lacking at the local level in the CRV. Measurement systems and necessary laboratory facilities that enable testing of the level of chemicals to identify the minimum acceptable level of polluting chemicals are not established. As a result, degrading water quality by water users and potential polluters continued in the area.*"

In addition, sources of evidence indicate that the lack of incentivizing mechanisms for small-scale farmers and the absence of well-capacitated regulatory water institutions at the local level were attributed to low accountability in irrigation water supply and service delivery in the study area. For instance, participants of the focus group discussion (FGD3) explained that the local community members were not empowered to check, monitor, and evaluate the performance of public service providers and private companies that are involved in water matters. Data obtained from the discussants revealed that water actors' engagement lacks systematized mechanisms, clear roles, and responsibilities that make them accountable for their actions to improve water governance in the CRV of Ethiopia.

Moreover, there were no clear mechanisms that every actor should know, play their roles, and be accountable accordingly. One of the key informants (e.g. KI-7) mentioned that:

> "*Some government bodies assume that the Basin Development Administrative Office (BDAO) is accountable for violation of laws, rules, and regulations in water use. BDA is educating those polluting water resources, but it can't take measures such as warning and closing the polluting companies. This responsibility is given to the Environmental Protection Authority. However, there is no clear linkage between these two organizations to exchange data and information for decision-making. The majority of irrigators use irrigation water individually, and they think that irrigation water is infinite and loses a sense of ownership. Chemicals used in the farm are drained into water bodies by flood, and no one takes accountability for this fault*."

Evidence from the study indicates that actors failed to play their roles; non-compliance was left without accountability, and communities' awareness was low about freshwater scarcity in the CRV of Ethiopia. For instance, a key informant (KI-22) stated that: "*There was no clear understanding about the concept of water accountability including implementing agencies, irrigators, and stakeholders. Water users did not give attention to the main source of their production, i.e. the purity and sustainable availability of irrigation water.*" The informant argued that this is mainly due to a lack of community awareness about freshwater scarcity and finite, unless conserved and protected.

Participation in water governance in the CRV

Participation implies the meaningful and active involvement of a broad spectrum of stakeholders, including vulnerable or marginalized groups in decision-making processes and other activities (Jiménez et al. 2020). Participants of this study (e.g. KI-5) stated that "*The process of water resources management and water-related policy formulation was improved in terms of participating relevant stakeholders.*" The informant added that several times, water actors' workshops were arranged on environmental conservation and protection (including water resources) issues.

Various stakeholders have been participating in water resources matters in the CRV of Ethiopia. These include government organizations, local communities, irrigation water user associations, individual water users (farmers and private companies), development organizations, and NGOs. These stakeholders have been involved in different aspects of water resource development, management, and its uses. For instance, data obtained from community representatives (CR-28) indicates that members of the IWUAs participated in water resources development and governance such as scheme maintenance (in-kind contribution in developing and maintaining irrigation canals, in soil and water conservation activities, and managing irrigation schedules, etc), and contributing money for irrigation water development.

In addition, to improve water resources governance and to facilitate effective irrigation scheme management it was attempted to involve local elders in conflict resolution and irrigation schedule management. For instance, one of the community representatives (CR-28) stated that a public grievance outbreak due to the water shortage of Bulbula River as a result of high irrigation water abstraction at the upper catchment was resolved by elders' participation in negotiation between upper and lower catchment community members. Similarly, evidence from this study (e.g., KI-24 and KI-26) indicates that development partners and NGOs have also participated in water resources governance in the CRV of Ethiopia.

Moreover, there was evidence that efforts were exerted to improve community participation in water resources governance by inviting irrigator farmers to be registered in IWUAs. One of the key informants (KI-28) stated that "*IWUAs have attempted to ensure participation and maintain equity, particularly by including women as committee members in the user associations*." Efforts were also exerted to involve different groups (e.g. women, poor people, elders, and youth) in water matters in the CRV of Ethiopia. However, a lot remains in addressing women's desires for water access and irrigation technologies in the study area. The community could contribute a lot to improving water resource protection and sustainable uses if they participate in a meaningful manner.

Although there was improvement regarding participation in water laws development, participants of the study complained that the concerns and inputs from participants were not well addressed in the final policy and strategy documents. One of the key informants (KI-7) stated that:

"Most of the time, the contents of the water-related policy documents you commented on and criticized were not changed when you see the final version of the documents. The process of participation was not effective because of two reasons. On one hand, participants were not taking sufficient time and were not committed to providing valuable input, rather than simply attending the meetings and forwarding ideas. On the other hand, organizers of workshops mostly lack in-depth preparation such as preparing agreement documents, roles and responsibilities of each participant, and summarizing the consensus among participants, taking minutes and developing evaluation systems for the participation processes."

The data obtained from focus group discussions (e.g. FGD2) also showed that even though there were initiations regarding the participation of stakeholders, essential efforts were not undertaken to ensure meaningful participation in water governance in the CRV of Ethiopia. According to the ideas of the discussants, the participation of stakeholders in planning, implementing, monitoring, and evaluating processes in water resources governance was inadequate, and not systematized. Although efforts were exerted to improve participation in the water resources governance process, discussants of the study (FGD4) mentioned that the participation was not inclusive. For instance, all important stakeholders from the community, development partners, NGOs, individual investors, fishery associations, hotels and restaurants, and other private companies did not adequately participate in water resources matters in the CRV of Ethiopia.

Evidence indicates that the stakeholders' participation was not inclusive and holistic in addressing water governance problems in the CRV of Ethiopia. One of the key informants (KI-27) expressed that: "*The community members may contribute a lot in terms of protecting and conserving if they fully participate in the entire processes of water decision, implementation, and evaluation."* According to the informant's argument, if the community were fully engaged and reached a consensus on water resources governance processes and activities, they could be a safeguard for the entire irrigation infrastructure and scheme management. Another key informant (KI-9) also addressed that there were influential private Companies and Investors who could

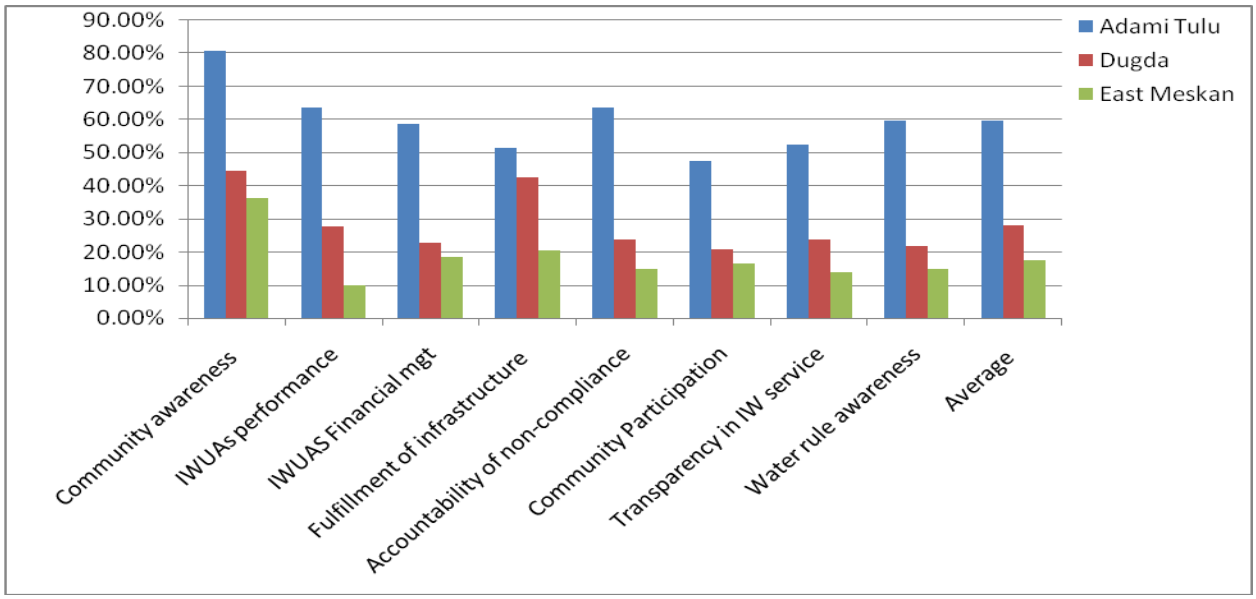
contribute more to water resource-saving and protection if they fully participated in water resources decision and implementation processes.

Data generated from this study indicate that the failures of public agencies to coordinate stakeholders' participation have contributed to the degradation of water resources in the study area. For instance, one of the community representatives (CR-37) mentioned that due to the lack of a dedicated and responsible organization to coordinate all stakeholders and facilitate essential procedures, Lake Dembel was put under stress. As a consequence, members of the community were under frustration and fragile situations due to the decline of aquaculture in the study area.

Districts' and Kebeles' irrigation water governance performance

The performances of the districts were analyzed using selected irrigation water performance indicators. The result of the study indicates that there is significant difference among districts irrigation performance. As one can observe from fig. 2.2 Adami Tullu Jiddo Kompolcha (ATJK) District had performed better than the rest two districts in all irrigation water governance indicators. The reason might be associated with the better establishment of IWUAs and the strength irrigation schemes such as Abune Germama and Golba Aluto Kebele in the ATJK District.

Fig 2.2: Summary of irrigation water governance by districts



Source: Compiled from field data collection (2023)

According to the data indicated on fig. 2.2, 80% of the respondents from ATJK district agreed that the community had awareness regarding the impact of over-abstraction of irrigation water on future sustainable water uses in the area. Similarly, the data obtained from participants indicate that ATJK was better regarding IWUAs performance, IWUAs financial management, taking corrective measures on non-compliances of local rules, community participation, and transparency in irrigation water service. East Meskan had performed less comparing to the other two districts of the sample study in the CRV sub-basin of Ethiopia.

In similar manner, the study also attempted to identify better Kebeles among the selected sample Kebeles in terms of irrigation water governance. As one can observe from Table 2.2, 86% of the participants of Abune Germama Kebele agreed that the community has awareness on the impact of irrigation water degradation on sustainable development in the study area.

Table 2.2: Irrigation water governance performance by Kebeles

Governance indicators	**Kebele performance in %**						**Asymp. Sig. (2-sided)**
	Abune Germama	**Bati Futo**	**Bekele Girris**	**Dobena Gola**	**Golba Aluto**	**Shubi Gamo**	
Community awareness	86.00	54.20	40.90	20.40	75.50	69.20	0.000
IWUAs performance	64.00	8.30	28.40	11.20	63.20	23.10	0.000
IWUAS Financial mgt	66.00	20.80	21.60	16.70	51.00	30.80	0.000
Fulfillment of infrastructure	50.00	14.50	38.70	26.00	53.10	69.20	0.000
Accountability of non-compliances	72.00	25.00	26.10	5.60	55.10	7.70	0.000
Community Participation	58.00	25.00	21.60	9.30	36.70	15.40	0.000
Transparency in IW service	62.00	20.90	26.20	7.40	42.80	7.70	0.000
Water rule awareness	74.00	16.70	20.40	13.00	44.90	30.80	0.000
Average	**67.33**	**22.92**	**27.66**	**12.80**	**51.91**	**29.92**	

Source: Compiled from own field data collection (2023)

Regarding to irrigation infrastructure fulfillment, Golba Aluto kebele is better than the other Kebeles. Abune Germama had better performance in terms of implementing accountability

system (sanction on no-compliances of IWUAs rule), community participation and transparency in irrigation water service provision, and educating the community on irrigation water rules. On average, Abune Germama Kebele had a better performance among the rest Kebeles on water governance in the CRV sub-basin. The P-value result also shows significant at 95% and 99% confidence intervals.

2.4.2. Discussion

Common-pool resources such as water resources need rules that indicate how the resources will be shared, the quantity allowed for each user, the rights, and obligations of the users (Rouse 2013; Ostrom 2015). The government of Ethiopia enacted various rules and regulations for water resources management and uses at different levels. Efforts were also exerted to undergo reforms and institutional arrangements to improve the governance and management of available water resources. The government of Ethiopia has also developed policies, regulations, and strategies to manage water resources sustainably. However, these rules and regulations were not yet precisely implemented in the CRV. Water resources management policy and strategy were not supported by clear and detailed standards and implementation guidelines and they lacked procedures for water resources protection and means of sustainable uses in practice. The policy lacks enforceable mechanisms, and not implemented on the ground. A policy is said to be good when it is implementable and enforceable on the ground rather than merely existing as ideas or concepts on paper (Ménard et al. 2017). This fact was missed in water governance in the CRV of Ethiopia.

The Constitution of the country (FDRE 1995) asserts that the trans-regional water resources should be administered by the federal government. It also granted regional governments the ability to manage natural resources in their administrative jurisdiction. However, there was no clarity about the specific responsibilities of these government levels, which led to an overlap of mandates and confusion of roles between federal and regional government water sectors. Such practices may result in institutional overlaps, financial challenges, insufficient management capacity, and policy and operational gaps as mentioned by Muok and Onyango (2020).

A catchment partnership of stakeholders working together within a catchment is essential to improve water co-governance (Foster 2021). However, in the CRV this practice was missed. For

instance, there was no consultation between adjacent Districts (Dugda and East Meskan) on how to use the Meki River to address unfair water allocation and distribution among upstream and downstream water users. This situation was exacerbated by increasing investment and deforestation upstream and competition for water uses for different purposes in the area (Vilalta 2010; Pascual-Ferrer and Candela 2015). Over-abstraction of water for irrigation at upper and middle catchments caused the shortage of drinking water for livestock at the lower catchment in the CRV. This type of trade-off might be from a lack of streamlining coordination policy and legal framework of different actors, poor strategic planning, failure to align national and regional policies, delayed real decentralization, and failures to accommodate and harmonize pluralistic and diversified local practices (Hagos et al. 2011; Haileslassie 2019; Muok and Onyango 2020). To manage such trade-offs Schluter et al. (2009) suggested enforceable regulations or incentives, negotiations, and possible synergies between irrigation and other water uses and facilitating an integrated water management plan. Stefano and Garrick (2018) also suggested that effective inter-state and central-local coordination are needed to deal with the distributional conflicts associated with reallocating water across administrative boundaries such as in CRV cases.

There are various actors engaged in water resources governance in the CRV. These actors have been involved in different aspects of water resource development, management, and its uses. However, all potential and concerned stakeholders were not comprehensively engaged in water resources decision-making processes. Water actors in the CRV lacked an integrated plan and were not systematically coordinated. The main reasons for these limitations emanated from the failure to develop a strategy for stakeholders' engagement and the inability to establish a common platform. As a result, fragmented efforts were the common feature of actors' engagement in water governance in the CRV. The engagement and interactions of multiple actors can have several implications, such as user influence and shifting accountability structures to foster coordination (Lieberherr and Ingold 2019). To effectively contribute to decision-making in a coherent, holistic and integrated way, having a consultation, participation, and coordination mechanisms of all stakeholders at all levels and scales is important (OECD 2015; OECD 2020). Moreover, the engagement of actors needs to be designed as social learning that offers much scope for developing informed and outcome-oriented contributions to water policy design and

implementation (Akhmouch and Clavreul 2016; Wehn et al. 2018). These processes and practices were lacking in water governance in the CRV of Ethiopia.

Notwithstanding the policy, water allocation systems between upstream and downstream and between water uses were not implemented in the CRV. Hydrological datasets such as availability of water quantity and its demand, and annual inflow and outflow are paramount for improving estimates, and making better water allocation rules and regulations before allocating water resources at the basin or catchment scale (Mutiga et al. 2010; McKay 2011; OECD 2015; Kaune et al. 2020; Schmidt 2020). However, the current situation of irrigation water use in the Central Rift Valley is characterized by grabbing the available water resources because of the absence of a water resources distribution system among water uses and users. This resulted in high irrigation water abstraction and wastage in the area.

Regarding water permits, the Ethiopian Water Management Regulation (FDRE 2005) asserts that any person who uses water resources shall hold a permit though it was one of the missing practices in the CRV. The process of a permit system for smallholder farmers was assumed to be implemented through the irrigation water users association (IWUAs); however, IWUAs were not well organized and were not capacitated to handle the responsibility in an efficient manner. In a similar manner, this study also revealed the deficiency of established and implemented cost recovery systems in the public-funded irrigation schemes in the CRV. IWUAs were not strengthened institutionally and financially to cover all operations and maintenance of irrigation schemes.

This study also revealed that efforts were made to ensure transparency in irrigation water service supply by enacting rules, regulations, and IWUAs proclamations and regulations that promote transparency. According to these legal documents, any irrigator who has irrigation land in the identified irrigation area has a right to be registered in IWUAs and use irrigation water for agricultural purposes. Another mechanism attempted to ensure transparency in water sectors' (public institutions) service delivery was by establishing structure and assigning focal persons who educate about anti-corruption and follow up on any misconduct against irrigation water service delivery procedures and practices.

On the other hand, information-sharing practices that enable irrigators to make informed decisions regarding water availability and their irrigation activities at different irrigation seasons were missed in the CRV of Ethiopia. A lack of tracking mechanisms to identify the level of transparency in water supply and service delivery was observed in the study area. Devising and implementing mechanisms that enable diagnosing and preventing poor transparency practices at different levels are essential as suggested by the OECD (2015). Transparency also requires actors to facilitate all means for citizens to understand the decisions that may affect them; and make the information accessible through open data that is complete, relevant, and timely (Hosseini et al. 2018). However, all these processes and practices were missed in irrigation water service delivery in the CRV of Ethiopia.

Accountability is a process of making actors answerable for their actions, as well as compliance with rules and standards, and putting in practices of responsibility and enforceability (Jiménez et al. 2018). However, none of the actors were accountable for the over-abstraction, over-flooding, and depletion of water resources in the CRV of Ethiopia. There were no implemented accountability tools such as monitoring systems, performance agreements, systematic complaints mechanisms, and public meetings to ensure accountability in water governance in the study area. Well-functioning accountability mechanisms can help to clarify the commitments of actors, lead to efficient management of fiscal resources, protect water resources, increase control over the actions of public and private stakeholders, and ensure minimum quality standards (UNDP 2013). In the CRV case, the lack of commitment of respective stakeholders was attributed to the deficiency of accountability in water resources governance and sustainable uses in the CRV of Ethiopia.

Ethiopian Water Resources Management Policy recognizes and promotes fairness, social equity, water efficiency, and sustainability norms in water resources management in the country. Regarding this, efforts were exerted by various concerned actors to enhance participation in water resources governance in the CRV of Ethiopia. In the case of CRV sub-basin, the IWUAs have attempted to include women in committee members to ensure equity; however, a lot remains in addressing women's desires in water access and irrigation technologies in the study area. The participation of stakeholders in planning, implementing, monitoring, and evaluation

was not systematized. The result is similar to the previous study reported by Yami (2013) which indicates that equity in irrigation water service provision for women and other disadvantaged groups remains much behind in Ethiopia.

The study results indicate that there were various actors involved in water resources governance in the CRV, Ethiopia. However, all potential and concerned actors did not inclusively participate in water resources matters. Key stakeholders of water resources governance were not systematically coordinated. Stakeholders' participation failed to develop a strategy and common platform for an inclusive participation system in the study area. As a result, fragmented efforts to protect and conserve the resources were the common features of stakeholders' participation in water resources decision-making processes in the CRV of Ethiopia. OECD (2015) suggests a coherent, holistic, and integrated way of participation and coordination mechanisms of all stakeholders at all levels and scales to effectively contribute to improved water resources governance.

To ensure effective participation, having a coherent participation policy and strengthening the participation of local communities and indigenous people in water resources management are suggested by scholars (Morris-Iveson and Alderwish 2018; Glass and Newig 2019). In addition, participation is meaningful when all stakeholders, including marginalized and resource-poor groups, are meaningfully involved in deciding how water is used, protected, managed, and allocated (Das et al. 2016). These enable collective interest to respond to risks and safeguard water resources. In the case of CRV of Ethiopia, precisely designed participation policy enforcements and mechanisms that enable inclusive participation of local communities in water resources decision-making processes were missing. Moreover, the performance of districts and kebeles were different and the difference is significant. Among the selected three districts and six kebeles ATJK and Abune Germama were better in performing irrigation water governance when observed using various governance indicators in the CRV sub-basin of Ethiopia.

2.5. Conclusions and recommendations

The study was conducted to analyze the state of water governance in the Central Rift Valley (CRV) of Ethiopia. In the study area, water is used for domestic, agricultural, industrial, and

ecosystem services. Irrigation activities were extensively expanded and resulted in water resources under severe stress. Lack of policy enforcement mechanisms, lack of clear shared roles and responsibilities among water actors, and absence of action coherence between water sectors were the current features of water resources governance practices in the CRV. Failing to ensure accountability, the absence of meaningful stakeholders' participation and engagement of the local community in the water decision-making process, and the limited capacity of local water governance institutions to manage the trade-offs exacerbated the gaps. Failure to answerability of actors for their own actions and performance were observed. In addition, providing relevant data and information, and the capacity to devise simple information dissemination platforms or mechanisms to improve transparency in water service delivery were not manifested in the study area. These governance shortcomings lead to malpractices such as grabbing and over-abstraction of the available water resources for irrigation, deteriorating buffer zone, upstream deforestation, and overuse of agrochemicals, which resulted in a reduction of water quantity and quality in the CRV. These challenges have threatened aquatic lives, ecosystem services, and the livelihoods of the surrounding communities. Hence, attention should be given to aligning national and regional water governance framework, inter-sectoral coherences, decentralization with clear roles and responsibilities of actors, effective inter-state and central coordination, enforceable regulations or incentives with relevant instruments, and enhancing community engagement to improve water resources governance. Fostering catchment partnerships among relevant stakeholders is essential to improve water co-governance and collective actions, to build possible synergies between irrigation and other water uses, and between upstream and downstream water users. Moreover, capacitating regulatory institutions with necessary resources, encouraging local and informal institutions to enhance participation and inclusiveness in water decision-making, advancing evaluation and consultation mechanisms to improve regulatory processes, and devising and implementing appropriate enforcement tools are essential to address transparency, accountability, and participation in water governance in the study area.

Chapter Three: The role and interplay of institutions in water governance in the Central Rift Valley of Ethiopia

Abstract

Institutions can play a key role in coordinating how natural resources are effectively managed and used without over-exploitation. Institutions are laws, policies, and organizational arrangements that permit, forbid or regulate human action. This study aimed to look into the roles of formal and informal institutions, and their interactions in water resources governance in the Central Rift Valley (CRV), Ethiopia. Key informant interviews, focus group discussions, and secondary data sources were employed to collect relevant data. The result of the study indicated that there were various institutions (both formal and informal) playing their roles independently in water resources governance in the study area. However, the interaction between informal and formal institutions was weak, and unable to influence the actions of water users in the CRV. Other limitations observed in water resources governance in the CRV include a lack of actors' clear roles and responsibilities, absence of decentralization, limited engagement of key actors in policy development, lack of synergy between the institutions, and absence of enforcement mechanisms. Considering the local contexts and community's traditional knowledge of water governance in water-related policy, rules, and regulations, and enhancing the capacity of local-level institutions, strong interplay among all institutions involved in water governance, and meaningful actors' engagement were recommended to advance the role of institutions in water resources governance in the CRV and in the country. Hence, the harmonization of formal and informal institutions in the water management can enhance the governance of water resources in the study area and elsewhere in the country.

Key Words: Governance, Institutions, Institutional Interplay, Role of Institution, Water Users

3.1. Introduction

Institutions can shape natural resource users' actions and encourage efficient resource use (Medase 2023). The term ‘institution’ is referred to multiple times in development literature such as specific organizations, human relationships in a society, and rules that individuals use to shape specific relationships with others (Pradhan *et al.*2022). Institutions are also laws, policies, and organizational arrangements that societies develop to allow, prohibit, or regulate certain human actions (Chopra and Ramachandran 2021).

Water management is a mix of formal and informal institutions in many countries in the world (Yeboah-Assiamah *et al.* 2017). Formal institutions are related to the official channels of the governmental system, and enforced by lawful procedures, while informal institutions refer to socially shared rules such as social or cultural norms and reflect local people’s views (Gilmore *et al.*2022). Both formal and informal institutions are shared, enforced, and long-lived (Hassenforder and Barone 2019). Empirical studies, e.g., Yami *et al.* (2009) indicate that both formal and informal institutions played a great role in natural resources governance.

Institutional diversity can enhance the capacity of a certain community by educating multiple ways of responding to challenges (Pellowe and Leslie 2020). For instance, Yami *et al.* (2009) revealed that informal institutions contributed to sustainable Common Pool Resources (CPR) management in Sub-Saharan Africa through common decisions, reducing costs for CPR users, taking advantage of local knowledge, and implementing locally agreed rules. Institutional measures such as enforced formal laws, informal norms, and standards shared among communities help to govern the individual actions of resource users (Medase 2023).

Several studies indicate that the interaction of formal and informal institutions results in positive effects on water resources governance. For instance, Yeboah-Assiamah *et al.* (2017) reported that informal institutions were harmonized with formal and synergistically improved the viability of the natural resources in Ghana. Similarly, both formal and informal institutions have shaped fishing practices in Mexico (Pellowe and Leslie 2020). In some cases, informal institutions gradually become part of formal institutions, and formal also take informal forms in governing resources such as water resources (Nhundu *et al.* 2015). Hence, scholars, for instance, Tinoco

(2012) suggested the need to consider both formal and informal water institutions to operate and enforce them at different levels based on local reality.

Productive interactions between formal and informal institutions could be facilitated when shared experiences exist between diverse actors (June *et al.* 2019). Mechanisms designed to enable shared learning, feedback, and adaptation experiences between both institutions can facilitate positive management development, and encourage institutional interplay. It is also important to devise intervention mechanisms to enhance the capacity of the informal systems to manage water resources because both institutions can draw lessons from each other (Nhundu *et al.* 2015).

On the other hand, there is also a situation where formal and informal institutions conflicts have notably compromised water service delivery (Muok and Onyango 2020). For instance, the informal institution of the ancient caste system in India hindered the effectiveness of formal institutions (Haider 2017).

The effectiveness of institutions depends on the nature of institutions and their enforcement mechanisms (Yeboah-Assiamah *et al.*2021). The strength of the governance system, planning, and financial adequacy can be factors affecting the effectiveness of institutions and are essential for improved water governance (Tortajada 2010b). Institutional ineffectiveness may be caused because of inadequate consideration of the human element and its failure to take into account the need for awareness of future uncertainty to adapt to changes (Akamani 2016).

There are different institutional theories and frameworks developed by scholars. The conventional theory of common-pool resources presumed that external authorities need to impose rules on those appropriators trapped into producing excessive externalities (Ostrom 2011). The Institutional Analysis and Development (IAD) Framework (Ostrom 2005; Ostrom 2015), which is a widely used framework in common-pool resources governance, provides a means of describing and linking resource systems, governance systems, resource units, users, interactions, outcomes, and related ecosystems. Williams and Kosta (2019) argued that a lack of vertical and horizontal trust are associated with institutional failings due to non-alignment between formal and informal institutions (vertical) and horizontal trust.

In this paper, institutions are defined as formal and informal institutions. Formal institutions include rules and regulations decreed to use and conserve water resources in the country, the role of state structures engaged in water decisions and actions, the contribution of development partners and irrigation water user associations in water resources governance practices in the Central Rift Valley (CRV) of Ethiopia. Informal institutions include traditions, and customs practiced in water uses and conservation activities in the CRV of Ethiopia. The focused on what and how these institutions are playing their roles and their interplay in water resources governance actions.

The interplay of institutions is the interaction of these institutions (whether they overlap/are similar or conflict) on the grassroots level in irrigation water resources collective actions in the study area. To what extent the actions of these institutions support each other, how they are contributing in water resources governance, what are their linkages in governing water, and related issues were the concern of this study. Previously, there was no study conducted on the harmonization of formal and informal institutions and their roles to improve water resources governance in CRV of Ethiopia. Hence, the main aim of this study was to assess the roles of formal and informal institutions and their interplay in water resources governance in the CRV of Ethiopia.

3.2. Research approach and method

This study employed a qualitative research approach. The study covered wider areas (both site and beyond the site). The study used key informants' interviews, focus group discussions, and a review of policy documents and literature to collect relevant data. The study involved various government tiers: federal, regional, District, and Kebele (which is the smallest administrative unit in the country). A total of 36 key informants were interviewed. Key informants were selected from government organizations, Irrigation Water Users Associations (IWUAs), fishery associations, farmers, local elders, development partners, researchers, and representatives of informal institutions. Semi-structured guiding questions were prepared for data collection. The interview guide was prepared and discussed in detail with supervisors before field data collection.

In addition, four focus group discussions (FGD) were held. The participants were selected from farmers, considering IWUAs members, local elders, gender, age, experiences on irrigation activities, and accessibility to information. The total participants of the focus group discussion were 28 farmers; 8 in each group of 1 and 2, and 6 farmers in each group of 3 and 4. Participants were categorized based on the selection criteria mentioned in this paragraph. Five main guiding questions were prepared, and explained by the moderator for the participants.

The data was collected at the workplace, and on field through face-to-face interviews and group discussions. The data collection was assisted by audio recording based on the full consent of participants. The field note was made during the interview and focus group discussion and was revised using the audio recorded. The start and end time of the interview and focus group discussion duration was recorded. Key informant interviews and focus group discussion activities were conducted until data saturation was reached. The data collection was carried out using local languages (Afan Oromo and Amharic) and translated to English later on. The data were transcribed, organized, and used for analysis. Data were collected in March and May 2021.

Regarding secondary data, laws and water policy-related documents including the Constitution of the Federal Democratic Republic of Ethiopia (FDRE 1995), Environmental Policy of Ethiopia (FDRE 1997), Water Resources Management Proclamation (FDRE 2000), Water Resources Management Regulation (FDRE 2005), Ethiopian Water Sector Strategy (FDRE 2001), Power and Duty of Ministry of Water and Energy, and Power and Duty of Ministry of Agriculture (FDRE 2018a), Irrigation Water Users Association (FDRE 2014), Power and Duty of the Basin Development Authority (FDRE 2018b), National Water Policy and Strategy (FDRE 2020), and other related policy documents were analyzed. These water policy, strategy, rules, regulations and reports were collected from respective organizations and internet sources. The data were analyzed by triangulating with the primary data sources associating with sub-themes using thematic approach.

3.3. Data organization and method of analysis

Data collected through interviews and focus group discussions were transcribed and documented. The transcribed data were coded and organized under sub-themes of the study by carefully

reading the transcribed data. The backgrounds of the respondents were organized separately using Excel Sheets. Following data organization; the data were imported into NVivo 11 software for coding and analysis purposes. In a similar manner, different water policies and strategies, proclamations, regulations, and related PDF documents were imported into NVivo 11.

After importing all the necessary information into the NVivo 11 software application major themes and sub-themes were created using the software. As Zamawe (2015) stated, NVivo helps in the analysis of qualitative data by facilitating the tasks of managing data and ideas, modeling visually, and reporting. Following this procedure, all the imported data were carefully read and coded under each of the major themes and sub-themes, and qualitative analysis was carried out using a thematic approach. The data was organized and analyzed under major themes and sub-themes.

3.4. Results and discussion

3.4.1. Results

Institutional arrangements

Federal and two regional governments were engaged in managing water resources in the CRV of Ethiopia. At the federal level, various organizations such as the Ministry of Water and Energy, Ministry of Agriculture, Ministry of Irrigation and Lowland Development, and Rift Valley Basin Development Office were established and involved in water resources governance in the study area (FDRE Proc. No. 1097/2018; FDRE Proc. No. 841/2014). The two regional states have also arranged similar water-related organizations, and engaged in various activities related to water resources governance including at the District level. In addition, at the Kebele level (the lowest administrative unit in Ethiopia) Development Agents (DAs) and other natural resources experts were assigned to support the development by providing extension services and advice on crop and livestock production, and natural resources conservation activities including water resources.

The federal Constitution (Art 52/3 (d)) granted regional governments to administer natural resources in accordance with federal laws. The existing institutional arrangements indicate that agencies established at regional and lower levels were engaged in water resources governance

activities in the area. The Constitutional provision promotes decentralization of authority to the lower administrative levels. However, evidence from this study indicates that there was a lack of alignment between the constitutional provisions and the implementation of rules and regulations on the ground. For instance, one of the key informants (KI-1) mentioned that:

> "*Alignment between Constitutional provisions and implementation are lacking when going down from federal to region, District, and Kebele levels. Integration is lacking among respective sectors; the agriculture sector is not worrying about water efficiency and buffer zone areas while doing irrigation activities; the industry sector is not worrying about water pollution. Water sectors were not integrated (they have no common plan), and each of the institutions ran their duties independently without considering water saving and conservation contrary to the rules and regulations.*"

Institutional arrangements were established at all levels; however, their coordination and integration were weak to improve water resources governance due to a lack of enforcement mechanisms of the existing rules and regulations, and a lack of systematized monitoring and evaluation in the study area.

Empowering the local level institutions and decentralization were attempted to be implemented in the study area. However, there was a capacity gap among water resource users, particularly farmers and public institutions that are supposed to support and enforce the implementation of improved water governance in the area. One of the key informants (KI-2) stated that "*Water sectors do not have equivalent capacity in terms of finance, logistics, knowledge, technology, and human resources. Only roles were decentralized to the lower levels without capacitating them with finance, knowledge, expertise, and other essential resources*." Another key informant (KI-8) also added that clear rules, regulations, directives, and guidelines that enable lower-level administration were not fully decentralized to manage water for sustainable uses in the study area.

Data collected for this study show that required institutional arrangements were established and in place at all levels. However, implementation limitations were observed. One of the key informants (KI-29) stated that:

> "*All structures of water sectors exist. However, the institutions were not implementing the policy and regulation of water resources management on the ground. There is no problem regarding structure, but not well performing. This may be caused due to a lack of capacity to implement their mandate and a lack of monitoring and evaluation from respective Regional and Federal level water sectors. The local government agencies should be capacitated by required knowledge and resources.*"

In addition to government institutional arrangements, there were also community-based institutions (for instance, Irrigation Water Users Associations/IWUAs) that were engaged in water resources governance in the CRV. The government recognized the role of these institutions in improving water use efficiency and protecting the environment. To strengthen these institutions, the federal government decreed IWUA's proclamation (FDRE Procl. No. 841/2014, FDRE Regulation 441/2018) with the objectives: to manage and operate an irrigation and drainage system; to provide water equitably to its members for agricultural purposes; to maintain, and rejuvenate and improve the irrigation and drainage system; and to maintain and operate irrigation equipment.

The proclamation also stated that the IWUAs shall be guided by principles of fairness and equity in decision-making and allocation of irrigation water; preventing wastage and pollution of water; protecting and administering irrigation and drainage system within the operation area; and complying with a system of cost recovery and efficient use of resources. The associations have also developed their own rules (agreements) that address how to distribute water for the members, how to undertake scheme maintenance and impose sanctions on non-compliance, and the way they conduct monitoring and evaluation. The performance of the associations varied from association to association due to factors such as financial capacity, the commitment of the IWUAs committee, and support from the district office.

In addition, development partners and NGOs were also involved in water resources matters, particularly in protection and conservation activities in the CRV of Ethiopia. Data obtained from key informants (e.g.KI-19 and KI-26) shows that development partners and NGOs were supporting farmers and IWUAs in awareness creation, material support, and providing capacity

building training. An informant added that a gap was observed among government institutions and community-based organizations in taking the responsibility of sustaining projects initiated by development partners and NGOs when their projects were phased out.

Role of public institutions in water governance in the CRV

The government of Ethiopia adopted various water policies, rules, and regulations to improve water resources governance in the country. Information from secondary data (FDRE 1995; FDRE 2001; FDRE 2005) shows that the policy documents advocate the necessity of building and strengthening the capacity of water institutions, institutional stability, and user-based management of irrigation systems. In addition, the rules and regulations promote the development of appropriate institutional structures as well as decentralization to the lowest level of governance for better and more efficient management of water resources. Various public institutions were also established to play their roles in the implementation of these policies and regulations.

One of the roles of public institutions in improving water resources governance is undertaking studies and collecting relevant and updated water-related information. In this regard, one of the key informant (KI-7) expressed that some of the institutions (e.g. Rift Valley Basin Development Office/RVBDO) have conducted the study, and the study addressed water use sustainability, current and future demand for water, the potential of available water resources, and the government development plan in the area. An informant added that identifying present and future demand could help to allocate water resources for domestic, livestock, environment, agriculture, and industry, and also for catchment-based water allocation. Another key informant (KI-26) mentioned that the RVBDO was playing its role by working with respective Districts' implementing agencies on conservation activities such as terrace and watershed development at the upper catchment to protect Lake Dembel. The informant also stated that RVBDO was educating/consulting individuals and companies polluting water resources although taking measures was not its mandate.

Regional water sectors such as Water and Energy, Agriculture, and Environmental Protection have attempted to exchange data, and coordinate horizontally at the District level. They were

exerting efforts to contribute to improve water governance in the study area. One of the key informants (KI-11) mentioned that:

> *Government institutions have played roles in irrigation water supply, and conservation activities by building a check dam at the upper catchment, mobilizing the community to plant grasses and trees to protect siltation entering into Dembel Lake, developing and maintaining irrigation schemes, registering and organizing IWUAs, providing irrigation water services, supporting women and economically poor people during IWUAs registration by providing pump, motor, and technical training and advice for farmers.*"

Evidence of this study shows that public institutions have supported Irrigation Water User Associations to enhance their capacity to manage irrigation schemes and use the resources in a sustainable manner. Data obtained from participants of focus group discussion (FGD1) shows that public institutions have attempted to improve irrigation water use (i.e. water saving, protecting wastage, implementing crop-water requirement technique, etc) by enhancing the awareness of the local water users to bring behavioral changes and improve water use practices. The discussants explained that institutions have contributed in terms of supplying irrigation equipment, providing technical advice related to cropping and water use, and mobilizing the local community to protect the environment in the CRV. The data indicates that the institutions conducted various capacity-building training, monitoring, and evaluation of the implementation of water sector policy and strategy, supporting IWUAs to strengthen community-based institutions for better water resources governance.

Even though these public institutions have exerted efforts to improve water resources governance in the CRV, this study pointed out some limitations of the institutions. These institutions were not coordinated and systematically not managing the resources by sharing roles and responsibilities. For instance, RVBDO was mandated to educate while the Environmental Protection Authority (EPA) was mandated to take measures on polluters. However, there was no clear linkage between these two organizations to make informed decisions. One of the key informants (KI-8) stated that:

"*There is a license so-called 'treat and release water license'. The license is given by the Regional Water and Energy Bureau (WEB). Any company that has this type of license must treat wastewater before releasing it to water bodies. Due to lack of strong coordination between WEB and EPA, and absence of enforcement mechanisms, measures were not taken on polluters*."

Another observation of this study was related to the capacity of public institutions which were supposed to play a great role in improving water governance in the study area. The information obtained for this study show that public institutions operating at lower levels (at Kebele and District) were not fully capacitated by human resources skills, required facilities, logistics, budget, and decision-making mandates. One of the key informants (KI-13) mentioned that "*Licenses were provided by Region or Zone where relatively better capacity exists, based on the study conducted by District experts where capacity is relatively low*." Public institutions at regional and zonal levels have not played expected roles in terms of capacitating lower-level institutions by knowledgeable experts, finance, technology, logistics, etc to improve water resources governance. In addition, water sectors at the District level were not empowered to take corrective measures for non-compliance with water rules and regulations in the CRV of Ethiopia.

Respective sectors are expected to conduct a detailed study before providing licenses related to water projects. In the case of CRV, water projects were designed either at the Zone or Region level without detailed study. One of the key informants (KI-13) mentioned that:

"*Decisions such as license for projects are made at Region and Zone. The projects are not supported by a detailed study that shows the availability of water (what quantity of water is available, how much quantity of water the project needs, how much quantity of water remains for the environment, etc) are not studied by project owners either government or private. Similarly, the Agriculture Office organizes IWUAs by simply observing the availability of water resources (without a detailed study of the availability of water resources, environmental flow requirements, irrigable land size and volume of water demanded, amount of water required for irrigation discharging, etc).*"

Moreover, projects designed at the upper catchment were not supported by a detailed data such as the amount of water discharged throughout the year; the number of populations whose livelihoods depend on the river at the lower catchment, the quantity of water could be diverted at upper, need to flow for the lower catchment and etc. Irrigation projects at the upper catchment were implemented without considering relevant water availability data.

As a result, water resource degradation still continued in the study area. For instance, over-abstraction and waste of water resources were continued. Irrigation water saving were not practiced on the field, and users were not protecting the resource from exploitation. The lack of enforcement mechanisms and the absence of clear roles and responsibilities of water sector institutions were among the causes of the failure to implement the promulgated and decreed policies and regulations. Water resources management policies, rules, and regulations were not adequately implemented. As a result, the behavior and misuse of water users were not significantly changed in the CRV. One of the key informants of the study (KI-22) stated that:

> *"The behavior of water users' did not change, and a majority of users did not understand the impact of current water over-abstraction and malpractices because a majority of water users and implementing agencies did not understand well the severe water scarcity unfolding in the area."*

Evidence of the study shows a lack of monitoring and evaluation system, an absence of institutional performance evaluation, a lack of coordination and integration among water sectors, a low level of public organizations' capacity and community awareness, and a lack of implementation capacity at a local level were the factors affecting the effectiveness of public institutions in the CRV. One of the key informants (KI-23) mentioned that *low policy awareness of implementers and lack of integrated plans and actions among water sectors contributed to the inefficiency of formal institutions in water governance in the CRV of Ethiopia.*

Data obtained from the focus group discussions (FGD2) indicated that *there was a committee established from various sectors to mobilize the community for specific water resources management and environmental conservation activities in the CRV*. However, the efforts were not systematically assessed, and its implementation lacked continuity and consistency.

Participants have also addressed that insufficient budget and logistics to reach farmers in remote areas, and lack of knowledgeable experts on water resources management and governance hindered the role of these institutions in water resources governance in the study area.

Role of IWUAs, development partners and NGOs in water governance in the CRV

In addition to government institutions, there are community-based institutions that have developed local rules/agreements by members of the IWUAs and are involved in water governance in the CRV of Ethiopia. Informants (e.g. KI-29 and KI-30) stated that IWUAs have contributed by developing local rules which address issues such as an irrigation water distribution schedule, sanction on non-compliance, annual fee contribution, conflict resolution mechanisms, and protecting water and scheme equipment from wastage and damages.

Participants of focus group discussion (FGD2) noted that according to the IWUAs' rules, any member of the IWUAs who violates the local regulations would be sanctioned according to their agreements. According to the discussants explanation, members of the IWUAs were expected to contribute to the sustainability of the irrigation system by developing and cleaning irrigation canals, developing soil and water conservation terraces, and removing harmful plants. In this regard, community members and the IWUAs committee have attempted to play roles to minimize irrigation water wastage and reduce conflicts in the CRV.

The major factors attributed to the low performance of IWUAs in terms of improving water resources governance in the CRV were related to financial limitations, skill gaps, and low implementation capacity. For instance, the report of Agriculture Office of Adami Tulu Giddo Kombolcha (ATGK) District indicates that out of 70 active IWUAs in the District, about 87% of them have no offices and documentation facilities, 55% have no local regulations, and 19% are not legally registered and certified (ATGK Agriculture Office Annual Report 2020). Moreover, the local regulations decreed by the associations were not adequately practiced among irrigation water users in the study area. Information obtained from key informant interviews (e.g. KI-28) indicates that the main factors attributed to the inefficiency of IWUAs were the failure of public institutions' support and lack of continuous monitoring and evaluation systems, lack of capacity, low financial and technical capacity to undertake scheme operation and maintenance. Participants of the focus group discussion (FGD-3) also mentioned that lack of awareness and

mistrust among some members, particularly on financial management, were factors attributed to the inefficiency of the associations in the study area.

In addition to IWUAs, there were also various development partners and NGOs who were exerting their efforts to improve water resources governance in the CRV of Ethiopia. For instance, Farm Africa, International Water Management Institute, Sustainable Environment and Development Agency, SOS Sahel Ethiopia, and Population and Health Consortium Ethiopia have been playing roles in terms of awareness creation on irrigation sustainability, and providing capacity-building trainings and water-saving technologies such as pumps. The main purpose of their engagement was to protect Lakes Dembel, Langano, and Abijata-Shalla which were under pressure due degradation of natural resources at the upper and middle catchments. Moreover, Wetland International was also working on watershed management at the upper catchment, buffer zone development, and wetland management in the study area.

The role of informal institutions in water resources governance in the CRV

In addition to formal institutions, there were also informal institutions contributing to water resources governance in the CRV of Ethiopia. When disputes and conflicts occurred because of disagreements between water users, elders mediated and resolved the disputes at the local level. There was a group of elders – very respected and known individuals, the so-called 'Tulama', who could resolve the disputes, particularly in Dugda District. According to the statement of a key informant (KI-13), "Any individual who ignores the decision made by the 'Tulama' would be socially sanctioned." The 'Tulama' is a broad informal institution that manages various issues including disagreements between individuals on irrigation water use in Dugda District. The role of this institution in resolving problems was great, and it is also recognized by the District Administration.

Traditionally, the community members were protecting water sources from pollution and maintaining their cleanliness. One of the key informants (KI-5) stated that there were social norms that encouraged the purity of water sources by saying "*Malkaa gubbaatti hin fincaa'iin ykn hin bobba'iin*", which means never urine or defecate at the head of water sources. Similarly, another key informant (KI-13) mentioned that "*the communities were protecting lands*

surrounding water bodies by protecting lands from cultivation/farming, which was previously covered by water bodies, instead they have planted trees."

Sources of this study indicate that the opportunity of implementing informal rules is greater than the governments in some areas because community members trust the local elders more than others. One of the key informants (KI-29) mentioned that "*Community members have contributed a lot to the environment by involving forestation, watershed management, soil and water conservation, optimizing fertilizers, etc.*" Moreover, another source of this study (KI-19) pointed out that the local social norms, traditions, customs, and practices were used as a source for IWUA's rules and agreements. The informant added that informal institutions could be more fruitful if the government institutions supported them in terms of providing extension services and technical advice without interfering in their local agreements.

Even though informal institutions have played a great role in the governance of water resources in the CRV, various factors have hindered its effectiveness. One of the major factors was the lack of strong support from policy direction. The majority of water-related rules and regulations decreed by the country have not recognized and addressed the roles and means of informal institutions' engagement in water resources governance. In the Ethiopian Water Sector Strategy (FDRE 2001), there is an article that promotes the involvement of religious and customary organizations in water source selection, public awareness, and environmental education. However, there were no clear enforcement mechanisms devised to implement the provisions in practice. In other water resources policy documents, the issue was partially or completely untouched.

The existing traditional practices and norms that had been used in earlier times in water governance at the local level were gradually replaced by formal institutions such as IWUAs and farmers' cooperatives. One of the key informants (KI-13) mentioned that in earlier times elders were educating children and younger by saying that "*Making open defecation at the head of water sources is forbidden and unethical*." This was how the community members were protecting water sources traditionally from pollution in the area. However, nowadays such traditional advice and practices were not observed in a wider manner in the community. The informant associated this with the effect of the modern supply of water resources by pipelines,

pumps, and water points for drinking water as it minimized interaction with open water sources partially or completely. In addition, informal institutions may lack data so that formal institutions may have to make informed decisions. The informant added that in recent times farmers were cultivating closer to water bodies due to population pressures and economic factors such as meeting current production and benefits.

Moreover, these informal institutions lacked capacity-building support to play more roles in the governance of water resources in the CRV of Ethiopia. One of the key informants (KI-31) mentioned that District and kebele-level public institutions and other partners had not provided sufficient support and capacitated them to enhance the capacity of informal institutions at the local level. The informant addresses that giving priority to formal institutions and losing attention to informal institutions from public organizations negatively affected the role of informal institutions in water resources governance in the study area.

Interplay between formal and informal institutions in water governance in the CRV

Understanding the types of institutions and their interplay can indicate how the resource users engage in their common-pool resources governance (Etiegni *et al.*2017). In the case of CRV, rules decreed by the government and the traditional practices advocated by elders such as 'Tulama' in Dugda District were similar and overlapped in many aspects of the governance of water resources. For instance, both formal and informal institutions promote efficient water use and equitable distribution of water resources among water users. Both institutions also discourage the over-abstraction of water resources and impose sanctions on non-compliance. These institutions were interacting with one another to improve water resources governance in the area.

Although the rules and procedures of formal and traditional practices of informal institutions involved in water resources governance were supporting one another, the practices of water users contradicted the rules and traditional customs. Both formal and informal institutions promote saving irrigation water use, environmental conservation, and equitable and fair distribution of irrigation water. However, irrigation water users were practicing over-abstraction, flooding excessive quantities of water on their farms, and degrading water resources in the CRV of Ethiopia. One of the key informants (KI-11) mentioned this:

"Farmers assume that they are more productive by flooding more water on their farming, which is opposite to what public (formal) institutions were advocating in that excessive irrigation of crops negatively affects the quantity of water, increases the cost of fuels of pumping, causes erosion of soil and agro-chemical inputs, reduce productivity, consume more time of the farmers, disturb the schedule of other irrigators and negatively affects water efficiency."

On the other hand, the local community believes that every member of the community should benefit from the available water resources and projects related to water in the area. One of the key informants (KI-5) states that:

> "*The society in the CRV believes that 'water is for all*', '*malkaan kan hundaati*'. *The government constructed irrigation schemes benefiting farmers who have irrigation land in the irrigation compound. Farmers who do not have irrigation land in the identified irrigation compound were not benefiting from the schemes though the budget used to construct the schemes was public funds, which should equally benefit all the community members in the area.*"

In this case, the public institutions' action, which is benefiting those who have a plot of land in an irrigation compound, contradicts the society's belief that '*water is for all*'. The policy statement of the country did not address such issue to make benefit all the community through cost recovery system or other mechanisms. Hence, there should be some mechanisms that benefit all community members either devising rotation or cost recovery of the public budget that was used for the scheme construction. If the gap in the economy between the scheme users and non-users is widening, it may be a source of conflicts in the future.

Irrigation water management practices in the CRV

The Ethiopian water resources management policy documents addressed the roles and responsibilities of the water supervising body and water users to properly manage the resources. For instance, the Ethiopian Water Resources Management Regulation (FDRE 2005) asserts that the supervising body needs to indicate the volume of water permitted monthly or annually for water users, and water users are expected to use the amount of water quantity permitted. Accordingly, the supervising body has the responsibility to periodically monitor and evaluate the

quantity of water abstracted by users, and supervise water quality standards and related issues to take corrective measures if there are any failures to comply with the regulation.

Over-abstraction or using excessive irrigation water was practiced in the CRV sub-basin of Ethiopia. Releasing wastewater into Lake Dembel and other water bodies from floriculture industries and from irrigation farming was visible in the study area. In spite of this failure to comply with the rules and regulations, there were no measures taken on non-compliance of water use in the CRV of Ethiopia. Individual farmers and private companies were contributing to water resource degradation. Respective public institutions and other actors were not playing their roles and responsibilities.

In addition, data obtained through field observation (fig. 2, a & b) indicates that significant regulatory measures were not taken to monitor and control chemical uses, and waste management, which potentially degrades water resources, and affects human and livestock health. For instance, many generators were installed at the mouth of Lake Ziway/Dembel (fig 2, a) that instant for draining gasses and lubricants from generators into the Lake. The second figure (fig 2, b) indicates the outlet of the Sher-Ethiopia Floriculture Industry that was draining to a plot of land close to Lake Dembel.

As observed during the field visit, draining gasses from generators and waste from the floriculture had been deteriorating the quality of the Lake though no one was accountable for these negligent practices. Measures such as developing buffer zones and other mechanisms to protect the drain of gasses into the water body were not undertaken.

Fig 3.1. Figure shows activities of depletion water resources

(a) (b)

Fig 2 (a) Pumping generators on Lake Dembel, (b) Sheer Ethiopia outlet (Source: Field observation, 2021)

In general, various organizations were involved in different aspects of water resource matters such as its management and uses in the CRV. These organizations include government organizations (both federal and regional States), community water user associations, individual water users (farmers and private companies), development organizations, and NGOs. However, interlinks among the institutions were weak to positively influence one another to improve water resources governance in the CRV of Ethiopia. For instance, to improve water resources governance and other resources in the area, committees were organized from different water sectors at District levels. However, the established committee was not inclusive; the committee did not include representatives from the community, development partners, NGOs, individual investors, fishery associations, and other private companies who were very decisive for sustainable water resources in the study area.

3.1.1. Discussion

Role of institutions in water governance

The Constitution of the Federal Democratic Republic of Ethiopia recognizes the need to enact laws for the utilization and conservation of land and other natural resources. Following the Constitution, several water-related policies, rules, and regulations were promulgated and decreed by federal and regional governments. These rules and regulations advocate the necessity of building and strengthening water sector institutions in terms of facilities, human resources, finance, system, and institutional stability (FDRE 1995; FDRE 2001; FDRE 2005). The rules and regulations also promote users-based-management of irrigation systems, appropriate institutional structures, as well as decentralization to the lowest level of governance for better and more efficient management of water resources. Following the rules and regulations, public institutions were established and arranged to implement and enforce the policies, rules, and regulations at all scales.

The result of this study revealed that public institutions attempted to play their roles to improve water resources governance through awareness creation about water saving and environmental protection, supporting irrigation equipment, and providing technical advice to irrigator farmers on how to use scarce water resources in a sustainable manner. In addition, the government organizations have conducted various capacity-building training, monitoring and evaluation, and

support local institutions to strengthen community-level institutions for better water resources governance. The institutions have also attempted to decentralize water resources governance to the lower administration levels.

Although public institutions have exerted efforts to improve water governance in the study area, the outcomes were setback by different causes. For instance, the absence of clear roles and responsibilities sectors, lack of harmonized integration among organizations, lack of skilled human resources at lower administrative levels, and insufficient budget and logistics were the majors. Study conducted by Hagos et al. (2022) also found similar results, and call for re-examining the role of institutions and capacity building in the CRV of Ethiopia. The result agreed with the arguments reported in previous studies which state that lack of clarity on roles and responsibilities, and poor implementation capacity at a lower scale can constrain the success of decentralization in water resources governance (Stoa 2014; Hegga *et al.* 2020).

The lower level of water sectors in the CRV lacked the capacity to make effective the rules and regulations of water resources management. The institutions lacked skilled experts to make assessments of water resources availability and collect relevant data, process data and disseminate information. At a lower administrative level, funds for operation and maintenance were not available in the study area. The existing local water institutions were not capacitated with the required facilities to identify specific characteristics and requirements regarding the water resources situation and devise operational strategies to implement water rules and regulations in the CRV of Ethiopia. The result is similar to studies conducted in Tanzania where formal institutions contributed little in water resources governance (Bulengela 2024).

Water sector rules and regulations promulgated at different levels set obligations that irrigators must comply with when using water resources. For instance, preventing wastage and pollution of water, fairness and equity in water distribution, and protecting and administering irrigation and drainage systems can be mentioned as an example. However, these commitments were not attained in the CRV of Ethiopia. The higher water demand and failing of water governance were leading to over-abstraction and water resource degradation. Public institutions could not place an accountability system on non-compliance. These limitations, exacerbated by water hyacinth invasion, put the resource under serious stress and a fragile situation. This implies that public

institutions engaged in water resources governance have not achieved results associated with their roles in the study area.

In addition to public organizations, there were also other institutions such as IWUAs, Development Partners, and NGOs engaged in water resources governance in the CRV of Ethiopia. IWUAs have attempted to contribute to water resources governance in irrigation water distribution, conflict resolution, protecting irrigation schemes and equipment from damage, and collecting annual fees for maintenance and operation. In addition, various development partners and NGOs have also exerted their efforts via awareness creation, capacity building training, watershed management, wetland management, and providing irrigation technologies to improve water resources governance in the CRV of Ethiopia. These development partners and NGOs also contributed to activities such as integrated natural resources management (reforestation, conservation, etc).

However, the efforts of these institutions were not systematically integrated and coordinated. The efforts of these organizations were not interlinked with public institutions and with other similar institutions to boost the contribution of the institutions. There was no strong platform that could bring all actors to plan, act, and evaluate together to intervene in the problem systematically. In addition, many works have been done by different development partners and NGOs were slid back due to a lack of an institutionalized system that sustains the initiatives designed by development partners and NGOs when their projects were phased out. This study also suggests similar interventions reported by Haileslassie et al. (2016) such as capacity building, implementing appropriate regulations and engagement of all key actors.

In addition to formal institutions, informal institutions have been positively contributing to water resources governance in the CRV. For instance, traditional practices of the so-called ‘Tulama’ in Dugda District have been contributing positively to water resources governance in terms of equitable distribution of irrigation water, and resolving disputes and conflicts. A ‘Tulama’ is a local institution established by a group of respected and well-known elders who resolve various disputes including water conflicts in the Dugda District. These respected elders mediate among disputants after understanding the cause of their conflicts. The ‘Tulama’ made a decision that the disputants would accept. If any of the disputant parties refused the decision made by ‘Tulama’,

the individual/s would be socially sanctioned. The District Administration has also recognized the role of 'Tulama' in conflict resolution. This type of institution was also reported from a study conducted in the Borena Zone of Oromia which indicates 'Abbaa konfi' who first excavated the pond and the ponds were administered by respected local elders (Edossa *et al.*2007). There were also the community's customary practices such as developing terraces for soil and water conservation, planting trees in their home garden, and arranging irrigation schedules considering priority for women and elders in the study area.

Previous studies also show that informal institutions could play significant roles in natural resource governance in many parts of the world. For instance, a study conducted in northern Ethiopia, in Zimbabwe, and in India reported that informal institutions have contributed to positive outcomes in resource governance including water resources (Degefa 2010; Nhundu *et al.*2015; Haider 2017; Pellowe and Leslie 2020). This positive influence of informal institutions on resource governance implies that the rural community set up in most developing countries including Ethiopia has greater values for local leaders and respected individuals such as elders and religious leaders, and they were playing great roles in resource governance.

Although informal institutions were contributing to improving water resources governance in the CRV, different factors were setting back its effectiveness in the area. The major factors attributing to the lower efficiency of these institutions in the study area were: a lack of technical and financial capacity and a lack of organized working environment and facilities can be mentioned as an example. Similar to this finding Torjatada (2010a) mentioned that even though informal institutions have played key roles in the governance of commons like water bodies, many of these institutions were challenged due to a lack of support, limitation of funds, and lack of capacities. This study also revealed that the informal institutions were hampered due to a lack of policy support and limited support from public agencies. Previous studies argued that informal institutions can contribute positively to resource governance if they are considered during policy formulation, and interlinked with the existing formal governance system (Anaba 2016). Hence, it is important to consider the role of informal institutions when policies, rules and regulations are drafted, as well as when public agencies are established for the management of water resources.

Interplay between institutions in water governance

Understanding the types of institutions and their interplay can indicate how the resource users engage in their common-pool resources governance (Ostrom 2011; Etiegni *et al.* 2017). There were instances where institutions conflicted or overlapped with one another. These conflicts were the results of incongruence between the objectives of formal institutions and the practices of water users or the rules of informal institutions (Pellowe and Leslie 2020). In the case of CRV, the objectives and roles of both formal and informal institutions were overlapping in many aspects. For instance, monitoring and evaluation techniques, conflict resolution mechanisms, means of irrigation water distribution, and conservation activities of water resources were some of the overlapping roles and operating mechanisms of formal and informal institutions in water governance efforts in the study area.

On the other hand, the interplay between formal and informal institutions was weak and not systematically coordinated. Water institutions engaged in the CRV were not well interlinked horizontally and vertically at all scales. The organizations lacked an integrated plan and missed the opportunity of collaboratively operating to efficiently use the available resources that enable better water sector performance. Organizations engaged in water resources governance failed to engage and coordinate all relevant water-related institutions operating in the study area, and were unable to establish a common stakeholders' platform. Fragmented efforts were the common feature of institutions in water resources governance in the study area. This finding is similar to Jacobi *et al.*(2014) reports, which addressed that major challenges related to water institutions are a lack of integrated planning, a lack of coordination among key actors, and missing management mechanisms that may fit local conditions.

Moreover, the interplay between water institutions engaged at the federal, regional, district, and local level were not strong enough to advance the efforts towards improving water resources governance in the CRV of Ethiopia. Hence, identifying the types of institutions involved in the governance of water resources, understanding how the existing institutions interact, and considering an integrated view of these institutions to shape water users' behavior is essential to improve water resources governance and sustainable uses of water resources, particularly in the CRV of Ethiopia.

Irrigation management practices

Regarding water management aspects, Ethiopia drafted Water Resources Management Policy in 1999 and Water Sector Strategy in 2001 to promote national efforts towards efficient, equitable and optimum utilization of the available water resources to achieve significant socioeconomic development on a sustainable basis (FDRE 1999; Arsano et al. 2010). The major principles of the policy include decentralizing ownership to lower tiers and enhancing management autonomy to the lowest possible level; and promoting the involvement of all stakeholders including the private sector. In line of its objective, the policy presumed commitment to allocate and share water, based on comprehensive and integrated plans and optimum allocation principles that incorporate efficiency of use, equity of access, participation of all stakeholders; particularly women's participation in all the aspects of water resources management (FDRE 1999).

Significant regulatory measures were not taken to monitor and control chemical uses, which potentially degrades water resources and affects human and livestock health in the study area. The absence of local community empowerment to check, monitor, and evaluate the performance of public service providers was also attributed to the limitations. Moreover, the lack of incentivizing mechanisms for small-scale farmers and the absence of a capacitated regulatory structure to control and monitor the activities of non-complaints have contributed to low efficiency in irrigation water management practices in the study area.

The Ethiopian water resources management policy documents stated the participation of citizens in water management matters in general; however, there were no clear mechanisms and procedures that enforce the implementation of the policy provisions through backup strong monitoring and evaluation system in the CRV sub-basin. Previous studies conducted related to the issue in Bangladesh, India, and Pakistan indicate similar results, which state that although the water policy of these countries recognizes public participation in all aspects of the water sector, in practice, people rarely participate (Shunglu et al. 2022). With the same talking, promulgating rules and regulations of water resources in Ethiopia is not sufficient unless the policy is accompanied by enforcement mechanisms such as periodical policy review, effective monitoring and evaluation, diagnosing institutional performance to implement water resources management policy of the country at the grassroots level.

Moreover, operation and management of the existing water infrastructures such as irrigation systems were dominated by traditional practices and lack scientific knowledge support to improve efficiency in the CRV of Ethiopia (Ayana et al. 2015). There were also deficiencies in irrigation management which include over irrigation, poor drainage, salinity and alkalinity in the irrigated areas of the country (Michael and Awulachew 2007; Zelalem 2010). As reported by Haile (2015), one of the challenges of irrigation practices in Ethiopia is lack of community involvement, and lack of consultation in scheme planning, construction and implementation of irrigation development. These deficiencies resulted in degradation of soil fertility, reduce land and water productivity in Ethiopia (World Bank 2006).

Previous studies, for instance, Abera et al. (2021) reports that the existing irrigated agriculture and the future expansion has to consider the quality of irrigation water and the management required to reduce the adverse effects on soils. The authors suggest the need to establish water quality monitoring program at strategically selected sites along Lake Zeway, and upgrade the existing ones considering the current water competition and the upcoming development impacts in the CRV sub-basin, Ethiopia. Besides to other limitations, deficiencies in irrigation water management practices such as lack of strong and periodical monitoring and evaluation, performance management and abstain from taking corrective measures on non-compliances were contributing for lagging of effective water resources management and sustainable water use in the study area.

3.2. Conclusion and recommendations

There were various formal and informal institutions engaged in water resources governance in the CRV of Ethiopia. The formal institutions have played significant roles in terms of providing training for water users and agencies, supporting irrigation equipment, and providing technical advice to irrigators about cropping, water use, and how to protect the environment. In a similar manner, informal institutions were also contributing to water resources governance in terms of awareness creation, conflict resolution, and environmental conservation in the CRV. The roles of these institutions overlapped in many aspects. However, the interplay between the institutions was weak in water resources governance in the CRV. There were also instances where both types of institutions failed to harmonize in improving water resource governance due

to the absence of equal attention for both types of institutions; particularly, a lack of clear supporting policy for informal institutions. Lack of strong monitoring and evaluation, lack of incentives, and low level of capacity at lower administrative scales were the main factors contributing to the low contribution of water institutions in the study area. These limitations were also associated with weak interlinks between both formal and informal institutions, which emanated from a lack of consideration in policy formulation. As a result, actions undertaken via both institutions did not significantly change the behavior and practices of water users, and were unable to improve water resources governance in the CRV. As a consequence, water resources degradation was continued in the study area, which was in turn affecting the livelihoods of the community, stressing the sustainability of irrigation activities, and degrading the environment. Hence, revisiting how formal and informal institutions could be synergistically embedded, and reconsidering the role of informal institutions in water policy, rules, and regulations are essential. It is also very important to reconsider customary and traditional practices, and socially constructed values, and respected elders could engage in governance of water resources. Moreover, developing strategies and techniques to strengthen the interplay among all institutions involved in water governance at different scales, meaningful decentralization and key stakeholders engagement, and horizontal and vertical institutional integrations of water sectors need greater attention to enhance the role of institutions, and to improve water governance in the country in general and in the CRV in particular.

Chapter Four: Stakeholders' interaction and power dynamics involving in the water governance in Central Rift Valley, Ethiopia

Abstract

Identifying the key stakeholders and analyzing their interactions and power relations are essential in water governance as it enhances participation, partnerships, dialogue, conflict resolution and consensus building among actors. The main aim of this study was to identify key stakeholders and their roles and responsibilities in water governance, examine their interaction and power dynamics in the Central Rift Valley (CRV), Ethiopia. The study design employed both quantitative and qualitative methods using stakeholder analysis methods. Data was collected through key informants interview and focus group discussion using semi-structured questionnaire. The data was analyzed using the software UCINET 6. Standard network measurements such as degree centrality, closeness centrality, betweenness centrality and eigenvector centrality were used for the analysis. Social Network Analysis was also used to analyze collaboration and power relations among stakeholders, and the influence of stakeholders on water decisions. The result showed that there was no single actor who was dominant among the interacting actors in water governance. There was imbalance of power among key actors, particularly in terms of capacity, authority, and knowledge and information accessibility at different hierarchal levels. Stakeholders' involvement in water governance decision making was not inclusive. Future policy interventions, hence, should consider the aspects of power balance, inclusive engagement and effective interactions among key actors of water governance.

Key words: inclusive engagement, key stakeholders, power balance, stakeholders' interaction, water governance, Ethiopia

4.1. Introduction

For sustainable water governance, multi-stakeholder collaborations and interactions that facilitate the sharing and integration of diverse sources and types of knowledge are very important (Medema et al. 2017). Stakeholders' collaborative processes and repeated interactions, which build trust and strong network ties, are crucial to improve water governance through knowledge co-creation between different stakeholders (Berkes 2009; Bodin and Crona 2009). In this aspect, identifying the key stakeholders and analyzing their interactions and power relations are essential through horizontal and vertical institutional coordination because it enhances participation, partnerships, dialogue, conflict resolution and consensus building among multiple stakeholders (Mayers 2005; Nikitina et al. 2009). Stakeholder analysis is vital to be aware of the diverse range of potentially conflicting stakeholder interests (Prell et al., 2007).

In national and international environmental policy, the need to understand who is affected by the decisions and actions taken, and who has the power to influence the outcome of the decision is becoming for decision-making (Reed et al. 2009; Stein et al. 2011). Stakeholder power is the extent to which stakeholders are able to persuade or coerce others into making decisions, and following certain courses of action (Mayers 2005). Undermining stakeholders and their interaction has the potential to marginalize important groups, bias results and jeopardize long-term viability and support for the process (Reed et al. 2009).

Stakeholder analysis in natural resource governance has often focused on inclusivity, to empower marginal groups, such as women, those without access to well established social networks, the under-privileged, or the socially disadvantaged, and those who are not easily accessible (Johnson et al. 2004; Keller & Hartmann 2019). The distribution of power, capacity and resources is generally imbalanced. Failure to recognize the power imbalances can result in some stakeholders dominating others and less powerful stakeholders being abused, overruled or excluded (Eriksson et al. 2015). The power balance requires key actors to have mutual respect and trust. The existing different degrees of power to control decisions among stakeholders have effects on policies and institutions (Mayers 2005). It is argued that natural resource governance such as water bodies typically deals with conflicting interests of various stakeholders as they use the same resources for different purposes.

Although this is a vital first step, stakeholders are often identified and selected on an ad hoc basis, rather than considering them as vital actors for sustainability (Mayers 2005). It is essential to facilitate collaborative processes and repeated interactions that build trust and strong network ties, which is a crucial condition for successful knowledge co-creation that provides more insight into the properties of relationships between different stakeholders within a collaborative network (Berkes 2009; Bodin and Crona 2009; Medema et al. 2014).

Therefore, in order to improve water governance and water resources management, it is imperative to understand the different perspectives and power of the actors involved. Identifying the key stakeholders and analyzing their interactions and power relations are essential to improve the governance of water resources because their interaction within river basins becomes a powerful tool through institutional coordination between various government bodies (Nikitina et al. 2009). Studies, for instance, Reed et al. (2009) suggests making an inventory of those who could have a role in decision-making, gauging their importance through their level of influence and their interest for a particular outcome, mapping their relationships, and understanding their potential for developing alliances.

Moreover, actors' engagement is emphasized as a prerequisite to successful water governance along with process and structure requirements (Akhmouch and Clavreul 2016). Experiences in water reforms in Canada, South Africa, the United States, England and Wales have shown that stakeholder engagement processes can be valuable to gain a deeper understanding of the preferences of different water users (OECD 2015). A Case Study of Lake Ontario and the St. Lawrence River Regulation, using "Shared Vision Planning" approach to resolve conflicts in efforts to develop a new water regulation plan revealed that the approach succeeded when stakeholders perceived that they had something to gain from collaboration (Megdal et al. 2017).

Involvement of actors in water decisions allows understanding how different actors interact, power dynamics between them and how they influence policies (UNDP 2013). In addition, involving users of water in the governance of the resource make their participation more meaningful because local stakeholders may be more familiar with the peculiarities of local economic, social, cultural and environmental situations (Torjatada 2010a); and users involved may help to accept the regulations as appropriate and consistent with their values and interests

and more willing to comply with them (Kooiman 2003). Actors involvement also give meaningful for coherence, i.e. when more than one layer of government is dealing with the same natural resource and these layers of government are recognized as mutually dependent and influencing each other's effects, which indicates the existence of substantial degree of interaction in the policy network (Bunch et al. 2011; de Boer 2012; OECD 2015). Active involvement of a broad range of stakeholders, including vulnerable or marginalized groups implies the existence of meaningful participation and equity between and among various interest groups and stakeholders with fair and impartial processes of decision making (Biad et al. 2015; Jiménez et al. 2020).

In Ethiopia, the water resources management policy of the country recognizes the identification of the relevant stakeholders and their involvement in water resources management activities (FDRE 1999). The policy also encourages discussions and consultations amongst the various stakeholders. To understand the state of water governance in the study area, conducting stakeholder analysis is essential to capture their opinions, interests and concerns, interactions thereof and roles in decision-making.

Several studies have been conducted so far in Ethiopia regarding the role of stakeholders and their participation. For instance, a study conducted focusing on stakeholder analysis of the Koga Irrigation and Watershed Management Project reports that stakeholders have conflicting interests and views about the project's economic benefits and social impacts (Gebre et al. 2008). A study conducted on stakeholders' arena in the Awash River Basin found that the stakeholders are not acting synergistically, power asymmetry among them and constrained effective participation, which lead to hinder the efforts to tackle the anthropogenic and natural factors affecting water security in the basin (Hailu et al. 2017).

Moreover, stakeholders' participation is mostly taken as information provision, lesser extent consultation and involvement in Ethiopia (Oosterloo 2015). Different efforts have been made to achieve efficient, equitable and optimum utilization of water resources for significant socioeconomic development on a sustainable basis. However, the intended goals were not attained due to deficiencies such as lack of community involvement, less collaboration, lack of networking among stakeholders and administrative levels (Haile 2015; Duguma 2017). The

study undertaken in Hawassa catchment focusing on stakeholders' influence and interaction also reports that the influence of stakeholders on natural resources restoration was imbalanced, and the relationship among relevant stakeholders was weak or informal (Mekuria et al. 2021). Such comprehensive study of stakeholders' analysis employing Social Network Analysis (SNA) method that uses standard network measurements was not undertaken in the study area. Hence, the main aim of this study is to examine the key stakeholders' interaction and power dynamics among them in water governance in the CRV of Ethiopia using standard network measurement methods.

4.2. Approach and methods data collection

The study design employed both quantitative and qualitative methods. This study was addressed using stakeholder analysis methods. In many stakeholders analysis literature, it is supposed that stakeholders are self-evident and self-constructed, and as a result it has been focused on categorizing pre-identified stakeholders to understand their interests, interactions and relationships (Reed et al. 2009). However, it is important to identify relevant stakeholders who hold stakes on the phenomena under investigation, those stakeholders who are most likely to affect its functioning or organization given their interests, resources, and influence, because it is not possible to include all stakeholders to conduct stakeholder analysis (Grimble and Chan 1995).

Stakeholder analysis embraces three steps (Mekuria et al. 2021). The first step is identifying stakeholders; in which an inclusive view of stakeholders is vital to give a voice for those powerless as argued by Bryson (2003). In this study, key stakeholders were identified and listed through the methods of group discussion, semi-structured interview and experts' opinion from Federal, Regional, Basin, District, NGOs, water development partners, community-based organizations, local leaders, etc dealing with water resources management, irrigated agriculture, and environmental conservation. The second step is differentiating between and categorizing stakeholders. It was used to manage the representation of marginalized or powerless groups in natural resources management (Hare and Pahl-Wostl 2002). The third step was investigating the relationships between and among stakeholders.

There are several principal methods used to conduct stakeholder analysis. Some of the methods include: Actor-linkage matrices, Knowledge Mapping and Social Network Analysis (SNA) - makes use of matrices to organize data on the relational ties linking stakeholders together, to analyze collaboration and power relations among stakeholders, and the influence of stakeholders on water decisions (Reed et al. 2009). Data was collected through semi-structured questionnaires and key informants interviewed to conduct stakeholder analysis. The collected data was analyzed using the software UCINET 6.0 (Borgatti et al. 2002). SNA used numbers and graphs to represent i) the presence/absence of a tie; and ii) the relative strength of the tie in each matrix which represents a unique relation. The extent of tie between stakeholders indicates trust among stakeholders, the extent of stakeholders influencing one another and mutual learning, and the sharing of resources and advice (Newman and Dale 2007).

4.3. Data organization and method of analysis

The data was analyzed using the software UCINET 6.0 (Borgatti et al. 2002). SNA used numbers and graphs to represent i) the presence/absence of a tie; and ii) the relative strength of the tie in each matrix which represents a unique relation (Reed et al. 2009). The extent of ties between stakeholders indicates trust among stakeholders, the extent of stakeholders influencing one another and mutual learning, and the sharing of resources and advice (Newman and Dale 2007).

In this study, standard network measurements were used for analysis of degree of relationship (Freeman et al. 1979). These include degree centrality, closeness centrality, betweenness centrality and eigenvector centrality. Degree centrality enables to identify actors that are extensively involved in relationships with other actors. It highlights the node with the most links with other nodes in the network, and it was defined by the following equation for the node (actor) in a network having N nodes (Uddin 2017):

$$CD(ni) = d\frac{(ni)}{(N-1)} \quad (1)$$

Where, D for degree, $d(n_i)$ is the number of nodes with which node i is connected. The maximum value of $C_D(n_i)$ is 1, when node i is linked with all nodes in the network; and 0 when it is isolated from other nodes (Uddin 2017). Closeness centrality (actors that have highest centrality) is the

idea that a node is central if it can quickly interact with all other nodes in a network. The following equation represents the 'closeness centrality' for a node i in a network having N nodes (Freeman et al. 1979):

$$Cc(ni) = (N-1) \,/\, \Sigma d(ni, nj) \tag{2}$$

Where C is closeness, $d(n_i, n_j)$ is the number of links in the shortest path between actor i and actor j and the sum is taken overall i different from j. A higher value of $Cc(n_i)$ indicates that node i is closer to other nodes of the network. On the other hand, betweenness centrality means to be central in the sense of sitting in-between many others, and indicates influential actors in the network (Reed et al. 2009). That is, nodes that occur on many shortest paths between other pairs of nodes have higher betweenness centrality than those do not. The betweenness centrality for a node ni (i.e. CB(ni) can represented by the following equations (Uddin 2017):

$$CB(ni) = \sum_{(j<k)} gjk\,(ni) \,\Big/\, gjk \tag{3}$$

Where i, j, k are different from each other, gjk(ni) represents the number of shortest paths linking the two nodes that contain node i, and gjk is the number of the shortest paths linking nodes j and k. The highest value of CB(ni) is 1 and the minimum is 0. Eigenvector Centrality is another metric based on the assignment of a relative score to each node and measures how well a given actor is connected to other well-connected actors (Uddin 2017). This score is given by the first eigenvector of the adjacency matrix. Eigenvector was used to analyze the power and status of actors, and it refers to the actors that are directly connected to a specific actor. Hence, these standard network measurements were used to analyze the relationship, power dynamics and interactions among water actors in the CRV of Ethiopia.

4.4. Results and Discussion

4.4.1. Results

In the following section, the results of the study were presented in four sub-sections. The first section discusses the types of stakeholders identified who are involved in decision making of water governance and its uses in the CRV of Ethiopia. The second section presents about stakeholders' interaction particularly focusing on the collaboration among them in terms of

exchanging information, resource sharing, engagement in collective decision making, and mission and goal sharing. The third sub-section discusses stakeholders' power dynamics, mainly their influences in terms of resources mobilization, knowledge generation and authority to make rules and regulations with respect to water issues. The fourth subsection discusses the extent of stakeholders' involvement in water resources decision making processes in the study area.

Types of Stakeholders

Several categories of stakeholders including government organizations, development partners/NGOs, IWUAs, private companies, and local administrative organizations were identified (Table 5.1). In these stakeholders' network analysis 57 individuals (representatives of different organizations from different levels) participated. These participants were from government agencies, development partners/NGOs, Irrigation Water Users Associations, Fishery Associations, Private Company, and Research Institutes. Table 5.1 shows the types of stakeholders involved in the governance of water resources in the CRV.

Table 5.1: Types of stakeholders involved

	Types of Stakeholder	**Frequency**	**Percent**
Type of Stakeholder	Government	29	50.9
	Development Partners/NGOs	6	10.5
	IWUAs	9	15.8
	Fishery Association	3	5.3
	Private company	2	3.5
	Research institutes	2	3.5
	Total	**57**	**100.0**

Sources: Compiled from own survey, 2022

The majority of organizations which participated were from government agencies, including agencies from federal, regional, district and Kebele (the lowest administrative unit) levels. The result also indicates to what extent the government agencies were involved in the governance of water resources related to others. This shows that government agencies are dominating (50.9%) of all other types of actors involved in water issues in the study area.

The types of stakeholders and forms of their involvement in water resources governance were presented in Table 5.2. The result revealed that the major forms of stakeholders' involvement in water resources governance include policy formulation, capacity building, providing services,

oversee, environmental regulation, conducting studies, information dissemination, and participating in environmental conservation activities.

Table 5. 2: Types of stakeholders and forms of their involvement in water governance

Stakeholders	Type of organization	Forms of stakeholders' involvement
Water and Energy Offices at different levels	Government	Develop water management policy, regulation, guidelines
Agriculture Offices at different levels	Government	Register IWUAs, provide irrigation extension services, capacity building, community mobilization for conservation activities
EPA Offices at different levels	Government	Develop environmental standards, environmental regulation, conduct EIA and monitor its implementation
Basin Development Offices at d/t levels	Government	Coordinate stakeholders in the basin, conduct studies and disseminate information, prepare master plan, capacity building
Local communities	Farmers	Use water for irrigation, participate in conservation activities such as terrace development, planting trees
IWUAs Committees	Farmers	Managing irrigation schedule, conflict resolution, communication,
Fishery Associations	Farmers	Harvesting fish, contributing to environmental pollution
Sher-Ethiopia	Private Company	Horticulture production, contributing to environmental pollution
SEDA	NGO	Capacity building, provide training, provide material and financial supports, experience and resources sharing
SOS Sahel	NGO	Capacity building, provide training, provide material and financial supports, experience and resources sharing
SNV	NGO	Capacity building, provide training, provide material and financial supports, experience and resources sharing
CALM	NGO	Capacity building, provide training, provide material and financial supports, experience and resources sharing
Farm Africa	NGO	Capacity building, provide training, provide material and financial supports, experience and resources sharing
Green Climate Fund	NGO	Capacity building, provide training, provide material and financial supports, experience and resources sharing
FAO	Development Partner	Capacity building, provide training, provide material and financial supports, experience and resources sharing
Wetland International	Development Partner	Capacity building, provide material and financial supports, participate in watershed development, protection and restoration of wetlands
World Resource Institute	Development Partner	Integrate water and climate data, help water supplies, conduct research and provide policy recommendations

Source: *Compiled from field data collection, 2022*

The involvement of the stakeholders in these forms can contribute for the improvement of water resources conservation; enhance community awareness, build local governance capacity, and improve resource use efficiency in the study area. On the other hand, the dominance of few

stakeholders' types; for instance, government organization, and lack of consistency stakeholders' platform may halt the advantage of collective action in improving water resources governance and sustainable uses.

Table 5.3 shows the number of stakeholders participated from various administrative levels. The result indicates that the distribution of samples was done among various hierarchical levels. Majority of participants were from District and Regional levels. Since the study area was located in two Regional States' administrative boundaries, more actors participated from Regional and District levels.

Table 5.3: Hierarchical Level of Stakeholders

	Hierarchal level	**Frequency**	**Percent**
Hierarchical **Level**	Federal	9	15.8
	Regional	16	28.1
	District	17	29.8
	Kebele	15	26.3
	Total	57	100.0

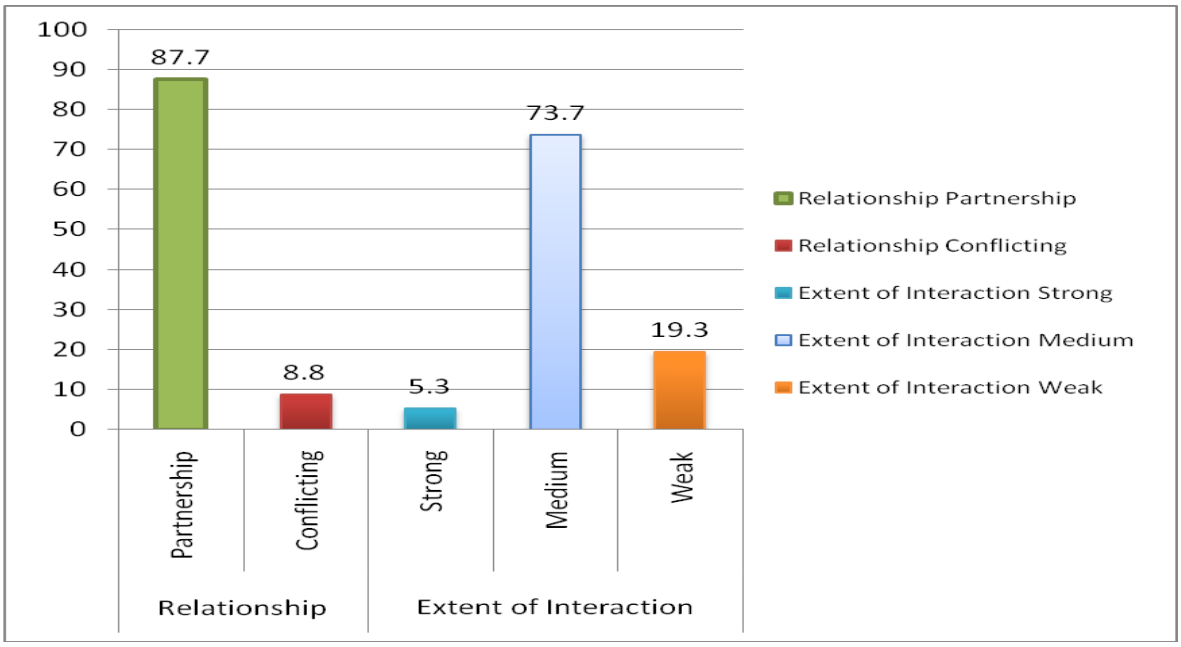
Source: Compiled from own survey, 2022

Stakeholders' Interaction

The network of stakeholders' interaction was produced from information gathered during interviews with key actors (representatives of actors working on water resources management, and those using water resources) who were asked how often they exchange information and collaborate on water governance in the CRV of Ethiopia.

Regarding interactions among the actors, data collected indicates that 73.7% of the participants evaluated the existence of cooperation at medium level. On the other hand, 5.3% of the participants rated the existing cooperation at high level. The result presented on figure 5.1 indicates that the interaction among water actors in the CRV of Ethiopia is medium. Regarding relationships among actors, the majority of participants (87.7%) rated that the existing relation is partnership while 8.8% of them evaluated the existing relationship as conflicting.

Figure 5.1: Relations among Water Actors in the CRV, Ethiopia



Source: Compiled from own survey, 2022

Regarding the issue of key actors working together in activities such as planning, writing reports, exchanging information and providing support for each other, the result of the study indicates that the extent of their interaction was also medium. Majority of the key actors did not often interact daily and weekly to exchange information. There were few key actors who have exchanged information biweekly and monthly. These actors have interaction commonly quarterly, and once in six months to exchange information, work together, have meetings, etc.

Degree centrality, which measures the proportion of nodes (in our case actors) that is adjacent to that node in a network, was one of the centrality measures used in this study. The highest value of degree centrality implies the highest associated actor in the network. Degree centrality measures the extent of interaction of actors among themselves in the network. Accordingly, the value of degree centrality of the nodes (actors of water actors in the CRV) ranges 0.037 to 0.064. Table 5.4 shows the Ministry of Agriculture, Ministry of Water and Energy, and Federal Environmental Protection Authority have higher interaction with other key actors of water resources in the CRV. On the other hand, IWUAs, District Irrigation and Lowland Development Office, and Kebele Level Administration have low interaction (association) with other key actors.

Table 5.4: Degree centrality of key actors in water governance in CRV

Stakeholder Name	Degree	NrmDegree	Share
Ministry of Agriculture	152.000	53.333	0.064
Ministry of Irrigation and Lowland	142.000	49.825	0.060
Federal Environment PA	134.000	47.018	0.056
RVBD Office	133.000	46.667	0.056
District Agric Office	130.000	45.614	0.055
Ministry of Water & Energy	129.000	45.263	0.054
District Environment PA	125.000	43.860	0.053
District Water Office	123.000	43.158	0.052
Regional Environment PA	118.000	41.404	0.050
Research Institutes	116.000	40.702	0.049
Regional Irrigation Bureau	114.000	40.000	0.048
Private Companies	114.000	40.000	0.048
Development Partners	114.000	40.000	0.048
Regional Water B	111.000	38.947	0.047
Regional Agri Bureau	110.000	38.596	0.046
Fishery Associations	110.000	38.596	0.046
Municipality Water Sewerage Office	108.000	37.895	0.045
Local Kebele	107.000	37.544	0.045
District Irrigation Office	98.000	34.386	0.041
IWUAs	88.000	30.877	0.037

Source: compiled from own survey using UCINET 6, 2022

It is also possible to observe the interactions among key stakeholders of water resources governance from fig. 5.2.

Figure 5.2. Interactions of stakeholders involving in water resources governance

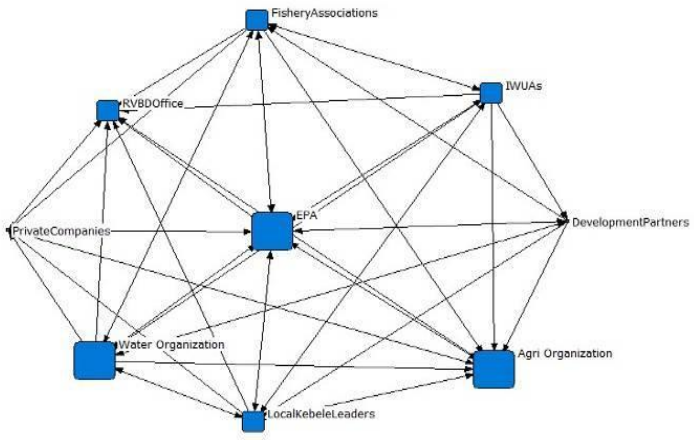


Fig. 5.2: Degree Centrality. Source: owns from survey using UNICET 6 software, 2022

Figure 5.2 also confirms that the Ministry of Agriculture, Ministry of Water and Energy, and Environmental Protection Authority have higher interaction; while IWUAs, District Irrigation Office and Kebele Level Administration have less interaction with other key actors. The sizes of the boxes representing these organizations are larger than the other boxes. This implies that these organizations have more interactions with other key actors who are involved in water resources issues in the CRV.

Another network centrality measure is closeness centrality, which measures how an actor is close to all other actors in the network. If the actor is central, it can interact quickly with other actors. A higher value of closeness centrality is 1, which implies the actor has direct interaction with all other actors in the network. As one can observe from the output of UCINET 6 software depicted on fig 5.3 EPA, Research Institutes, Water Organization and Municipality were closer to all actors in the network. On the other hand, private Companies were less close to all other water actors in the network.

Fig 5.3. Relationship between stakeholders

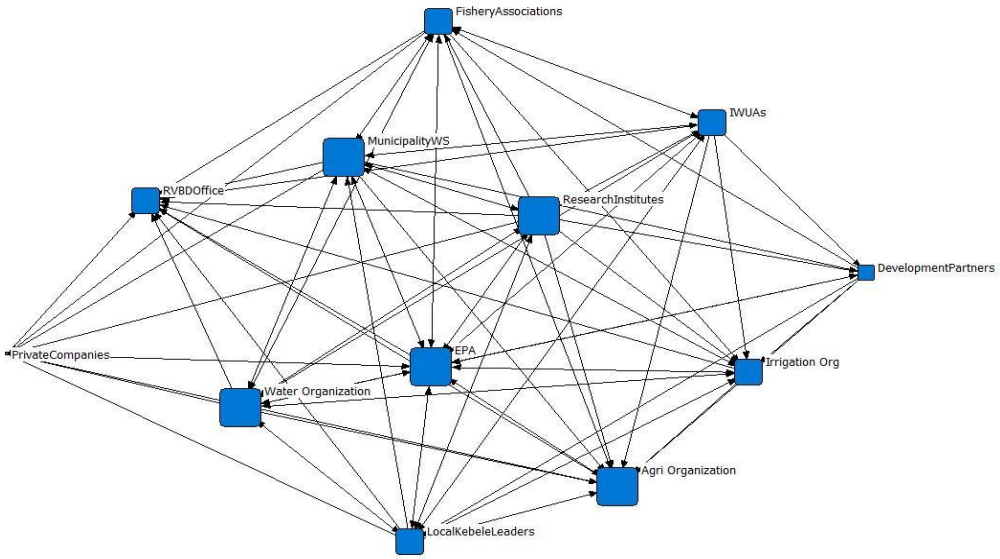


Fig 5.3. Closeness Centrality, Developed from own survey using UCINET 6, 2022

Another standard network centrality measure used in the analysis of key actors' interaction in this study was the betweenness centrality. It measures the shortest path (position) between other pairs of nodes (actors) in the network (Reed et al. 2009).

The nodes that occur on many shortest paths between other pairs of nodes have high betweenness centrality. In this study, actors have direct interaction with each other; therefore, the nodes have shortest paths.

Figure 5.4. interactions of key stakeholders in water governance in the CRV

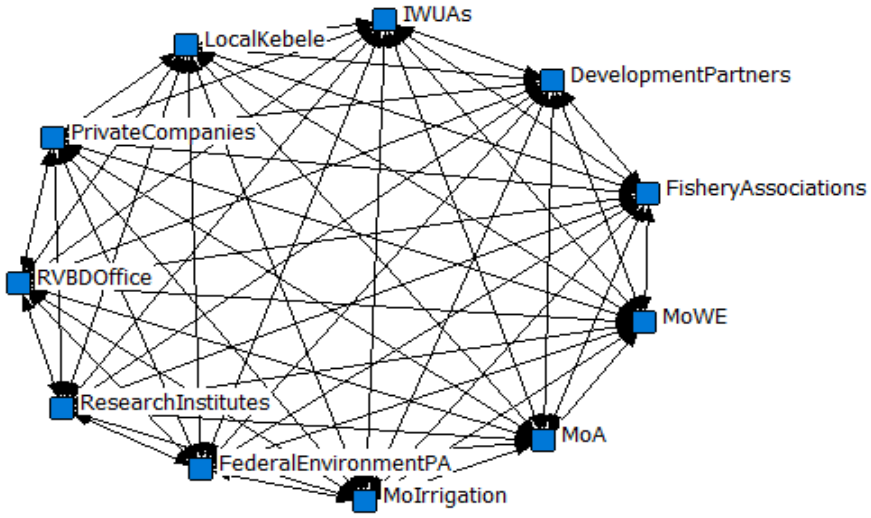


Fig5. 4: Betweeness Centrality, Own Development from Survey Using UNICET 6, 2022

Eigenvector centrality measures how well a given actor is connected to other well-connected actors (Uddin 2017). This standard network was also used to measure the interaction of key stakeholders in water governance in the CRV of Ethiopia. Table 5.5 shows the value of eigenvectors for each key stakeholder and their share.

It is possible to observe from the table that the eigenvector value of the actors ranged from 0.161 to 0.305. According to the value from the table, the Ministry of Agriculture was connected to many other actors including those who have a high score of eigenvector value. On the other hand, IWUAs was less connected to other key actors in the water governance in the CRV of Ethiopia. This implies that the Ministry of Agriculture is the most connected to other actors related to others, while IWUAs is the least connected actor to other well-connected actors in the network.

Table 5.5: Eigenvector Value of Actors

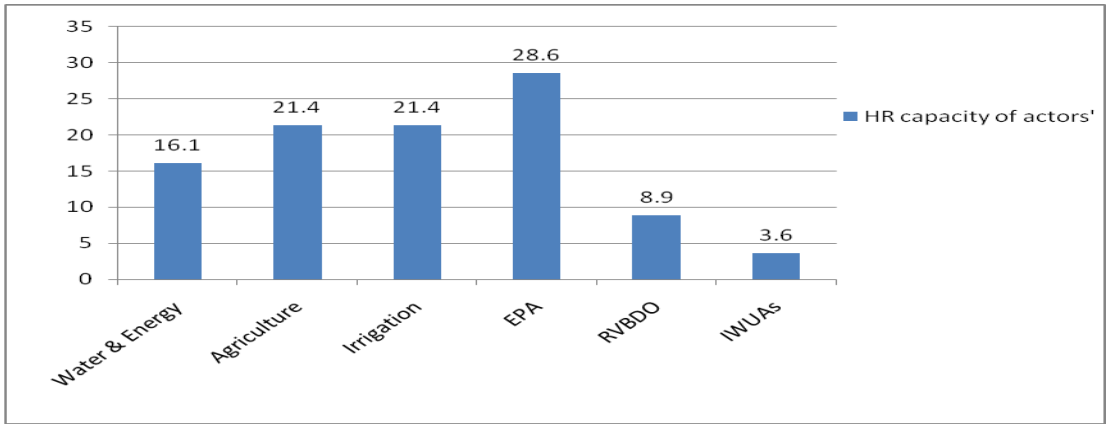
S/N	Stakeholder Name	Eigen Vector
1.	Min. of Agriculture	0.305
2.	Min. Irrigation	0.278
3.	Federal EnvironmentPA	0.259
4.	MoWE	0.256
5.	RVBD Office	0.242
6.	District Agric Office	0.236
7.	District Environment PA	0.228
8.	District Water & E Office	0.223
9.	Research Institutes	0.215
10.	Regional Environment PA	0.214
11.	Private Companies	0.214
12.	Development Partners	0.208
13.	Regional Irrigation Pst	0.206
14.	Regional Agri Bureau	0.203
15.	Municipality Water Sewerage Office	0.202
16.	Fishery Associations	0.201
17.	Regional Water & EB	0.198
18.	Local Kebele	0.196
19.	District Irrigation Office	0.179
20.	IWUAs	0.161

Source: Compiled from own survey using UNICET 6, 2022

Stakeholders' Power Dynamics

Stakeholders' power is the extent to which stakeholders are able to persuade or coerce others into making decisions (Mayers 2005).

Figure 5.6: Human Resource Capacity of Actors



Source: Compiled from own survey, 2022

The distribution of power, capacity and resources is generally imbalanced (Eriksson et al. 2015). Figure 5.6 shows the potential of organizations in terms of having qualified human resources to

accomplish their overall missions. According to data gathered for this study, EPA had better human resources potential to implement the organizational mission followed by Agriculture, and Irrigation and Lowland Development respectively. On the other hand, IWUAs was in the least position in terms of owning human resources capacity to accomplish its mission.

In similar manner, the power or potential of actors in terms of mobilizing resources to carry out their mission was also assessed in this study. The results shown in Table 5.7 indicate that the majority of the stakeholders (63.1%) assured that they have high potential to mobilize resources to carry out their assignments or missions.

Table 5. 7: The Potential, accessibility to information and cooperation among Actors

Items	**Scales**	**Frequency**	**Percent**
Potential to mobilize Resources	I don't know	1	1.8
	Very low	3	5.3
	Low	17	29.8
	High	28	49.1
	Very High	8	14.0
	Total	57	100.0
Accessibility to water information	Very low	4	7.0
	Low	19	33.3
	High	23	40.4
	Very High	11	19.3
	Total	57	100.0
Cooperation among actors	I don't know	1	1.8
	Low	14	24.6
	High	28	49.1
	Very High	14	24.6
	Total	57	100.0

Sources: Compiled from own survey, 2022

With respect to the power of actors in terms of accessibility to water information, the result indicates that 59.7% of the actors have high accessibility to the relevant water information. In another dimension of power which is related to making rules and taking actions, the result of the study indicates that key stakeholders at hierarchical levels, mainly federal and regional levels were more powerful than those at District and Kebele Levels. For instance, the Ministry of Water and Energy possesses 72.7% authority to make rules related to water resources management. Regarding the capacity of resources mobilization, the Ministry of Agriculture has more capacity (63.6%) to mobilize resources to accomplish its mission. Similarly, the result of the study

indicates the Ministry of Agriculture and Ministry of Irrigation and Lowland Development have more knowledge generation power related to other actors.

On the other hand, government organizations established at District level, local community organizations, and development partners have low power in terms of making rules and taking corrective actions related to water issues in the study area (See Table 5.8).

Table 5.8: Indicators of stakeholders' power dynamics

Types of Stakeholder	**% of Authority to make rules and take action**	**% Capacity to mobilize resources**	**% Power of knowledge generation**
MoWE	72.7	54.5	63.6
MoAgri	63.6	63.6	72.7
MoIrrig	63.6	59.1	72.7
FedEPA	50	27.3	50
RegWE	45.5	36.4	54.5
RegAgri	40.9	40.9	50
RegIrrig	50	36.4	59.1
RegEPA	63.6	40.9	63.6
DistWE	9.1	22.7	22.7
DistIrrig	9.1	9.1	22.7
DistAgr	9.1	9.1	22.7
DistEPA	9.1	13.6	18.2
MunSew	9.1	4.5	4.5
Local Kebele	13.6	4.5	9.1
Dev't Partn	9.1	31.8	45.5
Research Institutions	13.6	34.6	59.1
Fishery	9.1	13.6	9.1
Private	13.6	27.3	31.8
Community (IWUAs)	13.6	18.2	13.6

Source: Compiled from own survey, 2022

These local organizations have also lower capacity in terms of resources mobilization, and knowledge generation. Hence, actors' power was imbalanced in terms of human resources, resource mobilization and knowledge generation.

Stakeholders' Involvement

Stakeholders' involvement in the decision making process of water matters has been paramount for the improvement of water resources governance and its sustainable uses. Table 5.9 shows the percentage of key stakeholders' frequent involvements in the water resources decision in the CRV of Ethiopia.

Table 5.9: Stakeholders' involvement in water decision making process

Type of stakeholder	% of frequent involvement in decision making
MoIrrig	77.3
MoWE	68.2
MoAgri	68.2
RegAgri	63.6
FedEPA	54.5
RegIrrig	45.5
RegEPA	45.5
DistWE	40.9
DistIrrig	40.9
DistAgr	36.4
MunSew	36.4
Research Institutions	36.4
RegWE	36.3
DistEPA	31.8
Local Kebele	27.3
Dev't Partn	24.2
Fishery	22.7
Private	22.7
Community (IWUAs)	18.2

Source: Compiled from own survey, 2022

The result revealed that stakeholders at hierarchical levels (federal and regional) were frequently involved in the water decision making processes. For instance, the Ministry of Irrigation and Lowland Development, Ministry of Water and Energy, and Ministry of Agriculture were the first among actors who were involved frequently in water decision making processes. On the other hand, key stakeholders at lower hierarchical administrative levels (District and Kebele) such as IWUAs, as well as development partners who are engaged in water resources development, capacity building, water protection and conservation activities were involved less frequently in water decision making processes. This implies that actors who are close to the water and frequently access the resources were less involved in water decision making while actors who are physically far away from the resources were more involved in decision making about the resource (water).

4.4.2. Discussions

There were various stakeholders involved in the water resources governance and uses in the CRV of Ethiopia. From various stakeholders involved in water issues in the area, key actors were

identified and included in this study. The stakeholders were identified through iterative process methods using expert opinion, focus groups, semi-structured interviews as suggested by Reed et al. (2009) and Stein et al. (2011). Snowballing method was used to identify focal actors, in which each of the focal actors was asked to name some or all of their ties to other actors (Hanneman and Riddle 2005). Accordingly, key stakeholders (actors) from government agencies of different levels, development partners/NGOs, community organizations and private companies were included. The result indicates that half of the participants were from government agencies from Federal, Regional, Districts and Kebele levels.

The interaction of key actors in the water governance; for instance, in activities such as working together, planning events, writing reports, exchanging information and providing support for each other was moderate. In addition, regarding issues of reporting, accountability, monitoring and evaluation, horizontal and vertical communication, direct and or indirect communication, the existing interaction was also moderate. In most cases, the key actors interacted quarterly and semi-annually. Exchanging information, planning together, and periodical monitoring activities were rarely carried out in shorter time such as weekly, biweekly and monthly.

Centrality measures are one of the commonly used methods in stakeholder analysis to measure the extent of interaction. The highest value of degree centrality implies the highest associated actor in the network. The result from UNICET 6 software indicates that key stakeholders at federal and regional levels have more interactions among the network compared to stakeholders at lower levels. Stakeholders at the federal level such as EPA, Ministry of Agriculture, and Ministry of Water and Energy have more interactions with other actors in the network. This implies that the associations among key actors of water resources governance in the CRV are imbalanced.

The interactions or associations of key actors were also observed using closeness centrality measures. The study result indicates that EPA, Research Institutes, Water Organization and Municipality were among actors who are close to all other actors in the irrigation water governance network in the CRV of Ethiopia. Among all actors, EPA was the one who was close to all actors while Private Company was the most ignored actor in the stakeholder network in water governance in the area.

Another centrality measure used in the analysis of key actors' interaction in this study was the betweenness centrality. In this study, almost all actors have direct interaction with each other; therefore, the actors have similar shortest paths between other pairs of actors. In similar manner, the power or potential of actors in terms of mobilizing resources to carry out their mission was also assessed in this study. With respect to the power of actors in terms of accessibility to water information, the majority of them have high accessibility to the relevant water information.

Stakeholders have position, power, and networking (Rustinsyah 2018). In this study, the power of key actors were assessed in terms of indicators such as human resources capacity (knowledge), access to information, authority to make rules and take action. The results of the study revealed that the power of making rules and taking actions were confined to the hands of government agencies at hierarchical levels, mainly at federal and regional levels. Key actors such as community associations, private, development partners/NGOs, and government agencies at District and Kebele levels have low or no power to make rules and take actions regarding water resources in the area.

In similar manner, the powers of knowledge and resources mobilization capacity were not fairly distributed among key actors acting at different hierarchical levels. Government agencies at Federal and Regional levels, development partners, research institutes hold higher power of knowledge and resources mobilization. On the contrary, key stakeholders who are very close to the physical resources (water) at local level were suffering from lack of such capacity. Stakeholders have meaningful contribution in the governance of environmental resources when they have balanced power with other actors involved in the aspect, if not their contribution is minimal (Mekuria et al. 2021). The freedom of stakeholders to set their roles and responsibilities, and take actions is paramount to improve the governance of resources in question. Some of the key actors of water governance in the CRV, for instance, kebele administration, district level government agencies, and water users associations were highly dependent on the agencies at federal and regional levels to make effective their roles and responsibilities due to lack of knowledge, resources and logistics.

As indicated earlier, stakeholder engagement is an important tool in developing the common understanding of context that is necessary for making decisions that affect sustainable water

governance (Megdal et al. 2017). The evidence of this study implies that some of the key actors of water governance, particularly actors at federal and regional levels, were frequently involved in the water decision making processes. Key stakeholders, particularly at lower levels, including District and Kebele, as well as development partners who were engaged in water resources development and contributing for sustainability of resources through designing of various initiatives involved less frequently in water decision making processes.

Previous studies, for instance Wehn et al. (2018) and Foster (2021) suggest that the engagement of key stakeholders is very essential not only for participation purposes, but also for social learning that contributes for sustainability. Multi-stakeholder participation is encouraged to coordinate the implementation of multilateral environmental agreements because non-governmental organizations, the private sector, and civil society can use their networks to build capacity and increase public awareness (Razzaque 2009). However, the involvement of key stakeholders in governance of water resources in the CRV was not inclusive.

Moreover, the analysis of focus group discussion implies that there was a weak linkage between water sectors in the CRV. Lack of coherences in regulations from national to local, and lack of integrated plan among relevant sectors were among the shortcomings in the study area. Failure to consider collaborative governance may discourage actors from future participation, and leaving inequality unaddressed. For coherent policy implementation, continuous information exchange, both top down and/or bottom up, and paying attention to power relations between institutions at different levels and scales are essential (Lieberherr and Ingold 2019).

4.5. Conclusions and recommendations

Water actors in the CRV have been exerting their efforts to improve water governance. However, these stakeholders have been mostly acting independently for water protection, conservation and development, not in a collaborative manner. Multiple actors across different institutional levels can play a great role in water governance, when effectively coordinated. Water actors in the CRV lacked an integrated plan and were not systematically coordinated and missed the opportunity of collaboratively operating the available logistic, financial and human resources that enable better performance on water governance improvement. Moreover, the power of actors

involved in water resources governance was dynamic, and imbalanced in terms of human resources, knowledge generation, access to information, and resources mobilization. Hence, strong partnership of stakeholders working together, involving local water actors in decision making, balancing the capacity of all actors in terms of resources and knowledge, and establishing stakeholders platforms that enhance their interactions and relationships need emphasis in the study area.

Chapter Five: Farmers' Willingness to Pay for Irrigation Water: Opportunities and Challenges for Implementation of Water Charge Policy in the Central Rift Valley of Ethiopia

Abstract

Considering farmers' preferences is vital for proper policy intervention because farmers might value the irrigation water attributes differently at different price levels. Central Rift Valley (CRV) is currently one of the area where individual farmers' irrigation activities such as withdrawing from lakes, river diversion, and individual wells are largely practiced. This study examines farmers' willingness to pay for improved irrigation water and to identify the most important attribute that farmers prioritize when deciding on WTP for irrigation water services. The study employed a multi-stage sampling technique to select 3 districts and 6 Kebeles, and a random sampling method to select 302 farmer households. A choice experiment (CE) was employed to design the survey. The D-efficient design technique was employed using Stata dcreate command to generate efficient design. The mixed Logit (MXL) model was used for analysis using Stata 17 for econometrics and SPSS for socioeconomic data and follow-up questions. The result of the study indicated that the mean willingness to pay for irrigation water of non-monetary attributes such as irrigation intensity, irrigation frequency, and water quality were positive and significant. The result also indicates that irrigation water users were interested and requested for cost-effective technology inputs such as solar pumps than petrol pumps to abstract irrigation water from sources. Hence, policy intervention on water charges in the CRV and similar areas should consider essential attributes and cost-effective energy technologies to improve water resources governance and sustainable use.

Keywords: water governance, willingness to pay, attributes, choice experiment, solar pump

5.1. Introduction

Enhancing water governance requires consideration of tools that facilitate the effective distribution and use of water. In irrigation development, policy designers have adopted strategies such as price setting linking with the preferences of local governance items to make it effective (Veettil et al. 2011). Failure to consider the users preferences, might cause irrigation systems rely heavily on subsidization and increasing pressures on the physical resources (Lankford et al. 2016). On the other hand, considering users preferences, has the opportunity to enable users to value of water and maintain the system for a long term (Ren et al. 2018).

The linkages between price setting and local governance items are of the utmost importance (Veettil et al. 2011). In irrigation water pricing, considering farmers' preferences is vital for proper policy intervention as farmers might value the irrigation water attributes in a different way at different price levels. For instance, a study conducted in Krishna River Basin in India on price sensitivity preferences for water-pricing methods showed that farmers preferred volumetric pricing at higher price levels and quota pricing at low price levels (Burton et al. 2020). Where users' preferences are considered, many farmers with access to surface water irrigation expend large sums of money to secure groundwater points to the value of water and to maintain the system for a long term (Ren et al. 2018).

Some researchers advocate water pricing as policy and economic instruments arguing that it enhances efficient use of water (Dinar and Mody 2004). There is also an argument that the failure to collect appropriate fees from irrigation farmers for the use of the irrigation network implies poor water delivery, low productivity, low incomes, inadequate cost recovery and maintenance effects (Burton et al. 2020). Efficient allocation of water through water pricing requires getting the right pricing, because it is sensitive to social, physical, institutional and political settings (Veettil et al. 2011).

To improve the efficiency of water allocation and use, policy designers have adopted strategies such as price setting, decentralizing irrigation water governance and improving water rights (Burton et al. 2020). Applying these strategies individually, without considering the complementary relationships between them may not provide complete information for decision making. Since farmers live in a micro-environment, within a particular type of irrigation water

governance and institutional framework and with different cropping systems, the linkages between price setting and local governance items are imperative (Veettil et al. 2011). A study conducted by Salman et al. (2008) in Jordan revealed that there was relative success of participatory irrigation partly because of making adjustments related to the willingness of stakeholders in the course of implementation. One of the shortcomings of previous works are failure to understanding the specific preferences of farmers about how they will be charged for water, and the composition (farmers preferences and engagement) in the local institutions that would administer irrigation water supply and management, which is a common problem in most developing countries (Burton et al. 2020).

It is also imperative to address the perspectives of users regarding to water governance aspects to ensure the sustainability of water uses beside willingness to pay for water use. Burton et al. (2020) suggested an approach that directly seeks farmers input in the first instance, rather than reverting to a top-down approach where local preferences are ignored. In this regard, just collecting irrigation water fee may not ensure the improvements of water governance unless backed up with appropriate management (Salman et al. 2008). For instance, a study conducted on irrigation water pricing in Awash River Basin of Ethiopia indicated that the collection of irrigation water fees has insignificant contribution to the improvements of the water management, failing to consider water governance dimension (Ayana et al. 2015).

A study conducted on farmers' perception regarding sedimentation management in small-scale irrigation schemes of Ketar and Arata-Chufa (farmer-led irrigation schemes) in Ethiopia, indicated that farmers use their local knowledge, own technique and informal institutions to mobilize and engage huge amounts of labor for intensive sediment cleaning campaigns (Gurmu et al. 2019). For a problem related to lack of regular maintenance and rehabilitation on Koga irrigation project in the Mecha district, Amhara region, a result of study suggested farmer's contribution for recovering the cost burden for management, maintenance and operation of the irrigation system by assessing farmer's willingness to pay (Alemayehu 2014). The result of a study undertaken using Contingent Valuation Method (CVM) to identify farmer's willingness to pay (WTP) for irrigation water use in Agarfa District of Oromia Region showed that the importance of user's participation in decision making to contribute for the sustainability and

effectiveness of irrigation water use (Birhane and Endrias 2016). In addition, demographic and socio-economic factors such as education level, family size, irrigable land size, total annual income, access to credit and experience in irrigated farming have significant effect on households' WTP for the improvement of irrigation water use (Alemayehu 2014; Ayana et al. 2015; Birhane and Endrias 2016; Ejeta et al. 2019).

It is suggested that taking consideration of users' preferences into water pricing is vital because it helps as policy and economic instruments to enhance efficient use of water (Ayana et al. 2015). The irrigation water policy of Ethiopia also promotes all pricing systems and mechanisms should be geared towards conservation, protection and efficient use of water as well as promote equity of access. The policy encourages tariff setting shall be site specific, depending on the particulars of the project, location, the users, the cost and other characteristics of the schemes (FDRE 1999). The policy also asserts that willingness to pay by users of water systems is a powerful drive for financial sustainability of water resources systems, and willingness to pay shall be promoted by instituting fairness in water systems, promoting transparency and communications. Ethiopian water management proclamation enacted in 2005 (Procl. number 115/2005) also legalized and encourages charging water use. CRV is currently one of the sub-basins where irrigation activities by individual farmers are largely practiced. Hence, studying farmers' willingness to pay for irrigation water (service) can benefit decision makers by providing information for better water decisions and water policy intervention to improve water resources governance in the area.

Recognizing and estimating respondents' heterogeneous preference for the non-market goods and services of irrigation water is crucial for the sustainable irrigation system in the CRV of Ethiopia. Farmers play multifunctional roles in the water resources protection process. In addition, farmers are also consumers of the irrigation water non-market goods and services. They need to share the cost of improving the water resources ecosystem. It is critical to understand the crucial role of farmers by exploring their heterogeneous willingness to pay for irrigation water at non-market value.

As the above components are not traded in markets in Ethiopia, a hypothetical market is need for the valuation work. Stated preference technique that can account for irrigation water non-market value was used in this paper to analyze the choice modeling data. Quantitative monetary trade-

off information between cost and irrigation water non-market benefits can be obtained from the outcomes, which was of fundamental help to the decision makers and the public in understanding the whole value of irrigation water, making the right decision on whether irrigation water pricing should be implemented or not, and designing irrigation water resources non-market value protection policies that associated more with farmers' heterogeneous preference in the study area.

The main aim of this study was to assess respondents' heterogeneous valuation of irrigation water services and the associated social-economic characteristics that have impacts on this valuation work, coming from the perspective of farmers in the CRV, Ethiopia. The examined irrigation water non-market value contains irrigation intensity, irrigation frequency, irrigation water quality, readiness to share water for downstream users and irrigation services. The specific objectives were: i) assess the farmer's willingness to pay for irrigation water services in the area; ii) identify the most important attribute that farmers give priority to decide WTP for irrigation water services; iii) analyze the major factors affecting farmers' willingness to pay for irrigation water service; iv) explore the existing opportunities and challenges to implement irrigation water fee system; and v) to inform policymakers on what they should focus to improve the water governance in the CRV of Ethiopia.

5.2. Materials and methods

Research Design

Discrete Choice experiment (DCE) was the research design employed to conduct the study. DCE is stated preference technique widely used in environmental valuation when the phenomenon under investigation has multiple attributes (Abramson et al. 2011). DCE allows the practitioner to estimate values for multiple attributes of a product and their trade off (Cooper et al. 2018). Choice experiment is based on Lancastrian microeconomics (1966) in which individuals derive utility from characteristics or attributes of a good and in McFadden's (1974) random utility theory, in which utility has deterministic and probabilistic components.

DCE is commonly employed in environmental valuation because of its robust experimental designs, statistical efficiency, and multidimensionality (Louvier et al. 2015). DCE decomposes

scenarios or goods into bundles of attributes, from which households derive utility, rather than from the goods themselves (Lancaster 1966). Respondents are presented with alternatives with various attributes and levels of these attributes, for which they indicate their most preferences rather than stating their maximum WTP for an environmental good (Abramson et al. 2011). Choice experiments can also be helpful for testing new policies or ideas that have not yet been administered; and in DCE a respondent is presented with a choice set comprising alternatives (usually two or three) from which they must choose one (Burton 2020). In addition, data from choice experiments help to enumerate the trade-offs individuals make between the attributes of a product, policy or outcome; and to design tariffs of irrigation in line with farmers preferred approaches to payment (Cooper et al. 2018).

Modeling Framework

Using discrete choice experiments, associated with nonmarket goods and services, individuals can select one among several alternatives (Louviere et al. 2015). Most models developed to analyze those hypothetical choices are built upon the multinomial logit (MNL) model within a random utility model (RUM), whereby consumers are assumed to maximize their utility when choosing among different alternatives with contrasted attributes (McFadden 1974).

Lancaster (1966) argued that the attributes of a good are determinants of the utility derived from the good, and that utility could therefore best be explained in terms of the attributes. Lautze (2011) also recognized that people making the choices did not have complete information and were faced with uncertainty in making their utility calculations. As a result, the utility function has come to be thought of as the sum of two parts: an observed or measurable component, and an unobserved or random component (Lee et al. 2014). The random utility model allows for random (error) influences in addition to the identified fixed ones (McFadden 1974):

$$Uiq = Viq + \varepsilon iq \tag{1}$$

where:

U_{iq} represents utility derived for consumer q from option i

V_{iq} is an attribute vector representing the observable component of utility from option i for consumer q

ε_{iq} is the unobservable component of utility derived for consumer q from option i (Lee et al. 2014).

Assuming a linear additive form for the multidimensional deterministic attribute vector (V_{iq}):

$$Viq = \beta_1 if_1(s_1 iq) + \ldots + \beta kifk(Skiq) \quad (2)$$

where:

β_{ki} are utility parameters for option i, and

s_{iq} represents 1 to k different attributes with differing levels, Eq. (1) can be expanded to:

$$Uiq = \beta_1 if_1(s_1 iq) + \ldots + \beta kifk(skiq) + \varepsilon iq \quad (3)$$

This random utility model is converted into a choice model by recognizing that an individual (q) will select alternative *i* if and only if (iff) U_{iq} is greater than the utility derived from any other alternative in the choice set (Lee et al. 2014). Alternative *i* is preferred to *j* iff $P[(Viq + \varepsilon iq) > (Vjq + \varepsilon jq)]$, and choice can be predicted by estimating the probability of individual (q) ranking alternative *i* higher than any other alternative *j* in the set of choices available (Louviere et al. 2015).

In this study choice (y) is a dependent variable whereas non-monetary attributes such as irrigation frequency (f), intensity (i), water quality (q), sharing water to downstream users (s) and irrigation water service fee (r) were independent variables.

The basic MNL model serves as a reference point but is limited to several assumptions. For instance, it assumes independence of irrelevant alternatives (IIA), i.e., choice situations are uncorrelated (Kahneman & Knetsch 1992); and the model only allows for one parameter for the entire population, tastes for observed attributes are assumed to be homogeneous, which is also very restrictive as one can expect a diversity of preferences in the population (Vivithkeyoonvong & Jourdain 2017).

To address those limitations, one of the recent models has been used is Mixed Logit (ML) model. To investigate the heterogeneity of farmers' preference, a mixed logit model is applied in this paper to capture more realistic non-market valuation estimation. In Mixed logit (ML) model assumption, marginal utilities of individuals are not constant but vary across a sample. The

Mixed Logit is centered on random coefficients, and it relaxes the restrictive "independence from irrelevant alternatives" assumption and allows every individual to have their own preferences assuming that parameters from each decision maker are independent of each other (Yang et al. 2019). The random parameters for the particular individual should be constant across the repeated choices (Mariel et al. 2021).

In the mixed logit model, the probability P of individual farmer *q* choosing alternative *i* is computed as follows (Chipfupa and Wale 2019):

$$Pqi = \int \left[\frac{(\exp(\beta' Xqi))}{\left(\sum_{(i-1)} I \exp(\beta' Xqi) \right)} \right] f(\beta) d\beta \quad \ldots\ldots(4)$$

where *f*(β*)* is the distribution function for β and X_{qi} is a vector of observed variables.

There are three main advantages when a ML model specification is used: preference heterogeneity is directly incorporated through individuals' random taste variations; it avoids any reliance on the IIA property; and it has a capability of incorporating correlation across choice sets and alternatives (Ramos 2010). In this paper, panel Mixed Logit Model was used to run the model because of more than one choice occasion per respondent was undertaken.

Choice Experiment Setting (Scenario)

In this choice experiment study, the research question was refined through consultation with experienced scholars and farmers from the study area. The attributes in the choice experiment were chosen following extensive literature searches and early in-depth interviews to identify the most important aspects of irrigation water services. Semi-structured interview and focus groups discussion were used to gather qualitative information before conducting the choice experiment. During the interview, participants were asked to identify the most important non market services provided by irrigation water and its attributes. Using the same tool, focus group discussion was held with farmers across the study locations to refine attributes for the final choice experiment. These types of discussions provide inputs to the study regarding the most important attributes and their levels, personal characteristics that affect choice behavior, possible reasons for

differences in utility, the number of alternatives in a choice set, and whether different decision rules are used (Kragt and Bennett 2012; Louviere et al. 2015; Burton et al. 2020).

Five attributes were selected from which three of them have three levels, two have two levels and one has four levels. Full factorial design shows that there are 3x3x2x2x4= 144 rows and (144 x143)/2= 10296 possible combinations, which is too large to ask one respondent as it creates fatigue to participants (Goos and Jones 2011). Hence, the D-efficient design contains 12 choice sets each for the head and tail-end were designed using Stata *dcreate* command to generate efficient design. Each choice set contains three options, five alternatives (attributes) with levels in addition to reference options from which a respondent chose. The order of the choice sets was randomly determined. The "payment" choice experiment was established with five attributes which include: irrigation intensity, irrigation frequency, irrigation water quality, readiness to share water and irrigation water (service) fees. Before running data analysis in STATA, data clearing process was undertaken. During data clearing, one inefficient choice set and missed data were dropped. Finally, the analysis was undertaken using data from 11 choice sets.

Data Collection

The study used data from a discrete choice experiment on the farmer's willingness to pay for irrigation water service in the Central Rift Valley of Ethiopia. The aim of the experiment was to elicit the farmer's preferences for different attributes of irrigation water service in order to advise policy makers on how to improve water resources governance and management. The "payment" choice experiment for pre-testing was established with five attributes such as: irrigation water (service) fee, irrigation intensity, irrigation frequency, irrigation water quality and readiness to share water for downstream users. A pre-test of the experiments were conducted with participants in the study location, and fine-tuned the study design. On the basis of the findings in the pilot test, adjustments were done for the final survey. An extensive survey was administered to more than 302 farmers who engaged in agricultural activities (cultivating land and animal husbandry) in the study area.

The DCE formed the main part of the survey though socioeconomic and demographic characteristics of the farmers such as gender, age, education level, household annual income,

number of household members, formal educational attainment, occupation, agricultural working experience and other related background were also collected. In this study, the respondents' socioeconomic and demographic characteristics information was used to assess the representativeness of the sample and used the data as explanatory variables to investigate heterogeneity in preferences.

During the survey, trained enumerators read the explanation (separate) sheet describing different options and choice scenarios along with the attributes used in the choice experiment for respondents. The current state of irrigation water supply and challenges facing the Rivers and Lakes were also described to the farmers. Then, the enumerators presented options to the respondent and asked them to choose their best option from three given options in each of 12 cards. Each card was presented for the respondents as the only option provided to be chosen separately. The third option is the status quo, meaning farmers will continue using irrigation water as they are practicing currently without paying irrigation water service fees in the study area. The choice sets and alternatives were arranged in two blocks "block 1" and "block 2", meaning farmers at head-end and tailed-end of the irrigation network respectively (See Appendix II). The household survey data were collected through face-to-face personal contact by trained enumerators. Sample of choice cards presented for households is presented in Table 6.1.

Table 6. 1: Sample choice set (card)

Attributes	**Option 1**	**Option 2**	**I don't like both options**
Irrigation intensity 	1 irrigation seasons in a year	3 irrigation season in a year	
Irrigation frequency 	Once a week	Every two weeks	
Water quality for irrigation 	Not suitable	Suitable	
Readiness to share water 	Yes	Yes	
Irrigation fee 	1100 ETB	1500 ETB	
Please tick/mark (√) only one			

Source: own development, 2022

Regarding irrigation water (service) fees, 4 alternative prices in Birr (1500, 1300, 1100, and 900) were provided to the respondents. The irrigation water fees were determined based on the data collected for a pilot test from 20 farmers from the study area before the final survey. During the pilot test, farmers (irrigators) were asked "How much money they could pay for irrigation water (service) supplied annually to irrigate one 'Kart' throughout the year. In the study area, 'Kart' is a well-known measurement of plots. 1 kart is equivalent to ¼ or 0.25 hectare. The value of the irrigation water service fees used in the choice experiment was determined by using the minimum and the maximum prices the bidders (20 farmers who participated in the pilot) showed a willingness to pay annually to get improved irrigation water (services) to irrigate 1 'Kart' for various irrigation seasons in a year.

Sampling Technique and Sample Size Determination

The sampling frame included individual farmers or households who are economically active (from age 18-64), and both males and females who were engaged in cultivating crop/vegetable/fruit, and livestock production. The target study area included 8 Districts and 16 Kebeles, those having long term irrigation experiences. This study employed a multi-stage sampling technique. Targeted Districts in the CRV were categorized into three catchments (upper, middle and lower). From each of the catchments, a District was selected using a simple random sampling method. Accordingly, East Meskan, Dugda and Adami Tullu Jiddo Kombolcha Districts were selected from upper, middle and lower catchments respectively.

Table 6. 2: Sample and sampling technique

Stage	**Category of Districts**			**Methods used**
	Upper catchment	**Middle catchment**	**Lower catchment**	
1st stage (identifying target population)	1. Tiyo, 2. Munessa 3. East Meskan 4. South Sodo	1. Dugda 2. Arsi Negelle 3. Heben Arsi	Adami Tulu J/K	Clustering
2nd stage (selection of sample Districts)	East Meskan	Dugda	Adami Tulu J/K	Random sampling
3rd stage (selection of sample kebeles)	1. Enseno Husme 2. Dobena gola	1. Shubi gamo 2. Bekele Giris	1. Abne Germama 2. Golba Aluto	Purposive (long term irrigation experience)
4th stage (selection of farmers)	Farmer household	Farmer household	Farmer household	Random sampling

Source: Own proposal, 2022

From each selected District, two Kebeles (totally 6 Kebeles) were selected purposively focusing on long term experiences and potential irrigation practices to get sufficient data. The selected Districts are located in two different administrative Regions (in Oromia Regional State and in SNNPR) that help to observe institutional alignments at different levels. The sampling frame included individual farmers or households who are economically active, and who were engaged in cultivating crop/vegetable/fruit, and livestock production. The sample size was determined by power calculation.

The household survey data were collected through face-to-face personal contact by trained enumerators. Participation in the survey was voluntary and they were randomly selected from 6 kebeles in the CRV of Ethiopia. After excluding incomplete responses, the study used 302 respondents for final analysis. The analysis of the study employed STATA 17 software packages.

5.3. Results and discussions

5.3.1. Results

Background and Descriptive Results

From a total of 302 respondents, there were more male respondents than female (87% and 13% respectively). From the total participants, respondents were proportionally participated from the three districts, i.e. participants from Adami Tulu Jiddo Kombolcha, Dugda and East Meskan were 32.89%, 33.22% and 33.89% respectively. Of the total participants 45% of them were educated, which ranges from primary to tertiary (78% primary, 18% secondary and 5% tertiary). The average family size was 6 (range 2–14), and the average age of respondents was 41.76 years (range 22 - 70). The average experiences of participants in agricultural activities were 19 years (range from 2 - 50 years). The average distances of irrigation water sources and plot from respondents' homes were 17.76 and 13.22 minutes respectively. The average annual income of the household was 63,574.92 Birr (see table 6.3 for detail). These variables can help to achieve a more precise estimation and indicate how well the sample represents the population.

Table 6.3 indicates that, the result of the mean distance of the household from the main water source was 16.58 minutes and its Std. deviation was 15.24. The mean of household's annual crop production in kuntal was 41.39kunt and its Std. deviation was 40.06. The result of the Std.

deviation related to variables such as distance from main water and agricultural production indicates that the data were clustered around the mean. On the other hand, the Std. the deviation scores of annual income of farmers' shows that the data were more spread out from the mean.

Table 6. 3: Respondents' background information

Items	**N**	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Annual income	302	4000	750000	63574.92	75930.976
Age	302	22	70	41.66	10.060
Family size	302	2	14	6.0	2.204
Educated members	302	0	11	2.71	1.425
Plot leased in	302	0	8	.52	1.150
Distance of main water source in minutes	302	0	90	16.58	15.241
Annual total production in kuntal	302	1	400	41.39	40.056
Distance of nearest plot in minutes	302	0	60	13.22	13.692

Source: Own survey, 2022

Regarding respondents' occupation, the majority of them were engaged in irrigation farming and mixed farming (47.4% each). The data implies that irrigation activity and mixed farming were the main occupations that farmers were engaged in the study area. Other types of occupation such as small business and trade activities were insignificant. On the other hand, of all participants, about 62.3% of them were registered in Irrigation Water User Associations (IWUAs); however, 37.4% of them were using irrigation water without being registered in IWUAs. The backgrounds of participants show that respondents were appropriate in participating in the study related to irrigation water fees and challenges related to fee payments to give sufficient information regarding the prepared survey questions.

Regarding irrigation water sources, the majority of farmers (67.5%) were using pumps to abstract water from Lake and Groundwater (32.5% and 35.4% respectively), whereas 28.2% were using river diversion and other sources.

Table 6.4: Respondents' main occupation and member of IWUAs

Items	Responses	Frequency	Valid Percent
Main occupation	irrigation farming	145	47.4
	animal husbandry	11	3.6
	mixed farming	145	47.4
	Missing	5	1.6
Member of IWUAs	Yes	188	62.3
	No	113	37.4
	Missing	5	0.3

Source: Compiled from own survey, 2022

To pump irrigation water from its sources to irrigated land, 68.2% of the irrigation water users were using petrol pump while 9.3%, 9.6%, 2.0% and 2.6% were using solar pump, rope and washer pump, treadle pump and traditional method respectively. 8.3% of the participants were not irrigator and they practiced rain fed farming.

Table 6.5: Sources of Irrigation and Irrigating Technology

Items	Responses	Frequency	Percent
Source of Irrigation	river diversion	82	27.2
	pumping from lake	98	32.5
	Groundwater	107	35.4
	Other	3	1.0
	Missing	16	3.9
Types of water lifting technology	solar pump	28	9.3
	petrol pump	206	68.2
	rope and washer pump	29	9.6
	treadle pump	6	2.0
	Traditional	8	2.6
	Practicing rain fed farming	25	8.3

Source: Compiled from own survey, 2022

The result indicates that the majority of farmers were using petrol pump technology to lift-up irrigation water from Rivers and Lakes to irrigate their farms in the study area.

Results from choice experiments

The model fitness was assessed using the Chi-square statistics. The P-value was less than 0.05, which proves significant relationships between dependent and independent variables. The value of Nagelkerke was also 0.963, and it is significant. It measures the proportion of the total

variation of the dependent variable explained by independent variables in the model. The result implies that the dependent variable was explained 96.3% by the independent variables.

Table 6.7: Model Fitting Information

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	Df	Sig.
Intercept Only	926.474			
Cox and Snell	.918			
Nagelkerke	.963			
Final	34.771	891.703	72	.000

P-value is significant at 1,5,10 levels.

The estimates of mixed logit models for the attributes are presented in Table 6.8. From the mixed logit model outputs, the mean willingness to pay for irrigation water services was estimated. It was calculated by ratio of coefficients of the non-monetary attributes to the monetary coefficient (fees). The results were presented on table 6.8.

Table 6.8: Mixed Logit Results of the Attributes

Attributes	**Coefficient**	**Robust Std. err.**	**P-Value**
Irrigation fee	-.2051141	.0480963*	0.000
Irrigation Intensity	.3414918	.0691695**	0.000
Irrigation Frequency	.329396	.0914171**	0.000
Water quality	.5674014	.121644	0.000
Sharing	-.0000449	.0667789**	0.999

*, ** are significant at 5, and 10 levels respectively

Source: own survey, 2022

The ratio of irrigation intensity coefficients to the coefficients of irrigation fee is a measure of the amount that farmers are willing to pay to irrigate additional seasons using irrigation water in the area. The mean willingness to pay irrigation frequency is the ratio of frequency coefficient to the coefficient of irrigation fee that implies the willingness to pay a farmer to have an additional irrigating schedule to irrigate his/her farm. In a similar manner, the mean willingness to pay for water quality is calculated by the ratio of coefficients of irrigation quality to the coefficient of irrigation fee. The result shows that irrigation intensity has a positive effect on the value of irrigation water. The positive sign of irrigation intensity attribute indicates that a higher intensity has a positive effect on respondents' utility. Similarly, irrigation frequency, and water quality

have a positive effect on the value of water. The coefficients of the attributes of irrigation intensity, irrigation frequency, and irrigation water quality are statistically significant.

The mean willingness to pay values from Table 6.9 (both magnitudes and sign) of the non-monetary attributes implied that farmers are positive and supporting towards irrigation water charge policy to improve irrigation water sustainability in the area. The value of the mean WTP shown in Table 6.9 implies that farmers are willing to pay for moderate increase price of irrigation water attributes. For instance, at one percentage change of irrigation water service fees, farmers have willingness to own irrigation water intensity by 1.66 percentages, other things remains constant. In similar manner, at a percentage change of irrigation water fees, the willingness of farmers to use irrigation frequency and improved irrigation water quality increased by 1.61 and 2.77 percentages respectively in the CRV of Ethiopia. On the other hand, a percentage increase of irrigation water service fees negatively affects the willingness of farmers to share irrigation water for downstream users.

Table 6.9: Mean Willingness to pay (WTP) of the attributes

Attribute	**Mean WTP**	**Std. dev.**
Intensity	1.66	. 665593
Frequency	1.61	. 7340579
Quality	2.77	. 7992221
Sharing	-2.19e-4	. 0000458

Source: own survey, 2022

Regarding the importance of non-monetary attributes, farmers prioritized improved irrigation water quality, which might be associated to alkalinity of groundwater in Dugda District that farmers were complaining during interview. The farmers also valued irrigation intensity and frequency to ensure the implementation of irrigation water charge policy in the CRV, Ethiopia. On the other hand, sharing water for the downstream users has no positive values and this attribute hardly contribute for the irrigation water improvement plan in the study area.

Results of follow up questions

The results were supported by follow-up questions. 89.4% of the respondents indicated the interest of irrigating twice and three times in a year. Similarly, the positive sign of irrigation

frequency and water quality shows that watering farms frequently with quality of water has a positive effect on farmer's utility. From the participants, 76.41% of them ranked quality as the most important attribute to make choice among the given alternatives; followed by irrigation intensity (40.86%) and frequency (26.25%).

Readiness to share water was ranked as the least important attribute (8.07%) to decide WTP for irrigation water. When attributes were seen by the District, the result indicates that participants from Dugda District and Adami Tullu ranked irrigation intensity as the most important attribute to make a choice.

Table 6.10: Importance of non-monetary attributes

Attributes	**Importance of attributes ranked by respondents (%)**		
	less important	**Medium**	**more important**
Water quality	11.96	11.63	76.41
Irrigation intensity	16.61	42.53	40.86
Irrigation frequency	55.81	17.94	26.25
Water share	91.03	5.98	2.99

Source: Own survey, 2022

On the other hand, participants from East Meskan ranked irrigation fee as the most important attribute to decide the selection of the given alternatives in the choice alternatives.

Table 6.11: Cognition of participants' for the importance of attributes by district

Non- monetary Attributes	**Importance of attributes by district (%)**		
	Adami Tulu	**Dugda**	**East Meskan**
Irrigation intensity	33.91	40.87	25.22
Irrigation frequency	42.28	35.77	21.95
Water quality	35.44	20.25	44.31
Water share	22.22	33.33	44.45

Source: Own survey, 2022

During the interview, participants raised the reason that the majority of the farmers use ground water sources for irrigation purposes using fuel, which incur high cost related to price adjustment at country level.

Regarding the irrigation season, the majority of the respondents (89.4%) indicated they were using irrigation water twice or three times in a year. Only 10.6% indicated that they were using irrigation water once a year, and this result conforms to the econometric result, which shows positive willingness to pay towards irrigation intensity.

Table 6.12: Annual Intensity of irrigation use

Responses	**Frequency**	**Valid Percent**
Once	32	10.6
Twice	165	54.8
three times	104	34.6
Total	301	100.0

Source: Own Survey, 2022

Regarding payment vehicles, the majority of the participants (59.5%) accepted that money is the right payment vehicle while other participants (40.5%) hesitate to accept money as the right vehicle. Even though the percentage of participants who accept money as a right payment vehicle was high, the percentage of respondents who were looking for other options such as labor contribution and in kind contribution rather than money as payment vehicle was also significant. This implies that irrigation water charge policy needs to consider other payment vehicle such as labor and in kind contribution for effective implementation of the policy.

Table 6.13: Perception of respondents towards payment vehicle

	Responses	Frequency	Percent
Monetary payment is the right vehicle	No	122	40.5
	Yes	179	59.5
	Total	**301**	**100.0**

Source: Compiled from own Survey, 2022

For questions asked to identify the cognition of respondents regarding the benefit of irrigation in increasing cropping season, 70.6% of them have agreed.

The result indicates that the majority of the farmers in the CRV were practicing irrigation activities for more than one season, which also confirms the results of the earlier one. Regarding irrigation water distribution between head-end and tail-end users, results from the follow-up question shows that participants who responded that distribution is differ between the two blocks was 53.8%, almost half of the participants. This implies that sharing irrigation water for

downstream users might not be a big deal for current users although consideration should be given for future policy interventions.

The result of participants' perception regarding the demand for irrigation water based on crop types was also presented in table 6. 14.

Table 6.14: Agree Disagree Types of Responses

Items	Scale	Frequency	Percent
Irrigation increases cropping season	very disagree	18	6.0
	Disagree	27	9.0
	neither agree nor disagree	40	13.3
	Agree	93	30.9
	very agree	123	40.9
Watering/irrigation frequency strongly varies in head-ends compared to tail-ends	very disagree	34	11.3
	Disagree	52	17.3
	neither agree nor disagree	53	17.6
	Agree	102	33.9
	very agree	60	19.9
The demand for irrigation water varies by crop categories	very disagree	33	11.0
	Disagree	39	13.0
	neither agree nor disagree	69	22.9
	Agree	108	35.9
	very agree	52	17.3
The type of crop grown (cash vs. staple crop) type differentiates the households' willingness to pay for water charges	very disagree	29	9.6
	Disagree	52	17.3
	neither agree nor disagree	69	22.9
	Agree	87	28.9
	very agree	64	21.3
How sure are you about your decision regarding how much you would pay?	very low	79	26.2
	Low	17	5.6
	Medium	92	30.6
	High	63	20.9
	very high	50	16.6

Source: Compiled from own survey, 2022

The result shows that the majority of the respondents (53.2%) agree that irrigation water demand varies by crop categories. With a similar question, half of the respondents (50.2%) agreed on the idea that types of crop grown differentiate the households' willingness to pay for irrigation water. In both cases, the percentages of respondents who disagree with the argument were 24% and 26.9% respectively. The rest of participants (22.9%) were indifferent, neither agreeing nor

disagree. The question asked respondents to ensure whether they are sure to pay the amount of money decided in the given choice alternatives, 37.5% of them rated high, 30.6% medium and 31.8% were low respectively. Hence, any policy formulation and intervention regarding to irrigation water (service) fees need to consider the types of crops grown in the study area.

5.3.2. Discussions

The study involved participants with various backgrounds: age, income, occupation, farming experiences at different catchments. The descriptive statistics shows that the backgrounds of the households participated in the study were heterogeneous. The econometric part employed discrete choice experiments (DCE) methods because of its robust experimental designs, statistical efficiency, and multidimensionality (Bateman et al. 2002; Louvier et al. 2011). In econometric parts, respondents were presented with alternatives with five attributes namely: irrigation intensity, irrigation frequency, water quality, sharing water for downstream users and irrigation fee. The attributes were presented with levels from which they indicated their most preferences.

The basic Multinomial Logit (MNL) model serves as a reference point for the choice model. However, it has limitations such as assumption of independence of irrelevant alternatives (IIA), which only allows for one parameter for the entire population, tastes for observed attributes are assumed to be homogeneous (Vivithkeyoonvong & Jourdain 2017). To avoid any reliance on the IIA property, the Mixed Logit (MXL) model was employed in this study. Mixed Logit has also an advantage of incorporating correlation across choice sets and alternatives (Ramos 2010; Mariel et al. 2021). Panel Mixed Logit Model specification was used because more than one choice occasion per respondent is undertaken.

The result of the study indicates that the mean willingness to pay to use additional non-monetary attributes of irrigation water services positively affect the farmers' utility. For instance, the mean of irrigation intensity was positive and significant. This implies that farmers have willingness to pay for irrigation water services in order to use additional irrigation season using irrigation water in the CRV, Ethiopia. The result shows that the farmers' have a positive attitude for willingness to pay demanding to use irrigation water twice or more seasons to produce crops in a year. The result is similar to the findings of a study conducted in Uzbekistan in which farmers' willingness

to pay for irrigation water is positive and significant for non-monetary value (Kassie et al. 2022). The positive result of non-monetary attributes confirms with the Random Utility Theory of Lancaster (1966) and McFadden's (1974) that states individuals derive utility from the attributes of a good or service.

The mean willingness to pay for irrigation frequency was also positive and significant. This also implies that the willingness to pay farmers has a positive effect on their irrigation water service utility; meaning, farmers have willingness to pay money to get additional irrigation frequency (additional watering schedule) to irrigate their farming land. This implies that farmers need to irrigate their farms once or more times per week or two weeks and get quality water for their crop production. The positive result indicates that farmers positively valued the attribute and they have willingness to pay to obtain additional services from irrigation water services. This result is similar to the findings of Chipfupa and Wale (2019).

In a similar manner, the mean willingness to pay farmers for irrigation water quality was also positive and significant. The result indicates that farmers have positive value for water quality and are ready to pay for the services upon supply of irrigation water quality. The result also conforms to the study conducted by Basarir et al. (2009). This implies that farmers were aware of the negative impact of lower irrigation water quality on deteriorating yield production and its impact on the health of the consumers. Hence, farmers have a positive willingness to pay for the quality of irrigation water for moderate increment of irrigation fee.

The result of econometric output indicates that farmers have a negative willingness to pay related to the non-monetary attribute of sharing water for the downstream users. Upstream water users need compensation to share water for downstream irrigation water users rather than paying (Swai, 2016). In this study, the coefficient of the attribute 'sharing water for the downstream' users indicates negative, which implies farmers are unsure to pay irrigation fee while they share irrigation water with downstream water users. This result was also supported by the idea of focus group discussion participants held in Golba Aluto Kebele of Adami Tullu Jiddo Kombolcha (ATJK) District. In Golba Aluto Kebele, a shortage of water for livestock drinking was evident at Bulbula River in 2020 due to high water abstraction of water resources for irrigation purposes at upper catchment. As a consequence, the community's grievance was outbreak and tried to

damage irrigation infrastructure of the upper catchment users. According to information obtained from FGD participants and ATJK District key informants', the problem was resolved by the intervention of local community elders and the District Administrator through deciding to leave water for livestock drinking at day time and irrigating farmlands at night.

In addition to econometric results, the data of socioeconomic and follow-up questions were also analyzed and presented. From the socioeconomic data, the result indicates that the majority of farmers were using Lake and groundwater for irrigation purposes. The technology employed to list irrigation water to farming areas was majorly petrol pump, which is incurring higher costs to the farmers. Hence, policy intervention regarding the implementation of irrigation water charge needs to consider alternative technologies such as solar pump provisions.

From the follow-up questions, it was attempted to observe the preferences of farmers by District. The result indicates that participants from Dugda District and Adami Tullu ranked irrigation intensity as the most important attribute. On the other hand, participants from East Meskan ranked irrigation fee as the most important attribute to decide the selection of the given alternatives in the choice alternatives. During the interview, participants from East Meskan raised the reason that majority of the farmers use ground water sources for irrigation purposes using fuel to lift to their irrigation farming areas, which was incurring higher cost due to fuel price adjustment as a result of government's subsidy revision of fuel at country level.

Regarding payment vehicles, even though the majority of the participants have accepted money as the right payment vehicle, considering non-monetary payment such as contribution in labor and in kind to protect water resources are also essential in the study area. On the other hand, the data sources from focus group discussion, key informants interview and observation, the following factors might challenge irrigation water charge policy in the study area unless appropriate intervention measures are taken. These factors include: over-abstraction of water resources (may cause decline of water quantity, invasion of water hyacinth, particularly on Dembel Lake), population pressure on environmental resources due to low intensity of alternative economic engagement, chemical erosion and siltation from farming area, large number of farmers using irrigation water without being registered in IWUAs and the increment

of fuel price for farmers who use petrol pump to lift water to their irrigation farming areas are the major one.

On the other hand, there are also prospects to implement irrigation water fees (service fees) to ensure sustainable water use and agricultural production in the area. For instance, the positive willingness to pay farmers considering non-monetary attributes (irrigation intensity, irrigation frequency and maintaining water quality), community awareness about water resources protection, the opportunity of Ethiopian Green Legacy Initiatives that practice planting trees in the country and the government policy of Ethiopia towards irrigation water charge. The irrigation water policy of Ethiopia also promotes all pricing systems and mechanisms and efficient use of water. The policy encourages tariff setting shall be site specific, depending on the particulars of the project, location, the users, the cost and other characteristics of the schemes (FDRE 1999). It also asserts that willingness to pay by users of water systems is a powerful drive for financial sustainability of water resources systems, and willingness to pay shall be promoted by instituting fairness in water systems, promoting transparency and communications. Stunning implementation of this policy has been paramount to the sustainable water resources and development in the study area.

In general, previous studies suggested that taking consideration of users' preferences into water pricing is vital because it helps as a policy and economic instrument to enhance the efficiency of water uses (Speelman et al. 2009; Ayana et al. 2015). Hence, future policy interventions regarding water charge should pay attention to the non-monetary attributes those farmers were very interested. Irrigation development projects such as scheme development and management, irrigation infrastructure construction, etc need to consider the supply of water with respect to the need of farmers regarding its intensity, frequency of irrigation and maintaining water quality to ensure the sustainability of irrigation water resources and production in the area.

5.4. Conclusions and recommendations

The result of the study shows that farmers' willingness to pay for irrigation water (service) has a positive effect on the utility they drive from irrigation water. The result of this study shows that farmers have a positive attitude toward the implementation of irrigation water charge systems to maintain sustainable irrigation activities in the CRV of Ethiopia. The result of the study implies

that water fee policy intervention needs to take into account non-monetary attributes such as irrigation intensity, irrigation frequency and water quality. The study reveals that farmers have a willingness to pay for irrigation water (service) fees towards these attributes. In a similar manner, the result of positive utility of farmers' willingness to pay with respect to the attributes of irrigation intensity, frequency and water quality implies that irrigation water charges need to consider the supply of irrigation water facilities and quality of water for irrigating planted crops. The coefficient of sharing water for downstream users was negative implying that upstream farmers have no willingness to share irrigation water to the downstream users. However, the coefficient of water sharing attribute value shows insignificance compared to other non-monetary attributes.

Hence, the irrigation water charge policy of the country needs to be designed in a way that considers non-monetary attributes and compensation mechanisms between upstream and downstream water users in the CRV of Ethiopia and other similar areas to ensure sustainable production and water uses. Moreover, development partners and concerned bodies should give attention to solar or other non-gasoil lifting technologies to pump groundwater and pump water from the water sources to irrigation farming lands to sustainably implement irrigation water (service) fees in the area, and elsewhere with similar conditions in the country. Regarding water resources governance, the capacity of actors, particularly IWUAs and smallholder farmers, need continuous awareness creation and capacity building activities on water resources protection and sustainable uses. Diversifying income-generating activities other than irrigation also need attention to minimize pressures on the physical resources in the study area.

Chapter Six: Synthesis

6.1. Introduction

Lack of effective water governance is one of the factors contributing to inadequate water resource management (UNDP 2016; Jiménez et al. 2020). The conflicts flaring up from the protracted social inequalities; the inefficiency, ineffectiveness, and inefficacy characteristic of water governance are among the prevailing challenges in many regions of the world (Castro 2007). Over-extraction and pollution of water have significantly affected the environment, resulting in over 60% of ecosystem services being degraded or used unsustainably (Kammeyer et al. 2020). Understanding water governance requires the underlying institutions and organizations involved and the prevailing legal and institutional policy frameworks (Lautze et al. 2011).

In the context of Ethiopia, various water resources management policies, strategies, rules, and regulations were enacted and endorsed (FDRE 1999; FDRE 2000; FDRE 2001; FDRE 2005), with the goal of achieving efficient, equitable, and optimum utilization of water resources for significant socioeconomic development on a sustainable basis. However, the intended goal was not attained due to deficiencies related to water governance, water resources management, and institutional flaws in the country (Seyoum et al. 2015; Duguma 2017; Hailu et al. 2018; Dessie et al. 2019; Goshime et al. 2019). Central Rift Valley (CRV), the study area was endowed with many lakes and rivers. However, these resources are currently endangered due to an imbalance in human-water interaction (Lemi 2019).

This study aimed to assess the water governance framework, governance practices, and the role of institutions, stakeholders' power dynamics and farmers' willingness to pay for improved irrigation water services in the CRV of Ethiopia. Hence, the major findings of the study and discussions, conclusions, and recommendations of the individual papers discussed in the previous chapters are presented in the following sections.

6.2. Synthesis of the major findings

6.2.1. Water governance framework, coherence and practices

Water governance framework, policy coherence, and practices in the CRV of Ethiopia were studied. The study findings showed that water resources management policy, rules, and

regulations were enacted, and institutional arrangements were undertaken to improve the management and sustainable use of water resources in the country. However, the policies were not sufficiently implemented in the study area. The limitations were associated with a lack of detailed standards, guidelines, procedures, checklist, and enforcement mechanisms, and a deficiency of implementation capacity at lower administrative levels. The policy or its enforcements lack mechanisms of oversee and inclusive monitoring and evaluation program, lack policy review mechanism (lack feedback and policy improve platform) that ensure the engagement of all key stakeholders. There was also an overlap of mandates and a lack of role clarity between federal and regional governments. Such practices may lead to institutional overlaps, insufficient management capacity, and operational gaps as reported by Muok and Onyango (2020).

Moreover, the study reveals that over-abstraction of irrigation water, particularly, at the upper and middle catchment was practiced. As a result, a shortage of drinking water for livestock, irrigation water, and other services repeatedly occurred at the lower catchment in the study area. Evidence from the study revealed that lack of consultation between upper and lower catchments, increasing investment and deforestation in upstream areas, competition for water uses for different purposes, lack of water allocation and distribution system between upstream and downstream users have exacerbated unsustainable water uses. Failing to manage this type of trade-off might be associated with a lack of policy coordination and improved governance, failure to align national and regional policies, failures to accommodate and harmonize pluralistic, and lack of enforceable regulations or incentives (Schluter et al. 2009; Hagos et al. 2011; Haileslassie 2019; Muok and Onyango 2020). Hence, comprehensive, tailored to specific contexts, and vertically and horizontally aligned water resources governance framework (water resources governance manual) is essential to address the existing gaps.

The study also attempted to look into transparency, accountability and participation (TAP) in irrigation water supply in the CRV, Ethiopia. The result of the study shows that efforts were exerted to ensure TAP in providing irrigation water through promulgation of rules and regulation, arranging organizations, and educating water actors on ethics and good conducts in

service delivery and practices. The local community participated in water matters, particularly via IWUAs.

However, the implementation of TAP in irrigation water service delivery was poor in the study area. Limitations observed were absence of information accessibility to all actors, lack of inclusive participation in decision making, absence of periodical monitoring and evaluation mechanisms. Regarding gender equality in irrigation water use, though women were included in IWUAs committee members, women's desires in water access and irrigation technologies were not adequately addressed. This result match with the finding of Yami (2013) that reported equity in irrigation water service remains much behind in Ethiopia. Lack of tracking mechanisms to identify the level of transparency, accountability and participation in water supply, and lack of taking measures on non-compliances were identified. Failing to ensure accountability may hinder the commitments of actors, cause for failing water resources protection, and lose attaining minimum quality standards (UNDP 2013). In the study area, participation policy enforcements and mechanisms that enable inclusive participation of local communities in water resources decision-making processes were missed.

6.2.2. Role and interplay of institutions

As discussed in the previous chapters, water governance embraces, among other things, the processes and institutions that involve decision-making and the management of water through institutions (Rauschmayer et al. 2009; Lautze et al. 2011; Gallaher and Heikkila 2014). This study attempted to investigate the roles and interplay of formal and informal institutions in the water governance in the CRV. The finding of the study indicates that public institutions have played roles in capacity building, monitoring and evaluation, community awareness on water saving and environmental protection, providing irrigation equipment, and strengthening community-level institutions to improve water resources governance in the study area. In addition to public institutions, development partners and NGOs have exerted their efforts in areas of capacity building, watershed development and management, wetland management, integrated natural resources management activities, and providing irrigation technologies to improve the governance and sustainable water uses. The study also revealed that IWUAs (community-

based institutions) have contributed to irrigation water distribution, conflict resolution, and protection of irrigation infrastructures.

The study also revealed that informal institutions such as traditional practices, customs, and norms have been positively contributing to water resources governance in the CRV. For instance, a traditional practice called '*Tuulamaa',* a local institution established by a group of respected and well-known elders contributed to resolving disputes and water conflicts in Dugda District. Any of the disputants who refused the decision made by '*Tuulamaa'* would be socially sanctioned. Edossa et al. (2007) also reported a similar finding where informal institution role called 'Abbaa Konfi' that administers ponds in the Borana Zone of the Oromia Region. The community's customary practices such as developing terraces, planting trees, etc. were contributed in water resources governance in the CRV of Ethiopia. Several studies also show that informal institutions played significant roles in natural resource governance in many parts of the world (Degefa 2010; Nhundu et al.2015; Haider 2017; Pellowe and Leslie 2020).

Although both formal and informal institutions played great roles in water governance in the CRV, the study showed that the institutions lack systematic coordination and integration. There was no well-established platform that interlinks formal institutions such as public institutions, NGOs/Development Partners, and community institutions (IWUAs) that sustain initiatives and projects related to water governance and development in the study area. Informal institutions also have limitations such as a lack of technical and financial capacity, and a lack of institutional arrangements and facilities. This study revealed that informal institutions were hampered due to a lack of policy support and limited support from public agencies. Torjatada (2010a) reported similar findings that despite their great roles in the governance of water bodies, many informal institutions were challenged due to a lack of support, limitation of funds, and lack of capacities. Hence, the need to consider informal institutions in policy formulation, and interlinking with the existing formal governance system is suggested (Anaba 2016).

Previous studies (e.g. Ostrom 2011; Etiegni et al. 2017) mentioned that understanding the types of institutions and their interplay can show how the resource users engage in resource governance. This study revealed that the roles of formal and informal institutions were overlapping in aspects such as monitoring, conflict resolution, irrigation water distribution, and

conservation activities in the CRV. On the other hand, the interplay between formal and informal institutions was weak; they were not interlinked horizontally and vertically at different scales. The informal institutions were gradually leaving their position and roles for formal institutions such as IWUAs in the study area. A place where informal institution like '*Tuulamaa'* has involved in water governance matter, lack of capacity and facilities, and absence of policy support has been challenging its contribution. Both formal and informal institutions were not influencing each other to improve water resources governance, and didn't significantly change the behavior and practices of water users in the study area. Hence, it is essential to revisit the water management policy that accommodates the role of both formal and informal institutions that enable synergistically in the resources governance to improve its sustainability in the study area, and beyond.

6.2.3. Stakeholders interactions and power dynamics

To improve water resources governance and management, it is imperative to identify the key actors and analyze their interactions and power relations (Nikitina et al. 2009). This study attempted to assess the forms of stakeholders' involvement, their interaction, and power dynamics in the study area. The results of the study indicated that the key stakeholders' involved in water governance was mainly in resource conservation, community awareness, providing irrigation technologies, supporting materials, and capacity-building activities.

The results of the study further indicated that the relationship among stakeholders was positive (partnership mode of relation), and no conflict in objectives and actions observed. Using degree centrality, which measures the extent of interaction of actors among themselves, the study identified that government organizations at the federal level were had higher interaction with other actors. From closeness centrality, which measures how an actor is close to all other actors, the study revealed that EPA was closer to all actors in the network. On the other hand, IWUAs, District Irrigation, and Lowland Development Office, and Kebele Level Administration had low interaction with other key actors. Similarly, private companies were also less close to all other water actors. The study also identifies practices such as exchange of information, planning together, providing support for each other and collaboration among key stakeholders were not adequate.

Stakeholders' power, the extent to which stakeholders can persuade others into making decisions is generally imbalanced (Mayers 2005). This study indicates that EPA, Ministry of Agriculture, and Ministry of Irrigation and Lowland Development have better human resource potential. On the other hand, IWUAs were in the least position in terms of owning human resources capacity to accomplish their mission. Regarding making rules and taking action, the study identified that organizations at federal and regional levels were more powerful than at the District and Kebele levels. Similarly, organizations at the federal level such as the Ministry of Agriculture and Ministry of Irrigation had more knowledge generation power related to other stakeholders. The study also revealed that stakeholders at hierarchical levels (federal and regional) were frequently involved in the water decision-making processes while stakeholders at lower levels (District and Kebele) were not adequately involved in water decision-making processes of water consumed public investment such as flowery-culture industries, road construction, and industry establishments in the study area.

On the other hand, district-level organizations, local community organizations, and development partners had low power in terms of making rules and taking legal corrective measures on related to water issues in the study area. These local organizations also had lower capacity in terms of resource mobilization, and knowledge generation. The study also revealed that few stakeholder types (e.g. government organizations) dominated when compared to others. This implies that stakeholders' power among actors at different levels was imbalanced in terms of human resources, resource mobilization, and knowledge generation, decision making, and taking corrective actions. Hence, identifying stakeholders who could have power in decision-making, gauging their importance and interest, and mapping their relationship for a particular outcome is essential as suggested by Reed et al. (2009). Establishing key stakeholders' platform that enable all stakeholders accessible to information, decision making, enhancing the capacity of local stakeholders in terms of knowledge, skill, and resources need emphasis in future.

6.2.4. Willingness to pay for improved irrigation services

Instruments that enable optimal and fair allocation and efficient use of water are essential to improve water governance. Policy designers could adopt strategies such as price setting, decentralizing, considering users' preferences, and improving water rights (Veettil et al. 2011;

Ren et al. 2018). In this study, it was attempted to analyze the farmers' willingness to pay irrigation water (service) fees in the study area.

The econometric result of the study indicates that the coefficients of non-monetary attributes such as irrigation frequency, irrigation intensity, and quality of irrigation water were positive and significant. The result shows that the farmers had a positive attitude for willingness to pay demanding to use irrigation water twice or more seasons to produce crops in a year. This implies that farmers are willing to pay for irrigation water services to use an additional irrigation season, demanding an additional watering schedule with quality water in the CRV, Ethiopia. Similar results were also reported related to irrigation frequency and irrigation water quality by Basarir et al. (2009) and Chipfupa and Wale (2019) respectively. The study results are similar to the findings reported from Uzbekistan in which farmers' willingness to pay for irrigation water was positive and significant for non-monetary attributes (Kassie et al. 2022).

On the other hand, the result of this study shows that farmers have a negative willingness to pay related to the non-monetary attribute of sharing water with the downstream users. The coefficient of the attribute 'sharing water for the downstream users' indicates a negative sign, which implies farmers are unsure about paying irrigation fees while they share irrigation water with downstream water users. The idea was also reflected during a focus group discussion held in Golba Aluto Kebele of Adami Tullu Jiddo Kombolcha (ATJK) district. The result was associated with the findings of Swai (2016) which stated upstream water users need compensation to share water with downstream irrigation water users rather than paying.

The study also attempted to look into the sources of irrigation water the majority of farmers use and their preferences. The result indicates that the majority of farmers were using Lakes and groundwater for irrigation purposes. The petrol pump was the most important technology employed in farming areas. The result also shows that the preferences of participants were heterogeneous against the non-monetary attributes. Accordingly, participants from Dugda and Adami Tullu Jiddo Kombolcha Districts ranked irrigation intensity first while participants from East Meskan ranked irrigation fee as the most important attribute to decide their willingness to pay fees for irrigation water. The preference of farmers of East Meskan was directly associated with the cost of petrol to pump water to their irrigation areas as the participants of FGD

mentioned. Hence, policy intervention regarding the implementation of irrigation water charges needs to consider non-monetary attributes, alternative technologies provisions such as solar pumps, and users' preferences in water pricing as some scholars suggested (e.g. Speelman et al. 2009; Ayana et al. 2015).

6.3. General conclusions

The analysis of water resources policy, governance framework, the patterns of TAP, the role of institutions, stakeholders' interaction and power dynamics, and farmers' preferences and willingness to pay fees for irrigation water service shows the general picture of water resources governance and institutional performance in CRV of Ethiopia. In the study area, water is used for domestic, agriculture and industry. The study results show that water-related policies, regulations, and strategies were enacted and attempted to implement in the country including the study area. a variety of institutions and stakeholders were involved and contributed in water resources governance. Water resources management policy and regulations were attempted to be exercised in the study area. Institutional reforms were also undertaken to improve the governance of water resources and to ensure accountability and transparency in water service delivery.

On the other hand, irrigation activities were extensively expanded and increased, and as a result over-abstraction has threatened the water resources in the study area. On top of climate change, governance problems and institutional flaws have been exacerbating the deterioration of water resources in the area. Over-abstraction, cultivating closing to the River/Lake mouth, grabbing available water resources, and deterioration of buffer zones were the practices prevailing in the CRV of Ethiopia. These problems have threatened aquatic lives, ecosystem services, and the livelihoods of the surrounding communities.

Insufficient support of policy enforcement, an absence of clear roles and responsibilities among water actors, and incongruence of actions between water sectors were attributed to the features of water resources management practices in the CRV. Poor accountability diagnosis mechanisms, the absence of meaningful participation and less engagement of the local community in the water decision-making process, and the limited capacity of local water governance institutions were observed. Regarding the patterns of transparency, accountability and participation (TAP) in

irrigation water service supply; the aspects were poorly addressed and practiced in the study area.

Various institutions were engaged in water resources governance in the CRV, Ethiopia. Both formal and informal institutions have engaged in water resources governance. The formal institutions have involved in capacity building, providing equipment, and environmental protection. Informal institutions have also contributed in terms of awareness creation, conflict resolution, and water resources conservation and protection. However, interlinks between both formal and informal institutions were weak. Both types of institutions failed to harmonize in collective actions in water governance. As a result, the behavior and practices of water users and practices were not significantly changed in terms of saving and protecting water resources. Limited supporting policy for informal institutions, absence of incentives, and capacity gap at lower administrative scales were the main factors contributing to the low interaction among water institutions in the study area.

The power of actors involved in water resources governance was dynamic, and imbalanced in terms of human resources capacity, knowledge generation, accessibility to information, and resources mobilization. Hence, strategies that enhance their interactions and balance the power dynamics among the stakeholders need attention.

The study attempted to analyze farmers' willingness to pay for irrigation water (service) fees. It was observed from the result that farmers have a positive attitude towards the implementation of irrigation water charge policy to maintain the sustainability of irrigation activities in the CRV of Ethiopia. Non-monetary attributes such as irrigation intensity, irrigation frequency and water quality were among parameters that valued

The result of the study implies that water fee policy intervention needs to take into account non-monetary attributes such as irrigation intensity, irrigation frequency and water quality. The study reveals that farmers have a willingness to pay for irrigation water (service) fees towards these attributes. In a similar manner, the result of positive utility of farmers' willingness to pay with respect to the attributes of irrigation intensity, frequency and water quality implies that irrigation water charges need to consider the supply of irrigation water facilities and quality of water for

irrigating planted crops. The coefficient of sharing water for downstream users was negative implying that upstream farmers have no willingness to share irrigation water to the downstream users. However, the coefficient of water sharing attribute value shows insignificance compared to other non-monetary attributes.

Hence, the irrigation water charge policy of the country needs to be designed in a way that considers non-monetary attributes and compensation mechanisms between upstream and downstream water users in the CRV of Ethiopia and other similar areas to ensure sustainable production and water uses. Moreover, development partners and concerned bodies should give attention to solar or other non-gasoil lifting technologies to pump groundwater and pump water from the water sources to irrigation farming lands to sustainably implement irrigation water (service) fees in the area, and elsewhere with similar conditions in the country. Regarding water resources governance, the capacity of actors, particularly IWUAs and smallholder farmers, need continuous awareness creation and capacity building activities on water resources protection and sustainable uses. Diversifying income-generating activities other than irrigation also need attention to minimize pressures on the physical resources in the study area.

6.4. Recommendations

Based on this study finding, the following suggestions are forwarded for future policy consideration:

- The study has produced the result based on empirical evidence on the water resources governance and institutional aspects. Hence, the study suggests water sectors acting at different levels, i.e., at the CRV sub-basin, national, regional, and local government organizations, and development partners working on environmental protection, and other actors use these findings in their planning, monitoring, and evaluation program, policy formulation, and strategy developments as input for their future interventions to improve water governance and institutional settings.
- The study identified that water resources management policy and regulations were not adequately implemented due to a lack of enforcement mechanisms. To support the policy implementation national and regional water sectors need to collaboratively develop detailed standards, guidelines, procedures, and incentive mechanisms that enable all actors to accomplish

their roles and responsibilities at all levels and scales to avoid institutional overlaps and operational gaps and manage the tradeoffs of water uses for different purposes and users in the CRV, Ethiopia. In this line a platform (from all key actors) that aware users and periodically evaluate policy implementation and make policy improvement based on the local context and community policy dialogue is essential.

 Evidence of the study revealed the lack of consultation between adjacent districts; particularly, between Dugda and East Meskan on how to fairly allocate irrigation water for farmers in both districts, i.e., between upstream and downstream water users. To address these limitations the adjacent districts, collaborating with national and regional water sectors and key actors, need to develop local partnerships (negotiation among the local people between the two districts on how to fairly use water resources) at the catchment level or beyond that enable them to collectively undertake planning, monitoring, conservation, water allocation, distribution, and management of water resources in the area.

 The findings of the study indicate that both formal and informal institutions have been contributing in many aspects to improve water resources governance in the CRV. On the other hand, these institutions have no systematic coordination and integration, they lack a common platform, and the interplay between these institutions is weak. Hence, revisiting water resources management policy to indicate the role of informal institutions, and how they synergistically act with formal institutions to improve the sustainability of water use in the study area. It is also important to devise incentive mechanisms and capacity-building strategies for informal institutions to excel in their contribution to water governance in the CRV, and elsewhere in the country with similar conditions.

 The interaction among the stakeholders was not strong, inclusive, and not systematized. Power relation is imbalanced; stakeholders at federal and regional levels were more powerful and influential in various aspects when compared to stakeholders at the district and Kebele levels. Thus, either policy or regulatory frameworks or both are required to address the imbalanced stakeholders' interactions.

 Farmers' willingness to pay for irrigation water shows positively towards the non-monetary attributes such as irrigation frequency, irrigation intensity, and water quality for irrigation production. However, the increasing cost of production associated with fuel (using petrol pumps)

might affect the farmers' willingness to pay for irrigation water fees in the future. Additionally, to implement an irrigation water pricing system in the study area, policy direction should emphasize non-monetary attributes of irrigation water, provision of non-fuel powered and cost-effective irrigation water lifting technologies, and devising strategies to manage the tradeoffs between upper and lower catchment water users.

6.5. Contributions of the study

As the study addressed various aspects regarding irrigation water governance and institutional aspects, it has the following contributions.

Empirical contributions: The dissertation investigated various issues related to water governance and institutions. Because of this study empirical data regarding the state of water resources in the study area, limitations prevailing in water resources governance and the policy direction for interventions are documented, and anyone who is interested can use for further investigations. This study revealed that there is problem related to water resources allocation between upstream and downstream users, absence of water allocation among water uses, over-abstraction of irrigation water, and environmental degradation of the study area. This helps any interested individual or organization to have empirical evidence for further investigation and interventions. The empirical findings of this study also benefit the Center for Environment and Development (CED), Addis Ababa University in providing information about the state of water resources in the CRV sub-basin, and the area of future research interventions. The study also implies the efforts of the CED in supporting such a current and very valuable research topic for the community at large.

Conceptual contributions: The study has helped to sort out, evaluate, and contextualize the existing concepts of irrigation water governance and institutional settings at various levels, which are frequently changed and unstable. The study also identified the gap in the governance framework, which has an ambiguity regarding trans-regional water administration in the country. Hydrological boundaries and administrative boundaries are not aligned in the CRV sub-basin. It also introduced the concept of local partnership or negotiation governance model in the CRV sub-basin, which was not previously explored.

Methodological contributions: The study employed a discrete choice experiment method to analyze the farmers' willingness to pay for improved irrigation water. The discrete choice experiment is a method widely used in environmental valuation, and it is undergoing developing methods and uses very sophisticated computer-assisted software packages. This study contributed to the development of the method by verifying its applicability to farmers' WTP for irrigation water service fees in the CRV sub-basin, Ethiopia.

Theoretical contributions: the study used various theoretical concepts such as institutional theory, theory of value, contextual interaction theory, and random utility theory in combination to analyze the water governance framework, policy coherence, institutional roles, stakeholders' interaction, and irrigators' willingness to pay fees for irrigation water services in the study area. The study attempted to use different theories and concepts to achieve the designed objectives of the study and verify their applicability.

6.6. Future research area

The study attempted to address water governance and institutions using qualitative data and household surveys focusing on water resources management policy and human-water interactions. A future study can be conducted further focusing on the governance of water resources associated with climate change or in the climate change conditions at the basin or sub-basin level of Rift Valley and/or other similar areas. Future studies should use additional satellite data to understand the magnitude of physical water stress and expansion of irrigation activities in the Rift Valley sub-basin to indicate policy direction for sustainable water resource uses and conservation in the area. Irrigation water valuation has paramount contribution to set irrigation water charges; hence, any interested one can undertake monetary valuation for irrigation water the CRV of Ethiopia. Moreover, improved water governance was not studied, and an interested one can conduct further investigation on this issue.

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Appendices

Appendix I: Qualitative Data Collection Guides

Addis Ababa University

College of Development Studies

Center for Environment and Development Studies

An Interview Guide for a PhD study on "**Water Governance and Institutional Analysis in the Central Rift Valley Lakes Sub-Basin, Ethiopia"**

Interview guide for Government Agencies, Development Partners, NGOs and Civil Society Organizations Representatives

Introduction

Dear, interviewee, I am Endalew Jibat and am a PhD candidate in the College of Development Studies Center for Environment and Development at Addis Ababa University. The following interview questions are designed to selected respondents at Federal, Basin, Regional, Woreda and Kebele levels Government Agencies, Development Partners, NGOs, and Civil Society Organizations representatives. The aim of the study is to investigate water governance and institutional analysis in the Central Rift Valley Lakes Sub-Basin, Ethiopia. Hence, the objective of the interview is to collect data associated with these aspects. The collected data will be used only for this research which to be used for the partial fulfillment of a PhD degree in Environment and Development at Addis Ababa University, Ethiopia. Your responses are, therefore, vital for the quality and reliability of the study. Thus, you are kindly requested to give your factual responses without any restriction. I assured that your responses will be kept with high confidentiality.

Can you give me your consent to ask you the questions?

Thank you for your cooperation!

Part I: Background information

1. Name of Organization: _____
2. Type and sector of the organization:
   a) Government b) NGO c) Development partners d) Civil Society Organization
3. Level of operation: a) Federal b) Basin c) Regional d) Woreda e) Kebele
4. Name of the interviewee (optional):_____
5. Educational Background/Qualification:_____
6. Current Position of Interviewee: _____
7. Work experience on the current position:_____
8. Date of the interview:_____
9. Signature of the interviewee:_____

Part II. General Questions

1. Could you explain the situation of water resources in the CRV Lakes Sub-Basin?

- The main challenges and the reasons behind these challenges?

2. What are the key aspects of weakness in water governance in irrigation in CRV/Ethiopia? In your opinion, what are the mainare main solutions to address these weaknesses?

Part III. Extent of water governance system

1. List the policies and strategies designed so far for water governance and sustainable water management in Ethiopia.
   - The implementation of the existing policies and strategies
   - Specific regulations, directives, instruments, programs and plans developed to support the implementation of these?
2. Who are the major actors involved in the governance of water across scales?
   - Do policies and strategies clearly indicateindicated their roles and responsibilities?
3. How were policies and strategies designed and developed?
   - Extent of participatory, transparency and involvement of key stakeholders in the process
   - The main gaps existing in water policies, strategies and programs dev't
   - Do we need new policiespolices and strategies to address these gaps in CRV/Ethiopia or are capacity building measures needed for their efficient and effective implementation?
4. Are there instruments (e.g., permit system, types of fees, etc) used to identify the beneficiaries/polluters to pay according to their level of use and level of pollution in CRV/Ethiopia? What are these instruments?
   - What about the transparency and participatory permittingparticipatory of permitting system, collecting fees, allocation and distribution of irrigation water for users?

Part IV. Coherence in Water Governance

1. Do the agreements at different levels and scales complycompliance with constitutional provision of water resources management?
   - To what extent water rules and regulations (e.g. agreement documents, plans, institutional arrangements, etc) among water sectors of d/t levels are interdependent and compatible?
   - Do the institutional performance indicators of water sectors at d/t levels and scales align?
2. What are the key stakeholders responsible for water governance at different scales (Federal, Regional, Basin, Woreda, etc)?
   - Do institutions (actors) at different scales share the same goal of IWRM?
   - Are institutional scales aligned to hydrological and ecological scales?
3. Is there a clear alignment of responsibilities, procedures and roles among federal and regions?
   - Are there horizontal co-ordination mechanisms (e.g. b/n regions, sectors e.g.water & land)?

- Are the lower levels implementing agencies equipped well and adequately financed?

4. What are the monitoring and evaluation mechanisms of water sectors performance at federal, regional and Woreda levels? List/explain. Do the mechanisms interact or contradict?
    - Cross-sectoral meetings, policy reviews, and joint actions at national and sub-national level?
5. Are there a national multi-stakeholder co-ordination platform including representatives from public of d/t levels, private and non-profit sectors and different categories of users? Explain.
6. Are there conflict mitigation (avoid unintended consequences) and resolution mechanisms to manage trade-offs across water-related policy areas, and among upstream and downstream water users (e.g, on Meki river, w/c crosses Oromia Region & SNNPR)?
7. What kind of strategy and measures are important to resolve the tradeoffs between the ecosystem services of water bodies (e.g. Meki River and Lakes Ziway and Abijata) and the various uses of these resources to enhance sustainability?

Part V. Institutional Arrangements

1. Are there empowering the local levels to make decisionsdecision that enable the stakeholders to act closely to address the local context? If yes, explain. If not, what are the challenges?
    - Explain the extentExplain extent of water management responsibility decentralized (e.g. Basin based, catchments based, watershed, lower tiers of government, private sector, committees, civil society organizations and communities or water users associations).
    - Is decentralizationIs the decentralization based on the principle of subsidiarity?
2. Who is/are regulatorsregulator of water resources? Are relevant regulatory and inspection authorities have clear mandates and capable to implement the mandates?
    - Are they equipped with resources in line with their mandate?
    - Do regulatory authorities take decisions that can also be legally binding? If yes, what are Indicators? If not, what are the limitations?

Part VI. Water Allocation, Permission and Abstraction

1. How (base) the country's legal framework allocates water among various sectors in Ethiopia?
    - Who is/are responsible (by law) for governing water allocation and setting water allocation priority in the country?
    - Does the waterDoes water allocation system clearly explain the volume of water abstraction, and allow transferability of water rights?
2. What is the guideline for allocating permits to smallholder farmers?
    - Are there public-funded schemes under the management of IWUAs?

- Can the irrigation water users association (IWUAs), a locallocal organization of irrigators, request a management transfer of a public-fundedof public-funded scheme from the government (federal/or national) on behalf of its members and obtain a permitobtain permit?

3. Is there the permit system for usingof using surface and groundwater for agriculture?
    - How a permit to use water for irrigation is obtained?
    - How are the feesthe fees are established or imposed for irrigation water (services)?
4. Is there an establishedthere established quality standard to control release of industrial or agricultural wastes in the surrounding environment (land, lakes, rivers, etc) and force pollution charges? Explain.

Part VII. Irrigation Water Services

1. Are there provisions for legislating and regulating water supply for irrigation services?
    - Is there a mechanismthere mechanism for provision of regular operation and maintenance of irrigation infrastructure, and improvement of irrigation water services?
    - Do regulating institutions establishestablished with their responsibilities to oversee implementation?
    - What is the structure of regulating and controlling water services of irrigation?
2. What are the role of the government, local institutions and private sector in irrigation water supply and improved services?
    - Is there a framework for private sector involvement in operation and maintenance of irrigation infrastructure and improvement of irrigation water services?
3. Do water laws address equity issues (e.g., women, youth and marginalized groups) in service provision, and water charges (such as social tariffs or other measures)?
    - Is theDo the distribution of irrigation water fair and accessible for all?
4. Do water laws and regulations clearly and sufficiently state about cost recovery and maintenance of irrigationirrigations schemes?
    - If yes, how is its implementation?
    - Main challenges related to cost recovery and maintenance of irrigation schemes,
    - What should be done to address these issues?

Part VIII. Transparency and accountability

1. Are there mechanisms/tools to track transparency, accountability and participation in the water sector?
    - Are there evaluation tools to track budget transparency in the water sector?
    - Are corruption risks and actual corruption in the water sector (e.g. manipulation of knowledge and information, bribery, extortion) diagnosed?

2. Are there mechanisms devised to resolve conflicts among stakeholders and to enhance stakeholder participation at all levels of decision-making? If yes, what are these mechanisms? If not, whynot why?
3. Are there clear mechanisms that make accountable those who violatethose violate water laws, rules and regulations? If yes, what are these mechanisms?

Part IX. Interplay of formal and informal institutions

1. Are there traditional, informal rules and social norms used in irrigation water governance in CRV/Ethiopia?
    - Are there mechanisms that integrate traditional, informal rules and social norms into formal governance of irrigation water in the CRV/Ethiopia?
2. How are water rightswater rights are created and defined in Ethiopia (through customary laws and practices, regulations, religious laws, etc)?
3. Do IWRM plans take into account the customary laws and practices?
4. Are there provisions or incentives for civil society monitoring?
5. Do water laws consider customary laws and find ways to reconcile customary practices and obligations to achieve efficiency and equity?
6. Which institutions, both formal and informal, governgoverning irrigation water uses in CRV? How do diverse institutional arrangements shape irrigation practices in CRV?
7. Is there a point where informalwhere do informal and formal institutions overlap or come into conflict in irrigation watering in CRV?

Appendix II: Quantitative Survey Tool

Addis Ababa University

College of Development Studies

Center for Environment and Development Studies

A survey questionnaire for farmers willingness to pay for irrigation water in Central Rift Valley: application of choice experiment method

Survey Questionnaire Consent Form

Enumerator: At the beginning of the interview, present yourself and the aim of the survey to establish trust with the respondent. The informed consent form should be read to the respondent, and a copy of the form should be handed to them for their keeping. Please take the time to answer the respondent's questions. Clearly ask if the respondent agrees to participate in the study.

Dear Participant,

I am, _____, enumerator in a study designed to collect data for the PhD study. The purpose of this study is to examine farmer's willingness to pay (WTP) for irrigation water in the Central Rift Valley (CRV) basin of Ethiopia. This questionnaire helps to gather household data of factors affecting their WTP using discrete choice experiment (DCE). This survey will allow us to contextualize the results from the DCE and better understand how households' willingness to pay for irrigation water differs across different types of households. You are selected to participate in this study as part of sample respondents, randomly selected household heads. Your participation in this survey is completely voluntary. I would like to confirm that there are no risks to you for participating in this study and the information you provide will remain completely confidential. The data generated from this survey will be analyzed and reported in summary form, like averages and other statistics, to support the government's efforts through enhancing informed policy decision-making. Your view could be used as an important input to officials and policy makers in their effort to provide irrigation water sustainably. It is very important that the answers to the questions are correct. The survey questionnaire will be filledwill filled by trained enumerators. This consent form is, therefore, written to kindly ask you to participate and help in providing genuine and honest responses to complete the survey questionnaire.

Do you consent to participate in this survey**?** Yes No

Do you cultivate any land, or do you raise livestock? Yes No

Enumerator: If the response to even one of these questions is NO, the questionnaire cannot be conducted for this household. Thank the person you spoke to and go to another household from the replacement list.

Part I. General Information

Region: 1= Oromia; 2= SNNP	Woreda Name (1= East Meskan; 2= Dugda; 3= Adami Tullu	Kebele: 1= A/Germama 2= D/Gola; 3= G/Qorke adii; 4=G/Aluto; 5= B/Fuxo; 6= Sh/ Gamo	HH name	HH ID	Name of the enumerator	Date of the interview (DD/M/Y)	Started when (hrs/min)	Ended when (hrs/min)

Demographic and socio-economic characteristics of the respondent (Put a check mark √ or write the required answer in the space provided)

Items	Responses
1. **Sex** of the household head	1 = Male 2 = Female
2. Age of the household head	_____ years
3. How many members does your household have, including yourself?	Male _____ Female _____
4. No of dependents (0-13 years)	Male _____ Female
5. No. of seniors (beyond 65 years)	Male _____ Female
6. No. of adults (between 13-65 years)	Male _____ Female _____
7. Have you or somebody in the household attended formal education?	1 = Yes 2 = No
8. If your answer for Q. No 1.7 is 'Yes', what is the highest-level education attended by a household member?	_____
9. What is the highest-level education you attended?	
10. Number of household members with primary education?	_____
11. Number of household members with secondary education?	_____
12. Number of members with tertiary (college) education?	_____
13. What is the highest-level education attended by a household member?	_____
14. What is your main occupation?	1= Irrigation Farming 2=Animal husbandry 3= Mixed farming 4= Fishing 5= Daily Labor 6= If other, please specify _____
15. If your main occupation is Farming, how long have you been engaged in this activity?	_____years
16. If you have been engaged in farming, do you practice irrigation?	1 = Yes 2 = No
17. If your answer for Q. No 1.15 is 'Yes', which source of irrigation water do youwater you use? (More than one choice is possible)	1 = River diversion 2 = Pumping from lake 3 = Groundwater 4= If other, specify. ----------
18. If you practice irrigation, are you a memberyou	1 = Yes 2 = No

member of registered IWUAs?	
19. If your answer for Q. No 1.17 is 'Yes', do you pay IWUAs membership fee? Specify the amount	1 = Yes 2 = No Amount in Birr _____
20. Does your household own any livestock for food, for sale or other purpose?	1 = Yes 2 = No
21. If your answer for Q. No 1.19 is 'Yes', which sources of water (Lake or River or ground well) do you use for livestock drinking?	Specify the name of the Lake or River Or well_____
22. How long (distance) does it take to go from your home to main sources of water you use (Lake or the River area or ground well)?	_____ Minutes or _____Hour
23. What is the annual income (estimation) of your household for the past year (2013)?	_____ (in Birr)
24. Which one is the main source of income for your household? (More than one choice is possible)	1. Cereal crops 2. Fruits &/ vegetables 3. Livestock sale 4. Small business or trade 5. Fishing 6. If other, specify_____
25. Social responsibility	7. Farmer development groups 8. Agricultural Cooperative 9. Member of finance cooperative 10. Member of water users association (IWUAs) 11. Women's association or group 12. Youth association of group 13. Iddir 14. Equb 15. Village council 16. Other group, specify: _____

Part II. Questions Related to Awareness and Observation.

After reading each question, provide answers based on your observation and awareness

1. How do you observe the status of the **quantity** of Lake Dembel/Ziway and rivers in the CRV over the past 10 years? 1) Deteriorating 2) Improving 3) No change observed
2. If your answer for Q. No 2.1is "Deteriorating", what do you think are the main causes? (More than one choice is possible) 1) Expansion of farmland, 2) Excessive water extraction for irrigation, 3) Soil erosion 4) Deforestation 5) other, please specify _____
3. How do you observe the status of the quality of Lake Dembel/Ziway and rivers in the CRV over the past 10 years? 1) Deteriorating 2) Improving 3) No change observed

4. If your answer for Q. No 2.3 is "Deteriorating", what do you think are the main causes? (More than one choice is possible) 1) Silt deposit 2) erosion of agri-input of small scale farmers 3) Pollution from heavy agri-chemical use by floriculture, 4) other, please specify _
5. If your answer for Q. No 2.1 or 2.3 is "Deteriorating", who is the responsible body for water resources degradation? (Multiple choices is possible): 1) Small scale farmers
   2) Horticulture and floriculture industries 3) Government 4) Municipality 5) other, please specify _
6. What **measures** do you think should be taken to improve water resources governance in the CRV? (Multiple choices are possible) 1) Regulation to protect from over abstraction 2) Regulation on chemical run-off from nearby industries and agricultural activities. 3) Plantation of new trees in the degraded areas (buffer zone) of Rivers and Lakes. 4) Others, please specify _____
7. Did you **participate in trainingon training** related to water resources conservation and protection during the last year (2014 E.C.)? 1) Yes 2) No

Part III. Water resource management

Hereunder are statements that are relatedthat related to your personal view towards the governance and conservation of water resources in the CRV. After reading each statement, please specify whether you: **5=strongly agree, 4=agree, 3= disagree, 2= strongly disagree, 1= don't know** with the statement. (Put a check mark √)

S/N	Items/Statements	Responses				
		5	4	3	2	1
1.	Irrigation water users should contribute money or labor for scheme maintenance					
2.	Irrigation water users have good awareness about the future impact of over abstraction of irrigation water					
3.	Payment for irrigation water use must be put into place in the CRV to ensure the sustainability of water uses					
4.	The current functioning of IWUAs (if there is any) is sufficient to improve water resources management					
5.	The management of finance (e.g. collection and administration of fees) by IWUAs is effective in the CRV					
6.	There are required water infrastructures and its maintenance is adequately undertaken					
7.	There are implemented mechanisms for encouraging payment of irrigation water fee in the CRV					
8.	There are mechanisms for enforcing sanctions on non-compliance of IWUAs agreements and rules					
9.	Different community members (e.g. women, youth) are involved in the decision-making process of water governance and uses in the CRV					

IV. Land, Crop and Water Access

Note: A plot is defined as a piece of land which is physically connected and is not separated by a natural obstacle or by land from another farmer. Plots can be divided into parcels.

1. How many plots do you own? _____ (kart/timad/ha)
2. How many plots do you lease-in or share crop in? _____ (kart /timad/ha)
3. How many plots do you lease-out or share-crop out? _____ (kart/timad/ha)
4. How many plots do you cultivate? _____ (kart /timad/ha)
5. How many of your cultivated plots are contiguous? _____ (kart /timad/ha)
6. How long does it take you to walk from your dwelling to your nearest plot? _____ in minutes
7. How long does it take you to walk from your dwelling to your furthest plot? _____ in minutes
8. How long does it take you to walk from your dwelling to the nearest road that is passable by a motor vehicle? _____ in minutes
9. What units are used to measure this land area? 1= hectare, 2= Kert, 3= timad, 4= other, specify. ____
10. How many of these units is one hectare (ha)? 1 ha = _____
11. What units are used to measure yield? 1= Kg, 2= Quintal, 3= …. = other, specify.

Please provide below details for all the plots that you cultivated

4.12. Plot no	4.13. area (unit)	4.14. What was crop planted on the plot last year?	4.15. Yield (kg)	4.16. Was this plot irrigated? 1= yes, 0= no	4.17. The source of irrigation water	4.18. Irrigation water lifting technology (see code)	4.19. Who owned the water lifting technology? (See code)	4.20. Equipment used to bring the water to the plot	4.21. Who owned this equipment	4.22. Distance to the nearest water source
1.										
2.										

Code 4.14	**Crop planted**

	Cereals: 1c= teff, 2c= black/mixed, 3c= wheat, 4c= barley, 5c= maize, 6c= field peas, 7c= oats 8c= linseed (Telba), 9c= chickpeas (shimbra), 10c= haricot beans (boloke), 11c= groundnuts (lewz), 12c= cowpeascow peas (ater), 13c= sesame (selit) 14c= inter cropped (specify), 15c= other (specify).	**Vegetables**: 1v= potatoes, 2v= tomato 3v=onion, 4v= green paper, 5c= pepper, 6v= garlic, 7v= sweet potatoes (sekuar), 8v= garlic (nech shinkurt), 9v= eggplant, 10v= cabbage (gomen), 11v= green beans (fosolia), 12v= fenugreek (abish), 13v= spinach (quosta), 14v= beetrootbeet root, 15v= carrot, 16v= pumpkin, 17v= other (specify).	Code 4.14. **Perennial plants and trees** 1f= coffee, 2f= pineapple (ananas), 3f= chat, 4f= mango, 5f= bananas, 6f= orange, 7f= sugarcane, 8f= gesho, 9f= eucalyptus, 10f= avocado, 11f= papaya, 12= enset, 13= other, specify.

Code 4.17. 1=Groundwater, 2= river, 3= lake, 4= pond, 5= tank, 6= canal, 7=other, specify

Code 4.18. 1= 1=solar pump, 2= diesel/petrol pump, 3= Rope and washer pump, 4= treadle pumps, 5= no

Code 4.19 or 4.21 = 1= self-household, privately owned, 2= other household, privately, 3= collectively owned by a group of households, 4= public, no private ownership, 5= other, specify

Code 4.20. 1= PVC pumps, 2= flexible pumps, 3= drip lines, 4= open furrow, ditch

V. Livestock holding

1. **Types of livestock**	2. **No. owned**	3. **Sold/ slaughter/ dead/ given as gift last year**	4. **From which source do they usually drinkdrink usually?**
Calves			
Bulls			
Oxen			
Cows			
Heifer			
Goats			
Sheep			
Horses			
Donkey			
Mule			
Camel			
Chicken			
Beehives			

Codes 5.4: 1=Groundwater, 2= river, 3= lake, 4= pond, 5= tank, 6= canal, 7=other, specify

VI. Markets

Selling method	Agricultural harvest 1=Yes 0=No	Livestock head or livestock products 1=Yes 0=No	How much time does it take you to travel there to sellto there for selling? (in minutes)	How much does it cost you to transport 1 quintal of teff or maize there in the dry season? (In Birr)	Do you go to the nearest market? 1=Yes 0=No	How long would it take you to go to the nearest market? (in minutes)
I go to the local market for direct selling						
I go to the cooperative for selling						
The cooperative comes to buy						
I go to a private company for selling						
A private company comes to buy						
I go to an agent/middleman to for selling						
An agent, middleman comes to buy						
I use another system to sell (Specify)						

VII. Credit access

1. In the last 5 years, has anyone in your household taken a loan in cash (or in kind) for agriculture or livestock purposes? 1= Yes 0= No
2. Please give details about these loans. Include those you have paid back, as well as loans you have not paid back as yet. Fill one line per loan.

7.3. When? (Indicate year E.C.)	7.4. Source of the loan (code 7.4.)	7.5. Location of lender (code 7.5.)	7.6. Purpose of the loan (code 7.6.)	7.7. Type of loan (Code 7.7.)	7.8. Duration of loan (Code 7.8.)	7.9. Finished repayment 1= Yes, 0= No

Code 7.4.	Code 7.5.	Code 7.6.	Code 7.7.	Code 7.8.
1= Neighbor/Relative/friend 2= Equib/Edir 3= Cooperative 4= Microfinance Institution 5= Other, specify	1= In the kebele 2=Another kebele 3=Local market town 4= Woreda town 5= Region city 6=other, specify _____	1=To buy pump for irrigation 2= To buy farm or other tools/implements 3= To buy inputs e.g, seeds/fertilizer/pesticides/ labor 4= To buy livestock 5= To pay rent/taxes for the farm 6= To buy food 7= To undertake social events 8= other, specify	1= received in cash/repaid in cash 2= received in cash/repaid in kind 3= received in kind/repaid in kind 4= received in kind/repaid in cash 5= Mixed cash and kind 6= Other, specify	1= half year 2 = year 3 = 2 years 4= 3 years 5= other, specify _____

VIII. Choice Experiment Scenario

Enumerator: please read the explanation (separate) sheet describing the different options. Then, the enumerators present options to the respondent and ask them to choose between the options representing two scenarios (head- and tail-end). The choice sets and alternatives were arranged in two blocks "block 1" and "block 2". Full factorial design shows that there are 3x3x2x2x4= 144 rows and (144 x143)/2= 10296 possible combinations, which is too large to ask one respondent. We need to estimate D-efficient designs. The D-efficientt design contains 12 choice sets each for the head and tail-end. The Stata *dcreate* command is used to generate efficient design.

A respondent is asked either "block 1" or "block 2" (based on your response to Q 8.1.). If a farmer owns plots at the head- and tail-end ask both choice sets. Each choice set contains three options, five alternatives (attributes) with levels in addition to reference (see Table) options from which a respondent chooses. The order of the choice sets is randomly determined. Please mark the preferred option as if it is the only choice you can make. If you face any difficulty in understanding the options, please do not hesitate to ask for further clarification. Also, in case you change your mind, feel free to go back and change your previous choice(s).

8.1. Position of plots in the irrigation infrastructure _____ 1= have plots in head-end, 2= private well, 3=have plots in tail-end, and 4= other (specify)

Indicate which option do you select, from the options given below?

Block 1

Choice set 1

Attributes	Option 1	Option 2	I don't like both options
Irrigation intensity 	3 irrigation seasons in a year	1 irrigation season in a year	
Irrigation frequency 	Once a week	Every three weeks	
Water quality for irrigation 	Not suitable	Not suitable	
Readiness to share water 	No	No	
Irrigation fee 	900 ETB	1500 ETB	
Please tick/mark (√) only one			

Choice set 2

Attributes	Option 1	Option 2	I don't like both options
Irrigation intensity 	1 irrigation seasons in a year	3 irrigation season in a year	
Irrigation frequency 	Once a week	Every two weeks	
Water quality for irrigation 	Not suitable	Suitable	
Readiness to share water 	Yes	Yes	
Irrigation fee 	1100 ETB	1500 ETB	
Please tick/mark (√) only one			

Choice set 3

Attributes	Option 1	Option 2	I don't like both options
Irrigation intensity 	3 irrigation season in a year	1 irrigation seasons in a year	
Irrigation frequency 	Every three weeks	Once a week	
Water quality for irrigation 	Suitable	Suitable	
Readiness to share water 	Yes	Yes	
Irrigation fee 	1300 ETB	900 ETB	
Please tick/mark (√) only one			

Choice set 4

Attributes	Option 1	Option 2	I don't like both options
Irrigation intensity 	3 irrigation seasons in a year	2 irrigation seasons in a year	
Irrigation frequency 	Every two weeks	Once a week	
Water quality for irrigation 	Suitable	Suitable	
Readiness to share water 	No	No	
Irrigation fee 	1100 Birr	1300 Birr	
Please tick/mark (√) only one			

Choice set 5

Attributes	Option 1	Option 2	I don't like both options
Irrigation intensity 	2 irrigation seasons in a year	2 irrigation seasons in a year	
Irrigation frequency 	Every three weeks	Every two weeks	
Water quality for irrigation 	Suitable	Not suitable	
Readiness to share water 	No	Yes	
Irrigation fee 	1500 ETB	1300 ETB	
Please tick/mark (√) only one			

Choice set 6

Attributes	Option 1	Option 2	I don't like both options
Irrigation intensity 	1 irrigation season in a year	3 irrigation season in a year	
Irrigation frequency 	Once a week	Once a week	
Water quality for irrigation 	Suitable	Not suitable	
Readiness to share water 	Yes	No	
Irrigation fee 	1300 ETB	900 ETB	
Please tick/mark (√) only one			

Choice set 7

Attributes	Option 1	Option 2	I don't like both options
Irrigation intensity 	2 irrigation season in a year	3 irrigation seasons in a year	
Irrigation frequency 	Once a week	Every three weeks	
Water quality for irrigation 	Suitable	Not suitable	
Readiness to share water 	No	Yes	
Irrigation fee 	1100 ETB	1300 ETB	
Please tick/mark (√) only one			

Choice set 8

Attributes	Option 1	Option 2	I don't like both options
Irrigation intensity 	3 irrigation season in a year	2 irrigation season in a year	
Irrigation frequency 	Every three weeks	Every three weeks	
Water quality for irrigation 	Not suitable	Not suitable	
Readiness to share water 	Yes	No	
Irrigation fee 	900 ETB	1100 ETB	
Please tick/mark (√) only one			

Choice set 9

Attributes	Option 1	Option 2	I don't like both options
Irrigation intensity 	1 irrigation seasons in a year	2 irrigation seasons in a year	
Irrigation frequency 	Every two weeks	Once a week	
Water quality for irrigation 	Suitable	Suitable	
Readiness to share water 	No	Yes	
Irrigation fee 	1500 ETB	1100 ETB	
Please tick/mark (√) only one			

Choice set 10

Attributes	Option 1	Option 2	I don't like both options
Irrigation intensity 	1 irrigation season in a year	2 irrigation seasons in a year	
Irrigation frequency 	Every two weeks	Every two weeks	
Water quality for irrigation 	Suitable	Suitable	
Readiness to share water 	Yes	No	
Irrigation fee 	1500 ETB	900 ETB	
Please tick/mark (√) only one			

Choice set 11

Attributes	Option 1	Option 2	I don't like both options
Irrigation intensity 	1 irrigation season in a year	3 irrigation seasons in a year	
Irrigation frequency 	Every three weeks	Every three weeks	
Water quality for irrigation 	Not suitable	Suitable	
Readiness to share water 	Yes	No	
Irrigation fee 	1300 ETB	1100 ETB	
Please tick/mark (√) only one			

Choice set 12

Attributes	Option 1	Option 2	I don't like both options
Irrigation intensity 	3 irrigation seasons in a year	1 irrigation season in a year	
Irrigation frequency 	Once a week	Every three weeks	
Water quality for irrigation 	Not suitable	Suitable	
Readiness to share water 	Yes	No	
Irrigation fee 	1100 ETB	1100 ETB	
Please tick/mark (√) only one			

Block 2

Choice set 1

Attributes	Option 1	Option 2	I don't like both options
Irrigation intensity 	1 irrigation season in a year	3 irrigation seasons in a year	
Irrigation frequency 	Every two weeks	Every three weeks	
Water quality for irrigation 	Suitable	Suitable	
Readiness to share water 	No	Yes	
Irrigation fee 	900 ETB	1500 ETB	
Please tick/mark (√) only one			

Choice set 2

Attributes	Option 1	Option 2	I don't like both options
Irrigation intensity 	2 irrigation seasons in a year	1 irrigation seasons in a year	
Irrigation frequency 	Every three weeks	Once a week	
Water quality for irrigation 	Not suitable	Suitable	
Readiness to share water 	Yes	No	
Irrigation fee 	900 ETB	1500 ETB	
Please tick/mark (√) only one			

Choice set 3

Attributes	Option 1	Option 2	I don't like both options
Irrigation intensity 	2 irrigation season in a year	2 irrigation seasons in a year	
Irrigation frequency 	Every three weeks	Every two weeks	
Water quality for irrigation 	Suitable	Suitable	
Readiness to share water 	No	Yes	
Irrigation fee 	1300 ETB	1100 ETB	
Please tick/mark (√) only one			

Choice set 4

Attributes	Option 1	Option 2	I don't like both options
Irrigation intensity 	2 irrigation seasons in a year	2 irrigation seasons in a year	
Irrigation frequency 	Once a week	Every two weeks	
Water quality for irrigation 	Not suitable	Suitable	
Readiness to share water 	Yes	Yes	
Irrigation fee 	1100 ETB	900 ETB	
Please tick/mark (√) only one			

Choice set 5

Attributes	Option 1	Option 2	I don't like both options
Irrigation intensity 	2 irrigation seasons in a year	1 irrigation seasons in a year	
Irrigation frequency 	Once a week	Every three weeks	
Water quality for irrigation 	Not suitable	Suitable	
Readiness to share water 	Yes	Yes	
Irrigation fee 	1500 ETB	900 ETB	
Please tick/mark (√) only one			

Choice set 6

Attributes	Option 1	Option 2	I don't like both options
Irrigation intensity 	3 irrigation seasons in a year	2 irrigation seasons in a year	
Irrigation frequency 	Once a week	Every two weeks	
Water quality for irrigation 	Not suitable	Suitable	
Readiness to share water 	Yes	No	
Irrigation fee 	900 ETB	1500 ETB	
Please tick/mark (√) only one			

Choice set 7

Attributes	Option 1	Option 2	I don't like both options
Irrigation intensity 	2 irrigation season in a year	3 irrigation season in a year	
Irrigation frequency 	Once a week	Once a week	
Water quality for irrigation 	Not suitable	Not suitable	
Readiness to share water 	No	Yes	
Irrigation fee 	1100 ETB	1300 ETB	
Please tick/mark (√) only one			

Choice set 8

Attributes	Option 1	Option 2	I don't like both options
Irrigation intensity 	2 irrigation season in a year	3 irrigation seasons in a year	
Irrigation frequency 	Once a week	Every two weeks	
Water quality for irrigation 	Not suitable	Not suitable	
Readiness to share water 	Yes	No	
Irrigation fee 	900 ETB	1500 ETB	
Please tick/mark (√) only one			

Choice set 9

Attributes	Option 1	Option 2	I don't like both options
Irrigation intensity 	3 irrigation seasons in a year	1 irrigation seasons in a year	
Irrigation frequency 	Every two weeks	Once a week	
Water quality for irrigation 	Suitable	Not suitable	
Readiness to share water 	No	Yes	
Irrigation fee 	1500 ETB	1100 ETB	
Please tick/mark (√) only one			

Choice set 10

Attributes	Option 1	Option 2	I don't like both options
Irrigation intensity 	3 irrigation seasons in a year	1 irrigation seasons in a year	
Irrigation frequency 	Every three weeks	Every three weeks	
Water quality for irrigation 	Not suitable	Suitable	
Readiness to share water 	Yes	No	
Irrigation fee 	1500 ETB	900 ETB	
Please tick/mark (√) only one			

Choice set 11

Attributes	Option 1	Option 2	I don't like both options
Irrigation intensity 	3 irrigation seasons in a year	1 irrigation seasons in a year	
Irrigation frequency 	Every two weeks	Once a week	
Water quality for irrigation 	Suitable	Not suitable	
Readiness to share water 	No	No	
Irrigation fee 	1300 ETB	1300 ETB	
Please tick/mark (√) only one			

Choice set 12

Attributes	Option 1	Option 2	I don't like both options
Irrigation intensity 	1 irrigation season in a year	3 irrigation seasons in a year	
Irrigation frequency 	Every three weeks	Every two weeks	
Water quality for irrigation 	Suitable	Not suitable	
Readiness to share water 	Yes	No	
Irrigation fee 	1300 ETB	1300 ETB	
Please tick/mark (√) only one			

IX. Follow-up questions

1. Which were the most important criteria in making your choices?

Attributes	**Please rank (5= most important, 1= least)**
Irrigation intensity	
Watering frequency	
Water quality for irrigation	
Readiness to share water	
Irrigation water fees (in Birr)	

2. How many times do you grow crops using irrigation? 1= once, 2= twice, 3= three times, 4= other (specify) _____
3. Was the WTP bid higher than you expected? _____ 1=yes, 0= no
4. Is the payment vehicle (Birr) appropriate? _____ 1=yes, 0= no
5. Did you expect that your responses will affect the water fee rate that will be introduced by the government? 1=yes, 0= no
6. How difficult was answering these questions to you? 1= Not difficult at all, 2= Some how difficult, 3= Very difficult
7. If your answer is to the above question is difficult or very difficult, express the reasons for this difficulty.
   1._____
   2._____

a. Please rank the attributes by their importance using a Likert-type scale between 1 and 5 where 1 indicates 'very unsure' and 5 indicates 'very sure'.

Attributes	**Likert scale**				
	Very unsure= 1	**Unsure= 2**	**Sure or unsure=3**	**Sure= 4**	**Very sure= 5**
Irrigation intensity					
Water frequency					
Water quality for irrigation					
Readiness to share water					
Irrigation fee					

b. Irrigation increases cropping season. 1=Very disagree, 2= disagree, 3= neither disagree nor agree, 4= agree, 5= strongly agree,

c. Watering/irrigation frequency strongly varies in head-ends compared to tail-ends. 1=Very disagree, 2= disagree, 3= neither disagree nor agree, 4= agree, 5= strongly agree,

d. The demand for irrigation water varies by crop categories (e.g., vegetables vs cereals). 1= Very disagree, 2= disagree, 3= neither disagree nor agree, 4= agree, 5= strongly agree,

e. The type of crop grown (cash vs. staple crop) type differentiates the households' willingness to pay for water charges. 1=Very disagree, 2= disagree, 3= neither disagree nor agree, 4= agree, 5= strongly agree,

f. How sure are you about your decision regarding how much you would pay? Please circle one number: 1 2 3 4 5

Thank you for your cooperation!