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MINISTRY OF WATER AND ENERGY

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RIFT VALLEY LAKES BASIN

PLAN

2021-2035 G.C.

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Prepared by:

National Advisory Team (Reviewers)

1. **Profesor Zinabu G/mariam—Chair**
1. **Profesor Tenalem Ayenew—V/chair**
2. **Dr. Tena Alamirew-----Secreatary**
3. **Profesor Anna Tengberg**

Technical Advisory Team

1. **Dr. Mulugeta Dadi----Chair**
2. **Dr. Habtamu Temesgen---Secratory**
3. **Dr. Mihiret Dananto**
4. **Dr. Abriham Asha**
5. **D/r Adane Kaldiso**
6. **D/r Samuel Mezmur**
7. **Mr. Sisay Kebede**

RVLBAO BASIN PLAN LEADERS

1. **Debebe Deferso**
2. **Teketel Tadesse**
3. **Debiso Dede**
4. **Kifle Degife**
5. **Cherinet Mehari**

RVL Basin Plan Compiling team

1. **Abebe Asele**
2. **Desalegn Engiso**
3. **Mesfin Mengesha**
4. **Zinabu Abrham**
5. **Geremew Gebru**


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Massage from Minister, Ministry of Water and Energy

Ethiopia has 12 basins, the second most populated nation in Africa and is situated in the Horn of Africa. It has access to a wealth of natural resources. One of the country's many natural advantages and its abundance in water resources, but there are many signs that it is not yet making the best use of these resources. Our nation can manage and utilize its natural resources to develop them sustainably and in a way that makes them a comfortable place for its residents to live. Our nation should therefore close any deficiencies in this area, develop its water resources, and manage and utilize its other natural resources effectively.

Because of this, Ministry of Water and Energy tries to improve the overall advantages of the citizens by developing and managing the nation's water resources in an efficient, sustainable, and integrated manner. As a result, it is working on numerous projects in the fields of developing renewable energy sources, integrated water resource management, and drinking water and sanitation.

Our water resources are used for agriculture and irrigation development in addition to for drinking water and electricity development. It serves as a crucial resource for the sector's tourism, entertainment, and other multifaceted services. If we develop, maintain, and utilize this resource well, the country will greatly benefit. Additionally, it plays a significant part in the growth and similar commercial contacts with the neighboring nations.

One of the 12 (twelve) key basins in our nation is the rift valley lakes basin, and the basin demands attention from all angles, especially given the scope and severity of the problems there. In particular, the natural resources are under a lot of pressure from the basin's development activities and rising public demand. These pressures include the deterioration of water resources' quality and quantity, the loss of forests, soil erosion, the silting up of lakes, the improper management and disposal of dry and sewage waste from cities and factories,

and the exposure to pollution. Additionally, the issue of handling and disposing of harmful solid and sewage wastes from cities is harming both human health and the environment as a result of the expansion of our nation's industry. Due to the complexity of the problem scenario in the Rift Valley Lakes Basin, a systematic and coordinated approach is required to solve it.

Therefore, the Rift Valley Lakes Basin Administration Office is in the phase of joint planning and implementation of a 15-year basin plan with important stakeholders and partners in order to accomplish integrated water resource management. Additionally, in order to make the plan effective in the upcoming years, attention has been paid to developing our people resources, organizational capacity, and technology capabilities, as well as fostering innovation. Additionally, it is thought to be crucial to heavily include the private sector.

In order to improve our water resources and secure the welfare of our population, I thus declare that we are prepared to collaborate with all stakeholders. I also invite others to engage with us in the same spirit and desire. I'm grateful.

Massage from Minister, Ministry of Water and Energy

One of the natural resources that significantly contribute to a nation's overall growth and prosperity is water. To ensure the quantity, quality, and proper usage of water resources, an integrated management approach is required. The Ministry of Water and Energy is working hard in this area.

In order for water resources to be adequately safeguarded and used, it is essential to create a water resource policy that is current with the times. The creation of inclusive and integrated watershed plans, rules, regulations, and recommendations based on the policy is another crucial responsibility. Therefore, the policy that has been in place since 1991 is being updated by our ministry. He has created a measure to establish a high watershed council, a national water tariff, and a bill to safeguard the borders of water bodies based on this strategy. This is done to make sure that the scarce water resources are used, preserved, and safeguarded in a proper manner.

Ethiopia's water resource challenges can be divided into two categories. The first is natural, i.e., the water availability in the nation or from the basin is slightly different; the second is driven by climate change, which includes flood and drought events. The damage from high water bodies, the loss of forest vegetation in the upper part of the watershed and the resulting formation of soil crust, the buildup of sediment in the water bodies, pollutants and substances released from factories and homes, and agrochemicals used for agricultural purposes are being leached into the soil are the main causes.

The invasive weed that is spreading quickly in water bodies is also one of the main problems of the day as a result of pollution and changes in the air layer. As a result, if these issues are not addressed quickly and in a coordinated manner, they could pose a severe threat to the security of the food, drink, and energy supply in the future. Therefore, in any case, we must carry out capacity-building activities to deal with climate change, such as using water wisely and efficiently, boosting water productivity, concentrating on crop species that can increase irrigation water efficiency, concentrating on numerous and various water storage configurations, and the encouraging the use of fuel-efficient stoves, and increasing forest cover.

Water resources should be effectively managed in order to ensure their availability in both quality and quantity everywhere and at all times. Therefore, it is important to protect water bodies from trash and contamination and should never be put off. The Ministry is working hard to ensure that everyone involved understands and applies the idea of Integrated Water Resources Management (IWRM) in order to make this a reality.

Additionally, they are attempting to safeguard the environment by using nature-based eco-hydrology science to protect the water bodies that are being harmed by invasive weeds like weed.

So that the idea of Integrated Water Resources Management (IWRM) can be put into practice and solve the problems that are currently being seen in a sustainable manner and in a timely manner, our ministry was chosen as one of the 12 basins to establish the Rift Valley Lakes Basin Management Office. In order to ensure the sustainable use of water resources and to give all parties in the watershed the opportunity to own the work, a watershed plan has been developed and implemented with the participant.

Therefore, to a greater or lesser extent, all humans use water in some capacity in their everyday activities. As a result, he or she should relinquish the duty that has been his or her life's work to protect our precious water resources from waste and pollution and to ensure that they are equally and fairly available to the future generation as well as to all of us.

Without water, life cannot exist

Message from Rift Valley Lakes Basin Administration Office

The Rift Valley Lakes Basin is one of the 12 basins in our country, and the office is one of the three basins for which the Basin Administration Office has been established. The basin is situated in three Regional States, Sidama, Oromiya and Southern Nations, Nationalities and Peoples Region (SNNPR), has 53,000 km^2 area coverage. RVLBAO is doing a lot of work by strengthening the existing organizations to enable it to carry out the key tasks given by the ministry to achieve the national vision where the society will benefit at every level by establishing an integrated, fair and sustainable management of water resources in the basin. The office is working to solve the challenges and problems faced in the basin. Among the activities they perform mainly;- Collecting and analyzing data by conducting research and analysis to identify problems in the watershed and providing support to those concerned; monitoring and supporting water users to maintain water quality; and creating awareness to prevent them from entering into the permit system; and undertakes watershed development and maintenance to prevent unnecessary wastes that cause pollution and silting of lakes; Also, by planning a 15-year basin plan that involves all parties to be effective in terms of the concept of integrated water resource management.

The Rift Valley Lakes Base Plan has been divided into three phases, starting from the previous institutional organization until it is now organized in a new form, based on the Road Map approved by the High Basin Council. The first phase is to prepare the base plan of each sub basin, the overall consolidated basin plan of the basin, and organogram that can show the organization of each basin, the second phase is to prepare the Thematic Plan, implementation plan and project plans as well. In the third phase, the stakeholder coordination forum is to be prepared and implemented.

For this purpose, our office has been implementing a cluster with eight universities in the basin, mainly using university-industry linkages. In this fiscal year, we are continuing our

good experiences from previous years and correcting weaknesses, especially focusing on the establishment and functioning of the Stakeholders' Forum.

Since the proposed basin plan will be implemented by multiple stakeholders, it is appropriate to involve implementing stakeholders from the planning stage. For this, it is very important to identify the stakeholders mentioned in the basin plan with the main activities to be implemented and connect them. Therefore, I am calling on all stakeholders, whether governmental or non-governmental, to contribute to the success of the plan, and I say let's work together to make the Rift Valley Lakes Basin a model basin. Thank you.

Acronyms and abbreviations

AFLaH	Association of Friends of Lake Hawassa
CBD	Convention on Biological Diversity
CCME	Canadian Council of Ministers of the Enviroment
CRGE	Climate Resilience Green Economy
CSA	Central Statistical Agency
CSF	Critical Success Factors
DZ	Development Zone
EEP	Ethiopian Electric Power
EFD	Ethiopian Forest Development
EIA	Environmental Impact Assessment
EMI	Ethiopian Meteorological Institute
ESS	Ethiopian Statistical Service
FAO	Food and Agricultural Organization
FDRE	Federal Democratic Republic of Ethiopia
GCM	Global Climatic Model
GEF	Global Environment Facility
HoPR	House of People's Representatives
IWMI	International Water Management Institute
IWRM	Integrated Water Resources Management
JICA	Japanese International Cooperation Agency
LPA	Learning Practice Alliance
LULC	Land Use Land Cover
MER	Main Ethiopian Rift
MoA	Ministry of Agriculture
MoF	Ministry of Finance
MoWE	Ministry of Water and Energy
MoWR	Ministry of Water Resources
MP	Master Plan
NMA	National Meteorological Agency

RBA	River Basin Authority
RBAO	River Basin Administration Offices
RBHC	River Basin High Council
RVLBAO	Rift Valley Lakes Basin Authority
RVLBAO	Rift Valley Lakes Basin Administration Office
RVLBMP	Rift Valley Lakes Basin Master Plan
SDG	sustainable Development Goals
SIWI	Stockholm International Water Institute
SNNPRS	Southern Nations and Nationalities People Regional State
SWR	South-Western Ethiopian Rift
TDS	Total Dissolved Suspended Material
WHO	World Health Organization
WQI	Water Quality Index
WRDB	Water Resource Development Bureau
WRD	Water Resource Development
WRD	Water Resources Development Fund
WRM	Water Resource Management
WSS	Water Supply and Sanitation
WWDSE	Water Works, Design and Supervise Enterprise
WUA	Water Users Association

Definition of terms

Action plan is a document that lists what steps must be taken to achieve a specific goal. It breaks down the goal into actionable steps that can be easily followed and tracked. The purpose of an action plan is to clarify what resources are required to reach the goal and formulate a timeline for when specific tasks need to be completed (*https://www.techtarget.com/whatis/definition/action-plan).*

Basin planning is the process by which decisions are made over the competing uses and different demands for water resources and associated systems within a basin (G. Pegram et al, 2013).

Integrated Water Resources Management (IWRM): 'IWRM is a process which promotes the co-ordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems (WWAP et al, 2009).

strategic basin planning can be defined as a coherent multidisciplinary approach to managing basin water resources and their users in order to identify and satisfy social, economic and environmental priorities(G. Pegram et al, 2013).

Strategic Plan: a set of short, medium and long-term action programs that are meant to realise the achievement of development goals and water-related policies. Strategy defines goals and agrees on how goals can be pursued.

Water Governance*:* describes the political, economic, administrative, social processes and institutions by which public authorities, communities and the private sector take decisions on how best to develop and manage water resources.

Water Resources Assessment: involves a holistic view of the water resources in a given country related to its use by society. It looks at both the quantity and quality of surface and groundwater. It identifies the pertinent parameters of the hydrological cycle, and evaluates the water requirements of different development alternatives.

Water Resources Development: addresses all the activities for the utilization of water resources such as water supply and sanitation, agriculture, hydropower development, navigation, etc.

Water Resources Management: comprises the whole set of human interventions in water resources. It consists of all activities for the study, planning, development, protection, conservation and control of water resources. It can also be defined as the decision making, manipulation, and non-manipulative processes by which water is protected, allocated or developed.

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EXECUTIVESUMMARY

Water is the central element of Integrated Water Resources Management. It is the most precious and foremost restraining natural capital asset with finite stock. Due to this importance, its quality, quantity and allocation, as well as ecosystem services, extreme events, and similar issues need to be strategically managed. This document is meant to strategically address these issues for the Ethiopian Rift Valley Lakes Basin, which is one of the twelve basins of Ethiopia. The basin is located in the South Western part of Ethiopia between 4^0 21' 54'' N and 8^0 28' 9''N latitude, and 36^0 45 '4''E and 39^0 22' 8.6''E longitude with a total basin area of 53,000 km^2. There are seven main lakes in the RVLB, namely Ziway, Abiyata, Langano, Shalla, Hawassa, Abaya and Chamo. Chew Bahir is still often referred to as a lake but is, in fact, a salt pan which rarely holds any water. Four of the seven main lakes (excluding Chew Bahir) are terminal by themselves. The others flow into terminal lakes, making all lake systems terminal with an annual water resource potential of 5.6 BM^3. Based on the surface hydrology of these lakes, the basin is divided into four sub-basins: Ziway-Shala Sub-basin (14,477 km^2); Hawassa Sub-basin (1,403 km^2); Abaya-Chamo Sub-basin (18,118 km^2); and Chew Bahir Sub-basin (19,029 km^2).

In 2007, the population of the RVLB was 9.8 million people. This is an increase from 7.3 million since the 1992 Reconnaissance Master Plan Study, equal to an annual rate of increase of about 2.3%. Allowing this growth rate to continue will result in a doubling of the population to 19.6 million by 2030.

In strategic planning, it is critical to understand interactions among a range of hydrological, ecological, social and economic systems and activities at work within a basin. Ethiopian water resources management policy also recognizes water as a scarce and vital socio-economic resource and advocates strategic planning with long term visions and sustainable objectives. In order to develop appropriate solutions to water related problems, planners must understand the prevailing physical, socio-economic, and governance systems along the upstream-downstream or land-to-water continuum. The policy also recognizes and adopts the hydrologic boundary or "basin" as the fundamental planning unit and water resources management domain.

This basin plan runs from 2021-2035 and contains strategies to realize the IWRM principles and the corresponding actions. It adopts the four basic principles of IWRM (*water as a finite and vulnerable resource; the need of participatory approach; gender sensitivity; and recognition of water as an economic good*). In addition, the principles that are included in the national IWRM

policy: *integration; sustainability; equity; efficiency/optimal beneficial use; harmonization and coordination; balancing bottom up – top down approach; and alignment*.

In order to develop appropriate solutions to water related problems, planners must understand the prevailing physical, socio-economic, and governance systems along the upstream-downstream or land-to-water continuum. In this regard, this basin plan relied on the situation assessment of the following four major themes: water resources availability and utilization; water quality; watershed and wetland degradation, and emerging issues such as climate change; water hyacinth etc.

Regarding the condition of water availability, the total surface water resource of the rift valley Lakes basin as calculated from total annual average River flow into the Lake systems is to the magnitude of 1553 Million m^3/yr in Ziway-Shalla sub- basin; 111 Million m^3/yr in Hawassa sub-basin; 4000 Million m^3/yr in Abaya-Chamo Sub-basin and 700 Million m^3/yr in Chew Bahir sub-basin. In total, the annual average River flow into the rift valley lakes is calculated to be 6364 Million m^3/yr.

The nature of the geological formations within RVLB and the intense tectonic disturbance that has affected them form a significant influence over the distribution and disposition of groundwater resources within the basin. The basin is comprised of volcanic (50%), sedimentary (25%), and crystalline strata (25%).

Having eight development zones delineated during the preparation of the master plan, the estimated annual direct Groundwater Recharge was 1080 Mm^3/year, out of which estimated groundwater resource availability is to the magnitude of 53 Mm^3/year.

Regarding water quality, the plan used the water quality index (WQI) as a metric for status determination and the correspond target. The index infers that almost all of the lakes (Ziway; Langano; Shalla; Abaya; Chamo; and Hawassa) have “poor” water quality (Av.WQI of the six lakes ≈ 33 as compared to a value of 100 which refers the best quality) for drinking; irrigation; recreation; and aquatic life and this basin plan attempts to reach at least to the ‘fair’ level (WQI>65).

The assessment of landscape degradation revealed that 17% of the Rift Valley basin area is severely degraded; 45% highly; 29% moderately; and 9% is slightly degraded. Here, instead of focusing on sectoral targets, this plan targets functional restoration of the landscape with multiple benefits.

About 11 governance instruments relevant to water resources management are identified in this basin plan including: The FDRE Constitution (1995); Environmental Policy of Ethiopia (1997); Conservation Strategy of Ethiopia (CSE) (1997); Ethiopian Water Resources Management Policy (EWRMP, 1999); Ethiopian Water Resources Management Proclamation (Proclamation No. 197/2000); Water Sector Strategy of Ethiopia (2001); Environmental Pollution Control Proclamation No. 300/2002 (2002); Food Security Strategy (2002); Water Resources Management Regulations (Regulation No. 115/2005); Prevention of Industrial Pollution Regulation No. 471/2005 (2005); Solid waste management Proclamation No. 513/2007; The Ethiopian Strategic Investment Framework for Sustainable Land Management (ESIF/SLM) (2010); Climate Resilient Green Economy of Ethiopia (CRGE) (2011); The Sustainable Development Goals /SDGs/ (UN, 2015); and Growth & Transformation Plan II (GTP II) (2016).

Whereas, about ten institutional frameworks are considered including: Ministry of Water, and Energy (MoWE); Ministry of Finance (MoF); Commission of Environment, Forestry and Climate Change(CEFCC) – formerly the Environmental Protection Authority; Ministry of Industry; Ministry of Agriculture (MoA); Ethiopian Meteorological Institute (EMI) - formerly the National Meteorological Agency (EMI); Water Resources Development Fund (WRDF); The Ethiopian Electric Power (EEP); Regional Bureaus/ Authorities, Zonal and Wereda offices; and River Basin High Council (RBHC) and River Basin Administration Offices (RBAO) – formerly the River Basin Authorities (RBA).

The five strategic goals of this basin plan include: [1] Enhance availability and optimum utilization of water resources for sustainable social, economic and environmental benefits; [2] Improve the quality of water resource in the basin for sustainable social, economic and environmental, benefits; [3] Improve water resource conservation, potential and community livelihood through integrated watershed management for sustainable social, economic and environmental, benefits; [4] Reduce flood, drought and invasive species risks in the basin to improve social, economic and environmental benefits; and [5] Ensure active and socially inclusive stakeholder participation in planning, decision making, implementation, monitoring and evaluation of IWRM.

While formulating the theory of change, the following assumptions were considered: [1] Actors are well qualified to actualize the governance instruments and coordination among the stakeholders exists together with political wills; [2] Effective trainings of the community is delivered properly; [3] Gender mainstreaming is ensured; [4] Mechanisms for coordination, cooperation, and collaboration across the source-to-lake continuum are established and functional; [5] Best-fit technologies and approaches are available; [6] The targeted stakeholders voluntarily accept the alternative livelihood options; [7] Monitoring and assessment of process, stress reduction, environmental and socio-economic status indicators and strategies to capture lessons learnt for dissemination and adaptive management are in place. Implementation of this basin plan requires a total of about **52.7 Billion ETB** within the coming 15 years (2021-2035) with annual average investment of **3.5 billion ETB** in order to address the anticipated targets. Different resource mobilization protocols are needed and these may include the Public Private Partnerships (PPP) framework for accelerating water resources management and development. The government fund which is mandate-based is considered as the major source of fund for IWRM implementation in the basin.

As a limitation to the preparation of this strategic IWRM plan, the impact of COVID-19 pandemic is the dominant one followed by the political unrests occurring here and there during the study period. These limitations significantly restricted the physical meetings of stakeholders which is the key component of basin planning. As a practical solution, the basin plan has been exposed to the wider stakeholders through virtual meetings as well as workshops in the context of physical distancing for limited number of stakeholders. Technically, a significant portion of this basin plan extract information from the Master Plan that was completed in 2010.

1

Background

1.1. Purpose and Scope of the Strategic Plan

River basin management (RBM) is one of the IWRM areas that can be defined as the process of coordinating conservation, management and development of water, land and related resources across sectors within a given river basin, in order to maximize the economic and social benefits derived from water resources in an equitable manner while preserving and, where necessary, restoring freshwater ecosystems.

Basin plans have become a core element of water management in the 21st century (Kazbekov et al., 2016) whereas methodology is not explicit and there is no standard 'one size fits all' blueprint or protocol for basin planning (Guy et al., 2013). The concept of strategic river basin planning has evolved since its emergence in the late 20th C. Until the 1990s, it essentially meant long-term infrastructural development planning, with relatively simple social or environmental analysis. Passing through different phases, basin planning contemporarily reached at strategic phase by focusing on multidisciplinary planning for economic, ecological and management

solutions that bring together a range of different disciplines and themes, from hydrology and engineering to ecology and economics.

In strategic planning, it is critical to understand interactions among a range of hydrological, ecological, social and economic systems and activities at work within a basin. Strategic river basin planning consists of a complex, socially ambitious set of knowledge production practices, involving monitoring and assessment, expert-led analysis, and participatory planning (Guy et al., 2013).

Water is our most precious and foremost restraining resource of natural capital with finite stock; whereas its quality and availability is endangered in Ethiopian Rift Valley Basin, for which this basin plan is prepared. Despite its challenges, complexity, and multi-faceted nature, water resources need to be considered from a holistic perspective (Nepal, 2012). It is precisely because water resources provide so many functions that planning for their use is so complex. Ethiopian water resources management policy also recognizes water as a scarce and vital socio-economic resource and advocates strategic planning with long term visions and sustainable objectives. The policy also recognizes and adopts the hydrologic boundary or "basin" as the fundamental planning unit and water resources management domain.

1.2. Structure of the Strategic Plan

This basin plan comprises ten chapters as shown in *figure 1* below.

Figure 1. Steps of the strategic basin plan

1.3. The background principles of the strategic plan as derived from the IWRM concept

The basis of IWRM is that different uses of water are interdependent, and integrated management means that all different uses of water resources are considered together. In the context of this reality, business as usual is neither environmentally sustainable, nor is it sustainable in financial and social terms. For this, our strategic plan attempts to integrate the three E's of the IWRM framework: **E**conomic efficiency, Social **E**quity, and **E**cological sustainability. The upcoming sub-sections explain how these principles are addressed in this strategic IWRM plan.

1.3.1. Principle 1: Freshwater is a finite and vulnerable resource, essential to sustain life, development and the environment:

Implication to our IWRM strategic plan:
[1] Holistic approach shall be employed
[2] Mandated actors on water, land, forest, industry, job creation etc. shall collaborate for one big vision
[3]Ecohydrologic system solutions (EHSS) will be adopted in some part of the basin to demonstrate enhancement of carrying capacity of the ecosystem as a new paradigm of IWRM implementation

1.3.2. Principle 2:Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels

Implication to our IWRM strategic plan:
[1] Those individuals (parties) concerned about decisions or who are affected by water-related decisions must participate in water governance.
[2] Our basin plan includes the establishment of LPA (Learning-practice alliances) as proven instrument for participation of the diverse stakeholders according to issues and/or basin

Here, the Learning-practice-alliances (LPA) model of stakeholders' participation that one of the multi-stakeholders' dialogues will be adopted for effectively mainstreaming of the above principle. LPA is a platform which brings together a range of stakeholders to exchange knowledge and generate innovation. The stakeholders are drawn from different interest groups, disciplines, sectors and organisations, and come together in an LPA to share experiences,

develop joint agendas for change, and to test new solutions to their common problems. There are a number of reasons for people to come together and have dialogue on shared issues. The expectation is that through dialogue, perceptions and problem definitions will change and converge. However, the multi-stakeholder dialogue is not just a conversation or the same as consultation. It is an interactive approach to getting things done- 'a contrived situation in which a set of more or less interdependent stakeholders in a resource are identified and invited to meet and interact in a forum for conflict resolution, negotiation, social learning and collective decision-making towards concerted action'. It is both a process and an outcome.

In the current policy discourse, the philosophy of involving multiple stakeholder groups in development projects appears to be unstoppable. Most of the issues we face today are neither owned nor solved by individual stakeholders anymore. Sustainable solutions for sustainability problems require sustainable processes of stakeholder involvement and engagement. With growing interdependence comes a growing need to search for collaborative approaches. Too often we talk about 'the community' as if we are all the same. Practically, stakeholders are diverse and need to properly participate in development projects for its success.

1.3.3. Principle 3: Women play a central part in the provision, management, and safeguarding of water

Implication to our IWRM strategic plan:
[1] We recognized the importance of women's role and incorporate the Women and Children Affairs Bureau in the LPA forum
[2] Gender mainstreaming tools are to be used while appraising and implementing the basin plan
[3] This plan is committed to at least 50% of LPA members being women

The following ten gender mainstreaming strategies in IWRM is suggested by the gender specialist of Rift Valley Lakes Basin Office and amended by the planning team members:

(1) Finding a point of interest for males and females to jointly engage in discussing, planning, and implementation of IWRM processes.

(2) Focusing on female headed households because they are more involved in agriculture and irrigation, and at the same time the most economically vulnerable in terms of income generation.

(3) Focusing on the merits of gender mainstreaming on the well-being of the family as a whole.

(4) Building the capacity of women to enhance their communication skills.

(5) Empowering women to participate in decision making and planning in IWRM.

(6) Enhancing gender equity, thus increasing equal representation of water users in water management which can lead to a more efficient use of resources and solving of problems.

(7) Strengthening poverty alleviation programs as the burden of poverty often affects women more than men.

(8) Ensuring equal and easy access to water management related information by both male and female water users.

(9) Making gender aware agricultural and water management policy decisions because good agricultural and water management policy requires an understanding of the gender dimensions.

(10) Providing alternative technologies to women to reduce deforestations (which occur because of the collection of firewood) in the rift valley basin.

1.3.4. Principle 4: Water has an economic value in all its competing uses, and should be recognised as an Economic Good

Implication to our IWRM strategic plan:
[1] We introduced water tariffing system
[2] Use of water with as high efficiency as possible
[3] Introduction of water allocation system (the detail will be addressed by the upcoming thematic plan
[4] In this basin plan, we anticipate to create jobs for the unemployed

1.4. Additional principles adopted from the National IWRM program

1.4.1. Integration

Water resource management is strongly multi-dimensional in a sense that it needs integration of all uses and users simultaneously. There is always a trade-off in using water for one purpose against another use. It is for this reason that integration, including the active engagement of sectors and development partners is imperative.

1.4.2. Sustainability

'Some, for all, forever, together': The interdependence between humans and ecosystems is clear. The more the quality and quantity of available water is compromised, the more livelihoods are compromised. Moreover, water allocation decisions must consider the needs of future generations as well since ecological and socio-economic sustainability depend on water resources.

1.4.3. Equity

Allocation of water should address the issue of fair access to water resources between existing and potential users. A special focus should be on those who have historically not benefited from water resources management, such as women and the poor. Equity issues also arise when an allocation regime is changed by changing a minimum flow, altering priorities or changing the total amount of water that can be allocated from a resource.

1.4.4. Efficiency/optimal beneficial use

Allocation of water to users should be guided by the need to encourage and support efficient, optimal and beneficial use of water. The aim of this principle is to allocate water to a broad range of uses in a variety of sectors so that a diverse, robust and stable economy can be supported.

1.4.5. Harmonization and Coordination

Develop partners support will be effective when supports are harmonized, aligned, owned, managed for the results, and accountability is ensured. The IWRM plan can therefore help to bring together development actors – donors, public institutions, academia, private sectors and NGOs together to chart the road towards effective use of the developmental support and strive towards the targets set under SDGs.

1.4.6. Balancing Bottom up – top down approach

Water management should be implemented at the lowest possible management unit. For instance, a small lake could be best managed by engaging the communities that have stakes in the well-being of the water body. It is however equally important that activities among different sectors be aligned and cascaded to respective bureaus and offices at region and wereda level. The role the Basin High Council (BHC) plays is equally vital in ensuring leadership ownership and enforcing grass root decisions.

1.4.7. Alignment

Donor countries and organizations bring their support in line with developing country's strategies and use local systems.

2

Brief Description of the Basin

2.1. Location

In Ethiopia there are 12 River Basins. Among these, the Rift Valley Lakes Basin is one of the major Basins. The Rift Valley Lakes Basin is located in the South Western part of Ethiopia between 4^0 21' 54'' N and 8^0 28' 9''N latitude, and 36^0 45 '4''E and 39^0 22' 8.6''E longitude (*figure 2*). The basin is situated in three Regional States, Sidama, Oromiya and Southern Nations, Nationalities and Peoples Region (SNNPR), has 53,000 km^2 area coverage and has the potential of 5.6 BM^3 annual water resource. The basin is sub-divided into 4 sub-basins which are endowed with the major seven lakes (hence it is called the Lakes basin).

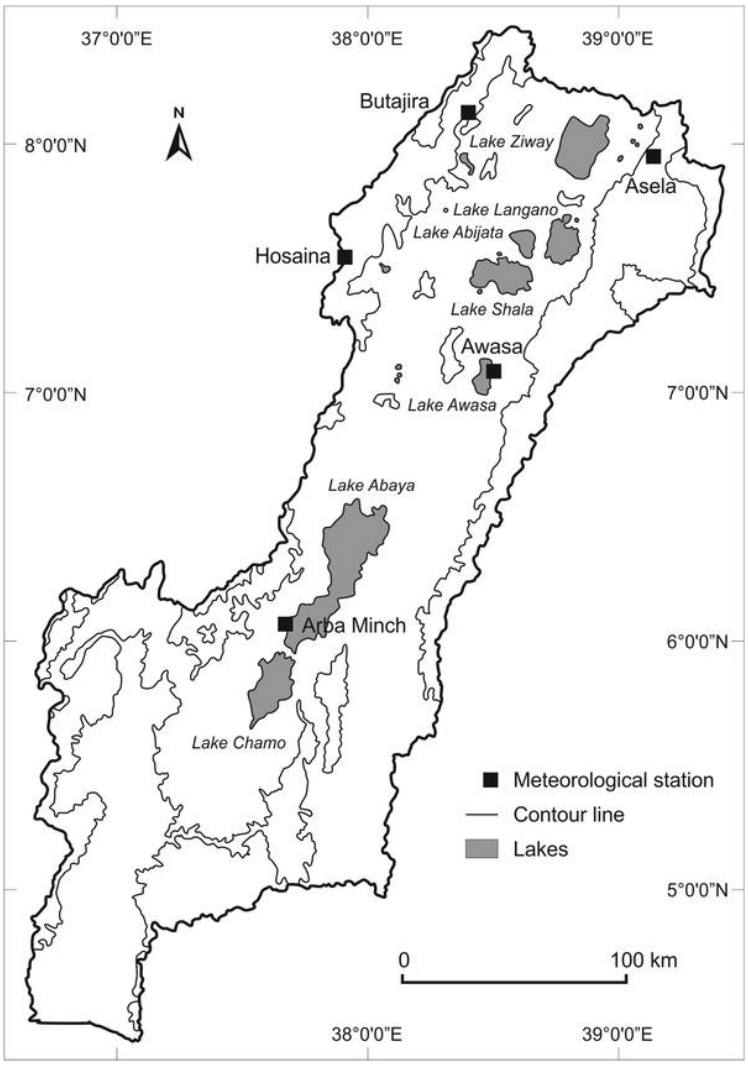


Figure 2.Location map of Ethiopian Rift Valley Lakes Basin

2.1.1. Population

In 2007, the population of the RVLB was 9.8 million people (MoWR, 2007). This is an increase from 7.3 million since the 1992 Reconnaissance Master Plan Study, or an annual rate of increase of about 2.3%. Allowing this growth rate to continue will result in a doubling of the population to 19.6 million by 2030.

2.1.2. Physiography, Climate and Hydrology of the RVLB

The principal feature of the RVLB is that it is a graben, a block fault geological structure in which the floor of the valley has become vertically displaced with respect to the valley sides. As in all areas, the temperature and rainfall of the RVLB tend to vary as a function of elevation and,

in consequence, so do relative humidity and potential evapotranspiration. The top of the Rift Valley on the east and west sides is therefore cooler, wetter and with lower evapotranspiration rates, than the hotter, drier and with higher evapotranspiration, central lowlands.

On the valley bottom, average annual rainfall varies from approximately 400mm at Chew Bahir in the extreme south of the basin, through approximately 700mm near the northern lakes. In contrast, average annual rainfall approaches 2,000mm near Gerese, west of Lake Chamo, and also at Yirga Chefe, east of Lake Abaya, both on the higher edges of the basin.

Two principal patterns of rainfall seasons are apparent in the RVLB. North of Lake Abaya, the main rains occur July through September, with a secondary peak in March or April. South of Lake Abaya, the main rains occur earlier in the year, between March and May.

Annual average potential evapotranspiration varies from approximately 1,200mm in the north-east of the basin to approximately 1,900mm at Chew Bahir. Throughout the Rift Valley floor, from Lake Ziway to Lake Chamo, the average values are typically on the order of 1,550mm.

Annual average temperatures vary from approximately 27^{o}C on the valley floor near Chew Bahir to a low of approximately 13^{o}C at higher elevations, particularly in the north-east of the basin.

2.1.3. Characteristics of the lakes

There are seven main lakes in the RVLB, namely Ziway, Abiyata, Langano, Shala, Hawassa, Abaya and Chamo. Chew Bahir is still often referred to as a lake but is, in fact, a salt pan which rarely holds any water.

Bathymetric surveys have been carried out on all of the seven lakes at various times. The earliest were Lake Abaya and Lake Chamo, carried out as part of a doctoral dissertation by Dr. Sileshi Bekele at Arba Minch University, both done in 2000. Lake Ziway was done in 2005 by MoWR. Lake Hawassa was done in 2006 by the SNNPRS administration. The data from these surveys was collected and analysed during Phase 1. Surveys for the three other lakes, Abiyata, Shala and Langano, were carried out as part of this current study. The basic characteristics of the lakes are given in Table 1.

Table 1. Characteristics of Rift Valley lakes (Source: Halcrow, 2009)

Lake	Surface Area (km^2)	Max depth (m)	Ave depth (m)	Volume (km^3)
Ziway	423	9	2.5	1.1
Abiyata	132	14.2	7.6	1.61
Langano	247	23	17	5.3
Shalla	302	252	87	36.7
Hawassa	93	23	11	1.3
Abaya	1095	25	7	8.2
Chamo	315	14	6	3.3

The RVLB is a hydrologically closed system, with no surface flow from the terminal lake systems. Four of the seven main lakes (excluding Chew Bahir) are terminal in themselves. The others flow into terminal lakes, making all lake systems terminal. The cross section along the lakes is shown in *Figure 3*.

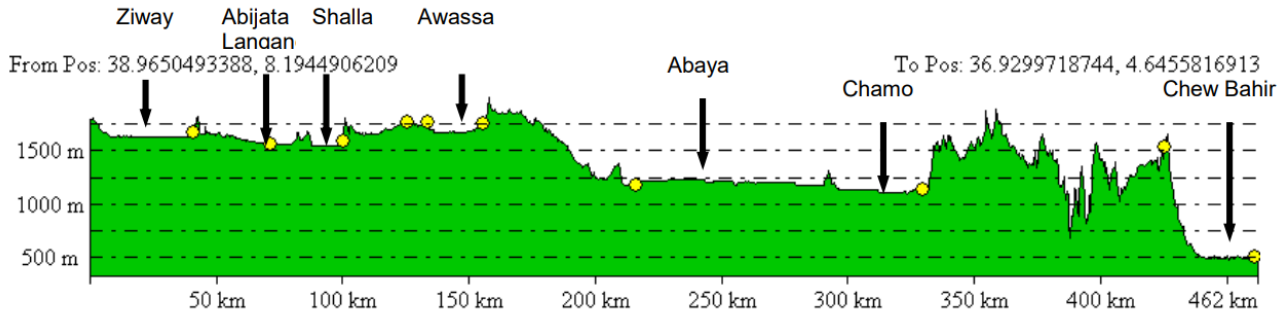


Figure 3.Cross Section of Major Lakes (with Lake Heights) (Source: JICA (2012))

2.1.4. Classification of the Rift Valley Lakes Basin

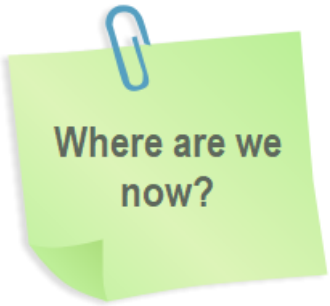
The basin is usually divided into the following four major sub-basins:

1. The **Ziway-Shala** sub-basin (14,477 km^2) which comprises the catchments of Lake Ziway, Lake Langano, Lake Abiyata and Lake Shala. Lake Shala is generally separate but under high flow conditions some water will transfer to Lake Abiyata.

2. The **Hawassa** sub-basin (1,403 km^2) which is hydrologically separate from the others but includes the former Lake Cheleleka, which is now mainly wetland, with grazing and even agriculture now encroaching.
3. The **Abaya-Chamo** sub-basin (18,118 km^2) which is the catchments of Lake Abaya and Lake Chamo. There has been some flow from Chamo to the Segen River in the past when lake levels have been extremely high, but it has been so long since this occurred that it is no longer considered to be one catchment.
4. **Chew Bahir** sub-basin (19,029 km^2) which is the catchment of Chew Bahir, mostly comprising the Weito River and Segen River catchments.

2.1.5. Geomorphology of the basin

According to JICA (2012), the Rift Valley Lakes Basin is divided into two areas. The northern portion of the area around the lakes of Ziway to Awasa is almost flat in the valley bed with several mounts of hills in the west. The hills are mostly in the shape of cone or semi-conical crests that leave the traces of past volcanic activity. The eastern terrain shows the stepwise crests bounding the eastern end of the valley. The lineaments of NNE – SSW direction are mostly abundant. In contrast to the northern geomorphological conditions, the southern area, from Lake Abay to Chew Bahir, has relatively precipitous terrain. East of Lake Abay-Chamo is characterized by a continuous range of mountains in a N-S to NNE-SSW orientation, and the lineaments can be tracked up to Lake Hawasa. ENE-WSW oriented lineaments are also abundant in the northern portion. The geological structures are characterized by two major rifts, the Main Ethiopian Rift (MER) and the South-western Ethiopian Rift (SWR), both of which are encompassed in RVLB. The MER extends from the southern Afar margin to the Lake Chamo area, whereas the SWR is located to the west and represents roughly N-S trending basins related to the Kenya Rift. The Gregory rift of Kenya links to the north with Chew Bahir rift.



3

Basin Situation Assessment

3.1. Introduction

In order to develop appropriate solutions to water related problems, planners must understand the prevailing physical, socio-economic, and governance systems along the upstream-downstream or land-to-water continuum. This chapter is dedicated to providing essential information on the current status, so as to provide the opportunity of narrowing down the focus of the planning strategy and develop an understanding of the key management concerns.

This chapter comprehensively assesses status of the basin from the perspective of the following major themes:

1. Water resources availability and utilization
2. Water quality
3. Watershed and wetland degradation, and
4. Emerging issues such as climate change; water hyacinth etc.

However, all of the four basins do not equally share the above environmental concerns. As shown in *figure 4*, each basin has a particular situation with some overlap.

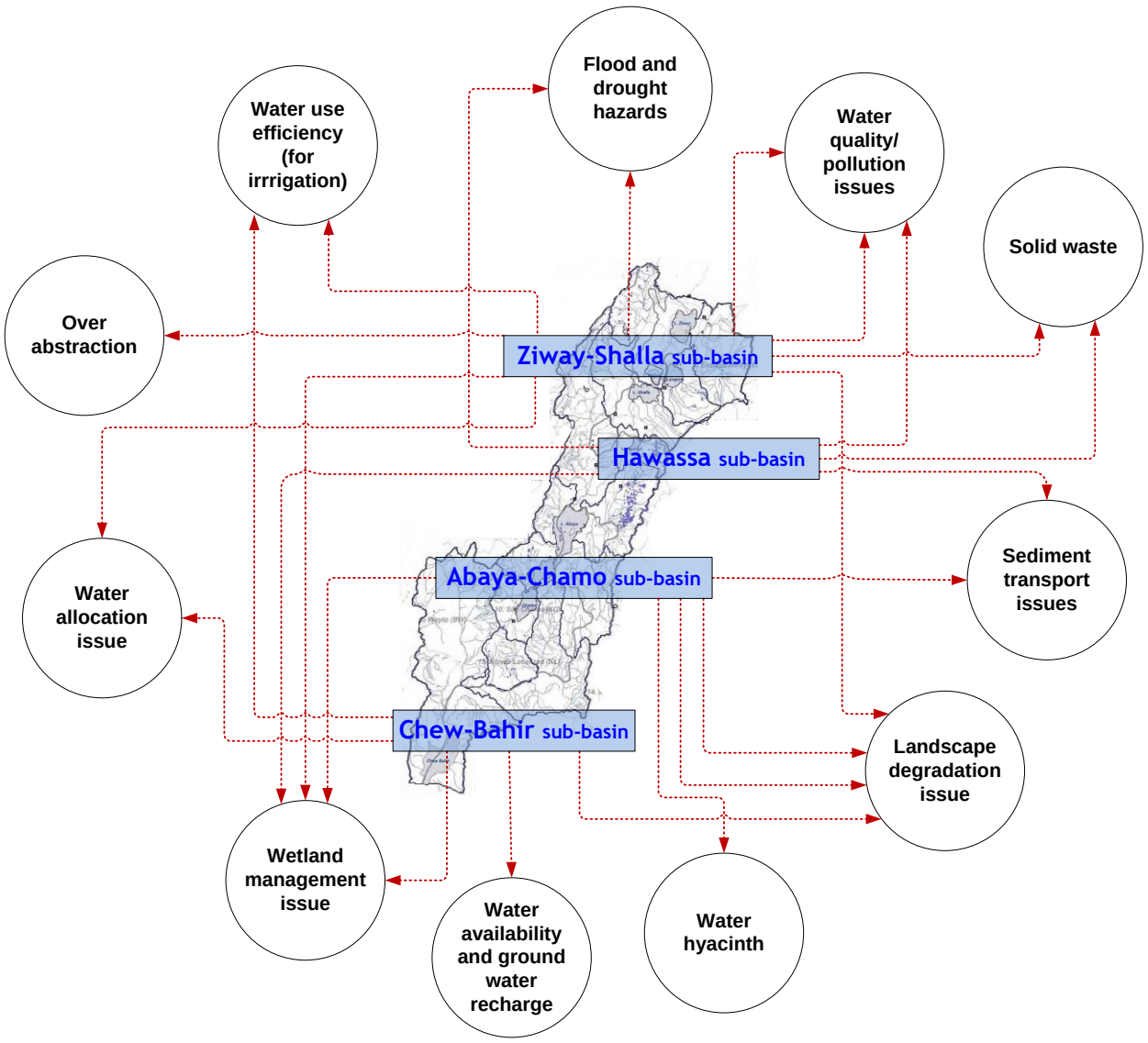


Figure 4. Circuit of key issues in each basin

3.2. Status of water availability in the basin

3.2.1. Status of surface water

Surface water is the primary source of water for human use. Knowing the potential, availability, and use of surface water would help to increase the productivity of agriculture, improve ways and means of the traditional water management systems, increase drinking water supply and the hydroelectric power generation in the coming future. Rivers are used as an important source for food, drinking and agriculture water, wildlife, grazing and water for livestock and as a repository for human and agriculture. This makes the issue of water resource availability very crucial for

effective water resources management and improved livelihoods, as is the case in the rift valley lakes basin.

The total surface water resource of the rift valley Lakes basin as calculated from total annual average River flow into the Lake systems is to the magnitude of 1553 Million m^3/yr in Ziway-Shalla sub-basin; 111 Million m^3/yr in Hawassa sub-basin; 4000Million m^3/yr in Abaya-Chamo Sub-basin and 700 Million m^3/yr in Chew Bahir sub-basin. In total, the annual average River flow into the rift valley lakes is calculated to be 6364 Million m^3/yr (*figure 5*).

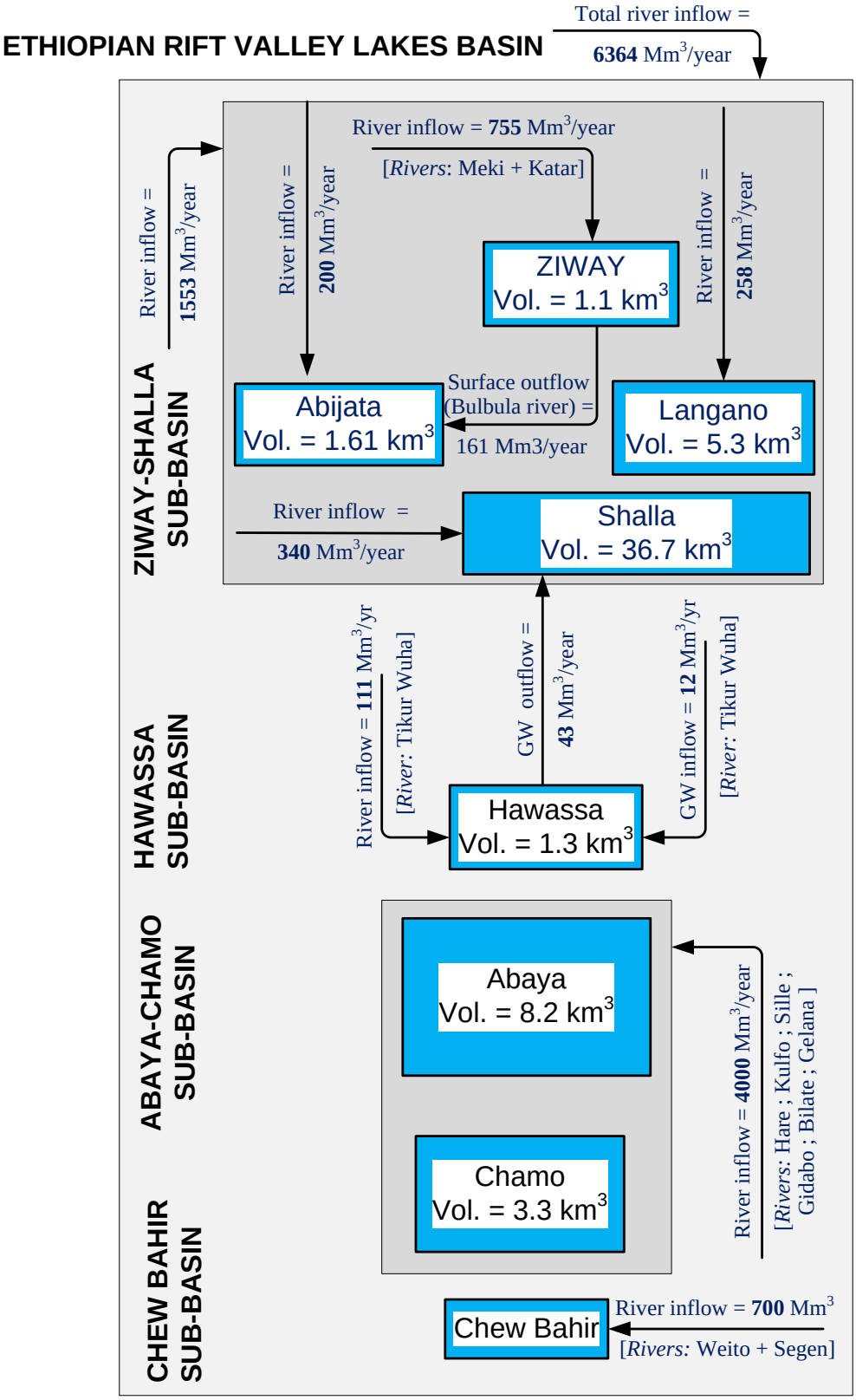


Figure 5.Surface and groundwater potential of the basin

3.2.2. Status of groundwater

Groundwater has special significance and is worth considering in the basin plan due to the following attributes:

(1) The water is clean in terms of water quality;
(2) The water quality is not largely affected by seasonal fluctuations;
(3) The amount of water is steady throughout the year, and necessary volume of water can be extracted by type of water supply facility
(4) Knowing that good aquifers exist below allows for flexibility in the point of source extraction.

Figure 5 contains some quantitative information on the status of groundwater in the basin. However, the upcoming sub-titles describe the key features of the basin to characterize status of the groundwater in the basin in terms of characterization of geological formation; spatial distribution of groundwater depths; and groundwater recharge and its potential availability as follows:

3.2.2.1. *Geological formation*

The nature of the geological formations within RVLB and the intense tectonic disturbance that has affected them form a significant influence over the distribution and disposition of groundwater resources within the basin. The basin is comprised of volcanic (50%), sedimentary (25%), and crystalline strata (25%). Groundwater storage and flow occurs through primary permeability and porosity in the sediments and in the volcanic and crystalline strata and results from secondary processes - principally fracturing, jointing, and weathering. As a result, development of aquifer systems in these strata may be discrete and much localized; there may be little interconnectivity and there may be little groundwater storage. Within the basin as a whole, major deep seated structural features such as regional fault systems may provide interconnection between these (otherwise) discrete units.

3.2.2.2. Spatial distribution of groundwater depths

The important parameter for the consideration of the groundwater flow is static water level of the existing boreholes. *Figure 6*shows the contour of upper surface of aquifer. However, due to the lack of bore hole at sub basins of Galana, Segen-AmessaGuracha, Kulfo Gina and Eastern Ziway, and Lake Langano, there is no indication of groundwater flow in these areas (JICA, 2012).

The contouring of upper (or lower) surface of the aquifer indirectly suggests the distribution of available groundwater level. The figures show that the groundwater gradient is high at the escarpment of sub basins of Western Ziway, Bilate, Hawassa, Gidabo and Galena. The groundwater rapidly flows down and becomes gentle at the valley floor. The gradient is almost parallel to the original shape of the valley (not considering undulation of volcanic cones and hills). The end point is not necessarily the lakes but seems to be gathered into the depression of groundwater between Lake Abaya and Lake Hawassa. At the far north of the study area, groundwater runs down along the Weito River and ends its flow into Chew Bahir.

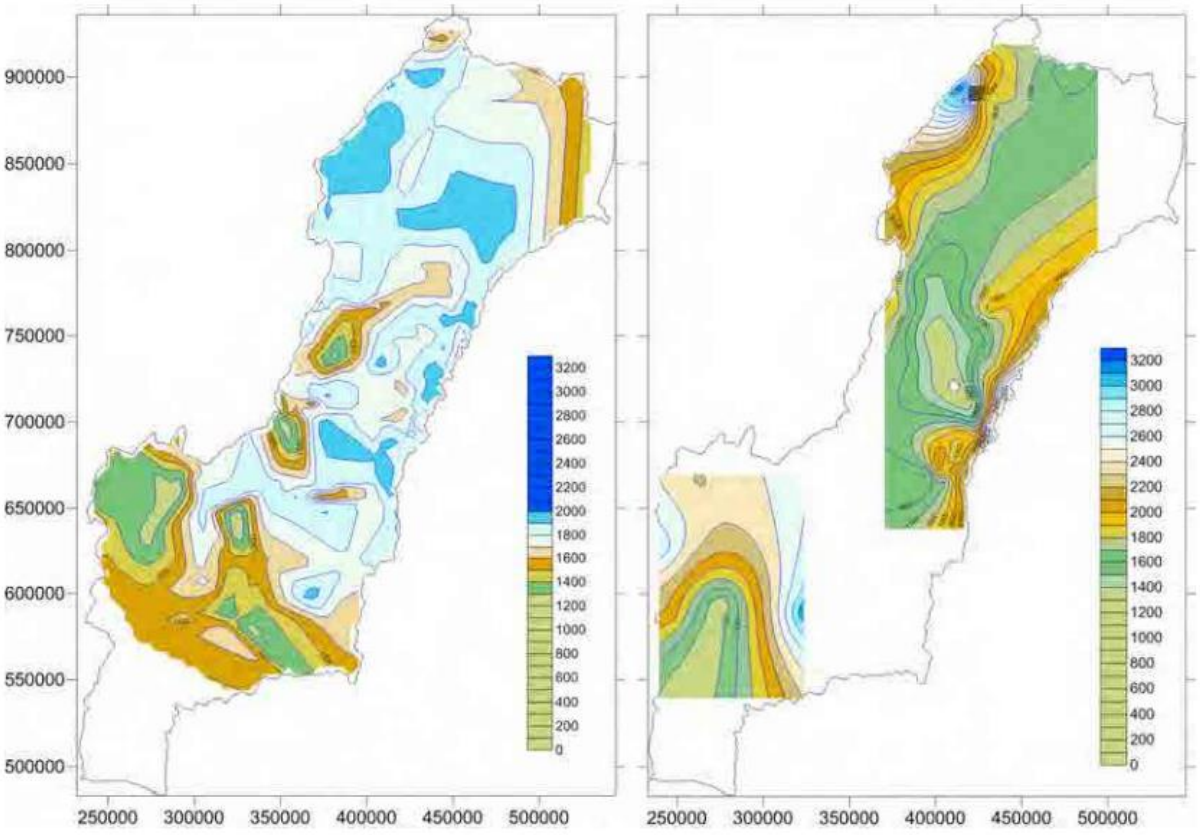


Figure 6.Groundwater Level Contour (Source: JICA (2012))

3.2.2.3. Groundwater recharge and availability

The nature of the geological formations within RVLB and the intense tectonic disturbance that has affected them form a significant influence over the distribution and disposition of groundwater resources within the basin. Groundwater is recharged by direct rainfall to permeable ground, (generally greatest in the basin margins where rainfall is relatively high), via river systems and lakes and from overlying or adjacent groundwater bodies. Groundwater discharge is from springs, either into surface waters (supporting base flow), directly into lakes, to the surface (e.g. wetlands, where evapotranspirative losses may be high) and into adjacent (or overlying) groundwater bodies. The movement between points of recharge and discharge, typically dominated by fractures and fissures, is often limited in geographical extent. Groundwater movement through shallow groundwater systems may be relatively rapid, as there is little groundwater storage available. In general terms, the groundwater flow system is in parallel with the surface water flow - from valley sides to valley floor. Within the valley itself, groundwater flow is also dictated by the relative elevations between the individual basins. In certain circumstances, due to the significant heads generated between the predominant areas of recharge in the highland areas, and deep seated, regionally extensive fracture systems, groundwater may flow at greater depth, emerging to and beneath the rift valley floor.

The hydrogeological complexity is such that the groundwater contribution to the overall water resource balance varies considerably throughout the basin. There are complex relationships between groundwater recharge, flow, storage and discharge and the surface water system. The frequent occurrence of groundwater as discrete bodies, which may not be readily identified, makes evaluation of the available groundwater resource extremely difficult.

However, in order to provide at least some indication of the overall level of this resource, some very simple analysis has been carried out by Halcrow (2010) based on a proportion of the direct groundwater recharge from rainfall. This data is summarised in table 2and figure7shows the basic planning units (=Development Zones (DZ)).

Table 2.Estimated groundwater recharge and availability

Development Zone	Location	Estimated Annual Direct Groundwater Recharge (Mm^3/year)	Estimated Groundwater Resource Availability (Mm^3/year)
DZ 1	North East Highland Zone	146	7
DZ 2	North Central Lowland Zone	119	6
DZ 3	North West Mixed Farming Zone	286	14
DZ 4	Eastern Enset and Coffee Zone	180	9
DZ 5	Eastern Mixed Farming Zone	51	3
DZ 6	Southern Mixed Farming Zone	167	8
DZ 7	Pastoral Zone: SNNPRS	65	3
DZ 8	Pastoral Zone:Oromiya	65	3
Basin Total		1,080	53

N.B: The resources estimate must be considered a first estimate only in order to help inform the planning process. As more information is gathered, and more proactive groundwater resources management processes are put in place, these estimates may be revised

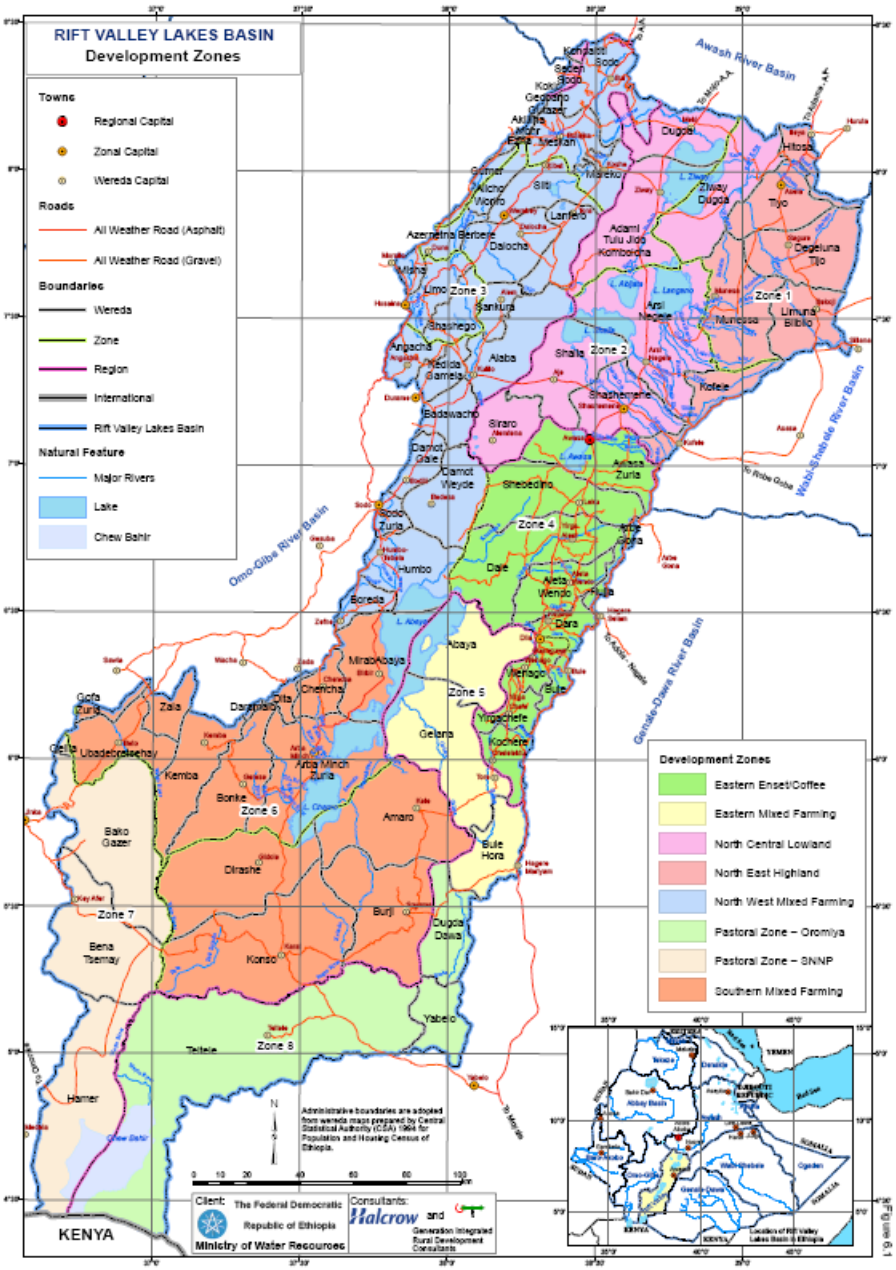


Figure 7.Locations of the development zones (DZ)

3.3. Status of water quality in the Basin

By the term “Water quality”, here we are referring to suitability of the water resources in the basin to sustain various uses or processes and it is an indicator for physical, chemical and biological properties of water. Any particular use of water will have certain requirements for the different (physical, chemical or biological) characteristics of water; for example, limits on the concentrations of toxic substances, restrictions on temperature and pH ranges for domestic water

supply, irrigation, recreation and supporting aquatic life. Therefore, Water quality can be expressed by a range of variables which limit water use. Although many uses have some common requirements for certain variables, each use will have its own demands and influences on water quality.

3.3.1. Status of water quality (surface water) in the Basin

Surface water comprises perennial and ephemeral streams, hot springs and numerous lakes. The streams and rivers are freshwater. The chemical composition of the water in the basin varies with elevation and length of the river course: rivers in the highlands contain low EC and dissolved minerals while the longer rivers of the lowlands such as Bilate, Meki, and Tikurwuha, contain relatively higher dissolved minerals. Suspended sediment loads are high following rainfall due to soil erosion. The water quality of rivers that drain lakes, such as the Bulbula River, are strongly influenced by the lake water quality. Some of the analyses indicate pollution from urban wastewater.

The hot springs in the basin tend to have higher concentrations of major ions and trace elements than other surface water bodies. Toxic chemicals such as Li, Sr, Pb, Cu and Hg are also found in greater concentrations and fluoride concentrations have been found to vary between 12.8 and 235mg/l.

Lake Ziway is the only freshwater lake suitable for potable water and irrigation. This may be due to the large catchment and dilution of the lake water due to inflows and overspills via the Bulbula River. The water quality in the lake is very good, with low salinity, fluoride, chloride, sodium, etc. and dissolved oxygen levels of about 6 mg/l which is required to support aquatic life including fisheries. The water in this shallow lake is well mixed and is not stratified.

Most of the other lakes are terminal lakes, or overspill infrequently, where freshwater inflows are evaporated leading to increased salinity in the remaining water body. The water quality of these lakes is moderately to strongly alkaline-saline. Salinity concentrations vary between the lakes and also seasonally, with increasing salinity during dry periods. The most saline lake monitored was Lake Shala (EC 48.15 mS/cm), compared with Lake Abiyata (EC11.58 mS/cm), Lake Chamo (EC 2104 µS/cm), Lake Langano (EC 1932 µS/cm), Lake Abaya (EC 1,319 µS/cm), Lake Hawassa (EC 886 µS/cm) and Lake Ziway (EC 460 µS/cm).

Despite being a terminal lake, water quality in Lake Hawassa is marginal: the main problems are its alkalinity (pH of 9) and its fluoride concentration (7.65 mg/l).

Lakes Abiyata, Shitu and Abaya are sodic lakes, and a soda ash production industry is based on Lake Abiyata where sodium was monitored to be 1,940 mg/l (compared with 63.5 mg/l in Lake Ziway) in 2007 (MoWR, 2008). Lake Abiyata also has high concentrations of total dissolved solids, salinity, chloride, and fluoride (70 mg/l).

Lakes Abaya and Chamo are moderately saline. They also contain high levels of fluoride (8.2 and 94 mg/l respectively), sodium (246 and 430 mg/l respectively), and pH (9.05 and 9.55 respectively). The water quality and volume in a number of lakes is also thought to be affected by groundwater contributions.

Most of the lakes are highly productive for phytoplankton biomass, the two exceptions are Lake Shala, which is very deep and where productivity may be limited by stratification in the water column, and Lake Abaya, where the photic layer is shallow due to the high turbidity of the water.

The groundwater resources in the RVLB are complex, reflecting the complexity of the underlying geology. The chemical composition of groundwater depends on the occurrence of basic and acidic volcanic rocks, the residence time of the water, and the water temperature. Groundwater varies from slightly acid to slightly alkaline. EC and TDS generally increase from north to south and with decreasing altitude. In the highlands and scarp slopes of the rift valley, groundwater is a major source of water for domestic consumption and livestock. However, in the valley floor, high concentrations of fluoride, TDS and salts make the water unsuitable for drinking. Fluoride concentrations exceed the WHO limit of 1.5 mg/l in almost half of the groundwater wells in Oromiya Regional State.

Due to the lack of regular and intensive research on the lakes' water quality status and its impact on the lake ecosystems, the potential of the lakes was not well addressed for multiple designated water uses like drinking, irrigation, recreation and aquatic life. While reviewing the available water quality status of the water bodies in the basin, it was found that there are a number of individual water quality parameters over space and time. So, in order to draw general

conclusions, the use of a ‘water quality index’ is of paramount importance. The following sub-sections contain this analysis.

3.3.2. Using water quality index for general overview of water quality status in the basin

Separate assessment of water quality suitability to the intended uses is time consuming and does not yield appropriate systems to monitor and control the water bodies. Due to this, evaluation of the water quality status of the lakes by using a “water quality index” is employed. Water quality index (WQI) is one of the most effective tools to aggregate and communicate information on the quality of water to the concerned citizens and policy makers (Puri et al., 2011). It numerically summarizes the information from multiple water quality parameters into a single value that can be used to compare data from several sites and months. The use of Water Quality Index (WQI) simplifies the results of analysis related to a water body as it aggregates in one index of all parameters analysed (Warhate&Wankar, 2012). For our basin planning input, we adopt the indices developed by the British Columbia Ministry of Environment, Lands and Parks and modified by Alberta Environment which is CCME WQI (1.0 model) for its suitability. This index provides numerical values in between 0 (worst water quality) and 100 (best water quality) with five descriptive categories such as excellent (value 95-100), good (value 80-94), fair (QI value 65-79), marginal (value 45-64) and poor (value 0-44) (CCME, 2001). This analysis is designed to determine the lake water suitability for drinking, irrigation, recreation and aquatic life by employing the water quality index calculation method. The results are tabulated below:

Table 3.Water quality status of the rift valley lakes

Name of the lake	Water quality index for **drinking** water uses	Water quality index for **irrigation** water use	Water quality index for **recreation** water use	Water quality index for **aquatic** life
Lake Hawassa	25	35	18	44
Lake Abaya	36	36	22	37
Lake Chamo	47	30	31	56
Lake Ziway	35	49	32	45
Lake Langano	33	15	36	33
Lake Shalla	23	9	23	43

N.B: This index provides numerical values in between 0 (worst water quality) and 100 (best water quality) with five descriptive categories such as:

- *Excellent (CCME WQI value 95-100),*
- *Good (CCME WQI value 80-94),*
- *Fair (CCME WQI value 65-79),*
- *Marginal (CCME WQI value 45-64), and*
- *Poor (CCME WQI value 0-44)*

3.3.3. Distribution and trend of fluoride (in the groundwater)

Concentrations of fluoride in the Ethioian Rift Valley Basin is critical due to its impact of the scoio-economic status of the community. The tendency fluoride value by the surface distribution and by the difference of depth was examined using the database in the Study area. Figure 8 shows the concentration of fluoride in the Study area. High fluoride concentration (more than 3 mg/l in reference with Ethiopian drinking water quality guidelines, 2002) distributes at north-western portion from Lake Ziway to Lake Shalla, especially at the inflection point at the slope and plane area. High concentration also can be observed in the north-eastern area of the Bilate River, and surrounding area of Lake Hawassa.

The characteristic of fluoride concentration is summarized as follows in regard to the data shown in these figures.

1. The concentration is high at the vicinity of recent volcanic cones surrounded Bitajila
2. High concentration zone can be observed at the area surrounding Lake Hawassa
3. It is not quite clear, but the fluoride value decreases by the depth of water source

It is more realistic to consider high concentration is related to the recent volcanic activity occurs at the shallower sub surface rather than it was brought from the deep ground. However, further study is required to justify the origin of fluoride concentration.

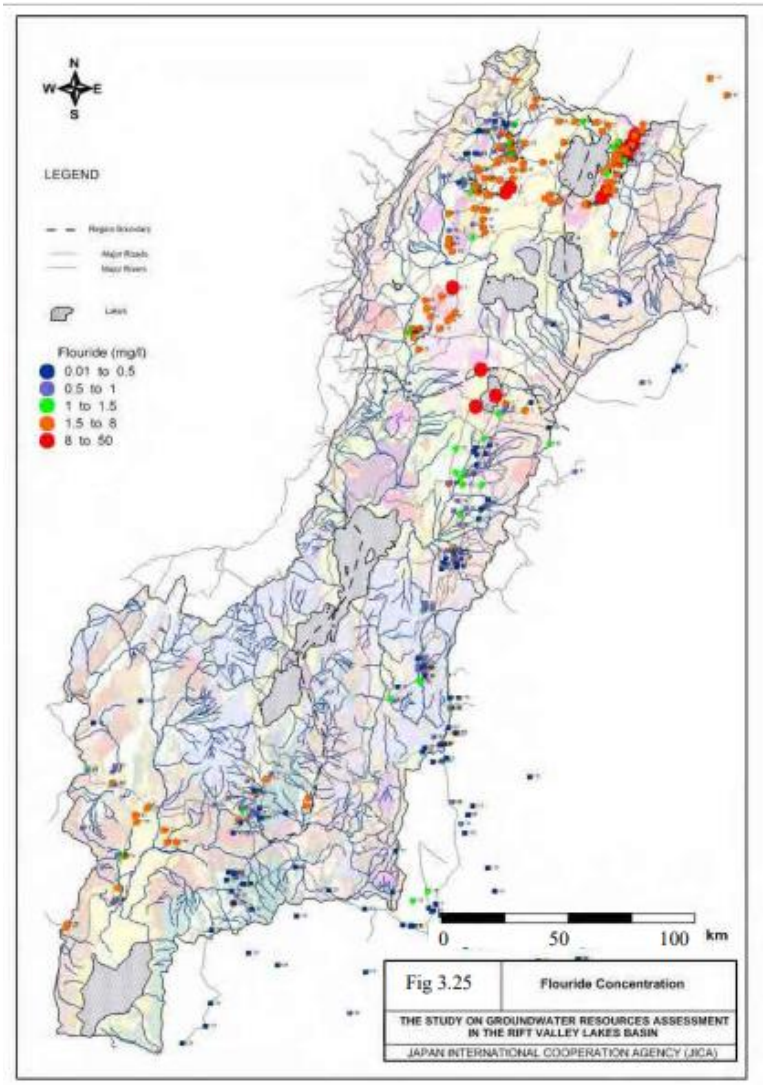


Figure 8.Spatial distribution of fluoride Concentration in the basin

3.4. Watershed situation assessment in the basin

3.4.1. Land Cover and Land Use Change

Over the last 30 years (1985–2015), the landscape of the Rift Valley Lakes Basin has significantly changed. As the studies have exhibited, the rates of land use and land cover change in the four subbasins are not the same. In the Abaya Chamo subbasin, there is a decreasing trend of shrub land (28.82%) and natural grassland (33.13%) and an increase in arable land (59.15%)

(Ashebir et al., 2017). In the Ziway-Shallabasin, there is a decrease in grass land (91.4%) and forest cover (24.9%) and an increase in arable land (46.2%) (Elias et al., 2019). Similarly, the land cover of the Chew Bahir subbasin has changed significantly, whereby shrub land has been reduced from 61.74 % to 12 % and intensively cultivated land has increased from 1.88 % to 12 %. This situation is also true for the Hawassa sub-basins

Rapid population growth, internal migration, policy shifts, and regime change, unplanned urbanization, massive agricultural expansion, were identified as the key driving forces of LULC changes in the Rift Valley Lakes Basin. The LULC changes and related trend of increasing landscape fragmentation in the basin increased soil erosion, the volume of surface runoff and sediment transport in the landscape and, consequently, affected the levels and water quality of the Lakes found in the rift floor. Furthermore, the destruction and fragmentation of shrub land, forest land and natural grassland led to the decline of wild plants and animals previously prominent in the basin. Therefore, protective measures that take into consideration the economic, social, and ecological dynamics of the basin are urgently needed to save the aquatic and terrestrial ecosystems of the basin from further damage.

3.4.2. Ecosystem Service

Terrestrial and aquatic ecosystems in the basin provide a multitude of benefits to humanity. The vegetation, wetlands, lakes, rivers, and other functional landscape units provide various services such as food, water resources, raw materials, and medicinal resources (Ayenew, 2001), regulating services of the climate, water resources, flood protection, erosion control, waste reduction, supporting services of soil formation, nursery services, nutrient and water cycling, and cultural services of recreation and ecotourism, spiritual, educational, and research services (Ayenew, 2007; Reynaud and Lanzanova, 2017).

The ecosystem of the basin supports the livelihoods of over 1.5 million people (CSA, 2013a) and 1.9 million livestock (Meshesha, 2012). The ecotourism potential of the basin is immense and still untouched. Lakes in the basin provide all the necessary amenities for eco-tourism, including scenic beauty comparable to anywhere in Ethiopia, rich wildlife resources, bird fauna, and land scape. However, a recent study of ecosystem services in the Central Rift Valley (Mekuria et al., 2021) found that extensive land cover change, particularly loss of forests and

grasslands between 1973 and 2020, had led to considerable loss of ecosystem services. Especially ecosystem service values related to water provision had been lost, but also water regulating services had been lost.

3.4.3. Livelihoods

The livelihood of the community in the RVLB is not similar throughout the basin. In most parts of the basin, Agriculture (by rainfed and irrigation) is the main sources of income, and livestock husbandry is an integral part of the farming system, supplementing crop production. In some part of the basin pastoralism is the main practice to support the livelihood of the community. Additionally, fishing petty trade is a source of income for many people specifically around and in the cities in the basin. The rural areas of the Rift Valley Lakes Basin are characterized by low agricultural productivity and small landholding sizes. The average farm size per household is about 0.8 hectares, but this falls to 0.4 ha per household in the densely populated highland areas of RVLB like the Sidama region and Gedeo zone of SNNPR. Many households therefore need to meet their basic food and household requirements through off-farm and non-farm activities. The current employment opportunities in the non-farm activities are limited for most households. This and other conditions create pressure directly or indirectly on the limited natural resources in the basin. Even though, there are also several livestock populations including cattle, sheep, goats, horses, donkeys, mules, and poultry in the basin. However, their productivity is below the national average because of feed and water shortage.

Other critical issue which directly has an impact on the livelihood of the people is level of infrastructure development. Access to infrastructure such as education is limited. About 70% of the population in the basin is illiterate. On the other hand, nearly 10% of the population can read and write without formal education (Halcrow, 2009). Healthcare facilities are poorly equipped and cannot handle the case-loads imposed by the population of the basin at the time. For example, the ratios of health professionals to the population in SNNPRS of the basin indicate that there were 45,852 people per doctor, 4,796 people per nurse, and 6,777 people per health extension worker. Selected ratios of health professionals to the population in Oromia of the basin indicate that there were 145,896 people per doctor, 7,943 people per nurse, and 13,048 people per health extension worker in Oromia (Halcrow, 2009). Road and other facilities, such as access

to electricity, clean water, and telecommunications, are limited in and around major towns of the basin.

3.4.4. Buffer Zone Protection

One of the major objectives of the Ethiopian water policy in its water governance scheme is the allocation and apportionment of water. This is based on comprehensive and integrated plans and optimum allocation principles that incorporate efficiency of use, equity of access, and sustainability of the resource. It ensures that projects, activities, and interventions related to water in the basin are in line with the integrated water resources management process in their content, schedule, impacts, and management. So, to alleviate the problems in agriculture, investment, and other water users, sustainable and reliable development and proper use of water resources have become an imperative.

All lakes and major rivers do not have any buffer zone protection or demarcation. As a result, the expansion of small-scale irrigation, illegal settlement, provision of land-use licenses to youth as job creation, uncontrolled cattle grazing, clearing of lake shore plants are increasing from time to time. These are intern exacerbates lake ecosystem degradation, the entrance of agrochemicals in to the lakes, soil erosion and sand mining creating gullies that discharge sediments into the lakes which are resulting to, degrading the lakes' water quality and sediment deposition leading to lake depth reduction, and eutrophication (Lencha et al., 2021). The problems are prominent in all lakes in the basin, but exceptionally, the problems are more common in lakes Hawassa, Chamo, Abaya, Ziway, and Langano (Gebretsadik and Mereke, 2018). So, paying attention to setting goals, objectives, and strategic plans for buffer zone protection in the basin plan development is vital (RVLBA buffer zone study report, 2016).

3.4.5. Wetlands

Wetlands are one of the most versatile ecosystems, providing humans with a variety of economic, biological, ecological, social, and cultural activities and benefits. All forms of wetlands are found in Ethiopia, except for coastal and marine-related wetlands and vast swamp-forest complexes. Nearly 1.5% of the country's total surface area covered with wetlands

(Mengesha, 2017). Wetlands provide a variety of ecosystem services that benefit humans, including food, building materials, water supply, water purification, climate regulation, flood control, and eco-tourism.

While wetlands are the most productive ecosystem in the basin, they are also the most threatened due to social, economic, and climatic factors. According to Alemayehu et al. (2006) and Maramo (2021), farmland expansion, overuse of water for irrigation and other development interventions like the establishment of new industrial zones and excessive water abstraction for industrial raw material from the lake (Abijata), lack of consistency among government policy across the sectors and information on wetland environmental benefits (Mengesha, 2017) are the biggest threats to the wetland in the basin. As stated above, the wetlands have been used as grazing land in the dry season for the agro-pastoralists of the basin. These peoples' and their animals' temporal and permanent settlement into and around the wetlands is mainly governed by the political-legal, social-cultural, economic, seasonality, geographical proximity, and ecological conditions of adjacent administrative areas.

3.4.6. Land Degradation

Soil erosion and land degradation have become an alarming problem in the country. The main causes of soil erosion are the rapidly increasing population (human and livestock) resulting in land use change, deforestation, overgrazing, and continuous cultivation of extensive steep slopes, which have adversely affected land productivity. Annually 1.5 billion metric tons of topsoil erodes from the Ethiopian highlands, which in turn causes an estimated potential loss of 1 to 1.5 million tons of grain (Taddese, 2001). Moreover, it is severe in arid and semiarid regions generally and in the Rift Valley Lakes Basin. Organic carbon losses, for example, amounted to 60–75 percent, contributing to a consistent decline in crop yields (Gebreslassie, 2014). According to Meshesha et al. (2012), during 1973–2006, the areas of water and forest land decreased by 15.4 and 66.3%, whereas mixed cultivation and degraded land increased by 79.7 and 200.7%, respectively. As a result, soil erosion increased markedly with annual rates of 31, 38, and 56 t/ha in 1973, 1985 and 2006, respectively.

*Figure 9*shows four areas of erosion potential; extreme, covering 17% of the basin, high covering 47%, moderate covering 26% and low covering 10% of the basin. To emphasize the

point, this means almost two thirds of the RVLB is an area of high erosion potential or worse. Areas of extreme erosion potential are associated with steep slopes and cultivated areas that are dominated by mixed cereals and maize, and sorghum mono-cropping. This includes the central of southwestern, eastern and the northwestern areas of the basin including the eastern side of Asela, Werabe and Silte, east of Lanfero, east and west of Lake Hawassa, north of Hossaina, the central highlands of DamotWeyede, the highlands of Kondaltiti, extensive areas west of Lake Chamo, most of Dirashe, the highlands of Hammer and Amaro, and the highlands of YirgaChefe, Bule and Wenago. The highest degree of current erosion occurs in similar areas, particularly the Bilate River basin, east and west of Lake Ziway, parts of the Gelana and Sile and Chamo watersheds. The main contributing factors are steep slopes, highly erodible volcanic soils, the predominance of cereal cultivation and a higher population density. Shallow to very shallow soils are an additional factor in places (MoWR, 2010).

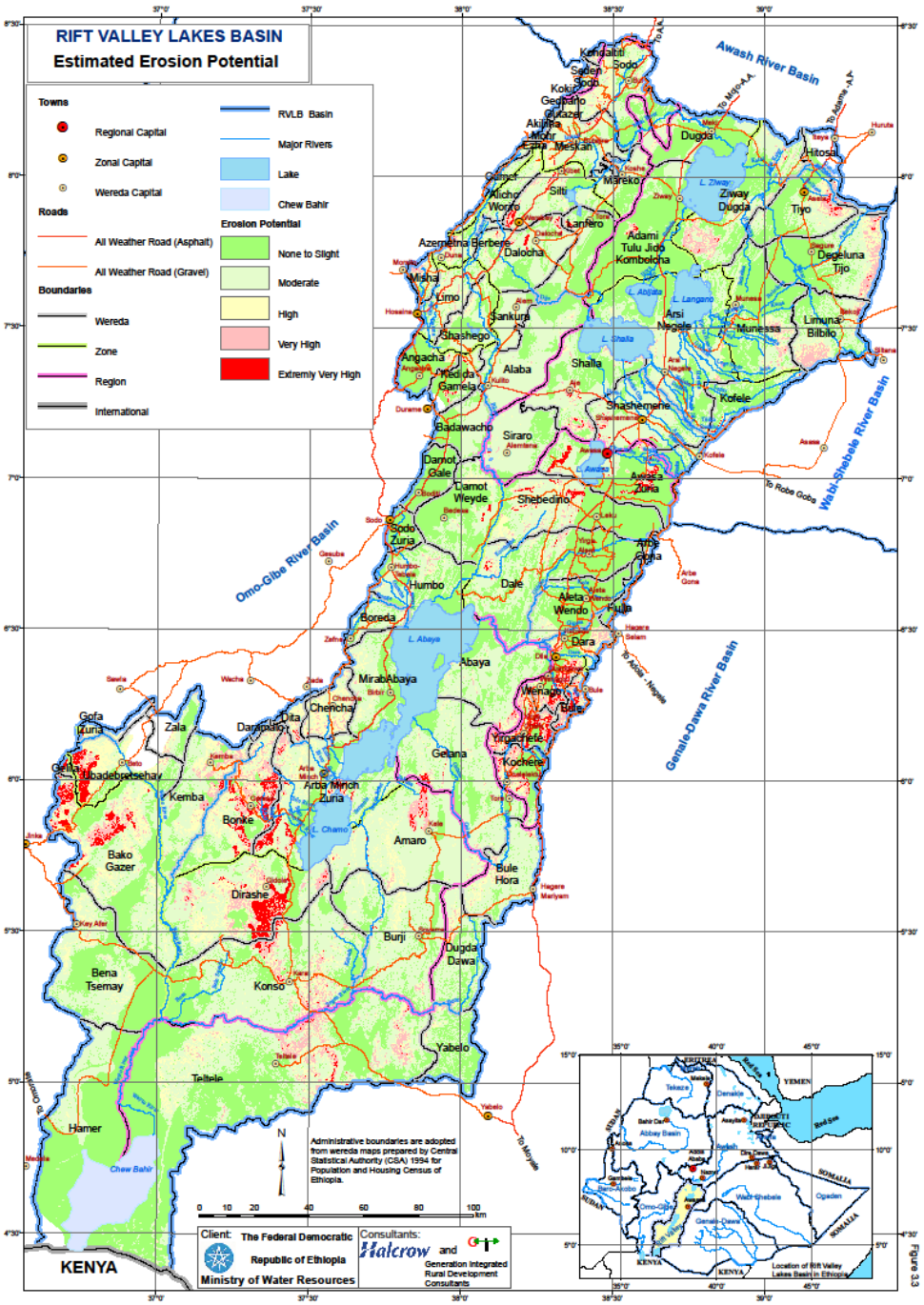


Figure 9. Spatial distribution of erosion potential in the basin (Source: MoWR, 2008)

3.5. Status of emerging issues: climate change; invasive species; flood and drought; and land slides

3.5.1. Invasive Species (water hyacinth)

In Ethiopia, close to 35 invasive alien plant species are posing negative impacts on native biodiversity, agricultural lands, rangelands, national parks, waterways, lakes, rivers, power dams, roadsides, and urban green spaces, with great economic and social consequences. They may also alter biological communities and ecosystem structure and processes in terms of food web structure and energy flow (Fessehaie and Tessema, 2014). These exotic species are the main challenges to the water bodies of the Rift Valley Lakes Basin. Some of the invasive species affecting the basin include prosopis or mesquite (Prosopis juliflora), giant sensitive tree or catclaw mimosa (Mimosa pigra) and water hyacinth (Eichhorniacrassipes) (Ethiopia's Fifth National Report to the CBD, 2014).

Water hyacinth was perceived to have an impact on fisheries by reducing production levels, decreasing species diversity, producing poor quality fish, and increasing operating costs, resulting in lower income for fishers and higher prices for consumers. The enlarged water hyacinth invasion has, therefore, damaged the water quality and amount, fishing activities, plankton life, farming and health. The rapid growth rate and infestation of large water areas are causing variety of problems. The weed affects solar light penetration into water bodies, reduces oxygen through decomposition, alters the chemistry of water, and substantially increases water vapor transpiration. The plant is now considered a serious threat to biodiversity. The environmental hazards associated with these plants are degraded water quality and drastic changes in the plant and animal community. Light and oxygen diffusion are severely curtailed due to reduction in water movement etc.

Water hyacinths have invaded some of the Ethiopian Rift Valley lakes. According to the RVLBA assessment report (2018), more than 78 hectares of the Shore of Ziway Lake (near to 8 kebele's of Dugdaworeda) and 24 hectares around Ziway town, a total of 102 hectares, are infested with this weed. According to the assessment report of SNNPR's environmental authority, more than 1570 hectares of the lakeshore are invaded by the water hyacinth. These invasive weeds are known to have harmful impacts on the lake habitat and could cause important economic, environmental, and social losses. According to Raynes (1964), a 1 hectare water

hyacinth can deposit approximately 1250 tons of rotting plant material each year. It affects the growth of other native aquatic plants by blocking sunlight penetration and photosynthesis. This creates a cascading effect by reducing other underwater life forms such as fish reproduction and a significant reduction in fish stock. Water hyacinth also reduces biological diversity, impacts native submersed plants, alters immersed plant communities by pushing away and crushing them, and alters animal communities by blocking access to the water and/or eliminating plants the animals depend on for shelter and nesting. Water hyacinth increases water losses from the lake, wetlands, and tributary rivers because of the plant's high transpiration rate, calculated to be almost eight times the evaporation rate of open water surfaces (Parsons, 1992).

3.5.2. Assessment of Climate Change and its impact on water resources

According to RVLBMP (2009), the impact of climate change on the water resources of the basin has been assessed using a climate change scenario based on output from the Global Climatic Model (GCM) together with scenarios used in other climate change studies for Ethiopia (Zeray et al., 2002). The change is essentially an increase in temperature of $+2^{o}C$ resulting in a 10% increase of evapotranspiration and a 10% decrease of rainfall over the Master Plan period of 30 years. Overall, these results in a reduction in total annual surface runoff of 24% compared to present day runoff. Presently, the total available surface water resources of the Rift Valley Lakes Basin (RVLB) is estimated to about 5,183 Mm^3/year calculated from total average River flow into the Lake system under 'existing' conditions with abstractions for irrigation and water supplies for domestic and industrial use. The water balance modelling shows that climate change reduces the total available surface water resources of the RVLB to approximately 3,939 Mm^3/year, a decrease by 1,244 Mm^3/year.

It is also identified that climate change also affects groundwater system in the Rift Valley Lakes basin Ethiopia. Spatial and temporal groundwater recharge variability is mainly controlled by the climate of an area. A sensitivity analysis reveals that annual recharge is very sensitive to variations in precipitation and moderately sensitive to temperature changes. In the context of the RVLB, the relative sensitivity increases from the highland to the rift floor across the basin. An increase in both precipitation and temperature, as suggested by climate change projections for Ethiopia, appear to have an overall positive impact on recharge in the majority of the catchment. This implies also for other catchments where recharge is spatially non-uniform and provides a

basis for further investigations into the assessment of groundwater resources and their vulnerability to climate change at the basin and watershed scale (Mechal et al., 2015).

In more detail, due to the anticipated future climate change, it is projected that the level of Lakes Abaya, Ziway, and Shalla decline on average by 1.75 m, 1.3 m, and 1.74 m, respectively. Since Lakes Abaya and Chamo are connected hydrologically, any impact on Lake Abaya will significantly affect Lake Chamo. Apart from this, it is also projected that the surface area of Lake Ziway will decrease by 17 %. In Lake Chew Bahir Sub-basin, runoff will decrease by 2.5 % with future climate change which, in turn, significantly increases stress on the Chew Bahir wetland. The impact of climate change on the wetland is examined by looking at the increasing 'stress' on the wetland which is calculated as the difference between the unmet demands presently under existing natural conditions and those unmet demands for a future changed climate. The increase in 'stress' on the wetland is 5 % due to anticipated change of future climate (RVLBMP, 2009).

3.5.3. Carbon Sequestration status in the basin

In recent years, many developed countries have been trying to reduce their carbon emissions through investment in afforestation and reforestation projects (or agro-forestry) in developing countries, with the latter being able to sell their sequestered carbon to the developed countries as an offset. If the largely degraded mountains and hills, especially in the Gamdofa, Silte, Bonke, and Konso areas of SNNPRS, highlands of Katar and Meki watershed covered with suitable forest species, we will benefit significantly from carbon trading initiatives and it might lead to a solution where everyone benefits: more income (carbon and timber revenue) and a sustainable environment. This could be used as a new opportunity to scale up biological soil and water conservation interventions. The landless members of communities could also gain if the benefits were distributed among all community members specifically those do not have land and are poor. Project funds might be secured from the World Bank and the Global Environment Facility (GEF). Recently, the World Bank carried out a prefeasibility assessment of the Humbo (WolayitaSodo) reforestation carbon project (Gete et al., 2006). The Rift Valley Lakes basin development office is also implementing integrated watershed management in some part of the basin in collaboration with woredas natural resource management office, which helps to rehabilitate more than 65,000ha of degraded land in 21 Woredas and two city administrations. As

a result of this, silt accumulation in the water bodies will be reduced where the innervations were implemented and carbon will be sequestered on rehabilitated land.

3.5.4. Assessment of water use conflict in the basin

As mentioned in RVLBMP (2009), in RVLB of Ethiopia there is essentially no water resources management or planning being carried out. This will lead to increased conflicts over water use as development proceeds. Population growth, increased economic activity, and improved standards of living have led to increased demand for water resources in the Basin. The main water competing sector is irrigation development that supports the economy of the basin as well as the country. Small scale, medium scale, and large scale irrigated agriculture has been expanding rapidly in the basin.

Compared to other river basins of Ethiopia there is fast development of infrastructure and services in the Rift Valley lakes basin. In addition, most cities, e.g. Hawassa, Ziway, Arbaminch, etc, are established at the center of the basin due to conducive environment for markets leading to the expansion of different water demanding industries in the basin. Though the demand is increasing in the basin water available for different purposes in these large towns is limited. Future climatic change which may be characterized by low rainfall, low river flows, high demand for industry and irrigation water, water pollution, failure of water storage delivery and distribution systems has accelerated water stress in the basin.

Overall increasing water demand without proper water management and planning leads to water scarcity, which in turn, inevitably leads to conflict over water resources. This indicates the basin is under a high risk of water use conflict which can further be aggravated by social inequity and economic marginalization.

In particular, the Lake Abaya-Chamo Sub-basin Silleareais where state and smallholder community farms are competing for water resources and known for conflicts between water users. In the same basin, Hamassa River is fully utilized by farms in its upper reaches before the water reaches farms in the lowlands. As a result, the lower Hamassa is subjected to water shortage which inevitably leads to conflicts between the water users. Similarly, in the Lake Chew Bahir Sub-basin there are a number of smallholder irrigation schemes along river courses of Segen, Yanda, and Kemaga rivers/streams. In this basin, since water abstraction is not controlled

and the waterusers in the upper catchment of the watershed divert the water without considering the downstream dwellers, conflicts frequently occur among investors and pastoralists and between upstream and downstream users. For example, the basin water-use conflicts also commonly occur between Konso and Bena-TsemayWoredas, between Bena-Tsemay and Hamer Woredas, and between Hamer and Erbore community.

3.5.5. Geological hazards

[1] Earthquakes

The active volcanism and seismicity nature of the Ethiopian rift valley lakes basin pose a significant hazard to the local population. According to the literature, the basin has "moderate" to "low" earthquake exposure and limited number of death reports. However, earthquakes are reported to have caused "widespread panic" (Kinde, 2002;Ayele, 2012), with an estimated US $6,750,000 of economic damage resulting per shock (Kinde, 2002).

In the past, large number of structurally damaging earthquake incidences occurred in the rift valley lakes basin of Ethiopia. The below table (Table 4) presents list of earthquakes and reported damages between 1979-2011 (Kinde et al., 2011).

Table 4.List of earthquakes and reported damages between 1979 - 2011

Earthquake	**M(Richter**Magnitude)	**Year**	**damage**
7.03N 38.6E	5.1	1983	• Rock slides and damage and destruction of masonry buildings in Wendogenet, east of Lake Hawassa. • Well-built single-story building cracked at the Forestry Institute. • Large boulders dislodged, plaster fallen off walls, electric poles thrown down.
Hawassa	5.3	1983	• Damage to steel frames in Hawassa. • Damage to Wetera Abo Church in Wondo Genet (1983 earthquake, masonry building with irregular vertical and horizontal stiffness. Damage seems to occur where there is stiffness discontinuity).
8.3 N 38.52E (Oitu Bay, Langano	5.1	1985	• Strongly felt in Lake Langano camp, central MER.

			• Cracks in buildings in resort area hotels.
9.47N 39.61 E (Langano)	4.8	1985	Panic in high buildings
	5.4	1987	Already weakened blocket building collapsed, strongly felt – Arba Minch. Panic – No damage in Jimma. Students knocked against one another in classroom, poorly built house collapsed in Sawla.
Hamer and Gofa Earthquake Swarm	5.3 – 6.2	1987	• Details given separately for Hawassa, Jima and Arba Minch.
Soddo [6.84N 37.88E]	5.0	1989	Widespread panic, broken windows and some injured in Soddo.
[8.1N 38.7E]	5.1	1990	Minor damage in towns at the western escarpment, i.e., at Silti and Butajira, West of Zway town.
Hosanna	5.3	2010	Damage tomany building in Hosanna.
Apposto/Yirgalem	5.0	2011	Damage to unreinforced cinder-block cladded timber building. 100 houses were destroyed and 2 people were injured in this earthquake.

The aforementioned examples reveal the high vulnerability of the Rift Valley Lakes basin of Ethiopia to earthquakes. Population and economic growth have led to increased urbanization, and more people are living close to active earthquakes in the basin. However, there is little awareness or preparedness in regards to potential earthquakes. Poor building structures, absence of alert systems, and earthquake-Resistant regulations make the urban public more vulnerable to disasters (Abebe et al., 2010; Ayele, 2012).

[2] Landslide and ground cracks

Landslide in Ethiopia is a common phenomenon which often causes significant damage to people and property. The rapid population growth demanded the use of areas which were not previously used for settlement, urban expansion, agricultural and other purposes thereby exposing these areas to landslide problems after rainy seasons (Mersha and Meten, 2020). Several authors, have reported the occurrence of landslides and associated natural disaster in different regions of the rift margins and associated highlands. For example, landslides have occurred on May 2018 in Dara Malo locality, Gamo-Gofa Zone, Southern regional state, which killed 9 people and injured 17.

In the Rift Valley Lakes basin ground cracks and fissures are also major geological hazards that damages different infrastructure (roads, water lines, etc). In the basin, ground cracks commonly occurs in the rift floor and cause damage to infrastructure (roads, water lines, etc.). For example, the cracks were observed in a small village called Muleti (about 20 km west of the town of Awasa), around Lake Shala (approaching the lake from northeast), and Adamitulu area. With a width of 1–3 m, a depth of 6–12 m and a length of more than 1 km, the cracks in the Adami Tulu, were the first major structures observed in the rift floor with no record of seismicity (Ayalew et al., 2004).

3.5.6. Drought and floods

Ethiopia has frequently experienced hydrological drought at an increasing intensity throughout the past many decades. For instance, the study conducted by Edossa et al. (2010) shows an increasing occurrence of drought events, with droughts occurring every 5 years. The study conducted by Gebrehiwot et al. (2011) showed that the frequency of recurrent drought in Ethiopia has been showing an increasing trend for over the past decades.

Hydrological extreme events such as floods and drought are commonly occurring in the Ethiopia Rift Valley lakes basin, which eventually causes environmental hazards (Yishak et al., 2020). Many previous studies have investigated long-term hydrological extreme even related to climate change (Ryu and Kim, 2019). Changes in Earth's climate system affect the balance of the hydrological cycle and eventually leads to increased occurrence of extreme events such as floods and droughts (Sheffield and Wood, 2007). Recent investigations also show that global climate change will create and intensify even more severe frequent floods and droughts in the region (Birhanu et al., 2016).

According to Mohammed and Yimam (2021), in the lakes' region of the Ethiopian rift valley the spatial patterns of drought events didn't exhibit clear patterns, rather a more localized distribution and variability; the frequency of drought incidence became intense from 2008 onwards at all timescales compared to the 1990s and 2000s; and the increasing tendency of drought in recent years might be the manifestation of borderless global warming. In general, the

same study concluded that drought events and their negative effects are highly localized in the lakes basin of Ethiopian Rift valley and provide useful information for local-scale planning for drought management and response.

[1] Lake Hawassa Sub-basin

In particular, in the middle part of the rift valley lakes basin, such as in the Lake Hawassa Sub-basin, drought conditions of future periods will increase with respect to the duration, severity, and frequency of the drought. The basin is moderately prone to both mild and moderate droughts, but less prone to severe and extreme droughts. Climate change will largely affect and increase drought duration, frequency, and severity in the basin and subsequently the design of future water resources projects. Thus, sustainable water management measures should be planned to mitigate future impacts of droughts in the basin.

The significant rising trend of Lake Hawassa water level is one of the main environmental threats for the City of Hawassa, which has been established at the eastern shore of the Lake. It is still the subject of concern and center of debate among the stakeholders since the last few decades, especially in the aftermath of the 1998 flood that caused displacement of resident population, destruction of properties and infrastructure by inundating vast areas along the lake shore. According to WRDB (2007) and WWDSE (2001), the lake level rise and the associated surface expansion affected about 162 urban and 2244 farmers' households, 13 different organizations, water supply schemes, 10 ha of sand quarry, roads, and forestland. In monetary terms, the total physical damage was estimated to be 43,490,524 Ethiopian Birr (about € 5.4 million).

[2] Lake Chew Bahir Sub-basin

In the southern part of the Rift valley lakes basin drought is a recurring phenomenon (People in Need, 2018). Previous field observations by various travellers have shown the sensitivity of hydrology of Lake Chew Bahir to even short term climate variability (Grove et al., 1975). In the late 19th century, the unprecedented drought, which occurred over the whole of East Africa, significantly affected the area during which both people and animals were starved and died; the river no longer reached the Lake Chew Bahir but spread out and disappeared. In recent times too, according to information obtained from local community, availability of pasture in the

area is reducing gradually due to drought and shorter rainy season. The dry season is becoming longer contributing to the gradual extinction of indigenous grasses and reducing crop yields and the availability of water in the area. As a result, the community are forced to migrate with their livestock to find pasture.

In Lake Chew-bahir sub- basin, floods occur in the basin as a result of prolonged heavy rainfall causing rivers to overflow and inundate areas along the river banks. Hammer, Bena Tsemay, Buriji, and Konso Zone/Woredas are the most flood prone areas in the basin (Flood alert Report, 2018). Therefore, these issues call for careful disaster preparedness in terms of adapting appropriate response mechanism to hinder and mitigate their catastrophic impact on the society.

[3] Abaya-Chamo Sub-basin

In Abaya-Chamo lakes basin flooding is associated with flash flooding from mountain streams and Rivers, which can cause infrastructure damages, loss of life, temporary displacement of large numbers of peoples, and loss of crops. The frequency and extent of out-of-bank flooding will depend on the flow levels and river morphology, while the flood-related damages will depend on the density of population and land use in flood prone areas. The flood prone area assessment report (Flood report, 2008) indicates the high and very high flood hazard threats in the down-stream part of the rivers flowing into lakes Abaya and Chamo. For example, flooding in the lower part of Kulfo River catchment becomes an unbeatable disaster and a challenge for the rural community living around the lower catchment. Farmers in the catchment extensively use Kulfo River for their irrigation, but their crops are affected by flooding each year.

According to RVLBMP (2010), flooding is common in Parts of the Middle and lower Bilate river; Middle Gelana; and Lower Kulfo where flooding events affect thousands of people and damages irrigation infrastructure. The most frequently affected woredas in the Abaya-Chamo Sub-basin includes Shashego Wereda of Hydiya zone; Humbo Wereda of Wolita Zone; Hula, Dale, ShebedinoWereda of Sidama region; AlichWoriro, Dalocha, Lanfaro, Siltee, Sankura in Silite Zone; Halaba special woreda; Galana Woreda of West Guji Zone; and KochoreWoreda of Gedeo Zone. Apart from flooding, as in other parts of the rift valley lakes basin, most parts of Abaya-Chamo Sub-basin is affected by recurrent drought which results in production failure. In

this regard, Halaba-Mareko area, Badawacho, Kedida, Damote Gale, DamotWeyde, Humbo, Amaro, and Derasheworeda/area are the most affected regions

3.6. Analysis of cause and effect of the major themes using problem trees

The goal-setting was assisted by development of DPSIR, problem and objective trees analysis, logframe and SWOT analysis for water quantity, water quality, watershed degradation, and for cause and effect relationships of natural hazards in the Rift Valley Lakes Basin (figures10-13).

3.6.1. Problem tree for water quantity decline in the basin

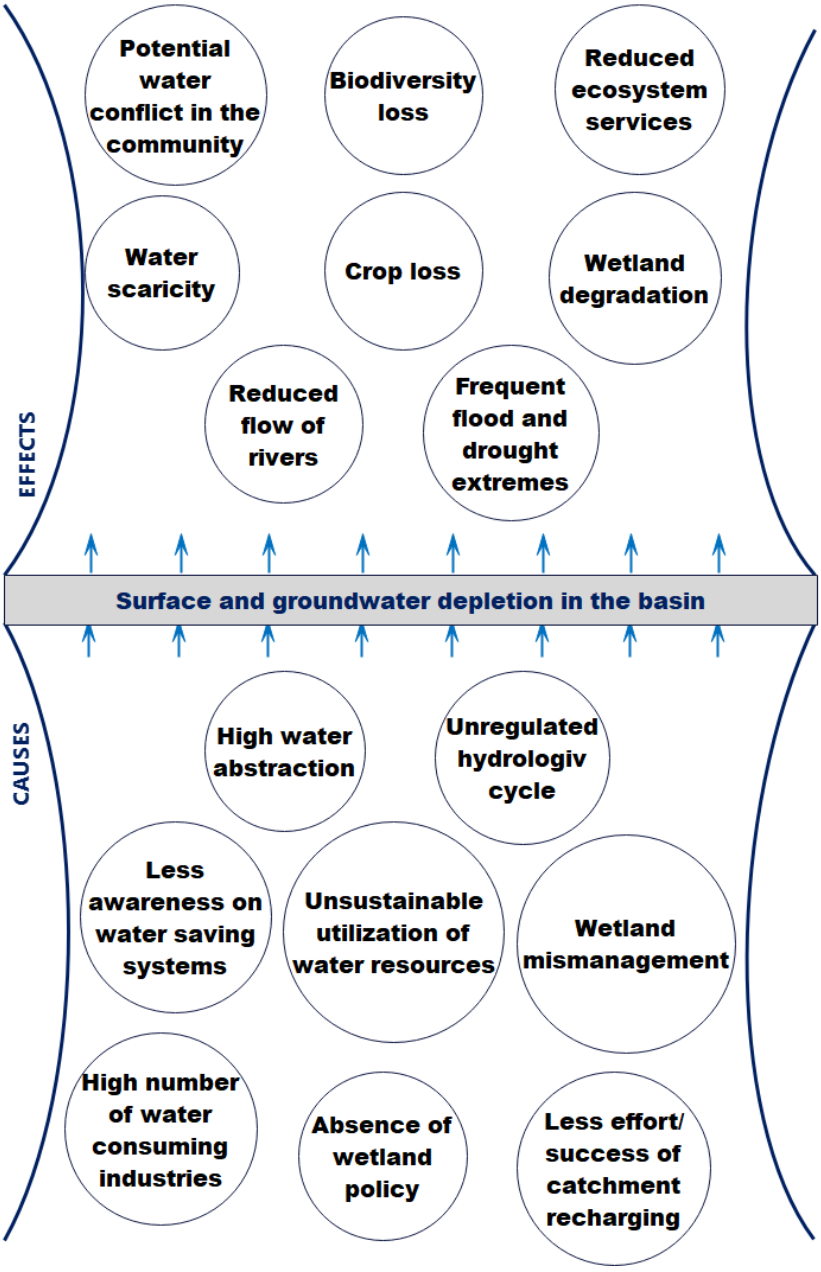


Figure 10.Cause-effect analysis using problem tree for surface and groundwater depletion

3.6.2. Problem tree for water quality deterioration in the basin

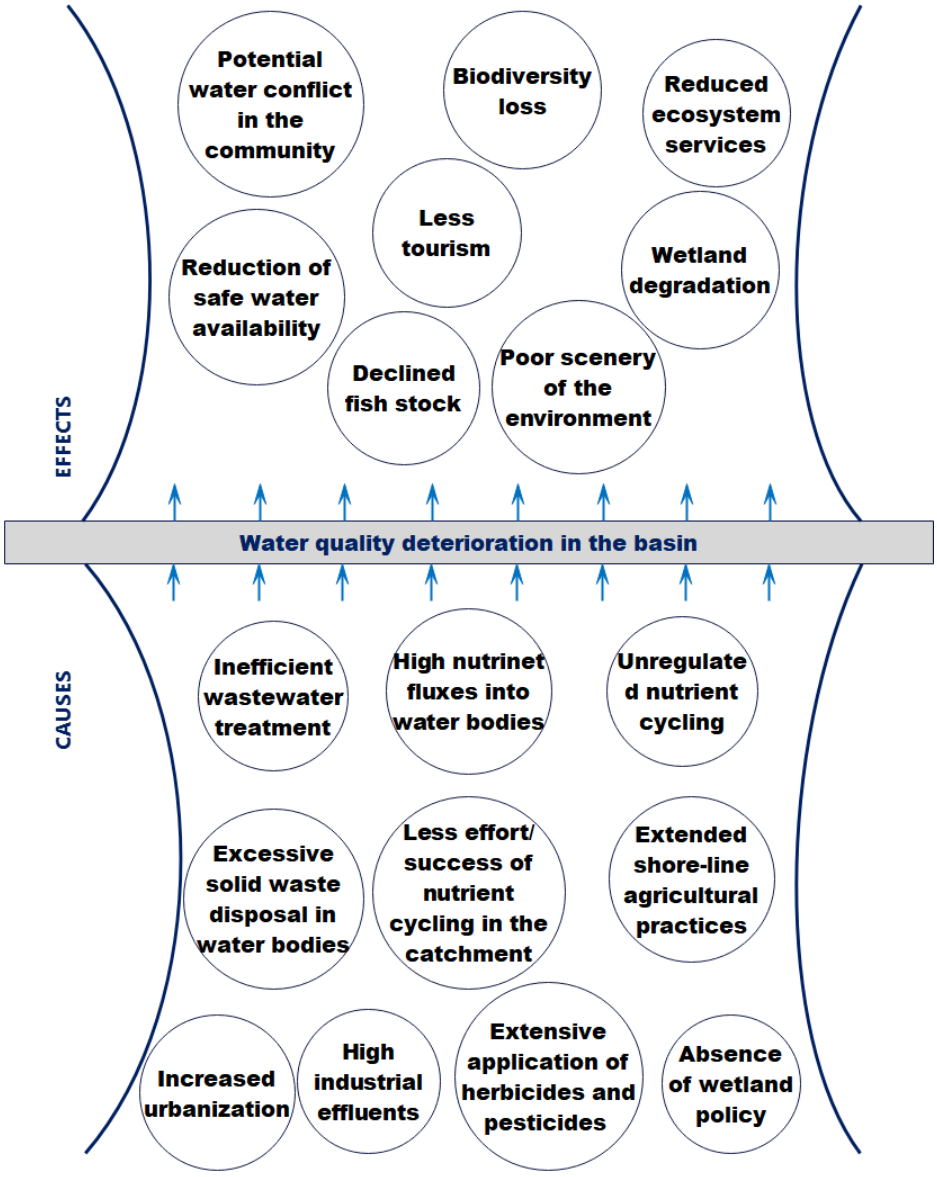


Figure 11.Cause-effect analysis using problem tree for water quality deterioration in the basin

3.6.3. Problem tree for Watershed Degradation

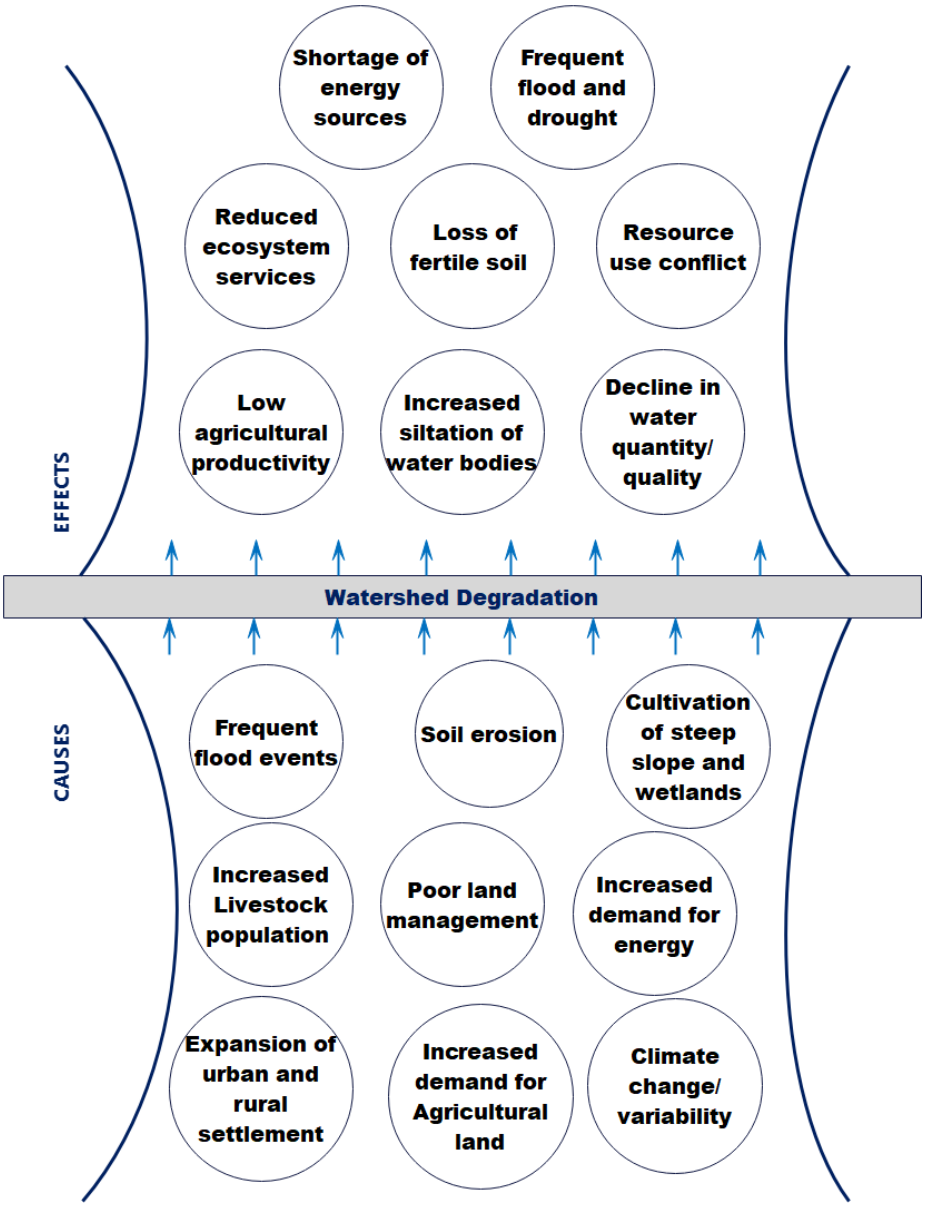


Figure 12.Cause-effect analysis using problem tree for watershed degradation

3.6.4. Problem tree for cause and effect relationship of Natural Hazard in Rift Valley Lakes Basin

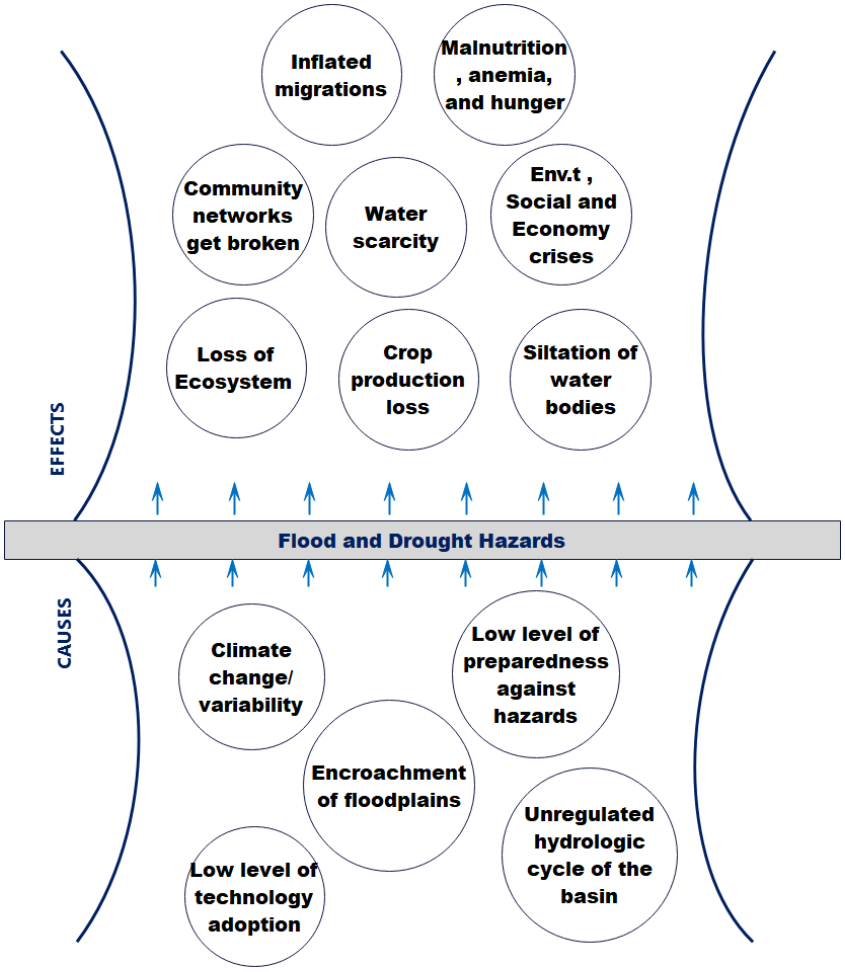


Figure 13.Cause-effect analysis using problem tree for flood and drought hazards

4

Legal and Institutional Assessment

4.1. Legal Situation Assessment

Strong institutional and legal frameworks are critical for strategic basin planning and management. A basin plan is a multi-phase and multi-owner activity and its development process has to be in accordance with policies, proclamations, regulations and institutional arrangements developed in the country. Therefore, in developing this basin plan, sustainable development goal/SDG/, FDRE Constitution (1995), Water Resources Management Policy (WRMP), Environmental Policy of Ethiopia (EPE), Water Resources Management Proclamation (Proclamation No.197/2000), Water Resources Management Regulations (Regulation No. 115/2005), and other related policies, strategic documents and mandated institutional setups were assessed and reviewed.The following table (Table 5) lists and provide a brief descriptions of the legal frameworks considered in this Basin plan.

Table 5.Brief descriptions of the legal frameworks considered in this strategic plan

Legal framework	Brief description
[1]The FDRE Constitution (1995)	The FDRE Constitution states that all national policies, laws and institutional arrangements of the country, including those related to the management and administration of water resources and other natural resources must be in line with constitutional provisions. Article 51(11) gives the Federal Government the mandate to manage and administer rivers and lakes, determining of the use, allocation and protection of water resources. Article 52(2) gives the provision to regional states the power to administer land and other natural resources in accordance with Federal laws. Articles 44(1), 90(1) and 92(1, 2, 3, and 4) deal with the people right to have a clean and healthy environment, access to public health and education, clean water, housing, food and social security and other environmental issues.
[2]Environmental Policy of Ethiopia (1997)	Its overall goal is "to improve and enhance the health and quality of life of all Ethiopians, and to promote sustainable social and economic development through the sound management and use of natural, human-made and cultural resources and the environment as a whole, so as to meet the needs of the present generation without compromising the ability of future generations to meet their own needs". It incorporates sector specific environmental policy provisions for water resources and related sectors.
[3]Conservation Strategy of Ethiopia (CSE) (1997)	The CSE provides a strategic framework detailing principles, guidelines and strategies for the effective management of the environment. It sets out detailed strategies and action plans as well as the institutional arrangements required for the implementation of sectorial as well as cross-sectorial interventions for the management of Ethiopia's natural, man-made and cultural resources.
[4]Ethiopian Water Resources Management Policy (WRMP, 1999)	The overall goal of the policy is to enhance and promote all national efforts towards the efficient, equitable and optimum utilization of the available water resources of Ethiopia for significant socioeconomic development on sustainable basis. The general policies recognize that water resources development, utilization, protection and conservation go hand in hand and ensure that water supply and sanitation, irrigation and drainage as well as hydraulic structures, watershed management and related activities are integrated and addressed in unison.
[5]Ethiopian Water	This Proclamation is the basic legal instrument governing the

Resources Management Proclamation (Proclamation No. 197/2000)	management, planning, utilization and protection of water resources in Ethiopia. It has laid down the general conditions that need to be fulfilled for anyone wishing to use water resources for different purposes on the basis of water use permit. In addition, it consists of the fundamental principles, which are expected to be considered while basin plans are developed.
[6]Water Sector Strategy of Ethiopia (2001)	The overall goal of this strategy is to enhance and promote all national efforts towards the efficient, equitable and optimum utilisation of the available water resources of the country for significant socio-economic development on a sustainable basis. In this strategy, the water allocation plans will be developed taking into consideration basin, basin and other hydrological boundaries, with due consideration to the needs of drought prone areas. To this effect, appropriate watershed management practices will be used to maximise water yields and quality.
[7]Environmental Pollution Control Proclamation No. 300/2002 (2002)	It provides the basis for the development of relevant environmental standards and to make violation of these standards a punishable act based on the "polluter pays principle". It also provides a gestation period of five years for existing industries during which they are expected to reduce the strength of their effluents to lie within the industrial standards.
[8]Food Security Strategy (2002)	This strategy aims at increasing domestic food production; ensuring access to food for food deficit households; and strengthening emergency response capabilities. It is recognized that soil, water, and vegetation are the main asset base of both the farming community and economy of the country, without which the achievement of food security is unlikely. Water and natural resource conservation based agricultural development is considered as a centerpiece of the strategy.
[9]Water Resources Management Regulations (Regulation No. 115/2005)	Its objective is to provide detailed provisions for the effective implementation of the Proclamation No.197/2000. It provides in detail the main requirements for the issuance of permits for different uses of water; construction works; wastewater discharge, the conditions for the issuance, renewal, revocation etc. of such permits, and fees for application for permits as well as the requirements of water charges to be paid for different uses of water
[10]Prevention of Industrial Pollution Regulation No.	This regulation states that factories must make sure their liquid waste meets environmental standards, and obtain a permit before discharging any liquid and also must monitor the composition of its waste, keep

471/2005 (2005)	records and report periodically to the Environmental Protection Authority (EPA).
[11]Solid waste management Proclamation No. 513/2007	This proclamation sets out the obligation for urban administrations to create the right conditions to promote investment in solid waste management services.
[12]The Ethiopian Strategic Investment Framework for Sustainable Land Management (ESIF/SLM) (2010)	This framework was developed to improve the coordination between donor's support and government's development effort in land administration and sustainable land management. It provides a holistic and integrated strategic planning framework under which government, development partners and civil society stakeholders can work together to remove the barriers, and overcome the bottlenecks, to promote and scale-up sustainable land management in Ethiopia.
[13]Climate Resilient Green Economy of Ethiopia (CRGE) (2011)	The CRGE understands water management as key to achieving a green economy because of the role of water for developing hydropower and agriculture. The Ministry of Water, Irrigation and Energy (MoWE) is listed as one of the actors with a role in encouraging the formulation and implementation of green economy.
[14]The Sustainable Development Goals /SDGs/ (UN, 2015)	Goal 6 states 'Ensure availability and sustainable management of water and sanitation for all'. Goals 6.5 and 6.6 give emphasis about protecting and restoring water-related ecosystems by 2030.To achieve this goal, The Government of FDRE is committed to working to achieve SDG goals.
[15]Growth& Transformation Plan II(GTP II) (2016).	This plan focuses on ensuring fair and equitable development and utilization of the country's water resources for sustained socioeconomic development. In the period of five years of the plan, water resource development interventions will include, water supply, irrigation and drainage development, hydropower study and design, surface and groundwater study and integrated master plan study and watershed management.
[16]African Beacon Prosperity	Vision 2030; Ethiopia: An African Beacon of Prosperity, 10 years government plans (2020). In this plan, the economy envisages an average annual economic growth of 10.2%, while the per capita income is expected to increase by 8.2% each year to reach USD 2,220 by 2030. Regarding poverty reduction and unemployment, the plan also envisages a reduction in the proportion of people living below the

	poverty line from the current 19% to 7% in 2030 and a reduction in the unemployment rate by at least 1% each year. The plan also foresees for universal access to clean drinking water and electricity by 2030. Furthermore, the improvement irrigation system, ICT, education, and health services are vital features of the new development plan. The plan also intends to accelerate the structural transformation of the economy by substantially increasing industry's contribution to GDP from the current 27.8% to 35.9% by 2030.

4.2. Institutional Framework

The following Federal, Regional, Zonal and Woreda-level institutions are involved in IWRM and are key stakeholders in both development and implementation of the basin plan. Institutional set up reviewed bellow are enabling environments for IWRM implementation. However, the roles they play in water resources management differ in accordance with their level of influence. The list of key institutions in the water sector in Ethiopia and their responsibilities are provided in the table given below (Table 6)Table 6.List of key institutions in the water sector in Ethiopia

Institution	Roles and Responsibilities
[1]Ministry of Water, and Energy (MoWE)	Develops overarching policies and laws; is responsible for overall planning and coordination as well as monitoring the implementation of WRM and development programmers within the sector. Issues licenses for large and medium-scale irrigation schemes.
[2]Ministry of Finance	Responsible for all spending with regard to WRM and WRD, including investments under the Water Master Plan/Strategy. It also sets development priorities and strategies in cooperation with the other ministries, formulates strategies for managing foreign aid and loans, negotiates and signs aid and loan agreements and monitors their implementation.
[3]Commission of Environment, Forestry and Climate Change(CEFCC) – formerly the Environmental Protection Authority	The CEFCC is in charge of EIAs at the federal level and decides on EIAs for projects that are likely to produce trans-regional impacts. Regionally, EIAs are a competence of the regional state environmental agencies. MEF (together with MoFEC) is also a Coordinating Entity for the CRGE; in this role, it focuses on putting in place the overall technical approach and system for coordination for CRGE implementation and the monitoring of progress.
[4]Ministry of Industry	Issues licenses and permits to industrial development projects.
[5]Ministry of Agriculture (MoA)	Responsible for watershed management, water harvesting and small-scale irrigation schemes.
[6]Ethiopian Meteorological Institute - formerly National Meteorological Agency	Establishes and operates a national network of meteorological stations.
[7]Water Resources Development Fund (WRDF)	It provides small-scale financing to water supply, sanitation and irrigation development initiatives. Loans are granted for extended periods of up to 30 years, to be repaid through the collection of tariffs with fixed interest rates

	of 3%.
[8]The Ethiopian Electric Power (EEP)	It is a state-owned electric producer engaged in development, investment, construction, operation, and management of power plants, power generation and power transmission.
[9]Regional Bureaus/ Authorities, Zonal and Woreda offices	According to the Ethiopian Constitution (Article 52 c), states have the power to administer land and natural resources in accordance with laws enacted by the Federal Government. Proclamation 197/2000 further provides for the possibility of the Federal Government delegating its powers to manage water and other resources to regional states.

4.3. Institutional arrangements

The following institutional arrangements were taken into consideration during the development of this strategic plan:

4.3.1. Federal Government (MoWE)

At the federal level, responsibility for policy and strategy development for the water sector is with the Ministry of Water and Energy(MoWE). It also coordinates with external agencies for financing sector investments. MoWE is responsible for developing the Sector Development Programme for IWRM, Water Supply and Sanitation (WSS)and Energy development for Ethiopia. With the enhanced role of regional governments, the role of MoWE is to ensure effective monitoring and evaluation, and to provide capacity building for economic regulation in the sector.

4.3.2. Regional and Woreda Governments

Under the emerging decentralization framework, responsibility for ensuring the provision of these services will be increasingly with the regions and Woredas. The BWR, along with their other responsibilities for water resources, are responsible for water and sanitation at the regional level. At the zonal level there are water departments, which were established in 1996 to support development, implementation and regulation of WSS activities. Zonal level essentially represents a de-concentration of administration. Gradually, with recent developments, the emphasis is shifting from the Zone to transferring responsibilities to the Woreda level.

4.3.3. Woreda Desks/Offices

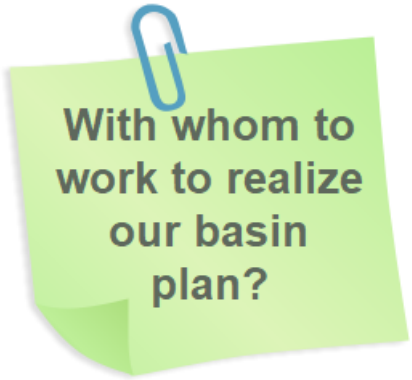
Decentralization to the Woreda level has been followed up with the establishment of water desks/offices in as many Woredas as possible. The Woredas are expected to take over very many of the regional bureau and zonal department functions. Although the bureaus still have important roles in providing support with regard to the introduction of technologies and undertaking complex overall studies, the Woreda desks/offices are the ones which are now intimately involved with rural water schemes and their committees or boards both in the regulatory aspect as well as the provision of technical assistance.

4.3.4. Non-Governmental Organizations

NGOs are important actors in the WSS sector in Ethiopia, with about 125 active NGOs in 1994; with some presence in all the regions, though a few large ones dominate. Almost all are externally funded and provide both technical and funding support to the sector. Funding by NGOs may be an important source, though recent details of its extent are not available. While NGOs need to register with the Ministry of Justice, their projects are reviewed at the regional level.

4.3.5. Private Sector

The private sector in Ethiopia is at an emerging stage and is mainly involved in consultancy and the construction sector. To a large extent this reflects a lack of demand during the past two decades, though during the 1990s efforts were made to promote the private sector. Considerable efforts and capacity building support, along with a better development of opportunities to nurture demand for private sector services, will be needed in the coming years. A detailed assessment of the nature of support measures and capacity building requirements is essential. An assessment of small-scale providers and operators in the informal sector would also be useful.



5

Stakeholders Identification and Analysis

5.1. Stakeholder identification

5.1.1. Federal level Stakeholders

Stakeholders at Federal level include Ministry of Water, and Energy, Ministry of Planning and Development, Ministry of Innovation and Technology, Ministry of Agriculture, Ministry of Irrigation and Lowland; Ministry of Finance; Ministry of Labor and Skill, Ethiopian Agricultural Authority, Ethiopian Statistical Service ; Ethiopian Geological Institute; Enviroment Protection Authority, Ethiopian Disaster Risk Management Commission, Ethiopian Meteorological Institute, Federal Investment Commission; Institute of Bio-Diversity; Ethiopian Wildlife Conservation Authority; Ethiopian Agricultural Research Institute; Livestock Development Institute, Ethiopian Forest Development, Ethiopian Horticulture Development Agency; Ministry of Mines,; and Ministry of Tourism;

5.1.2. Regional level Stakeholders

The Basin is shared between part of Oromia National Regional State, Sidama National Regional State and South Nations, Nationalities and Peoples' Regional State respectively. Public institutions at regional level include Bureaus of Agriculture, Bureaus of Water, and Energy, Bureaus of Environmental Protection and Climate Change, Forestry and Wildlife Agencies, Bureaus of Livestock and Fishery Resources Development, Bureaus of Rural Land Administration and Use, Bureaus of Industry and Urban Development, Bureaus of Trade and Transport, Bureaus of Culture and Tourism, Irrigation Development Authorities; Investment Commissions, and Small and Micro Enterprise Development Offices.

5.1.3. Water users

- **Small-scale farmers with irrigated agriculture**: These are the smallholder farmers engaged in cultivation under rain fed and irrigation agriculture.
- **Private commercial agricultural farms (large users):**-this category includes farms with extensive irrigated land area or those who practice intensive agriculture systems. These are irrigated farms such as cotton farms, banana farms, maize farms, etc.
- **Domestic water users** are rural and urban water supply users. There are many water points in rural parts of the Basin and urban water supply systems in the urban areas of Chew Bahir Basin.
- **Recreational and Tourism:** under this category hot springs, hotel and resorts, lodges and other recreational centers are included.
- **Knowledge institutes and NGOs;-**There are knowledge institutions/research institutions and Universities/ National and International NGOs working on various studies and researches in the basin, which are key stakeholder in the Basin plan preparation and implementation. These groups of stakeholders are involved in issues and options of water use efficiency, water abstraction technology, aquatic resources management, water pollution, soil erosion and land degradation, watershed conservation, forest resource management, endemic wildlife and bird's management.

5.1.4. Decision makers

Decision makers include the House of People's Representatives (HoPR), Council of Ministers, , Ministry of Water, and Energy; Rift Valley Lakes Basin Administration Office, Ministry of Agriculture, Administrative Administrative Council of Oromia National Regional State Administrative Council of Sidama National Regional State And Council of Southern Nations, Nationalities and Peoples Regional State,

5.1.5. Regulatory bodies

Regulatory bodies include Ministry of Water, and Energy, and Rift Valley Lakes Basin Administration Office.

5.1.6. Implementers

Key implementers are those who are involved in planning and implementation of the basin plan. The main stakeholders in the hierarchy are Ministry of Water, and Energy, Rift Valley Lakes Basin Administration Office, Ministry of Agriculture, Ministry of Culture and Tourism, Ethiopian Wild Life Development and Conservation Authority, Regional, Zonal, and Woreda-level Bureaus of Agriculture and Natural Resources, Water and Irrigation Development, Mines and Energy, Environmental Protection, Forestry, and Climate Change, and Rural Land Administration.

5.1.7. Funding organizations

The Basin Plan requires a concerted technical and financial support of international organizations and NGOs working on natural resource, environment, and climate change. For example, World Bank, UNESCO, Africa Development Bank, and others can be mentioned in this category.

5.1.8. Private companies

Private companies found in the Basin include commercial farms such as: Omo Sheleko Agro-industry, Nasa Farm, Enchete Kebele farmers, Duma Kebele farms, Gisma, Bola and Bura Kebele farmers, Babo Kebele farmers, Masoya Kebele farmers, Gete Kebele farmers, Zegerma Kebele farmers, Cherkaka Kebele farmers, and Arbore Kebele farmers.

5.1.9. Community (water user association)

This includes consumers who rely on the safe supply of water, Hayonda irrigation water user farmer associations. It includes Water Users Associations (WUA), Water Supply, Sanitation and Hygiene Committee (WaSHCo), Water Users Federation (WUF) at Woreda and Zonal levels.

5.2. Stakeholder mapping and engagements

Successful stakeholder engagement allows concerned bodies to have opportunities for intensive involvement in planning, decision making, and evaluation of all activities in the basin plan preparation and implementation processes. In order to develop applicable engagement plans, primarily, stakeholders have to be grouped into various categories in order to facilitate consultation and data collection processes. Secondly, engagement stages should be formulated to specify stages where the stakeholders will participate. Accordingly, potential stakeholders in the Basin are grouped in to the following hierarchies (H) based on the nature of their involvement in water resource planning, utilization, and management.

Hierarchy(H_1): These are policy, decision makers, and regulatory bodies which includes The FDRE Parliament, Council of Ministers,, MoWE, MOWE, RVLBAO, MoA, MOF, ONRS, SNRS and SNNPRS Administrative Councils

Hierarchy (H_2): These are implementers who are involved in planning and implementation of the Basin plan. The main stakeholders in this hierarchy are MoWE, RVLBAO, MoA, Ethiopian Wild Life Development and Conservation Authority, Regional, Zonal and Woreda-level Bureaus of Agriculture and Natural Resources, Water and Irrigation Development, Mines and Energy, Environmental Protection, Forestry, and Climate Change, Rural Land Administration.

Hierarchy (H_3): These groups of stakeholders are called media and knowledge institutions like universities, public institutions, research institutes that provide technical support, capacity building, innovative research, and development works.

Hierarchy (H_4): These refer to Civic organizations, international funding institutions and NGOs which give a concerted technical and financial support. The main international organizations are WB, UNESCO, and EU.

Hierarchy (H_5): All Water users in RVLB are included in this group. They are sub-grouped into three classes based on their resource use practices, level of intensification, purpose of water abstraction, and socioeconomic nature in order to facilitate the engagement plan and implementation process.

- **Smallholder irrigation water users:** include smallholder individual farmers and water user association groups that abstract water for irrigation purpose.
- **Commercial irrigation water users:** includes irrigated farms using water from the main Rivers – Segen, Weito, Bezo and other tributary rivers, streams, springs – and groundwater sources.
- **Domestic water users** which include town and village water users for water supply and other domestic purpose.

In general, the following stakeholder engagement framework (Table 7) and stakeholder involvement flow chart show the successful engagement of all stakeholders in the basin.

Table 7.Stakeholder involvement flow chart

No	Stages of involvement	Decision makers and regulatory bodies(H_1)	Implementers (H_2)	Media and Knowledge Institutions (H_3)	Civic Organizations and NGOs (H_4)	Water Users and general public (H_5)
1	Basin plan Preparation	Roles: Plan evaluation and approval. Decide on issues for planning; Legal issue revision; Information disclosure	Roles: Law enforcement. Prepare basin plan; Sign agreement; Develop projects; Resource mobilization	Roles: Aware the public; Disseminate information; Conduct studies and provide necessary data	Roles: Reflect their interests/opinions	Roles: Provide the required information; Reflect their interests/opinions; Prepare pollution abatement plan
2	Implementing	Political leadership and Coordination; Allocate resource; Guiding implanters	Own and implement the plan; Aware, supervise and Consult users ;Capacity building; Guide the local Authorities; Mobilize the public and support community effort	Aware the public; Disseminate information and technology; Develop cost –effective implementation strategy; Adopt new technologies	Coordinate interested groups; Aware and support users; Fund projects; capacitate users; Mobilize the public & support community effort	Implement plan requirements; Attend awareness raising trainings; Use the adopted new technologies
3	Monitoring and Evaluation	Monitor implementation; Evaluate performance; Guide the implementers	Monitor implementation; Evaluate performance; Identify challenges	Aware the public; Disseminate information; Evaluate research results		Evaluate self-key achievements; Respond for success or failure
4	Review /Updating	Evaluate the outcome; Plan for next period/ updating overall plan; inform review results	Organize review meetings ; Get ready for further planning /updating	Aware the public; Disseminate information	Participate in review meetings	Participate in review meetings

6

Mission-Vision-Value Statements

6.1. Vision

Water resources in the basin are developed and managed in an efficient, equitable and sustainable manner by 2035.

6.2. Mission

Establish a beneficial legal and regulatory framework and effective mechanism for managing, developing, utilizing, protecting, controlling and conserving water resources in an environmentally and economically sound manner in order to meet the needs of all the people in the basin.

6.3. Values

In line with the MoWE, the RVL-Basin plan values:

1. New Ideas and Innovation
2. equal participation and benefit
3. Providing Quality service
4. Alert on Environmental protection
5. An attitude of always learning
6. Perseverance, Team work and work ethics7. Abhorrence of corruption and malpractice

7

Strategic goals, Objectives, and Activities

7.1. The underlying theory of change as a roadmap for basin plan

This section of the basin plan attempts to show the underlying hypothesis of how the stakeholders think change occurs to reach the anticipated goals. Such a road map can be referred as a 'theory of change' or 'intervention logics' or 'results chains' (*figure 14*). Designing this theory of change with stakeholders will:

- Lead to a common understanding of how change occurs
- Create awareness on different norms and values between stakeholders
- Generate co-ownership of the basin plan
- Help to decide on the scope of the basin plan
- Support decision-making on what interventions should be pursued to achieve the biggest impact by whom

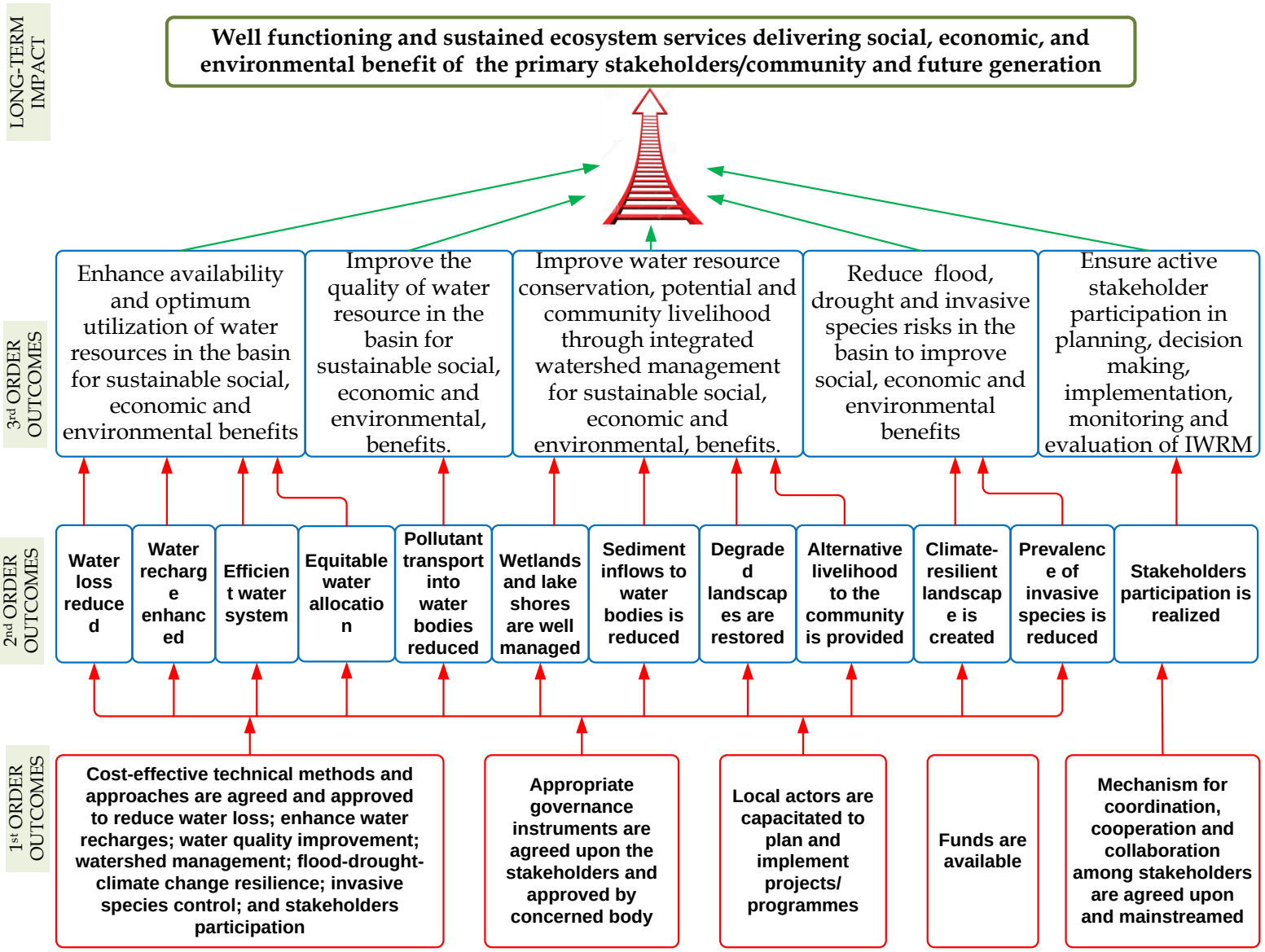


Figure 14. The underlying theory of change for the strategic basin plan

7.2. The major targets of the basin plan

As derived from the underlying theory of change, the major targets were set as shown in *figure 15*below.

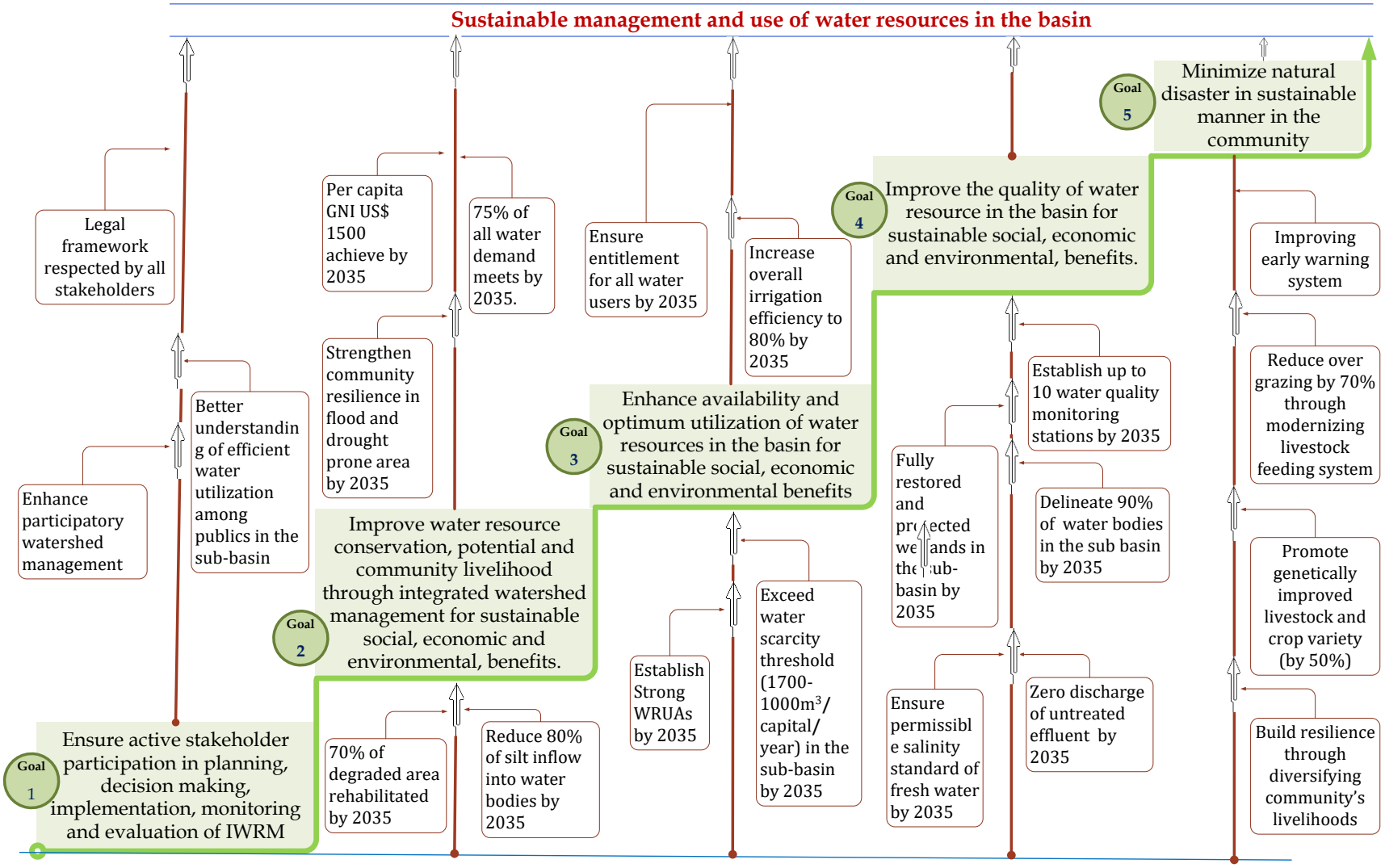


Figure 15.The major goals and specific targets of the basin plan

7.3. Logical framework for the basin plan

In complementing the theory of change and the major goals and specific targets, *table 8* presents the details of the logical framework.

Table 8. Logical framework for the basin plan

Goals	Specific objectives	Targets	Outcome	Outcome indicator	Data source &Means of verification	Risk and assumption	Risk Mitigation
GOAL 1: To ensure active stakeholder participation in planning, decision making, implementation, monitoring and evaluation of IWRM.	To improve public awareness on water resources management and optimal use	Better understanding of efficient water utilization among publics in the basin	Attitudinal change towards water management	Willingness of the stakeholder toward efficient water use	Consultation meetings, workshops, memorandum of understanding	Lack of stakeholder interest to engage in IWRM and basin planning and management	Advocacy and awareness raising of stakeholders
	To strengthen stakeholder's participation on watershed management	Enhance participatory watershed management	Successful watershed management practice	Rehabilitated watershed	Reports from Agricultural and natural resource bureau, EFD, RVLBAO	Lack of stakeholder interest to engage in WM and basin planning and management	Advocacy and awareness raising of stakeholders
	To implement legal framework related to pollution control through stakeholder participation	Legal framework respected by all stakeholders	Environment friendly economic development	Healthy environment	Environmental audit report	Lack of buffer zone regulation	Approval of draft Buffer zone regulation
GOAL 2: Improve water resource conservation, potential	To protect water bodies from siltation/sedimentation	Reduce 80% of silt inflow into water bodies by 2035	The lakes and riverine water resources environment restored	- Increased lake volume - Restored aquatic biodiversity	Stakeholders annual report, field surveys	Lack of adequate sustainable investment financing Weak stakeholders' commitment to implement basin plan	Institutionalized resources mobilization put in place. Adoption of basin plan by stakeholders and

and community livelihood in the basin through integrated watershed management							implementation action through the Basin High Council & RBLBA
	To improve surface and groundwater potential	. 75% of all water demand meet by 2035.	water scarcity reduced, water use conflicts minimized and socio-economic improvement	Access to water supply, Social stability, increase of per capita income	Water sector report, CSA report, socio economic survey	Frequent drought	Drought early warning & preparedness, Promotion of water harvesting technologies & water efficient irrigation
	To rehabilitate severely degraded watersheds	70% of degraded area rehabilitated by 2035	Soil erosion reduced, soil fertility improved and Agricultural productivity enhanced	Amount of soil saved. amount of yield per hectare/year	Report from agriculture & natural resource sector, ESS, RVLBAO,		
	To improve livelihood of the community	Per capita GNI US$ 1500 achieve by 2035	livelihoods diversified, reduced pressure on natural and economic transformation	Socio economic improvement,	Report from CSA, Plan commission, Finance and economic development offices	. Inflation .	. Increase saving habit
	To reduce flood and drought hazard	Strengthen community resilience in flood and drought prone area by 2035.	. Exposed community to flood and drought risk are reduced. Damage of life and Property reduced	Livelihood improvement, flood prevention structures, secured society	NMA report, Risk prevention &disaster reduction preparedness offices	Climate change	Implement Climate change adaptation measures
GOAL 3:	To ensure water availability in	Exceed water scarcity	• Improved discharge of streams,	• Satisfied all water	Assessment reports, performanc	Climate change	Climate change adaptation

Enhance availability and optimum utilization of water resources in the basin for sustainable social, economic and environmental benefits	the basin	threshold (1700-1000m^3/capital/year) in the basin by 2035	springs and groundwater • Increased and continuing River flows Increased inflow to the Lakes	use demand • Agricultural production increaseSocio economic development of the sub-basin	e evaluation reports and case study report from MoWE, ONS Water resource bureau, SNNPRS Water resource bureau and RVLBAO,		measures
	To improve irrigation water, use efficiency in the basin	Increase overall irrigation efficiency to 80% by 2035	• Decrease excess water abstraction • increase in irrigation water productivity • environmental sustainability	• transform irrigation water use trend • Optimum abstraction reduction in irrigation water loss	Assessment reports, performance evaluation reports and case study reports from MoWE, Oromia Irrigation and Lowland bureau SNS &SNNPRS Water resource bureau and RVLBAO	Unwillingness to use new irrigation technology	Awareness creation, technical and financial support for farmers
	To implement water allocation	?	• water abstraction based on legal framework • Acceptable water sharing principle in the basin water use conflict minimized	• number of licensed water users and proper use	Assessment reports, case study reports from MoWE, ONS, SNS& SNNPRS Water resource bureau, and RVLBAO		

	To establish water users' association (WRUA)	?	Decrease illegal water user, improve Quality and quantity of water, livelihood improvement	• Number of water pumps decrease • number of water association, • reduced irrigation water loss	Regional co-operative office, Regional irrigation Authority, Water use and user assessment report.		
GOAL 4: Improve water quality of the basin to ensure sustainable social, economic and environmental, benefits.	To prevent industrial and municipal effluents	Zero discharge of untreated effluent by 2035	Improved water quality and aquatic ecosystem	Water quality standards and bio-indicators	water quality test reports	Leakage from septic tanks, artificial wetlands	Frequent monitoring and evaluation of treatment plant
	To reduce fresh water salinity problem across the sub- basin	Ensure permissible salinity standard of fresh water by 2035	Safe and potable water is maintained, aquatic ecosystem is maintained, socioeconomic use of water is enhanced	Low salinity values	water quality test reports from EFD/ RVLBAO, Water bureaus		
	To establish water quality monitoring system in the basin	Establish 10 water quality monitoring stations by 2035	Updated water quality status	Recorded data on water quality parameters	water quality test reports from EFD/, RVLBAO, Water bureaus		
	To conserve and restore wetlands in the basin	Fully restored and protected wetlands in the basin by 2035	improved water quality and quality, sustain biodiversity, enhanced socioeconomic benefit	No of restored wetlands in the basin	Assessment reports, case study reports from MoWE, ONS & SNNPRS Water	Lack of clear policy of wetland	Developing policy and legal framework

					resource bureau, and RVLBAO		
	To prevent lakeshore cultivation	Delineate 80% of water bodies in the basin by 2035	Reduce siltation, agrochemical pollution,	Reduced eutrophication	Assessment report	Land use conflicts	Awareness creation, effective directives, participatory leadership
GOAL 5: Minimize natural disaster in sustainable manner in the community	To enhance early warning system	Empowered community and institutions to take action prior to a disaster (80 % of total population will be trained and have clear understanding of causes and mitigation/ adaptation strategies by 2035)	Early warning information is readily available ahead of a disaster; Better understanding of causes and mitigation and or adaptation strategies of natural disasters	Reduced economic losses and the number of injuries or deaths from a disaster	Assessment report from regional disaster prevention offices at woreda, zonal, and regional offices	Financial shortage	Fund raising
	Enhance rangeland management system	Fodder is available to 80% of livestock in drought period	Minimized drought vulnerability of livestock and pastoralists	Presence of variety drought resistant plants in the rangeland; well-developed practices of	Assessment reports from agricultural and rural development offices in the sub basin	Unwillingness to manage rangeland lack of acceptance	Awareness creation technical and financial support for local communities

				rangeland grazing patterns to save forage for drought period; use of emergency forage			
	To reduce risk vulnerability through adaptation mechanism	genetically improved livestock to 70 % by 2035	Livestock production remain stable in drought period; Stable livelihood income	Ensure food security	Assessment report from Agricultural and Rural development offices in the sub-basin	Unwillingness to accept improved technology	Training and awareness creation
		Ensure Improved crop variety to 60 % by 2035	Crop production remain stable in drought period; Stable livelihood incomes	Ensure food security	Assessment report, from Agricultural and Rural development offices in the sub-basin	Unwillingness to accept improved technology	Training and awareness creation

Course of actions constituting the basin plan and financing strategies

8.1. The anticipated actions and their estimated costs at basin level

For the sake of time framing, this basin plan is divided into three implementation periods: 2021-2025; 2026-2030; and 2031-2035. The upcoming sub-sections summarize the required budget for the above time periods. The detailed activities are found in the appendix to avoid over sizing of the main document.

8.1.1. Ziway-Shalla sub basin: costs per goals

No	Goals	Estimated budget in mil. Birr			
		2021-2025	2026-2030	2031-2035	Total
1	Enhance availability and optimum utilization of water resources in the basin for sustainable social, economic, and environmental benefits	**195.5**	**199**	**137.5**	**532**
2	Improve the water quality of the basin to ensure sustainable social, economic and environmental, benefits	**226.1**	**241.3**	**236.3**	**703**
3	Improve water resource conservation, potential and community livelihood in the basin through integrated watershed management	**4545**	**5670**	**4057.9**	**14272.9**
4	Ensure active stakeholder participation in planning, decision making, implementation, monitoring and evaluation of IWRM	**35.48**	**23.2**	**21.42**	**80.1**
	Total				**15,588**
	Contingency 10%				**1,558.8**
	Grand total				**17,146.8**

8.1.2. Hawassa sub basin: costs per goals

No	Goals	Estimated budget in mil. Birr			
		2021-2025	2026-2030	2031-2035	Total
1	Enhance sustainable management of water resources including their proper allocation, development and protection and through increased efficiency of water use in the basin for sustainable social, economic and environmental benefits	**395.5**	**384.5**	**374**	**1154**
2	Ensure the availability of good water quality for sustainable national economic development by	**634**	**592.5**	**585.08**	**1817.75**

	effectively controlling pollution.				
3	Improve water resource conservation, potential and community livelihood in the basin through integrated watershed management	**2503.91**	**2462.4**	**2435.9**	**7402.31**
4	Ensure active stakeholder participation in planning, decision making, implementation, monitoring and evaluation of IWRM	**34**	**33**	**33**	**98**
	Total				**10472.06**
	Contingency 10%				**1047.206**
	Grand total				**11,519.27**

Abaya-Chamo Sub-basin: costs per goals

No	Goals	Estimated budget in mil. Birr			
		2021-2025	2026-2030	2031-2035	Total
1	Enhance availability, Management and optimum utilization of water resources in the sub-basin for sustainable social, economic and environmental benefits	**1497**	**1367**	**919**	**3883**
2	Improve the quality and quantity of water resource in the sub-basin for sustainable social, economic and environmental, benefits.	**2045**	**1530**	**1190**	**4765**
3	Improve the water resources conservation and community livelihood in the basin through integrated way	**1857.5**	**1902**	**1477**	**5236.5**
4	Ensure active stakeholder participation to improve planning, implementation, monitoring and evaluation of projects related to IWRM	**44**	**42.5**	**31.5**	**118**
	Total	**5,443.5**	**4,841.5**	**3,617.5**	**14,002.0**
	Contingency 10%				**1400.2**
	Grand total (Million ETB)				**15,402.20**

8.1.3. Chew-Bahir sub basin: costs per goals

No	Goals	Estimated budget in mil. Birr			
		2021-2025	2026-2030	2031-2035	Total
1	Enhance effective development, efficient utilization, and proper allocation of water resources in the basin for sustainable social, economic and environmental benefits	**200.75**	**211.25**	**153.25**	**565.3**
2	Improve water resource conservation, potential and community livelihood in the basin through integrated watershed management and Rangeland management	**2,050.2**	**2,891.85**	**2,084.35**	**7026.40**
3	Minimize natural disaster in sustainable manner in the community	**61.4**	**77.25**	**60.25**	**198.9**
4	Ensure good water quality for sustainable socio economic development	**17.5**	**10.5**	**9**	**37**
5.	Ensure active stakeholder participation in planning, decision making, implementation, monitoring, and evaluation of IWRM and prevention of natural disaster	**15.6**	**15.2**	**15.2**	**46**
	Total				**7873.55**
	Contingency 10%				**787.355**
	Grand total				**8,660.905**

8.2. Required institutional set-up and coordination

Proposed actions are key steps to be followed as the IWRM implementation strategy in the Basin. Following the endorsement of this action plan by all stakeholders and securing the required political commitment for implementation, it will be mandatory to establish or strengthen WRD, which would have the following major responsibilities to speed up the implementation process.

1) Develop quality project formulation proposals for priority projects that suite a range of donor requirements and organize donor consultation forum to speed up their implementation.
2) Coordinate and integrated all water sector institutions which are responsible for the implementation of their respective WRM actions/programs and provide technical and logistical support as necessary.
3) Coordinate and facilitate awareness creation and educational programs that support the creation of commitment for the successful implementation of WRM action plan
4) Associate water sector institutions engaged in implementing the part of the action plan with international and national organizations working on sustainable water resources development and/or similar WRM action plan.
5) Implement actions which are within the scope of WRD.
6) Facilitate the mainstreaming of the action plan into the national and regional budgetary system by identifying entry points and advising water sector institutions to streamline the proposed action.
7) Develop adaptive monitoring and evaluation procedure to follow up the WRM action plan implementation and advice of the Ministry Water and Energy for action.

As it is clearly stated in the Logical Strategic Framework for Action Plan, the responsibility for the implementation of the proposed priority actions/programs will be shared among the key institutions engaged in the water sector within whose operational mandates are the activities within the action plan are encompassed.

As part of the implementation strategy of water resources management, jointly with key implementing bodies, responsible institutes should revise the priority and categorize action plans into phases as per the need and priority of the respective implementation bodies. For example, most action plans which improve the basin knowledge on the water resources base and provide important enabling environment can be priority and start immediately with the available fund.

The plan needs to be reviewed periodically. This will ensure that it remains coordinated with the proposed applied research outcomes on water resources management and development, as well as with designed monitoring, evaluation and adaptive management system. The action plan is to be comprehensively reviewed after three to five years to ensure that the

implementation of its actions are on track, and that longer-term actions are integrated into the national water resources management and development strategy.

8.3. Proposed Fund Raising Strategy

In the previous sections, project portfolio/plans with their indicative costs are presented; implementation of the necessary institutional set up and the required coordination are indicated as part of the implementation strategy. For successful and timely implementation of these priority WRM actions, developing a fund raising strategy is another crucial implementation strategy that should be thought of at the initial stage of the planning process. Developing a fund raising strategy for any plan/project is a complicated task for which there is no guarantee of a successful outcome. The set of prioritized actions provide a firm basis for cooperation with funding agencies. To speed up the implementation of the identified priority plan/actions, the following funding strategies are recommended:

- Identify entry points to mainstream the identified short and long-term priority actions into the national and regional planning processes and development cooperation frameworks.
- Identify major funding sources that offer support for development projects at basin-scale and other development projects. Once identified, a mechanism will be proposed for communication and network establishment.
- Identify state groupings or initiatives that focus on intra- trans-boundary water issues,
- Analyze their mission and vision and identify how this action plan could be relevant to those institutions and indicate ways of funding the priority project/actions.
- Identify development partners who are involved or have close linkage with water resources, assessment and development. Using their overall mission and vision statements as a background, try establishing linkages between their projects and the implementation of priority actions identified in this process.
- Propose a way how a resources mobilization forum could be organized. This forum will accelerate the implementation of identified priority projects/actions of the main theme/action areas.

In general, the fund-raising strategy that is intended to be implemented by the responsible implementing and coordinating bodies should ensure that there is:

- Coordination of activities
- Popular participation and consultation
- A forum for discussion
- Partnership building
- Efficiency and transparency
- Commitment by government, communities and development partners
- Project/action targets with clear benefit
- Fundraising body or unit or officer who will implement fundraising activities.

8.4. Terms and Conditions to Implement the Basin Plan

There are some issues that should be taken care of as a condition for successful implementation of the WRM action plans. These are given in the following sub-sections.

8.4.1. Political commitment

The existing culture, tradition and way of carrying out water resources management related activities, development and use of water resources is quite different from the proposed WRM concept and, therefore, continuous and conscious actions focused on building political commitment starting from the beginning of the implementation of the action plan is crucial. The political commitment can be achieved through a continuous awareness creation program and the need for change among the highest political decision makers, managers, practitioners and other stakeholders.

8.4.2. Coordination of Institutions

The plan will be implemented mainly within the framework of Ministry of Water, Irrigation and Energy and the Basin Development Authority-Rift Valley Lakes Basin Development office, which are the responsible implementing bodies for most of the actions/plan portfolios identified to support WRM in RVLB. Despite their leading effort, all actions/plan portfolios can only be implemented with support and for some of them with the lead effort of all other government institutions identified as implementing body and involved either in the development and use of water resources of the BVLB.

8.4.3. Capacity development

Capacity development and training should be provided to all stakeholders engaged at strategic levels, including that of at federal and regional governments. Participants who may be adversely impacted and/or socially marginalized may be stimulated to participate within a consensus-building strategy.

8.4.4. Well-defined flexible and enforceable legal frameworks and regulation

It is necessary to assemble and review the full range of existing laws and regulations that apply to water-related activities and determine how existing legislation adapts or can be better adapted to accommodate sustainability and integration with regard to water resources management.

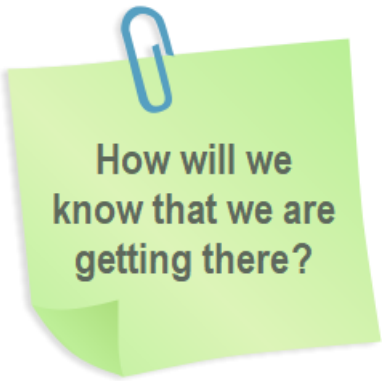
8.4.5. Water allocation plans

As water is a shared resource, water rights should be flexible in terms of allocation in order to accommodate changes. Preparing a master plan that reflects individual sector plans facilitates the coordination among various sectors and advocates the most appropriate utilization of a basin's resource.

8.4.6. Good knowledge of the natural resources present in the basin

Adequate knowledge and information on the water resources inventory and human resources of the basin is desirable. Including scientists as water resource managers can help maintain and accrue sound knowledge of the natural resources

Therefore, for smooth implementation of the action and its success, securing the commitment of all high level decision makers of the implementing partners, avoiding ambiguities of duties and responsibilities of institution and raising the awareness level of decision makers on the importance of WRM for the sustainable development of the nation are critical conditions.



9

Monitoring and Evaluation

This basin plan is prepared with the aim to ensure a balance between competing demands on water resources (environmental, social and economic), improve water resources conservation and potential, and minimize natural disaster in the basin. The main goals, objectives, and major interventions are well documented in the preceding sections. This section presents an effective monitoring and evaluation framework/plan which will help implementing bodies and those with obligations to gauge how effective implementation is put in place and the accomplishment of every action as per the timetable indicated in the basin plan document.

The general approach to monitoring and evaluation of the implementation of the basin plan is:

a) Collecting data of various sorts so as to be able to understand the effects that the basin plan is having;
b) Comparing changes against 'baseline' information about the basin;
c) Bringing this information together and making assessments of whether a range of objectives and outcomes are being achieved and how well the basin plan is being implemented;
d) Broadly tracking the effect of other influences and drivers on outcomes in the basin; and
e) Reflecting on what we learn and reporting to government to guide their decision-making.

9.1. Monitoring and evaluation schedule

As it is indicated above implementation of various activities are scheduled at a long-range timeframe rolling until 2035. Accordingly, the time of monitoring of changes and evaluation of outcomes varies depending on when a particular activity is implemented. Moreover, even for many activities which are implemented at an early stage of when the basin plan comes into effect, outcomes will take a long time to be achieved (and thus able to be monitored and evaluated); hence, until such times in-depth monitoring and evaluation of their effectiveness cannot occur. Further, focus of monitoring and evaluation in any given year will change as

implementation progresses and different components of the plan come into place. Therefore, the scope and depth of monitoring and evaluation shall be developed over time.

In general, after every five-years of the basin plan implementation, i.e., in year 2025 and 2030, detail assessment of effectiveness of the basin plan shall be conducted and at final year of plan implementation, i.e., in year 2035, basin plan shall be reviewed; however, in-between years' annual effectiveness report shall be prepared. A detail monitoring and evaluation schedule for some major achievement indicators are presented in the table below.

9.2. Methods of data collection and evaluation

Depending on the type of expected outputs both quantitative (e.g. numerical, yes/no) and qualitative (e.g. interviews, expert opinion or a combination of the two, leading to an informed judgment) data will be collected for monitoring and evaluation purposes. This data may be obtained through measurement, field surveys, computer models, and reported information. Survey results and reports in different government offices such as SNNPRS Water Bureau, Agriculture and rural development bureau, Ministry of Water and Energy, and Rift-valley Lakes Basin Development Office are valuable sources of information. Data on social and economic indicators will also be obtained from Ethiopian Statistical Service (ESS) – formerly the Central Statistical Agency (CSA), local community groups, local governments etc.

Once the data is collected, evaluation can be made using either of the two methods - activity reporting and comparative analysis. Particularly, activity reporting is used for an activity or a target that has been met (the yes/no). Comparative assessment (comparing observed results with the baseline) will be used for outcomes evaluation. Particularly, evaluation of ecological, governance, and socio-economic outcomes will be based on comparative assessment. Trend analysis of indicators, developing 'with' and 'without' basin plan comparison, detailed studies, and conducting qualitative research are some of specific data analysis and evaluation methods.

9.3. Indicators of outcomes

For a better monitoring and evaluation process, multiple set of indicators will be used to gauge environmental, social (gender mainstreaming), and economic changes in the basin. Because the basin plan is implemented in several stages over 15 years' time and some indicators

take time to be monitored, indicators will be refined with time and additional indicators will be developed. Refinements and development of indicators involve all stakeholders in the basin. Detailed outcome indicators along with main objectives in the basin plan are presented in Table 9.1 to Table 9.5.

9.4. Roles and reporting

I. In the process of implementation of the basin plan various stakeholders will be involved. These different stakeholders will have different roles in monitoring and evaluation. Monitoring and evaluation of effectiveness of implementation of the basin plan and accomplishments or being on the right track of the set objectives will be the responsibility of MOWE/(RVLBAO). Annual reporting of the results of monitoring and evaluation will commence one year after the start of the basin plan implementation. At the fifth year and tenth year since start of implementation of the basin plan five and ten yearly reports on effectiveness of the basin plan will be prepared. At the end of the plan implementation period, i.e. in year 2035, report on review of basin plan will be prepared by MOWE/RVLBAO presented to all concerned bodies.

Local governments (Woreda and Kebele-level) and communities will be important sources of information, particularly in relation to the social and economic indicators. MOWEMoWE/and RVLBAORVLBAO will work with them to review indicators, collect data, and evaluate the plan.

Monitoring and evaluation is not a one time job. It will be conducted throughout the plan implementation period. More importantly, what we learn through monitoring and evaluation leads to improved knowledge and continuous improvement of the basin. The monitoring and evaluation matrix for each goal is presented from Table 9 to Table 11. Gender mainstreaming indicators shall be one of the pillars of the monitoring and evaluation scheme.

Table 9.Monitoring and evaluation matrix for Goal-1

Specific objectives	Expected outcome	Indicator to be monitored	Data source &Means of verification	Frequency of measurement	Frequency of reporting	Responsible institutions
To ensure water availability in the basin	• Improved discharge of streams, springs and groundwater • Increased and continuing River flows • Increased inflow to the Lakes	• Satisfied all water use demand • Agricultural production increase • Socioeconomic development of the Basin • Gender main streaming	Assessment reports, performance evaluation reports and case study reports from MoWE, ONS, SNS &SNNPRS Water resource bureau and RVLBAO,	Annual	Annual	RVLBAO, MOWE; Regional Water Bureaus, NGOs, Knowledge institutions
To improve irrigation water use efficiency in the basin	• Decrease excess water abstraction • increase in irrigation water productivity • environmental sustainability	• transform irrigation water use trend • Optimum abstraction • reduction in irrigation water loss • Gender main streaming	Assessment reports, performance evaluation reports and case study reports from MoWE, ONS, SNS&SNNPRS Water resource bureau and RVLBAO,	per five years	Per five years	RVLBAO, MOWE, MoWE, EMI
To implement water allocation	• water abstraction based on legal framework • Acceptable water sharing principle in the basin • water use conflict minimized	• number of licensed water users and proper use • Gender main streaming	Assessment reports, case study reports from MoWE, ONS & SNNPRS Water resource bureau, and RVLBAO,	Annual	Annual	RVLBAO, MOWE, Regional Water resource and Irrigation office
To establish water users' association (WUA)	Decrease illegal water user, improve Quality and quantity of water, livelihood improvement	• Number of water pumps • number of water association • reduced irrigation water loss	Regional co-operative office, Regional irrigation Authority, Water use and user assessment report.	Monthly	Annual	MOWE, RVLBAO, MoWE

Table 10.Monitoring and evaluation matrix for Goal-2

Objectives	Expected outcome	Indicator to be monitored	Monitoring tools/ Source of information	Frequency of measurement	Frequency of reporting	Responsible institutions
To prevent industrial and municipal effluents	Improved water quality and aquatic ecosystem	Water quality standards and bio-indicators	water quality test reports	Quarterly	Binomial	RVBDO, Water resource bureau, and RVLBAO,
To reduce fresh water salinity problem across the sub- basin	Safe and potable water is maintained, aquatic ecosystem is maintained, socioeconomic use of water is enhanced	Low salinity values	water quality test reports from FECCA/B, RVLBAO, Water bureaus	Weekly for river flow and water level records/biannual for agricultural productivity	Binomial	MOWE, RVLBAO, Water source bureau, SNNPRS Water resource bureau
To establish water quality monitoring system in the basin	Updated water quality status	Recorded data on water quality parameters	water quality test reports from FECCA/B, RVLBAO, Water bureaus	Quarterly	Binomial	Regional Agricultural office; RVLBO; Local governments
To conserve and restore wetlands in the Basin	improved water quality and quantity, sustain biodiversity, enhanced socioeconomic benefit	Number of restored wetlands in the Basin	Assessment reports, case study reports from MoWE, ONS SNS & SNNPRS Water resource bureau, and RVLBAO	Quarterly	Binomial	District security offices; District Agricultural offices; MOWE; RVLBAO
To prevent lakeshore cultivation	Reduce siltation, agrochemical pollution,	Reduced eutrophication	Assessment report	Five years	Five Years	Biodiversity institute

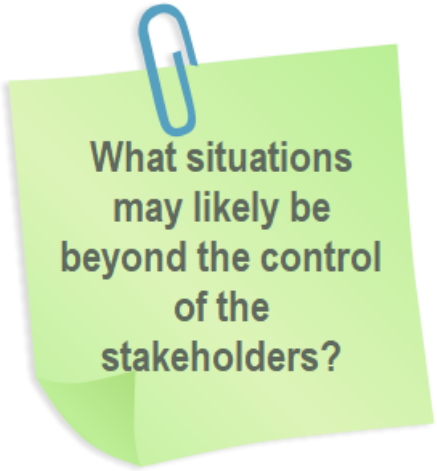
Table 11.Monitoring and evaluation matrix for Goal-3

Objectives	Expected outcome	Indicator to be monitored	Monitoring tools/ Source of information	Frequency of measurement	Frequency of reporting	Responsible institutions
To protect water bodies from siltation/sedimentation	The lakes and riverine water resources environment restored	Increased lake volume, Restored aquatic biodiversity	Stakeholders annual report, field surveys	Quarterly/Annual/five year depending on the type of indicator	Quarterly/ Annual/five year depending on the type of indicator	MOWE, RVLBAO; Regional disaster prevention and preparedness Local government
To improve surface and groundwater potential	reduced water scarcity, water use conflicts and improvement socio economic	.Access to water supply, Social stability, increase of per capita income	Water sector report, CSA report, socio economic survey	Biannual	Biannual	MOWE, RVLBAO; Regional disaster prevention and preparedness Local government; Agricultural and Rural development offices in the basin; Local government
To rehabilitate severely degraded watersheds	Soil erosion reduced, soil fertility improved and Agricultural productivity enhanced	. Amount of soil saved. .amount of yield per hectare/year	Report from agriculture & natural resource sector, CSA, RVLBAO,	Biannual	Biannual	MOWE;RVLBAO; Regional Agricultural office
To improve livelihood of the community	livelihoods diversified, reduced pressure on natural and economic transformation	Socio economic improvement ,	Report from CSA, Plan commission, Finance and economic development offices	Quarterly	Binomial	Regional planning offices, Regional Agricultural office; RVLBAO; Local governments
To reduce flood and drought hazard	. Exposed community to flood and drought risk are reduced. . Damage of life and Property reduced	Livelihood improvement, flood prevention structures, secured society	EMI report, Risk prevention &disaster reduction preparedness offices	Quarterly	Binomial	District Agricultural offices; MOWE; RVLBAO

Table 12.Monitoring and evaluation matrix for Goal-4

Objectives	Expected outcome	Indicator to be monitored	Monitoring tools/ Source of information	Frequency of measurement	Frequency of reporting	Responsible institutions
To improve public	Better understanding of efficient water	Attitudinal change towards	Willingness of the stakeholder	Annual	Annual	MOWE;RVLBAO; Regional Agricultural

awareness on water resources management and optimal use	utilization among publics in the basin	water management	toward efficient water use			offices
To strengthen stakeholder's participation on watershed management	Enhance participatory watershed management	Successful watershed management practice	Rehabilitated watershed	Annual	Annual	MOWE;RVLBAO; Regional Agricultural offices
To implement legal framework related to pollution control through stakeholder participation	Legal framework respected by all stakeholders	Environment friendly economic development	Healthy environment	Annual	Annual	MOWE; RVLBAO; Regional Agricultural offices; Local governments



10

Risks, Mitigations, and Critical Success Factors

10.1. Requirements for effective implementation of the plan

In order to ensure the effective implementation of the basin plan, the commitment of Basin Council is very crucial. Basin Council should insist RVLBAO and its subordinate directorates as a team to develop a schedule and structure to accomplish the strategic goals and specific objectives. Stakeholders and the community shall execute each activity according to the time and resources indicated in the strategic plan. The execution process will be conducted in collaboration and team spirit.

Though the responsibilities are equally shared among the different stakeholders, RVLBAO shall coordinate the activities mentioned under each specific objective given in chapter 8. RVLBAO shall bring the stakeholders and the community on-board to take preventive measures for potential problems and corrective actions to manage unforeseen risks and uncertainties. If

situations are beyond the stakeholders, attempts shall be made to resolve the problem through consultative meetings with RVLBAO/MoWE.

10.2. Risks, Uncertainties and Mitigation Options

RVLBAO and MOWE shall take different intervention mechanisms to manage the challenges and unpredictable problems. This could involve two aspects. One is to anticipate potential problems ahead and design different preventive options and strategies. The second is to effectively manage any unpredicted risk. This could be effectively managed through strong team spirits among the stakeholders. Handling the challenges with potential stakeholders and seeking a means towards a common advantage based on the intended objective(s) is another option that the RVLBAO and MOWE shall standby with. In the current strategic plan, expected risks and uncertainties shall be managed by discussing the issues with an existing system of RVLBAO, MOWE, Regional and zonal offices. The basin implementation body, specifically, shall share experiences from experienced IWRM based strategic plan executing basins nationally and internationally and use the lessons obtained as a useful input. The basin implementation body shall also prepare progress reports for project activities they have been assigned for, that can be related to specific project members or based on assignment. Though the responsibilities are equally shared among the basin implementation body, RVLBAO and MOWE shall coordinate the project activities in each goal and manage the possible risks in consultation MOWE. Lists of possible risks and uncertainties, and their mitigation options corresponding to each specific objective of the basin plan implementation are presented in Table 13.

Table 13.Risks, uncertainties and mitigation options

No	Source	Key Interests	Importance	***Risks and uncertainties***	***Mitigation options***
1	Basin High Council	- To Create Better Political and Legal Ground for the Implementation of the basin strategic plan In The Rift Valley Lakes Basin	- Facilitate the formulation of policies, proclamations and regulations that guarantee water resource sustainability; - Make decisions pertaining to issues under its disposal;	Lack of political power and legal support to pass strategic decisions	Supplying the strategic issues identified by the basin strategic plan
2	Ministry of Water, Irrigation and Electricity/MOWE	To see projects that ensure water resource sustainability through the Implementation of the basin strategic plan	- Deliver technical training on gaps related to project planning, basin planning, master plan preparation; - Give direction for the success of the project; Conduct monitoring and evaluation	Lack of skilled man power	- Supplying the strategic issues identified by the basin strategic plan; - Designed projects must be based on the prevailing problems in the basin strategic plan ; physical and financial periodical report containing factual truth;
3	Ministry Of Finance and Economic Cooperation	- Allocate budget for project that came from the basin strategic plan ; Assure effective use of state budget;	Give technical training on gaps related to planning, reporting and program budget; Allocate budget based on budget availability	Lack of awareness on the benefit of the project to allocate sufficient budget; it may face budget shortage;	- Designed projects must be based on the prevailing problems in the basin; Supplying physical and financial periodical reports containing factual truth; Implement effective monitoring and

No	Source	Key Interests	Importance	***Risks and uncertainties***	***Mitigation options***
			and request proposal;		evaluation schemes;
4	Minster Of Environment, Forest And Climate Change	-To see clean and safe environment; -To expand and facilitate afforestation programs; To work on capacity building for resource sustainability; -To execute community works to maintain environmental hygiene and sanitation;	-Have better legal ground and political acceptance to implement environment protection initiatives; -Attract donors on environmental management activities;	-Lack of institutional efficiency and weak legal and policy frame work; -Lack of willingness to work for the interest of the environment;	-Make them to participate in projects related to environmental protection; S-strengthen their institutional capacity and create suitable legal framework to enforce environmental regulation;
5	Disaster Prevention And Preparedness Commission	-To prevent disaster reduce its impact; -To raise awareness in affected and flood-prone areas about the risk of flooding in the basin;	-Closely monitor flood situation; -Led flood taskforce with representation from different organizations; -Conduct education and awareness campaigns;	-Inefficient performance due to lack information, poor coordination and budget shortage	-Strengthen the networking and communication system; -To secure budget by designing feasible projects;
6	Meteorology Agency	To create easy access to quality metrological information	-To forecast and release early warning information	-Lack of supervision to produce quality information; -Integration problem; -Lack of advanced	Strengthen the networking and communication system

No	Source	Key Interests	Importance	***Risks and uncertainties***	***Mitigation options***
				forecasting instruments;	
7	Ministry Of Agriculture	Enhancing agricultural productivity using best practices by controlling environmental degradation using water and soil conservation measures	They are partners in implementing watershed management activities that reduce erosion to preserve the ecosystem	-Lack of awareness on major policy issues; -Lack of skilled man power and shortage of finance;	Delivering appropriate training and conduct experience sharing on watershed management; preparing workshop on policy evaluation, as well as on stakeholder identification and participation;
8	Universities, Research And Development Institutions	To conduct research and development as well as deliver community services	-Supply solution based research out puts and basin information; -Deliver training on any identified skill gap; -Provide consulting services; -Assist in the transfer of environment friendly technologies;	Weak integration within and among institutions; Shortage of skilled man power and finance;	-Strengthen the networking and communication system; -To secure budget by designing feasible projects based on issues identified in the basin plan;
9	Water Works Construction Organizations	To conduct design and construction water works	-Deliver machineries and construction materials; -Give construction services;	-Weak integration within and among institutions; shortage of finance and skilled man power; -Delay of projects;	-Strengthen the networking and communication system; -Secure budget by designing feasible projects;

No	Source	Key Interests	Importance	***Risks and uncertainties***	***Mitigation options***
10	Design And Construction Supervision Enterprises	To conduct design and make supervision on the construction of water works	-Provide consulting services -Conduct feasibility studies	Weak integration within and among institutions; Shortage of skilled man power and finance;	-Strengthen the networking and communication system; -To secure budget by designing feasible projects;
11	Community Groups	-Get clean and sufficient water for their household, crop and cattle; -To live in a risk free environment protected from flood threats;	Have big contribution to implement watershed management activities, control sheet and gully erosion and rehabilitate the environment;	-Have low awareness about sustainable use of resource and water and soil conservation activity; -Use uncontrolled fertilizer and pesticide utilization;	Give them appropriate training to increase their awareness on resource sustainability and environmental protection; Give them skill training on water and soil conservation practices;
12	Donners/NGO	To give financial and technical assistance for effective development projects.	-Deliver technical and financial assistance; -Assist in transfer of environment friendly technologies;	The state sometimes impose political restrictions against assistance and grants;	-Prepare clear and feasible financial and technical proposal based on issues identified in the basin strategic plan; -Fulfill some of their political interests, given country's sovereignty is respected;
13	Ministry Of Livestock And Fishery Development	To increase livestock and aqua- culture productivity through modern management of the sector /research and development/	Partners to implement projects for the management of aquatic resources as well as livestock production as an alternative livelihood	-Lack of awareness on major policy issues; -Lack of skilled man power and shortage of finance;	-Delivering appropriate training and conduct experience sharing on modern livestock and aqua- culture production; -Preparing workshop on policy evaluation, as well as on stakeholder

No	Source	Key Interests	Importance	***Risks and uncertainties***	***Mitigation options***
			opportunity		identification and participation;
14	Ministry of Health	To protect the public from water born disease	-To give prevention based health services; -Deliver appropriate treatment;	Shortage of health information	Strengthen the networking and communication system
15	Ministry of Culture and Tourism	To facilitate full recreational service for tourists	-Supplying information about the local people and cultural sites; -Facilitate cultural exchange;	-Lack of awareness on major policy issues; -Lack of skilled man power and shortage of finance;	Delivering quality services; give them appropriate training on legal and policy issues about environmental pollution;
16	Investors/Private Sectors/	-They work for profit maximization by minimizing investment and production costs; -They need to operate in a clean environment and produce cost effective quality product;	-Technically and financially assist to control environmental pollution; they create local employment opportunities; -Are the major players for economic growth/poverty reduction and play a big role to stabilize the market;	-They may endanger the sustainability of resources; -They may adversely affect the environment, supply side of the market and the economy;	Raise their awareness on economic growth by guarantying resource sustainability

No	Source	Key Interests	Importance	***Risks and uncertainties***	***Mitigation options***
17	Ethiopian Road Authority	Create easy access to road infrastructure	Undertake close supervision on contractual activities	-Low quality of road infrastructure; -Delay of projects;	Strengthen the networking and communication system
18	Urban Municipalities	-To create a clean urban environment; -To provide better social services to the people under their disposal;	-Are strategic partners to implement this project; -They provide finance and man power to implement the project;	-They may lack finance; -They face problem of institutional capacity and legal frame work;	-Delivering skill training; -Building institutional capacity and developing applicable legal frame work on waste management;
19	Schools	To create a clean school environment smooth for teaching-learning process	-Are partners in delivering community service for solid waste management; -Participate in awareness creation activities;	-Low budget allocated for waste management; -Low awareness about environmental pollution;	Raise their awareness on resource sustainability and environmental protection; participate in project implementation and evaluation workshop;
20	Media Outlets	To disseminate information at their disposal on the real situation of environmental pollution and waste management practices	Create easy ground to access the general public	If miss informed, they transmit information that could easily spoil all the environmental protection initiatives	Set effective communication network and supply them truthful information

10.3. Critical Success Factors (CSFs)

Critical to the success of this strategic plan is finding a way to provide the basin governments and communities with the necessary confidence that enhance environmental outcomes nominated in the Basin Plan can be achieved in ways that have a neutral or positive socio-economic impact on Basin communities. The following five elements mentioned in the figure below can be considered as critical success factors to implement the strategic plan (Figure 16).

Figure 16.Critical Success Factors (CSFs) to implement the strategic basin plan

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Appendix 1: Water quality raw data for each lake

11.1. Lake Hawassa: Physicochemical and bacteriological water quality characteristics

	Parameters	Site sample taken					
		2004[e]	2007[a]	2007[b]	2012	2015	WHO, FAO, CCME
1	EC	837	848	848			1500
2	TDS	402	407	408	450.1	535.63	1000
3	pH	**8.69**	**8.98**	**8.98**	7.5	**8.88**	6.5-8.5
4	Temp		21.2	21.3	21.23	23.2	15-30
5	DO		6.8	6.7			>5
6	**Turb.**		**16**	**16**	**8.44**		**<5**
7	Fe	0.041	0.07	0.11			0.3
8	**BOD_5**				**117**	**463**	**<5**
9	Cu				0.013	0.033	2
10	**F^-**	**6.7**	**9.6**	**11**	**12.8**		**1.5**
11	Cl^-	37	51	51	30.84		250
12	TH	62.5	56.7	56.7	80.8	39.7	500
13	**Mn**	0.007			**0.09**	**0.26**	**0.05**
14	Zn				0.19	0.033	5
15	Mg^{2+}	6.32	5.346	5.35	28.07	12.1	200
16	Ca^{2+}	11.2	10.4	10.4	2.56	2.26	100
17	**K^+**	**29.3**	**30**	**36**	**74.06**	**127.83**	**20**
18	**Na^+**	156	168	176	**331**	**393.3**	**200**
19	NO_3^-	nil	0.32	0.39	5.27	10.84	45
20	**PO_4^{3-}**	**0.314**	**0.28**	**0.187**	**1.12**	**1.06**	**0.02**
21	Cr					0.016	0.05
22	Pb					**0.037**	0.01
23	Cd					Nd	0.003
24	Ni					0.014	0.02
25	**TC**				**11,883**		**<50**
26	**FC**				**99.67**		**<10**
27	**Clari**						**1.2***
28	SAR	8.58	9.7	10.16	16.01	**27.15**	26**
29	**SSP**	50.22	50.77	51.28	52.38	55.30	**60****
30	**KR**	5.43	6.44	6.75	8.9	21.56	**1****
31	**MAR**	**116.6**	**98.3**	**98.3**	34.5	**149**	**50****

Note: *All units are in mg L^{-1} saving Temperature, Turbidity, clarity, EC, and pH which are expressed in °C, NTU, m, µS cm^{-1}, and non-dimensional, respectively. TC&FC units in MPN/100ml and MAR, SAR, KR and SSP by %. *-indicates only for recreational use and **-express only for irrigation use. The bold once indicates analyses result is above the prescribed limits except clarity which is below acceptable level.[a]woods and Talling,1988; [b]HALCROW, 1992; [c]Tamiru Alemayehu,2000; [d]Zinabu and Nicholas,2003; [e]AAWSA water quality database, 2004; [f]Ababu, 2005; gHALCROW, 2007*

11.2. Lake Abaya: Physicochemical and bacteriological water quality characteristics

No	Parameter	Sampling Time					WHO
		1964	1995/6	2005	2007		
1	EC	623		1070	1313.5		750
2	TDS	771		837.5	627		1000
3	pH	8.9		8.69	9.05		6.5-8.5
4	Temp				21.25		15-30
5	DO				6		>5
6	Turb.			77	114		<5
7	Fe		2.3806		0.085		0.3
8	BOD_5						<5
9	Cu		0.00465				2
10	F^-				7.9		1.5
11	Cl^-	6.74		2.01	66		250
12	TH						500
13	Mn		0.0649				0.05
14	Zn		0.03135				5
15	Mg^{2+}	0.22		0.29	0.2		200
16	Ca^{2+}	0.7		0.975	0.72		100[5]
17	K^+	0.41		0.436	0.48		20[0.5]
18	Na^+	7.7		10.06	10.65		200[8.69]
19	NO_3^-			1.2			45
20	PO_4^{3-}	0.128		0.095			0.02
21	Cr		1.4				0.05
22	Pb		0.0032				0.01
23	Cd		0.0044				0.003
24	Ni						0.02
25	TC						<50
26	FC						<10
27	Clari						1.2*
28	SAR	11.35		12.65	15.70		26**
29	SSP	84.6154		85.53694414	88.38174274		60**
30	KR	8.36957		7.95256917	11.57608696		1**
31	MAR	23.913		22.92490119	21.73913043		50**
32	PI	120.9064		112.8177973	107.7967737		75**
33	HCO32-	7.41		7.38	3.32		

11.3. Lake Chamo: Physicochemical and bacteriological water quality characteristics

No	Parameter	Sampling Time					
		1964	**1995**	**1996**	**2004**	**2007**	
1	EC	1100			1960	1825	
2	TDS	1099			1500	899	
3	pH				**9.23**	9.41	
4	Temp					21.7	
5	DO					6.8	
6	**Turb.**				**100**	**66**	
7	Fe		0.0493	0.0469		0.32	
8	**BOD_5**						
9	Cu		0.0012	0.0017			
10	**F^-**					**8.9**	
11	Cl^-	2			4.52	8.47	
12	TH						
13	**Mn**		0.0033	0.014			
14	Zn		0.0161	0.0078			
15	Mg^{2+}	0.75			0.99	7.78	
16	Ca^{2+}	0.7			1	0.4	
17	**K^+**	**0.51**			**0.72**	**0.51**	
18	**Na^+**	11.6			**19.13**	**18.47**	
19	NO_3^-				3	3	
20	**PO_4^{3-}**				**0.03**	**0.23**	
21	Cr		0.0126	0.0154			
22	Pb		0	0.0024			
23	Cd		0	0.0014			
24	Ni						
25	**TC**						
28	SAR						
29	**SSP**						
30	**KR**	13.62			19.18	9.13	
31	**MAR**	85.5457			87.59157509	68.00441826	
32	**PI**	8			9.613065327	2.25794621	
33	HCO32-	**51.7241**			**49.74874372**	**95.11002445**	
34	Cation	114.18785			103.4404145	76.14291451	

11.4. Lake Ziway: Physicochemical and bacteriological water quality characteristics

No	Parameter	Sampling Time				
		1964	**1995/96**	**2004**	**2007**	**2019**
1	EC	322		498	459.5	665.3
2	TDS	349		238	219.5	
3	pH	8.9		**8.31**	8.7	**6.797**
4	Temp				19.1	22.19
5	DO				5.9	5.36
6	**Turb.**				**39**	**142.93**
7	Fe		0		0.52	
8	**BOD_5**					
9	Cu		0			
10	**F^-**			**3.2**	**1.51**	
11	Cl^-	0.24		24		
12	TH					
13	**Mn**		4	0.043		
14	Zn		51			
15	Mg^{2+}	0.615		0.68	0.62	
16	Ca^{2+}	0.7		0.84	1.12	
17	**K^+**	**0.3**		**0.32**	**0.29**	
18	**Na^+**	2.11		2.89	**2.66**	
19	NO_3^-			0.32	0.61	
20	**PO_4^{3-}**			**0.452**	**0.23**	
21	Cr		1.4			
22	Pb		0			
23	Cd		0			
24	Ni					
25	**TC**					
26	**FC**					
27	**Clari**					
28	SAR	2.60		3.32	2.85	
29	**SSP**	56.7204		61.09936575	56.71641791	
30	**KR**	1.60456		1.901315789	1.528735632	
31	**MAR**	**46.7681**		**44.73684211**	**35.63218391**	
32	**PI**	114.96545		108.7359612	101.8656072	
33	HCO32-	3.34		3.63	3.32	
34	Cation	3.72		4.73	4.69	

11.5. Lake Langano: Physicochemical and bacteriological water quality characteristics

No	Parameter	Sampling Time					WHO
		1964	**1996**	**2000**	**2004**	**2007**	
1	EC	1810		3250	1815	1949.5	750
2	TDS	1880		1273	887	927.5	450
3	pH	9.4		**9**	8.09	**8.9**	6.5-8.5
4	Temp					23.55	15-30
5	DO					6.25	>5
6	**Turb.**					79	**<5**
7	Fe		0.5679	4.2	0.341	0.1	0.3
8	**BOD_5**						**<5**
9	Cu		0.0015				2
10	**F^-**			**12.8**	**13.1**	8.75	**1.5**
11	Cl^-	4.7		5.42	4.57	5.2	250
12	TH						500
13	**Mn**		0.0299	0.14	**0.005**		**0.05**
14	Zn		0.0032				5
15	Mg^{2+}	1		0.19	0.08	0.08	200
16	Ca^{2+}	0.28		0.57	0.28	0.26	100/5
17	**K^+**	**0.67**		**0.58**	**0.59**	**0.58**	**20/0.5**
18	**Na^+**	19.6		17.4	**14.7**	**13.5**	**200/8.69**
19	NO_3^-			28	1.6	0.5	45
20	**PO_4^{3-}**	**90**		**0.08**	**0.037**	**0.465**	**0.02**
21	Cr	0.0047	0.002				0.05
22	Pb		0.0002				0.01
23	Cd		0				0.003
24	Ni						0.02
25	**TC**						**<50**
26							
27							
28	SAR	24.50		28.23	34.65	32.74	26**
29	**SSP**	94.0603		95.94450374	97.69968051	97.6422	**60****
30	**KR**	15.3125		22.89473684	40.83333333	39.7059	**1****
31	**MAR**	**78.125**		**25**	**22.22222222**	**23.5294**	**50****
32	**PI**	112.0437		113.384423	109.708411	117.619	**75****

		4		1	1	1	
33	HCO_3^{2-}	14.4		10.18	3.32	7.72	
34	Cation	21.55		18.74	15.65	14.42	

11.6. Lake Shalla: Physicochemical and bacteriological water quality characteristics

No	Parameter	Sampling Time				WHO
		1964	**2000**	**2004**	**2007**	
1	EC	19200	41200	41300	44000	750
2	TDS	21500	7200	19975	21300	450
3	pH	9.9	**9.7**	**9.92**	9.83	6.5-8.5
4	Temp		28		24.6	15-30
5	DO				2.7	>5
6	**Turb.**				**26**	**<5**
7	Fe		0.063	0.1	0.14	0.3
8	**BOD_5**					**<5**
9	Cu		0.01			2
10	**F^-**		**235**	**285**	**220**	**1.5**
11	Cl^-	79	100.3	3098	178	250
12	TH					500
13	**Mn**		0.01	0.039		**0.05**
14	Zn					5
15	Mg^{2+}	1	0.058	0	0	200
16	Ca^{2+}	1	0.31	0.36	0.32	100/5
17	**K^+**	**7.1**	**5.9**	**7.4**	**6.25**	**20/0.5**
18	**Na^+**	301	300	**382.6**	**302.1**	**200/8.69**
19	NO_3^-		83	0	0.75	45
20	**PO_4^{3-}**	**760**	**2.1**	**0.02**	**0.07**	**0.02**
21	Cr					0.05
22	Pb		0.01			0.01
23	Cd					0.003
24	Ni					0.02
25	**TC**					**<50**
26	SAR	301.00	699.38	901.80	755.25	26**
27	**SSP**	141.981	322.581	251.711	141.1682243	**60****
28	**KR**	150.5	815.217	1062.78	944.0625	**1****
29	**MAR**	**50**	**15.7609**	**0**	**0**	50**
30	**PI**	104.14529	103.0881	103.1253	104.7314129	75**
31	HCO32-	212	93	152	214	
32	Cation	310.1	306.268	390.36	308.67	

Appendix 2: Details of the strategic objectives, major activtities and budget breakdown of individual basins

12.1. Hawassa basin: Strategic objectives, major activities and budget details

No	Description of Goals, Objectives and Major activities	Unit	Qty.	Estimated budget in mil. Birr					Responsible body
				Unit price	Total Price	2021-2025	2026-2030	2031-2035	
Goal 1	**Enhance sustainable management of water resources including their proper allocation, development and protection and through increased efficiency of water use in the basin for sustainable social, economic and environmentalbenefits**								
1.1	**To enhance the creation of enabling environment that support optimal and efficient utilization of availabile water resources on the basis of priority of basin strategies**								
	Assessment of water scarce areas and identify alternative sources	No	5	2	10	3	4	3	MoWE,RVLBAO, RWB
	Constructing water harvesting structures	No	4	10	40	20	10	10	MoWE, RWB
	Strengthening community water harvesting capacity	No	15	2	30	10	10	10	MoWE,RVLBAO, MoANR
	Study of water-use conflict in the basin	No Doc	5	1	5	2	2	1	MoWE,RVLBAO, MoANR
	Traininig on water -use conflict and resolution in the basin	No training	15	1.5	22.5	7.5	7.5	7.5	MoWE,RVLBAO, MoANR
1.2	**Strengthen the basin capacity to collect, store, process, and disseminate hydro-meteorological data (quantity and quality).**								
	Upgrade existing manual and automatic hydrological gauging stations	No	15	3	45	15	15	15	MoWE,
	Improve the coverage and status of stream gauging stations for each major rivers of the basin.	No	10	1.5	15	5	5	5	MoWE,
	Improve the coverage and status of meteorological stations of the basin.	No	12	2	24	8	8	8	RVLBAO
	Develop standard and specification for acquiring and installation of hydrological and meteorological stations.	No	8	1.5	12	4	4	4	Meteorological office
	Provide equipments, facilities and training to strengthen the WRD and other institutions involved in collecting, storing, processing and disseminating of hydro-meteorological data.	No	8	4	24	10	8	6	NGOs, knowledge intuitions, water works enterprises.

1.3	**To improve irrigation water use efficiency in the basin**								
	Study irrigation efficiency in the basin	No of Docu	5	2	10	3	3	4	MoWE,RVLBAO, RWB
	Preparation of trainings on irrigation efficiency in the basin	No of taining	8	2	16	5	5	6	RIA, RVLBAO, MoWE
	Assess attitude and capacity of water user on efficient irrigation technologies	No of Docu	5	1.5	7.5	2.5	2.5	2.5	RVLBAO,
	Build technical capacity of the water user	%	75	-	50	17	17	16	RIA, RVLBAO, NGO, RVLBAO
1.4	**To implement water allocation for different uses**								
	Assess seasonal and annual total water availability of the basin.	Round	45	2.5	112.5	40	40	32.5	Farm consultant, KI, NGOs, RVLBAO
	Identify major water users (municipal, irrigation, industrial etc) and assess their existing water supply and delivery efficiency	No of Users	200	1.5	300	100	100	100	Farm consultant, KI, NGOs, RVLBAO
	Prepare appropriate action plans or mechanisms (like training on Operation & Maintenance, implementing efficient technology like drip irrigation, rain water harvesting) that will increase water supply efficiency.	No of Training	15	4	60	20	20	20	Farm consultant, KI, NGOs, RVLBAO
	Entitle water for all water demand.	No of Users	200	1.5	300	100	100	100	RVLBAO. Regoinal water bureau
	Provide training to build professional capacity to perform appropriate and effective decisions on water allocation and use.	No of Training	15	2	30	10	10	10	RVLBAO. Regoinal water bureaus
	Identify major public and private institutions and Verification	%	100	-	1.5	0.5	0.5	0.5	RVLBAO
1.5	**To establish water users' association WRUAs**								
	Identify gaps and prepare capacity building trainings on the benefit of WUAs.	No of Training	30	1	30	10	10	10	NGO, RVLBAO
	Establish and strengthen WUAs.	No of WRUAs	3	3	9	3	3	3	RVLBAO,NGO, Regional water bureaus
Sub-total				**49.5**	**1154**	**395.5**	**384.5**	**374**	
Goal 2	**Ensure the availability of good water quality for sustainable national economic development by effectively controlling pollution.**								
2.1	**Develop and enforce regulatory instruments focusing on maintaining**								

	water quality standards and control pollution								
	Review water quality standards for rural, municipal and irrigation water supplies	NoDocu	15	1	15	5	5	5	RVLBAO
	Inventory of water quality and pollution sources	No of sources	22	1.5	33	11	11	1.83	MoWE, RVLBAO
	Establish administrative procedures for discharge permit /licensing system as per regulations	No of Docu	3	1	3	1	1	1	MoWE, RVLBAO
	Prepare Guidelines for design of wastewater treatment, disposal and reuse facilities.	No of Docu	3	2	6	2	2	2	PO, MoWE, RVLBAO
	Provide equipments and facilities that enhance the water quality monitoring and regulating capacity of relevant institutions	No of Lab center	1	9	9	9			MoEFCC, REFCCA, RVLBAO
	Build/improve urban sewerage management infrastructure for main towns	No of towns	9	2.5	22.5	10	6	8	PO, REFCCA,
	Develop standards, guidelines and procedures on wastewater quality, solid wastes and discharge regulation	No of Docu	3	1.5	4.5	1.5	1.5	1.5	RVLBAO, REFCCA
2.2	**To reduce fresh water salinity problem across the basin**								
	Assess major pollutant contributing to water salinity	No of Docu	3	2	6	2	2	2	RVLBAO, REFCCA
	Monitoring salinity problems associated with irrigation projects	No of Projects	15	1	15	5	5	5	RVLBAO, RIA
2.3	**To conserve and restore wetlands in the basin**								
	Establishing permanent learning and practice alliances (LPA) with stakeholders	No Training	15	1	15	4	6	5	RVLBAO, MoEFCC, REFCCA
	Regulating illegal settlements	No round	15	1.5	22.5	10	6	6.5	MoEFCC, REFCCA

	Aware the community on the importance of proper grazing practice and develop by-laws of consensus towards native biota regeneration	No Training	15	2	30	10	10	10	RVLBAO REFCCA,
	Aware the community about the importance of buffer zone protection	No Training	15	2	30	10	10	10	RVLBAO, REFCCA
	Reduction of sediment transport into the wetland	No of Tone	1.5	2.5	3.75	2	1	0.75	RVLBAO, NGO
	Enhancing groundwater recharge: hydrologic restoration	m^3	1000	1.5	1500	500	500	500	RVLBAO, NGO
2.4	**To establish water quality monitoring system in the basin**								
	Establish permanent water quality monitoring sites for surface and groundwater	No	22	2	44	14	15	15	MoWE, RVLBAO, NGO
	Develop water quality monitoring database	No	1	1.5	-	1.5	-	-	RVLBAO, REFCCA, MEFCC
	Establish water quality laboratory and fulfil the necessary facility	No	1	20	20	20	-	-	NGO, RVLBAO,MOWE
2.5	**To prevent lakeshore cultivation**								
	Develop lake shore management legal frame work	No docu	3	2	6	2	2	2	MoWE, RVLBAO
	Delineate the lakeshore with adequate buffer zone	No	4	2.5	10	4	3	3	MoEFCC, REFCCA, RVLBAO
	Organize awareness raising program for all stakeholders	No	15	1.5	22.5	10	6	6.5	REFCCA, RVLBAO
Sub-total				**61.5**	**1817.75**	**634**	**592.5**	**585.08**	

Goal 3	Improve water resource conservation, potential and community livelihood in the basin through integrated watershed management								
3.1	Prepare watershed management plan for priority catchments								
	Undertake basin stakeholder consultation to identify major and priority catchments in the basin	ha	1mil	0.004	4000	1333.3	1333.3	1333.3	MoWE, RVLBAO, NGO
	Conduct situation analysis including establishing environmental degradation status	ha	1mil	0.004	4000	1333.3	1333.3	1333.3	MoWE, RVLBAO, NGO
3.2	Implement catchment programs and projects particularly on catchment to conserve, restore, enhance and maintain healthy environment.								
	Support biological diversity maintenance and improvement	ha	1mil	0.002	2000	666.67	666.67	666.67	MoWE, RVLBAO, NGO
	Support planning and implementation of soil and water conservation programs	ha	100,000	0.005	500	200	150	150	MoWE, RVLBAO, NGO
3.3	**To rehabilitate severely degraded watersheds**								
	soil and water conservation **(water harvesting structures, area closure, afforestation)**	ha	100 000	0.037	3700	1233.3	1233.3	1233.3	MoWE, RVLBAO, NGO
3.4	**To improve livelihood of the community**								
	Assess appropriate income generating activities	No of docu	3	5	15	5	5	5	RVLBAO, NGO
	Provide alternative income generating opportunities	No of hh	0.125	2.5	0.31	0.11	0.1	0.1	RVLBAO, NGO
3.5	**Develop appropriate awareness raising techniques and implement awareness programs focused on catchment protection and managements**								
	Identify relevant catchment protection and management topics or issues, devise appropriate methods of information dissemination and conduct awareness programs.	No tri/Pro	15	0.5	7.5	3	2.5	2	MoWE, RVLBAO, NGO
	Develop watershed education activities and establish education networks	No Ed/Ne	15	1.5	22.5	7.5	7.5	7.5	MoWE, RVLBAO, NGO
	Establish baseline on awareness level of community and society on catchments degradation and protection issue.	No tri/Pro	3	1	3	1	1	1	MoWE, RVLBAO, NGO
	Identify the most important knowledge gaps in public servants,	No	3	1	3	1	1	1	MoWE,

	CBO's and communities on catchment protection and management	tri/Pro							RVLBAO, NGO
3.6	**To reduce flood and drought hazard**								
	Soil and water conservation (gully treatment, afforestation and water harvesting structures)	ha	1mil	0.005	5000	100	100	100	MoWE, RVLBAO
	Prepare timely forecast and early warning of extreme events	%	-	-	1	0.33	0.33	0.33	DRPPC, NGO, RVLBAO
	Alternative sources of income	Types of income	5	10	50	20	15	15	DRPPC, NGO, RVLBAO
Sub-total				**21.557**	**19302.3**	**4904.51**	**4849**	**4848.5**	
Goal 4	**Ensure active stakeholder participation in planning, decision making, implementation, monitoring and evaluation of IWRM**								
4.1	**To improve public awareness on water resources management and optimal use**								
	Assessment of awareness gap on water resources management	No of docu	5	1.5	7.5	2.5	2.5	2.5	RVLBAO, RWRB
	Organize and validate gap filling workshops and capacity building trainings for each level of stakeholders	No of wrkshop	15	1	15	5	5	5	RVLBAO
4.2	**To strengthen stakeholder's participation on watershed management**								
	Organize experience sharing programs on best IWM practices	No	15	1.5	22.5	7.5	7.5	7.5	MoANR, NGO, RVLBAO
	Organize and validate gap filling workshops and capacity building trainings for each level of stakeholders	No	20	1	20	6	8	6	RVLBAO, NGO
4.3	**To implement legal framework related to pollution control through stakeholder participation**								
	Organize awareness creation programs to engage stakeholders in legal enforcement	No	15	2	30	10	10	10	RVLBAO, MoEFCC, REFCCA
	Establish stakeholder forum	No	2	1.5	3	1	-	-	RVLBAO,
Sub-total				**8.5**	**33**	**11**	**10**	**10**	
				141.057	**22307.05**	**5945.01**	**5836**	**5817.58**	
Total		**22,307,050,000**							

Contingency 10%	**2,230,705,000**	
Grand total	**24,537,755,000**	

12.2. Ziway-Shallabasin: Strategic objectives, major activities and budget details

				Unit price	Total Price	2021-2025	2026-2030	2031-2035	
Goal 1	**Enhance availability and optimum utilization of water resources in the basin for sustainable social, economic, and environmental benefits**								
1.1	**To ensure water availability in the basin**								
	Assess water scarce areas and identify alternative sources	No	3	2	6	2	2	2	MoWE, RVLBAO, RWB
	Constructing water harvesting structures	No	5	7	35	15	10	10	MoWE, RWB
	Strengthen community water harvesting capacity	%	75		15	5	5	5	MoWE, RVLBAO, MoANR
	Designing and developing groundwater scheme	No	4	15	60	20	20	20	MoWE, Water bureaus
	Establishment of groundwater monitoring equipment	No	3	2	6	2	2	2	MoWE, Water bureaus
1.2	**To improve hydrological information system**								
	Upgrade existing manual and automatic hydrological gauging stations	No	15	4	60	20	24	16	MoWE
	Establish new automatic hydrological gauging stations	No	10	6	60	18	30	12	MoWE
	Establish a hydrological database system	No	1	2	2	2	-	-	RVLBAO
1.3	**To improve irrigation water, use efficiency in the basin**								
	Study irrigation efficiency in the basin	No	3	3	9	3	3	3	RIA, RVLBAO, MoWE
	Assess attitude and capacity of water user on efficient irrigation technology	No	3	1	3	1	1	1	RVLBAO
	Build the technical capacity of the water user	%	75	-	30	15	10	5	RIA, RVLBAO, NGO
	Establish inter-sectoral coordination, linkages and networking with irrigation agencies (relevant sectors)	No	3	1	3	1	1	1	MoWE, Water bureaus
	Strengthen on-farm Irrigation Water and Crop Management	No	5	4	30	10	10	10	
	Establish standard M&E system to monitor and evaluate water use efficiency in irrigated agriculture	No	3	1	3	1	1	1	RBDO
	Establish a database management system on agricultural water management	No	2	2	4	2	2	-	
	Establish improved demonstrating sites for efficient irrigation technologies	No	5	12	60	20	20	20	MoA, RVLBAO, Irrigationcommission
1.4	**To implement water allocation for different uses**								
	Assess seasonal and annual total water availability of the area	No	1	3	3	1	1	1	MoWE

	Assess all type of water demands and demand management system	No	1	3	3	1	1	1	RWB, RVLBAO
	Entitle water for all water demand	%	80	-	50	15	25	10	RVLBAO
	Permit water use license	%	80	-	37	18.5	12	6.5	RVLBAO
1.5	**To establish and strengthen water users' association WUAs**				-	-	-	-	
	Identify gaps and Prepare capacity building training on the benefit of WUAs.	%	85	-	12	4	4	4	NGO, RVLBAO
	Establish and strengthen WUAs	%	70	-	33	16	12	5	NGO, RVLBAO
	Prepare draft regulation on irrigation water use, submit and follow up for its endorsement	No	1	2	2	1	1	-	MoWE, RVLBAO
	Aware WUAs to implement the regulation	No	2	3	6	2	2	2	MoWE, RVLBAO
Sub-total					**532**	**195.5**	**199**	**137.5**	
Goal 2	**Improve the water quality of the basin to ensure sustainable social, economic and environmental, benefits**								
2.1	**To prevent industrial and municipal effluents**								
	Identify type and extent of pollution from existing and proposed industries	No	60	0.04	2.4	1.2	0.6	0.6	RVLBAO
	Establish administrative procedures for discharge permit / licensing system as per regulations	No	60	0.04	2.4	1.2	0.6	0.6	MoWE, RVLBAO
	Establish a system of monitoring for implementation of water pollution management plan in industries	No	60	0.04	2.4	1.2	0.6	0.6	MoWE, RVLBAO
	Improve treatment efficiency of existing industrial plants to meet effluent standards	No	15	1	15	5	5	5	PO, MoWE, RVLBAO
	Build/improve urban sewerage management infrastructure for main towns	No	9	1	9	3	3	3	MoEFCC, REFCCA,
	Plan and implement adequate solid waste disposal site for main towns.	No	9	1	9	3	3	3	PO, REFCCA,
	organize awareness raising programs on water pollution	No	15	1	15	5	5	5	RVLBAO, REFCCA
2.2	**To reduce freshwater salinity problem across the basin**								
	Assess major pollutant contributing to water salinity	No	9	2	18	6	6	6	RVLBAO, REFCCA
	Monitoring salinity problems associated with irrigation projects	%	100	-	6	2	2	2	RVLBAO, RIA
2.3	**To conserve and restore wetlands in the basin**								
	Assess the existing wetland issue and prioritize wetlands to	No	30	1	30	10	10	10	RVLBAO, MoEFCC, REFCCA

	be restored								
	Develop Appropriate mitigation measures for wetlands management	No	30	2	60	20	20	20	MoEFCC, REFCCA
	Define Management zones and delineating Wetland Boundaries	No	15	1.5	22.5	7.5	7.5	7.5	RVLBAO, REFCCA,
	Conduct continues monitoring and Awareness Raising programs on the benefits of Wetlands	No	30	0.45	13.5	4.5	4.5	4.5	RVLBAO, REFCCA
2.4	**To establish a water quality monitoring system in the basin**								
	Establish permanent water quality monitoring sites for surface and groundwater	No	30	0.65	19.5	6.5	6.5	6.5	MoWE, RVLBAO, NGO
	Develop water quality monitoring database	No	1	2	2	1	1	-	RVLBAO, REFCCA, MEFCC
	Establish water quality Laboratory and fulfil the necessary facility	No	1	9	9	5	4	-	NGO, RVLBAO
2.5	**To prevent lakeshore cultivation**								
	Develop lake shore management legal frame work/ development of regulation	No	1	2	2	2	-	-	MoWE, RVLBAO
	Delineate the Lakeshore with adequate buffer zone	No	4	3	12	4	4	4	MoEFCC, REFCCA, RVLBAO
	Organize awareness-raising program for all stakeholders and ensure participative lakeshore management approach	No	6	1	6	2	2	2	MoWE, RVLBAO
	Develop Livelihood improvement projects to support communities using the Lakeshores/buffer zone	No	15	2	30	10	10	10	REFCCA, RVLBAO
2.6	To remove and control invasive species (water hyacinth) on shores of Ziway Lake	ha	100	2	200	60	70	70	
	Carryout Manual removal using labor force	Ha	100	2	200	60	70	70	MoEFCC, REFCCA, RVLBAO, AgNRO
	Conduct community mobilization and awareness-raising works	No	6	2	12	4	4	4	MoWE, RVLBAO
	Allocate budget and necessary coordination for operation (to act)	No	6	1	6	2	2	2	MoWE, RVLBAO
Sub-total					**703**	**226.1**	**241.3**	**236.3**	
Goal 3	**Improve water resource conservation, potential and community livelihood in the basin through integrated watershed management**								
3.1	**To protect water bodies from siltation/sedimentation**								
	Implement Integrated Watershed management intervention	ha	140000	0.034	2380	595	1190	595	MoWE, RVLBAO, NGO

	project for watersheds								
	Soil and water conservation work on hill side and (gully treatment)	ha	70,000	0.02	1400	467	467	466	MoWE, RVLBAO, NGO
3.2	**To improve surface and groundwater potential**								
	Soil and water conservation (Protection, Management &Conservation on of existing Natural Forests and conduct Agro-forestry and Community/Conservation Forestry	ha	140,000	0.008	1120	373	373	374	MoWE, RVLBAO, NGO
3.3	**To rehabilitate severely degraded watersheds**								
	Soil and water conservation **(w**ater retention structures, area closure on seriously degraded land and mountain afforestation	ha	0.75mil	0.0074	5550	1850	1850	1850	MoWE, RVLBAO, NGO
3.4	**To improve livelihood of the community**	$		-	50	-	-	-	RVLBAO, NGOs & stakeholders
3.4.1	Assess appropriate income generating activities	No	6	0.3	1.8	0.5	0.5	0.80	RVLBAO, NGOs & stakeholders
	Promote and strength rainwater harvesting systems	No	4	6	24	8	8	8	RVLBAO, NGOs & stakeholders
	Provide alternative income generating opportunities	No	6	10	60	20	20	20	RVLBAO, NGOs & stakeholders
	Job creation through watershed management	No	200	0.07	14	4	4	6	RVLBAO, NGOs & stakeholders
	Cut and carry system from rehabilitated area closure	ha	100	0.165	16.5	5.5	5.5	5.5	RVLBAO, NGOs & stakeholders
	Improving Livestock production in the area of (cattle, small ruminant, poultry, apiculture, and others)	No	5	80	400	120	150	130	RVLBAO, NGOs & stakeholders
	Adoption and promotion of alternative energy source in type	No	3	30	90	30	30	30	RVLBAO, NGOs & stakeholders
3.4.2	To Establish and maintain a functional, productive and sustainable fishery in the Ziway Lake and Langano								
	Develop a sound and functional management system for fisheries (introducing fishing licenses to reduce the number of fishermen and regulate catches)	No			9	3	3	3	RVLBAO, NGOs & stakeholders
	Enforcing fishery legislation in the basin	ls			3.3	1	1	1.3	RVLBAO, NGOs & stakeholders
	Promote aquaculture practices for increased output of fish supply.	No	15	3	45	15	15	15	RVLBAO, NGOs & stakeholders
	increasing awareness on Lake ecosystem conservation and capacity building to fishery community	No	15	0.22	3.3	1	1	1.3	RVLBAO, NGOs & stakeholders
3.5	**To reduce flood and drought hazard**								

	Implement Soil and water conservation works (afforestation and gully treatment, water harvesting structures**)** in upstream (like Balchi hill top)	ls			90	30	30	30	MoWE, RVLBAO
	Prepare timely forecast and Early warning of extreme events	%	70	2	6	2	2	2	DRPPC, NGO, RVLBAO
	Construct drainage, canals, river dykes where necessary	Km	15	4	60	20	20	20	
	Alternative sources of income	No	150,000	0.002	3000	1000	1500	500	DRPPC, NGO, RVLBAO
Sub-total					**14272.9**	**4545**	**5670**	**4057.9**	
Goal 4	**Ensure active stakeholder participation in planning, decision making, implementation, monitoring and evaluation of IWRM**								
4.1	**To improve public awareness on water resources management and optimal use**								
	Assessment of awareness gap on water resources management	No	6	1	6	2	2	2	RVLBAO, RWRB
	Organize and validate gap filling workshops and capacity building trainings for each level of stakeholders	No	15	1	15	5	5	5	RVLBAO
4.2	**To strengthen stakeholder's participation on watershed management**								
	Organize experience sharing programs on best IWM practices	No	15	0.64	9.6	4.48	3.2	1.92	MoANR, NGO, RVLBAO
	Organize and validate gap filling workshops and capacity building trainings for each level of stakeholders	No	20	0.5	10	4.5	3	2.5	RVLBAO, NGO
4.3	**To implement legal framework related to pollution control through stakeholder participation**								
	Organize awareness creation programs to engage stakeholders in legal enforcement	No	15	2	30	10	10	5	RVLBAO, MoEFCC, REFCCA
	Establish stakeholder forum	No	2	4.75	9.5	9.5	-	-	RVLBAO
Sub-total					**80.1**	**35.48**	**23.2**	**21.42**	
Total		**15588**							
Contingency 10%		**1558.8**							
Grand total		**1746.8**							

12.3. Chew Bahirbasin: Strategic objectives, major activities and budget details

No	Description of Goals, Objectives and Major activities	Unit	Qty.	Estimated budget in mil. Birr					Responsible institutions***
				Unit price	Total Price	2021-2025	2026-2030	2031-2035	
Goal 1	**Enhance effective development, efficient utilization, and proper allocation of water resources in the basin for sustainable social, economic and environmental benefits**								
1.1	To conceptualize state and dynamics of water resources of the basin								
	Assess surface and groundwater potential (surface water quantity and quality and groundwater occurrence, distribution, accessibility, quantity and quality)	Document	1	1	1	1	-	-	
	Assess water resource responses to natural and anthropogenic changes	Document	1	0.25	0.25	0.25	-	-	
1.2	To improve hydrological and meteorological information management								
	Upgrade existing manual and automatic river gauging stations	No	2	1.7	3.4	3.4	-	-	
	Establish new automatic river gauging stations	No	15	2.2	33	11	11	11	
	Upgrade existing manual and automatic meteorological stations	No	5	2	10	10			
	Establish new automatic meteorological stations	No	10	3	30	30			
	Establish new groundwater level monitoring system	No	10	2	20		20		
	Develop hydro-meteorological data gathering and management guideline	Document	1	0.5	0.5	0.5			
	Provide training on equipment and efficient data collection	No of training	6	2	12	2	2	2	
	Establish hydrological data base system	No	1	2.3	2.3	2.3	-	-	
1.3	To ensure water availability in the basin								
	Assess water scarce areas and identify alternative sources in the basin	Document	1	4	4	4	-	-	

	Constructing water harvesting ponds	No	45	0.25	11.25	3.75	3.75	3.75	
	Construct water storage reservoir	No	2	2.2	4.8	2.2	-	2.2	
	Develop groundwater schemes (well fields)	No	3	40	120	40	40	40	
1.4	To identify and manage water quality issues in the basin								
	Conduct baseline study of water quality in the basin	Document	1	5	5	5	-	-	
	Identify sources of water pollutants in the basin	Document	1	1.8	1.8	1.8			
	Develop water quality management strategy	Document	1	0.5	0.5	0.5			
	Establish water quality monitoring system	Document	1	3.7	3.7	3.7			
1.5	To improve the recharging capacity of the catchment & flow of the rivers								
	Develop wetland conservation regulation	Document	1	2.7	2.7	2.7	-	-	
	Rehabilitate degraded wetlands	%	100	0.6	60	18	24	18	
	Establish buffer zone for three Rivers	No	3	9.5	3.2	3.7	2.6	-	
	Identify potential sites and strategies for managed aquifer recharge in water scarce area	Document	1	2	2	2			
	Construct structures to initiate managed aquifer recharge in water scarce area	no	30	1	30	10	10	10	
1.6	To improve irrigation water use efficiency in the basin								
	Identify irrigation potential and crop types in the basin	Document	1	3.8	3.8	3.8	-	-	
	Study irrigation efficiency in the basin	Document	1	4.5	4.5	4.5			
	Assess attitude and capacity of water user on efficient irrigation technology	Document	1	1.9	1.9	1.9			
	Build technical capacity of investors/smallholder farmers about irrigation technologies	%	100	1.6	160	48	48	64	
	Establish demonstrating site for efficient irrigation technologies	No	2	5.7	11.4	5.7	5.7		
	Enhance drainage system on the irrigation schemes constructed across the Rivers	No	2	2.4	4.8		2.4	2.4	
1.7	To ensure effective and equitable water use in the basin								
	Assess and calculate water availability and	Document	1	9.7	9.7	9.7	-	-	

	demand (demand per user) in the basin								
	Develop water allocation plan	Document	1	7.8	7.8		7.8		
	Entitle water for all water demand.	Document	1	3.85	3.85		3.85		
	Permit water use license.	No	200	0.02	4	1.5	1.5	1	
	Provide training to build capacity to all major water users on importance and principle of appropriate water allocation	No of training	9	2	18	6	6	6	
	Develop water use monitoring and regulation guideline	Document	1	3.4	3.4	3.4			
	Develop water use conflict management strategy	Document	1	2.7	2.7	2.7			
1.8	To establish water user associations								
	Establish and strengthen Water user association/WUAs/.	No	15	3.75	56.25	18.75	18.75	18.7	
	Identify gaps and Prepare capacity building trainings on the benefit of WUAs.	Document	1	2.7	2.7	2.7	-	-	
1.9	To improve public awareness on water resources management and optimal use								
	Identification of knowledge gap of key stakeholders in areas of water resources management	No	1	1	1	1	-	-	
	Provide capacity building training to groups of all stakeholders in the basin	No	10	1.7	17	8.5	8.5	-	
Sub-total (In million)			**674.2**						

Goal 2	**Improve water resource conservation, potential and community livelihood in the basin through integrated watershed management and Rangeland management**								
2.1	To protect Rivers from siltation/sedimentation								
	Identify erosion hotspot area and major silt routes in the basin	%	100	0.1	10	4	3	3	
	Construct silt trap on the major routes	No	50	0.3	15	4.5	6	4.5	
	Implement gully treatment activities	No	60	0.45	27	4.5	11.25	11.25	
	Reforest buffer zone of three Rivers	No	3	4.6	13.8	4.6	4.6	4.6	
2.2	To improve surface and groundwater potential								
	Conserve existing forests in the basin	Ha	95,000	0.05	4,750	1,250	2,000	1,500	
	Implement afforestation and reforestation on deforested area in the basin	%	70	0.25	17.5	5	7.5	5	
	Develop land use plan to manage land use/cover change	Document	1	3.8	3.8	3.8			
	Develop forest management guideline relevant to the basin	Document	1	2.6	2.6	2.6			
2.3	To restore degraded watersheds								
	Identify and map degraded lands in the basin	Document	1	3	3	3			
	Implement physical and biological works on the degraded lands	Ha	3000	0.35	1050	350	525	175	
	Implement area closure	Ha	4000	0.16	640	240	160	240	
2.4	To enhance Range land management system								
	Assess best ways to manage Range land resources of in the basin	Document	1	1.5	1.5		1.5		
	Promote and Disseminate local best practices and other best ways of Range land management throughout the basin	No of training	15	0.5	7.5	2.5	2.5	2.5	

	Reduce over grazing through modernizing livestock feeding system	%	70	0.27	18.9	5.4	6.75	6.75	
2.5	To improve livelihood of the community in the basin								
	Assess potential livelihood activities in the basin	Document	1	1.3	1.3	1.3			
	Identify skill gaps of basin's community to involve in selected livelihood activities	Document	1	1.3	1.3	1.3			
	Train local communities skill to involve into selected livelihood activities	No of training	15	0.8	12	4	4	4	
	Diversify income generating activities	%	70	4.8	336	120	120	96	
2.6	To minimize conflict on Natural resources utilization								
	Assess and document indigenous conflict resolution practices in the basin	Document	1	2.2	2.2	2.2			
	Promote the implementation of indigenous conflict resolution practices	No of trainings	15	1	15	5	5	5	
	Create public awareness on sustainable natural resources utilization	No of trainings	15	1	15	5	5	5	
	Establish agreements between groups of stakeholders over use, co-management, and conservation of natural resources	No of memorandum	15	0.2	3	1	1	1	
	Set standards and mechanisms of information sharing in the basins	Document	1	0.1	0.1	0.1			
	Develop guidelines to monitor early warning and effective response mechanisms to conflicts arising over use of natural use of natural resources	Document	1	0.1	0.1	0.1			
	Conduct timely monitoring and evaluation (M&E) programs over natural resources utilization	No of M&E	6	1	6	2	2	2	
Sub-total (in million)				**6952.6**					
Goal 3	Minimize natural disaster in sustainable manner in the community								
3.1	To enhance early warning system								

	Develop standard surveillance mechanisms over natural disaster	Document	1	0.2	0.2	0.2			
	Monitor signs of natural disaster and make risk analysis	No of monitoring	15	1	15	5	5	5	
	Build institutional and technical capacity to effective and timely communications of early warnings and prediction of significant natural disaster	No of institutions/trainings	15	0.7	10.5	3.5	3.5	3.5	
	Promote community wide awareness and education over natural disaster and response mechanism	No of trainings/promotion	15	0.9	13.5	4.5	4.5	4.5	
3.2	To Reduce risk vulnerability through adaptation mechanism								
	Assess risks and identify alternative Adaptation strategies	Document	1	3.4	3.4		3.4		
	Promote genetically improved livestock bread in the basin	%	50	0.52	26	7.8	10.4	7.8	
	Introduce and promote drought resistant variety of crops in the basin	%	50	0.36	18	5.4	7.2	5.4	
	Build resilience through diversifying community's livelihoods	%	0	0.47	28.2	9.4	9.4	9.4	
	Expand infrastructure and improved technologies to increase access during the risk	%	70	0.54	37.8	10.8	16.2	10.8	
	Promote irrigation access to reduce dependency on rainfed agriculture	%	80	0.23	18.4	6.9	6.9	4.6	
	Sub total (in million ETB)			131.8					

Goal 4	Ensure good water quality for sustainable socio economic development								
4.1	Develop and enforce regulatory instruments focusing on maintaining water quality standards								
	Review water quality standards for rural, municipal and irrigation water supplies	No of document	3	0.5	1.5	0.5	0.5	0.5	
	Inventory of water quality and pollution sources	No of documents	3	6	18	6	6	6	

	Establish administrative procedures for discharge permit /licensing system as per regulations	No of documents	1	1.0	1.0	1.0	-	-	
	Prepare Guidelines for design of wastewater treatment, disposal and reuse facilities	No of documents	1	1.5	1.5	1.5			
	Prepare standards, guidelines, and procedures for fertilizer application , wastewater quality, solid wastes, and discharge regulation	No of documents	1	1.5	1.5	1.5			
4.2	To establish water quality monitoring system in the basin								
	Establish permanent water quality monitoring sites for surface and groundwater	No of sites	15	0.5	7.5	2.5	2.5	2.5	
	Develop water quality monitoring database	No of database	1	3	3	3	-	-	
4.3	To prevent lakeshore or river shore cultivation								
	Delineate sensitive Lakeshore/river shore with adequate buffer zone	No. document	1	3	3	1.5	1.5		
	Subtotal (In million ETB)				37				
Goal 5.	Ensure active stakeholder participation in planning, decision making, implementation, monitoring, and evaluation of IWRM and prevention of natural disaster								
5.1	To increase stakeholder awareness on resource allocation, efficient utilization, management and disaster prevention								
	Survey key stakeholders and their views and needs in the basin	Document	3	0.7	2.1	0.7	0.7	0.7	
	Create regular stakeholder consultation platform	No of platform	30	0.5	15	5	5	5	
	Provide awareness training to key stakeholders on benefits, challenges, strategies of efficient, equitable, and sustainable natural resources management	No of trainings	15	0.9	13.5	4.5	4.5	4.5	
5.2	To enforce implementation of legal frameworks in relation to natural resources management and prevention of natural disaster								
	Identify and fill gaps in legal frameworks	Documents	2	0.2	0.4	0.4			

	in relation to natural resources management and disaster risk minimization								
	Give training to key stakeholders on legal frameworks in relation to natural resources management	No of trainings	15	1	15	5	5	5	
Sub-total					184				
Total		7841.60							
Contingency 10%		**784.16**							
Grand total		**8625.76**							

*** For each major activity responsible institution is already indicated in chapter 7 (7.3).

12.4. Abaya-Chamo Sub-basin: Strategic objectives, major activities and budget details

No	Description of Goals, Objectives and Major activities	Unit	Qty.	Estimated budget in mil. Birr					Responsible body	Co-Partners
				Unit price	Total Price	2021-2025	2026-2030	2031-2035		
Goal 1	**Enhance availability, Management and optimumutilizationofwaterresourcesinthesub-basin for sustainable social, economic and environmental benefits**									
1.1	**Toincreasesurfaceandgrounwaterresourceavailabilityinthesub-basin**									
	Identificationoflevel of basin meteorological and hydrological database association	No. of Doc	5	2	10	6	2	2	MoWE, RVLBAO	NGOs,Higher Education & Knowledge Institutions
	Assessment of basindatabaseavailability with respect to all data types	No. of Doc	5	2	10	6	2	2	MoWE, RVLBAO	NGOs,Higher Education & Knowledge Institutions
	Assess water scarce areas and identify alternative sources in the sub basin	No. of Doc	5	3	15	9	3	3	MoWE, RVLBAO	NGOs,Higher Education & Knowledge Institutions
	Develop groundwater sources in selected areas as monitoring wells for database enrichment	No.	10	20	200	100	60	40	MoWE, RVLBAO	NGOs,Higher Education & Knowledge Institutions
	Developingmanual based oninternationalexperiences with rainwater harvesttechnology	No. of Doc	3	3	9	6	3	0	MoWE, MoANR, RVLBAO	NGOs,Higher Education & Knowledge Institutions
	Quantifytheexistingamountofsurfaceandgroundwaterinthesub-basin	No. of Doc	5	3	15	6	6	3	MoWE, RVLBAO	NGOs,Higher Education & Knowledge Institutions
	Strengthencommunitywaterharvestingcapacitywith rainwaterharvest technology	No of training	20	20	400	160	140	100	MoWE, MoANR, RVLBAO	NGOs,Higher Education & Knowledge Institutions
	Assesswater scarce areasandidentify alternative sources	No. of Doc	5	4	20	12	4	4	MoWE, MoANR, RVLBAO	NGOs,Higher Education & Knowledge Institutions
	Constructgroundandsurfacewaterresourceenhancin	No. of structures	8	350	2800	1050	1050	700	MoWE, MoANR,	NGOs,Higher Education & Knowledge Institutions

	gstructuresin water scarceareas								RVLBAO	
1.2	**To improveirrigationwateruseefficiencyinthesub-basin**									
	Assess the irrigation potential ofthesubbasin	No. of Doc	5	5	25	10	10	5	MoWE, MoANR, RVLBAO	NGOs,Higher Education & Knowledge Institutions
	Studyirrigationefficiencyproblemsofall existing schemes inthesub-basin	No. of Doc	120	5	600	250	200	150	MoWE, MoANR, RVLBAO	NGOs,Higher Education & Knowledge Institutions
	Assess attitude and capacityofwaterusersandassociationsonefficientirrigationtechnology	Noofschemes	100	4	400	160	160	80	MoWE, MoANR, RVLBAO	NGOs,Higher Education & Knowledge Institutions
	Buildtechnicalcapacity of the water users	No of training	20	25	500	175	200	125	MoWE, MoANR, RVLBAO	NGOs,Higher Education & Knowledge Institutions
1.3	**Toallocatewaterresourcesamongdifferentuses**									
	Assessseasonalandannualtotalwateravailabilityofthesub basin	No. of Doc	5	6	30	18	6	6	MoWE, RVLBAO	NGOs,Higher Education & Knowledge Institutions
	Assessalltypeofwaterdemands and demand management system	No. of Doc	6	10	60	30	20	10	MoWE, RVLBAO	NGOs,Higher Education &Knowledge Institutions
	Entitlewaterforallwater demand	%	80	-	400	100	150	150	MoWE, RVLBAO	Consultants
	Permitwateruselicense through training	No. of training	15	6	90	30	42	18	MoWE, RVLBAO	Woreda and zone regionalwateroffice.
1.4	**ToimprovepublicawarenessandundertakecapacitybuildingonIWRM**									
	Identifygapsonwaterresourcemanagementandutilization	No. of Doc	5	10	5	20	20	10	MoWE, RVLBAO	NGOs,Higher Education & Knowledge Institutions
	Apply Researches, innovations,Trainings,demonstrations,technologydissemination,onwaterresources	No. of Doc/training	20	10	200	100	50	50	MoWE, RVLBAO	NGOs,Higher Education & Knowledge Institutions
1.5	**To establish/rehabilitate hydro-meteorological information system**									
	Select sites and install newhydro-meteorologicalstations	No.	10	20	200	75	75	50	MoWE, RVLBAO	NGOs,Higher Education & Knowledge Institutions
	Upgrade existing manual toautomatichydrologicalgaugingstations	No.	12	25	300	100	150	50	MoWE, RVLBAO	NGOs,Higher Education & Knowledge Institutions
	ConductingbathometricsurveyatlakeAbayaandChamo	No.	5	15	75	45	30	0	MoWE, RVLBAO	NGOs,Higher Education & Knowledge Institutions

Sub-total 1				**548**	**6364**	**2468**	**2383**	**1558**		
Goal 2:	**Improvethequality and quantity ofwaterresourceinthe sub-basinforsustainablesocial,economicandenvironmental,benefits.**									
2.1	**To reduce fresh watersalinityproblemacrossthesub-basin**									
	Produce water quality mapforrivers,Lakes,groundwater through testing water samples	No of Packages	3	300	900	300	300	300	MoWE, RVLBAO, EPA	NGOs,Higher Education & Knowledge Institutions
	Assessmajorpollutantcontributingtowatersalinity	No of Doc	10	10	100	40	30	30	MoWE, RVLBAO, EPA	NGOs,Higher Education & Knowledge Institutions
	Monitor salinity problemsassociatedwithirrigationprojects	No of Doc	10	10	100	40	30	30	MoWE, RVLBAO, EPA	NGOs,Higher Education & Knowledge Institutions
2.2	**To ensure EnvironmentalfriendlyAgriculturalpractices**									
	ImplementAgro-chemicalpollutantpermitstandard	%	85	-	190	70	80	40	MoWE, RVLBAO, EPA	NGOs,Higher Education & Knowledge Institutions
	Increasepublicawarenessoncauseandmeansofenvironmentalpollution	%	90	-	180	60	70	50	MoWE, RVLBAO, EPA	NGOs,Higher Education & Knowledge Institutions
2.3	**Toestablishwaterqualitymonitoringsystem**									
	Establishadditional water quality sampling stations	No.	40	4	160	60	50	50	MoWE, RVLBAO, EPA	NGOs,Higher Education & Knowledge Institutions
	Establish water quality laboratory	No.	1	155	155	155	0	0	MoWE, RVLBAO, EPA	NGOs,Higher Education & Knowledge Institutions
	Develop water quality monitoring database	No.	1	150	150	150	0	0	MoWE, RVLBAO, EPA	NGOs,Higher Education & Knowledge Institutions
2.4	**Toimplementwastemanagementpractices**									
	ExpandliquidandsolidwastemanagementInfrastructure andrecycling	No.	3	250	750	250	250	250	MoWE, RVLBAO, EPA	NGOs,Higher Education & Knowledge Institutions

	Identify type and extent ofpollution from existing andproposedindustries	No.of Industries	60	3	180	90	60	30	MoWE, RVLBAO, EPA, Investment Bureau	NGOs,Higher Education & Knowledge Institutions
	Establishadministrativeproceduresfordischargeperm it /licensing system asperregulations	No.oflicense	100	2	200	80	60	60	MoWE, RVLBAO, EPA, Investment Bureau	Industries, Investment Bureaus
	Organize awareness raisingworkshopsonwaterpollution	No.of workshops	15	10	150	50	50	50	MoWE, RVLBAO, EPA	Local authorities,Community,Industries
2.5	**ToconservewetlandsandLakeshores**									
	Rehabilitatewetlands	No.of wetland	20	30	600	300	150	150	MoWE, RVLBAO, EPA, MoANR, HEIs	NGOs, Local authorities,Community,Industries
	Demarcate Lakes and rivers buffer zone	No.ofLakes andrivers	80	10	800	350	350	100	MoWE, RVLBAO, EPA, MoANR, HEIs	NGOs, Local authorities,Community,Industries
	Developlegalandpolicyinputsonbufferzonedemarcationandwetlandmanagement	Noofwetlands	3	50	150	50	50	50	MoWE, RVLBAO, EPA, MoANR, HEIs	NGOs, Local authorities,Community,Industries
	Sub-total 2			**984**	**4765**	**2045**	**1530**	**1190**		
Goal 3	**Improve the water resources conservation and community livelihood in the sub-basin through integrated way**									
3.1	**To capacitate the stakeholders**									
	Build institutional Integration	Number	40	10	400	200	100	100	MoWE, RVLBAO,	NGOs,HEIs

	Conduct awareness creationandtraining	Number	15	10	150	50	50	50	MoWE, RVLBAO,	NGOs,HEIs
	Makewatershedworks as a crosscuttingissue	%	95	-	60	20	20	20	MoWE, RVLBAO , MoANR, EPA	NGOs,HEIs
3.2.	**To rehabilitate severely degraded watersheds**									
	Issueeffectivelandusepolicyand rules	No.	1	-	100	20	30	50	MoWE, RVLBAO, EPA	NGOs,HEIs
	Establish and maintainnurserysites	No. of watersheds	30	5	150	50	50	50	EPA, RVLBAO, MoANR,	Community, NGOs, Private Companies, HEIs
	Conduct biological soilconservationmeasures	hectare	150,000	0.002	300	100	100	100	EPA, RVLBAO, MoANR,	Community, NGOs, Private Companies, HEIs
	Implementsoilandwaterconservationmeasures	hectare	1million	0.0004	400	100	200	100	EPA, RVLBAO, MoANR,	Community, NGOs, Private Companies, HEIs
3.3	**Toimprovethelivelihoodofthecommunity**									
	Enhancethefarmingsystemthroughmoderntechnology	No. of HHs	150,000	0.004	600	200	200	200	MoANR, MoWE, RVLBAO	Community, NGOs, Private Companies, HEIs
	Introduce modernlivestockbreedingsystem	No. of HHs	150,000	0.004	600	200	200	200	MoANR, MoWE, RVLBAO	Community, NGOs, Private Companies, HEIs
	Develop small andmedium scale manufacturingIndustries	Number	800	1.25	1000	375	375	250	MoANR, MoWE, RVLBAO	Community, NGOs, Private Companies, HEIs
	Conductjobcreationthroughwatershedmanagement	Noofpeople	25,000	0.04	1000	400	400	200	MoANR, MoWE, RVLBAO	Community, NGOs, Private Companies, HEIs
3.4	**Toreduceflood and drought hazards**									
	Preparetimelyforecastandearlywarningsystem	No. of system	3	35	105	35	35	35	Disaster Preparedne	NGOs, HEIs

									ss and Prevention Commission	
	Generate alternativesourcesofincomeforPeoplelivinginfloodproneareas	No. of HHs	150,000	0.006	900	300	300	300	Disaster Preparedness and Prevention Commission, NMI, MoWE	NGOs, HEIs
	Sub-total 3			**61.31**	**5765**	**2050**	**2060**	**1655**		
Goal 4	**Ensure active stakeholder participation toimprove planning, implementation, monitoring andevaluationofprojectsrelatedtoIWRM**									
4.1	To improve stakeholder awarenessonwaterresourcesmanagementandoptimaluse									
	Assesawarenessgaponwaterresources management	Document	10	10	100	40	30	30	MoWE, RVLBAO	NGOs, Knowledge Institutions, HEIs
	Organize and validate gapfillingworkshopsandcapacity building trainingsforeachlevelofstakeholders	Noofworkshops	25	10	250	100	100	50	MoWE, RVLBAO	NGOs, Knowledge Institutions, HEIs
4.2	**To strengthenstakeholder'sparticipationon watershedmanagement**									
	Organize experiencesharingprogramsonbest IWRMpractices	Noofprograms	27	10	270	100	100	70	RVLBAO, MoWE, MoANR	EPA,NGOs,Mediacenters
4.3.	**Toimplement legal framework on pollutioncontrolthroughstakeholderparticipation**									
	Organize awareness creationworkshopstoengagestakeholdersinlegalenforcement	No.of workshops	15	10	150	50	50	50	RVLBAO, MoWE, MoANR, EPA	NGOs, HEIs, ResearchInstitutes, Media centers
	Establish stakeholderforum	No. of forums	5	20	100	40	40	20	RVLBAO, MoWE, MoANR, EPA	NGOs, HEIs, ResearchInstitutes, Media centers
Sub-total 4				**60**	**870**	**330**	**320**	**220**		

			1,653.31	**17,764.00**	**6,893.00**	**6,293.00**	**4,623.00**		
Total (Million ETB)				**17,764.00**					
Contingency (10%)				**1,776.4**					
Grand total (Million ETB)				**19,540.40**					