MESSAGE FROM THE DIRECTOR GENERAL

Gete Zeleke (PhD)
Director General
WLRC, AAU

Dear staff members of WLRC, AAU,

Distinguished Partners and Stakeholders,

Dear Readers,

The year 2012 E.C. was a busy but successful year for Water and Land Resource Centre, Addis Ababa University (WLRC, AAU), its staffs, partners and stakeholders. Most of the activities planned to be done during the first half of the fiscal year (July 2019 – Dec. 2019) were accomplished as planned. As all of us recall it, the outbreak of Covid-19 and lockdowns and ban of movement to curtail the spread of the virus had negatively affected regular undertaking of duties during the second half of the year (starting Jan. 2020).

Despite the difficulty and uncertainty of the time, however, the staffs of WLRC have devotedly pursued their plans, and accomplished outstanding activities, taking all the necessary preventive measures against Covid-19. Most of the staff members even spent much of their time on field works away from home. As a result, most of the activities that had been planned for 2012 E.C were accomplished successfully. In this regard, I duly appreciate the WLRC staffs for their extraordinary commitments and courage to discharge their institutional mission and producing recognized outputs in the projects even under those difficult times. Thank God, all of us are doing well so far.

This Annual Report 2012 E.C. (July 2019 – June 30th, 2020) is organised under eight chapters. Chapter one gives general introduction about WLRC, its set-up and activities; chapter two dwells on its accomplishments in long-term monitoring of climate, hydrology, land use and other SE parameters; chapter three captures all our works related to water security; chapter 4 deals with our innovative research for development undertakings in developing and demonstrating science based ILM model sites for upscaling. Activities carried out on natural resources governance, socio-economic studies are presented in chapter five while chapter six presents all the accomplishments of the centre in generating useful knowledge for action and knowledge tools. Chapter seven reports our institutional development and governance engagements and chapter eight presents the Centre's human resources, administration, financial accounts and audit.

Finally, the report contains only a snapshot of the key undertaking in the Centre. Thus, I would like to invite the readers, and encourage you to demand for further details in the areas of your interest about the Centre and its activities.

Stay Safe, and have a happy reading time.

Gete Zeleke (PhD)
August 2020
Addis Ababa, Ethiopia
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1.1. Background

1.1.1. Evolution and constitution of the Centre

The Water and Land Resource Centre (WLRC) is an autonomous Resource Centre dedicated to generating and sharing scientific knowledge to inform policy and practice in water and land resources management in Ethiopia. The Centre was reorganised in 2011 from the then Soil Conservation Research Project (SCRP), which was initiated in 1981 by Centre for Development and Environment (CDE) of the University of Bern, Switzerland, in collaboration with the then Ministry of Agriculture (MoA) of Ethiopia. WLRC has 40 years of experience researching and disseminating evidence on water and land resources. The University of Bern and Addis Ababa University, Ethiopia signed, in 2014, Memorandum of Understanding for co-management of the Centre. CDE of the University of Bern is involved in the quality control of its scientific work. Later in 2016, WLRC was affiliated to Addis Ababa University (AAU), but with autonomous status.

From 2011 through 2018, its core functions were supported by the Swiss Agency for Development and Cooperation (SDC) of Switzerland under a bilateral agreement with the then Ministry of Finance and Economic Development of the Federal Democratic Republic of Ethiopia. The fund used to be channelled through CDE of University of Bern, Switzerland. Since 2019, WLRC’s core functions are financed through funds generated from different sources, mainly competitive project grants.
1.1.2 Vision, Missions, Goal, Values and Motto

WLRC aspires becoming a leading Centre of excellence in generating, developing and sharing scientific knowledge and practices on sustainable water and land resources management, and livelihoods in Ethiopia and the broader Horn of Africa, by 2030.

WLRC upholds the following values: **inter-disciplinarity, scientific rigor, partnership, inclusivity, environmental sustainability/ecosystem health, and sensitivity and respect to culture**. Its guiding principles include pursuing integrated approaches to the management of land and water resources; ensuring sustainable utilisation of resources; and proactive knowledge generation, management and sharing through open access modality.

WLRC’s motto: **“Water and land wise Ethiopia, food-secure and better-off people”**.

**Governance Structure**

WLRC is governed by Board of Trustees constituted of State Ministers and Deputy Commissioners form five ministries (i.e. Ministry of Agriculture; Ministry of Water, Irrigation and Energy; Ministry of Finance; Ministry of Science and Innovation; and Environment, Forest, and Climate Change Commission) and one senior scientist at Addis Ababa University from Ethiopia and Director of Centre for Development and Environment, University of Bern, from Switzerland. The Board is chaired by the AAU Vice President for Research and Technology Transfer. The Director General of WLRC is a Secretary of the Board.
International Affiliation

WLRC has a long-standing affiliation with the Centre for Environment and Development (CDE) of University of Bern, Switzerland and CDE designates WLRC as its Horn of Africa Regional Hub and provides strategic support to WLRC, including unrestricted access to ICT and remote sensing technologies and software. As per the MOU signed between the two parties (i.e., AAU and University of Bern for joint management of WLRC), CDE does quality check, international outreach and facilitates the formation of international strategic partnerships. WLRC and CDE also explore opportunities for joint programmes and funding.

Core Mandates

WLRC, AAU consolidates its efforts along the following core mandate areas of operation:

(a) Initiating and conducting applied as well as action researches aimed at:
   - improving the management of natural resources (mainly water and land, including water security and climate) and ecosystem services;
   - improving livelihoods, water supply and sanitation access, hygiene behavior and health; and
   - informing (or at best influencing) practice, decision and/or policy on same;

(b) Piloting, scaling up and scaling out community-based and community-driven integrated landscape management (ILM) and integrated water resource management (IWRM) approaches and demonstration sites, such as learning watersheds (regarding sustainable natural resource management) and community/school-led total sanitation and hygiene (C/SLTSH) (regarding WASH);

(c) Long-term scientific monitoring of (or generating and organising time-series data on) changes in ecosystems or their elements, such as climate, hydrology, land quality, land use, and socio-economic parameters using observatories, GIS/Remote Sensing and modelling;

(d) Generating, developing, managing and sharing knowledge and knowledge management systems and GIS/RS-based platforms such as WARLIS, Ethio-GIS, AGS, Map-Server, SLM-KMIS, and databases on the above-mentioned broad thematic domains; and

WLRC projects

I. Water Security and Sustainable Development HUB
II. REACH
III. DAFNE
IV. FOLU
V. PLRPES
VI. SUCCESS
VII. SLM-KMIS
VIII. SUDAC
IX. Kunzila ILMWA
(e) Building implementation and institutional capacities of federal and regional institutions, such as the Ministry of Agriculture, and Central Statistical Agency, as well as those of academia and academics, mainly MSc and PhD students.

Cumulatively, these functional areas of operation (see also Fig. 1) are geared towards ultimately contributing to realisation of the broad goal of improving environmental quality, sustainably improving peoples’ livelihoods, health and overall living standards.

1.1.3. Organisational arrangement and constituencies

WLRC, AAU is governed by a Board of Trustees and led by a Director General. The Centre’s mainstream functions are organised into a Program Management division and four technical divisions, all of which report to the Director General. The Program Management division constitutes Finance, Human Resource and Administration units and Legal and Audit Services. The technical divisions are: i) Hydro-sedimentology and Climate Change Research Division; ii) Integrated Water and Land Resource Management and Ecosystem Service Research Division; iii) Resource Governance and Socio-Economic Research Division; and iv) Knowledge Management and Outreach Services Division.

In account to human resource, WLRC had 33 staff on long-term regular contract employment and some workers that worked on short-term contracts.

WLRC has institutionalised constituencies, including six well established Learning Watersheds handed over to communities with minimum post-exit follow-up by WLRC, 16 observatories and more than 30 climate stations in different parts of the country. In addition, 12 new learning watersheds were established and seven observatories were under establishment at Kunzila area. These constituencies are useful platforms for knowledge generation and live-learning (demonstration) and for transferring knowledge, skills and technology on water and land resources. The centre runs six of the observatories and the six learning watersheds in collaboration with regional and local government agencies and communities; 4 observatories and 24 climate stations by its own. Also seven new observatories that are under establishment in Kunzila. WLRC had also handed over to Farm Africa three observatories and three climate stations which were established as part of EU-funded SHARE Ethiopia Project in Bale Mountain Eco-region. Besides, WLRC has broad-based and strong networks with a range of partners and stakeholders at local, regional, federal and international levels.
1.2. Highlights of projects

Currently, most of the technical activities of the Centre, including the inception activities for the new arrival Kunizila Integrated Landscape Management and WASH (KILMWA) project, are project-based. Here are the previews of each project.

I. Water Security and Sustainable Development HUB (2019 - 2023): is funded by the UK Research and Innovation of Global Challenges Research Fund (UKRI-GCRF). The collaborators in the programme are UK, Colombia, Ethiopia (WLRC and IWMI), India and Malaysia. The Hub is coordinated by The University of Newcastle, UK. WLRC leads and coordinates the Ethiopian segment of the project, which is implemented in collaboration with International Water Management Institute (IWMI). Different stakeholders in water and related sectors, such as the Federal MoA, MoWIE, EFCCC, EIWR, ACEWM, ARI’s, AAWSSA, Regional Bureaus, Basin authorities (Abbay, Awash and CRV), and Universities in the basins are local implementing partners.

The overall objective of this project in Ethiopia is to generate innovative knowledge and improve governance system for sustainable water security in Ethiopia, focusing on the Abbay and Awash River basins and the Central Rift Valley (CRV) basins of Ethiopia. The specific objectives at river basin level are to:

- assess the state of Upper Awash river pollution, mapping point sources, the pollution status of the river networks, contribution of non-point source pollutants, and associated risks to Riparian communities and the ecosystem services.
- enhance sustainable water security through a comprehensive understanding of possible risks and effective water resource governance systems in the Central Rift Valley Sub-basins.
- unleash the potential of rain-fed agriculture in unimodal rainfall areas through improved green water management to ultimately bring sustainable development in the Abbay River Basin.

II. Improving Water Security for the Poor (REACH): this is a seven-years research program (2015 - 2022) with the aim to create a more comprehensive understanding of water insecurity elements (climate, water pollution, groundwater-surface water interaction) and equitable institutional and governance development. The program is funded by the UK Department for International Development (DFID) and is being implemented in the UK, Ethiopia, Kenya and Bangladesh.

It is being led by Oxford University, which also implements the project in the UK. In Ethiopia, the REACH is being implemented by WLRC in partnership with IRC, IFPRI, HDSS of Mekelle University and UNICEF Ethiopia. The key collaborators are the Ministry of Water, Irrigation and Electricity (MoWIE), Awash Basin Authority (AWBA). The Kenya side collaboratory is being implemented by University of Nairobi while Bangladesh University of Engineering and Technology (BUET), University of Dhaka, and International Centre for Diarrhoeal Disease Research implement REACH in Bangladesh.
The REACH research project in Ethiopia has been ongoing since 2015 working on three water security observatories; namely, Sustainable Development in Awash River Basin, Managing Fragile Environments in the Blue Nile Basin, and Sustainable Human Development in Small Towns in Northern Ethiopia. By the end of the project year 2019, the project components were re-coined in line with the New Global Research Impact Strategies of DFID: Water Quality, Climate Resilience, Inequalities and Governance.

III. Decision-Analytic Framework to Explore the Water-Energy-Food Nexus in Complex and Transboundary Water Resources Systems of Fast-Growing Developing Countries (DAFNE): The DAFNE was a five-year project (ETH Zurich, Switzerland) (2016 – Dec. 2020) funded under the Horizon-2020 Europe Program. The core objectives of the project were to:

- develop a better understanding of the WEF (Water-Energy-Food) nexus in the Omo-Turkana and Zambezi river basins;
- generate and explore alternative planning and management solutions focused on the WEF nexus;
- contribute to solutions that foster profitable and equitable use of resources without infringing on environmental limits, and minimize and mitigate societal and stakeholder conflicts.

IV. The Food and Land Use Coalition (FOLU): This is a project funded by World Resources Institute (WRI), USA. FOLU was a coalition of organisations and individuals committed to transform the way they produce and consume food and use land for people, nature and climate. FOLU used to support scientific solutions and help to build a shared understanding on the challenges and opportunities to unlock collective ambitious action.

One of the gaps identified to secure fund from FOLU was lack of a system that allows the implementation of spatial planning that simultaneously considers agricultural commercialization technologies, land restoration interventions, and agroforestry in selected woredas within Agricultural Commercialization Clusters (ACCs). WLRC identified the gap and signed a research project agreement with FOLU aiming at developing/establishing a system that integrates spatial-based planning in ACC approach so as to improve its impact on agricultural transformation in the country. The main tasks of the assignment were mapping biophysical and socio-economic aspects of two selected case woredas and assessing the challenges to efficiently implement ACC concepts; developing system in producing planning units below woreda level, called Farmers Production Clusters (FPCs); and conducting crop suitability assessment using spatial modelling techniques and determining the type and number of suitable commodities that can be grown in a woreda. WLRC, AAU took also the responsibility to produce comprehensive spatial data for use in the planning process, also helping to identify potentials and map constraints for each commodity, restoration opportunities, and technological intervention.

V. Potential Landscape Restoration and Payment for Ecosystem Services (PLRPES): To cultivate the potential for landscape restoration by engaging communities in managing
their land sustainably, World Resource Institute (WRI) in collaboration with Ethiopian Environment, Forest and Climate Change Commission (EFCCC) and Water and Land Resource Centre (WLRC) identified, in 2016, forest landscape restoration options at national level. They then planned to introduce and promote payment for environmental/ecological services (PES) or “investment for watershed services” in two watersheds, Gojeb watershed of Omo-Gibe Basin, and Koka watershed of Abbay Basin. The practical pilot activities were downscaled to regional level and this work is part of this activities by EFCCC, WRI and WLRC that identify forest landscape restoration options at SNNP and Oromia regions. WLRC-AAU carried out all the technical and stakeholder analyses of this regional level work. PLRPES activities are financed by WRI, the FDRE Environment, Forest and Climate Change Commission (EFCCC) and the newly commencing Kunzila project. PLRPES will be implemented mainly in SNNPR, and Oromia.

VI. Sustainable Utilization and Conservation through Compensation for Eco-System Services in Tekeze (SUCCESS):

Hydropower relies on regular water flow as well as erosion control, both of which require intact ecosystems, which are equally vital for food production, yet there is pressure to increase cultivated land and agricultural outputs in the short-term at the expense of ecosystems’ long-term capacity for food production. There is a gap in sustainable financing of ILM activities. To address such gap, WLRC partnering with HELVETAS Swiss Inter-cooperation (Ethiopia Office) and Ministry of Water, Irrigation and Energy developed this project which is entitled as “Sustainable Utilization and Conservation through Compensation for Eco-System Services (SUCCESS) in Tekeze River Basin”. The project proposal has already won a grant from EU RESET plus Innovation –ICCO fund, and it is going to be implement over two years in six micro watersheds selected from three woredas in WagHimira Zone of Amhara Regional State.

The overall goal of the project is to enhance ecosystem services of watersheds in Wag-Himera Zone of Tekeze Basin for improved livelihoods of selected watershed inhabitants and to increase, or maintain, lifespan of downstream infrastructure, mainly Tekeze Hydrodam. To that effect, this project aims to introduce and adapt a financing tool – Payment for Environmental Services (PES), thereby lowering the cost barriers to increased ILM implementation and improving rural livelihoods, while at the same time helping to prolong the lifespan of critical renewable energy infrastructure.

VII. Developing and Managing the Knowledge Base for the Natural Resource and Sustainable Land Management in Ethiopia (SLM-KMIS):

This two-phase project was funded by the World Bank through the then Ministry of Agriculture and Natural Resources (MoANR): Phase I was run from May, 2016 through April 15, 2019 (immediately before the reporting period) and Phase-II from February 2020 through Jan 2023. The objectives of Phase-II of the SLMP KMIS project are to:

- make the existing Web-based SLMP KM Information System operational and enable the system to fulfil multi-year, annual and quarter level planning and reporting functions;
- upgrade the existing system to include Monitoring and Evaluation (M&E) module, and Mobile/Tab application for data collection module;
- enhance non-spatial micro watershed data linkages with corresponding spatial units;
- provide capacity building and skill trainings for experts and project management team at federal, regional and woreda levels; and
- provide periodic backstopping support and conduct system maintenance service.

VIII. Swiss Universities Development and Cooperation Network (SUDAC)—Academy 2030: as the name suggests, Academy 2030 is grounded on Agenda 2030 and questions on SDG trade-offs and co-benefits. SUDAC (Academy 2030) aims to apply a didactic teaching approach to show the interactions among SDGs. The ultimate goal of the project is to develop an online-teaching platform to enhance societal dialogue and support the implementation and mon-monitoring of the 2030 Agenda through collaborative partnerships between five Swiss higher education institutions and two partner institutions from Kenya and Ethiopia and their multi-thematic and multi-stakeholder networks. The approach is simple: designing spatial data browser and viewer to visualise data concerning certain SDGs and to understand trade-offs and co-benefits within the land-conflict-health nexus.

SUDAC (Academy 2030) aims to support policy processes, by developing and testing innovative, multi-sectoral approaches for data and knowledge sharing at the land–health–conflict nexus. Concretely, the project aims to develop and test a showcase – that would act as an incubator – for scaling out new knowledge generation approaches by amalgamating periodical official data sources with near real-time big data from earth observation and social media sources. Combining these different data sources is expected to lead to enhanced knowledge provision for dealing with trade-offs and synergies between the target dimensions, which are often contradictory. The project will then test the new approaches and processes in dealing with conceptual challenges inherent in the 2030 Agenda. This is intended to lead to improved steering and monitoring of the Sustainable Development Goals (SDGs), as well as to more informed policy processes amid interrelated targets in differing sociopolitical contexts. The project has selected to focus on the interlinkages of SDGs 15, 3, and 16 (i.e. “Life on Land”, “Good Health & Well-being”, “Peace, Justice & Strong Institutions”). As an integral part of its activities, and to amplify its intended outcomes, the project will engage in targeted education and training efforts for sustainable development. Capitalizing on the context-specific lessons learned, the project will prepare various training materials and carry out formal and informal training in technical and conceptual issues, both for staff of the partners as well as for people engaged in policy and dialogue from governmental and nongovernmental organizations. (https://www.phbern.ch/sites/default/files/19_09%20Abstract_Probst_73.pdf)

The idea of Academy 2030 was conceptualised in the year 2017, involving different project partners from different countries. The project partners are from different institutions, including: 1) Swiss TPH, Swisspeace and CDE bringing the ‘sectoral expertise’, 2) WLRC and CETRAD contributing the ‘contextual expertise’, 3) HSR bringing the ‘technical expertise’ (programming of platform & functions), and 4) PH Bern bringing the ‘didactic expertise’ (how to provide data and information to be used by stakeholders). It synthesizes
sectoral knowledge and aims to provide an integrated understanding on trade-offs and co-benefits of SDGs 3, 15, 16.

**IX. Kunzila Integrated Landscape Management and WASH Project (Kunzila ILMWA):**

Kunzila Integrated Landscape Management and WASH (Kunzila ILMWA) project is a five-year project (2020 - 2024) funded by The Embassy of the Kingdom of Netherlands (EKN) in Ethiopia following a dialogue in 2019 between the Amhara National Regional State (ANRS) and the Embassy of The Kingdom of Netherlands (EKN), in partnership with the Dutch Horticultural Investors, The Netherland Enterprise Agency (RVO.nl).

RVO.nl was commissioned to prepare an elaborated commonly shared Partnership for Action, Commitment and Transformation (PACT) proposal. RVO.nl proposed the implementation of Kunzila Integrated Sustainable Development Plan (KISDP) that had been initiated earlier focusing on five thematic pillars. Kunzila ILMWA project was thus proposed as part of the various interventions proposed in the PACT. The project with a budget of 16 million Euro was at initiation and approval stage during the reporting period.

Kunzila ILMWA will be implemented in six rural kebeles and one urban kebele by WLRC and SNV, in collaboration with the duty-bearers (concerned government organs Kunzila watershed, North Achefer Wereda, West Gojjam Zone and Amhara Region), the target beneficiary communities in Kunzila Watershed and Kunzila town, and partners and stakeholder organisations. WLRC is the lead of the project and it would consider this project as its flagship programme for the next five years.

The overall objective of the project is to contribute to a more prosperous and healthy population in Kunzila Watershed, in alignment with the other relevant projects and programs and national policies and plans. More specifically, this project aims to contribute to:

- improving income of at least 75% of the community members in the watershed (through agricultural support and capacity development);
- create employment opportunities for youth (males and females);
- improve institutional capacity for sustainable landscape management and utilization; and
- improve rural communities’ access to market places and roads;
- ensure sustainable access to basic water supply and sanitation services in rural areas;
- improve institutional capacity to deliver safe water supply and sanitation service in Kunzila town; and
- generate scientific evidence on the impact of the IWM and WASH interventions for upscaling.

In order to achieve these objectives, the project is structured into eight components that that commence after the inception phase (Component 0).
0. Inception phase
1. Strengthening of community watersheds management
2. Strengthening of agricultural productivity of smallholders
3. Strengthening of local capacities
4. Strengthening of rural WASH services
5. Strengthening capacity for improved urban WASH services Kunzila town
6. Strengthening of multi-stakeholder coordination under woreda leadership
7. Scientific monitoring
8. Project management and monitoring, evaluation and learning (MEL)

1.3. A Glimpse into 2019/2020 and the Centre’s accomplishments in the year

WLRC, AAU planned to undertake quite a lot during the year 2019/2020 (July 2019 – end of June 2020). Unfortunately, the fiscal year was marked by two major setbacks: the restrictions to prevent the COVID 19 Pandemic from spreading, and the wide-spread security problems that made field works difficult.

Even under those inconvenient and limiting conditions, WLRC embarked on a number of research and implementation activities both under its mainstream and cross-cutting functions and the project undertakings. The reports on its undertakings during 2019/2020 are organised and presented under the following macro themes: 1) Introduction (this section), 2) Valuing Science—Long-term Monitoring, 3) Water Resources Management for Sustainable Development, 4) Research for Transforming Environment and Livelihoods—Exploring Frontiers of ILM, 5) Governance and Socio-Economic aspects for NRM, 6) Transformative Knowledge for Sustainable Water and Land Resources Development, 7) Institutional Development and Governance (WLRC), and 8) Finance. We encourage readers to navigate through each section for the details.
CHAPTER 2
VALUING SCIENCE: LONG-TERM MONITORING

2.1. General introduction

Effective management of natural resources requires sustained monitoring of environmental resources that provide the foundation for assessment and decision-making. Long-term monitoring can provide indicators of changes in environmental conditions that initiate management actions. Monitoring is not only valuable for informing management actions, but also valuable for documenting long-term environmental change or anomalous events, increasing public awareness, or improving scientific understanding of an environment. The rapid pace of global environmental change lends greater urgency to the development and continuation of monitoring programs for early detection of trends and tipping points. The benefit of long-term scientific monitoring could reach places beyond the monitoring set up. The evidences generated can be used to develop models which also be used to scaling up to other places.

Long term monitoring at WLRC

Cognizant of the huge importance of long-term monitoring of environmental elements, WLRC puts much effort into setting up hydro-sedimentology, climatology and land use/land productivity monitoring sites across Ethiopia that represent various agro climatic zones and priority areas (fig 2.1). There are 12 observatories that are being observed for climate and hydro-sediment monitoring. Some of these are as old as 1981, and there are new additions. Table 1 lists the observatories and year of establishment.
The oldest observatories in WLRC are Anjeni, Maybar and Andit Tid. These smaller research watersheds (observatories) were established between 1981 and 1984 as part of the Ethiopian Soil Conservation Research Programme (SCRP) with the support of the Swiss Agency for Development and Cooperation (SDC). Since 1981, data and knowledge on hydro-sedimentology and land management have been accumulated from these observatories. Considering the gap on hydro-sedimentology and climate data related to larger watersheds and high altitude areas, the resource centre later established one Meso-scale observatory (Gerda Watershed close to Dembecha) and High-Altitude Observatory at Semien Mountain National Park, Hunde Lafto and Dizi in Oromia Region and Gununo in SNNP Region in collaboration with regional government institutes in Oromia and SNNP.

Although there is limited utilization of this massive data and knowledge, due to lack of appropriate institutions as well as lack of organized database system and dissemination mechanisms, the long-term observations in these observatories were found necessary under the current Global Change scenarios. These observatories have been institutionalized within Amhara Region Agricultural Research Institute (ARARI) and WLRC took the mandate to rehabilitate the infrastructure, instrumentation and continue the research work in an enhanced way in collaboration with ARARI. To this effect, the three observatories have been rehabilitated (including instrumentation) and all the new setups for the Meso-Scale Observatory at Dembecha and the High-Altitude Observatory at Semien Mountain National Park were finalized and all are now fully operational and data collection work has been resumed. The resource centre also applies modelling and other techniques to extrapolate findings from plot and smaller watershed level to larger areas through specialized studies. Building on these experiences, it is intended to ultimately expand the activities of the resource centre to serve as a regional knowledge hub facilitating national and trans-boundary decision support for sustainable, equitable, and rational use of water and land resources in the country and Eastern African sub-region.

Table 2.1. Long-term monitoring observatories

<table>
<thead>
<tr>
<th>No</th>
<th>Observatories name</th>
<th>Remark</th>
<th>Established</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Andit Tid</td>
<td>Small observatories</td>
<td>1982</td>
</tr>
<tr>
<td>2</td>
<td>Anjeni</td>
<td>Small observatories</td>
<td>1984</td>
</tr>
<tr>
<td>3</td>
<td>Maybar</td>
<td>Small observatories</td>
<td>1981</td>
</tr>
<tr>
<td>4</td>
<td>Gerda</td>
<td>Meso-scale observatory</td>
<td>2013</td>
</tr>
<tr>
<td>5</td>
<td>Hunde Lafto</td>
<td>Old observatory</td>
<td>1982</td>
</tr>
<tr>
<td>6</td>
<td>Gununo</td>
<td>Old observatory</td>
<td>1981</td>
</tr>
<tr>
<td>7</td>
<td>Dizi</td>
<td>Old observatory</td>
<td>1988</td>
</tr>
<tr>
<td>8</td>
<td>Semien Mountain National Park</td>
<td>High altitude observatory</td>
<td>2013</td>
</tr>
<tr>
<td>9</td>
<td>Aba Gerima</td>
<td>learning watersheds observatory</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Gosh</td>
<td>learning watersheds observatory</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Debre Yakob</td>
<td>learning watersheds observatory</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Debre Mewi</td>
<td>learning watersheds observatory</td>
<td></td>
</tr>
</tbody>
</table>
Very recently, the centre is in the position of establishing 7 hydro-sediment and climate monitoring stations at Kunzila watershed which is nearly 60 km away from Bahir Dar (Fig. 2.2). The intention of establishing the monitoring stations are to generate scientific evidences of landscape management interventions in the watershed as part of the Kunzila Integrated Landscape Management and Wash project.
2.2 Synthesis of findings from Observatories

2.2.1 Climate

Climate monitoring in the observatories is carried out to measure meteorological elements like rainfall, temperature, radiation, wind speed, wind direction and relative humidity. Recoding these elements are helpful to characterize the hydro climate and hydro-sediment conditions of the observatories and areas that are represented by the observatories. These meteorological elements are measured using conventional as well as compact automatic weather stations. The automatic weather stations were installed in 2013 and start recording data since then at 15-minute time resolution.

Some findings based on long years rainfall data from some of the observatories like Anjeni show increasing trend in rainfall amount while the contrary was revealed by findings that were based on data from other observatories like Andit Tid (Fig. 2.3). However, both the increasing and decreasing observatories do not show any significant change based on Mann Kendal trend test. Increased inter-annual rainfall variability was revealed by data from Anjeni observatory while the data from Andit Tid showed decreased inter-annual rainfall variability. This pattern clearly
2.2.2 Hydrology

Hydro-sediment monitoring

Long term hydro-sediment monitoring is carried out in eight observatories, which represent different agro climatic zones in the country. In the observatories river runoff and suspended sediments are measured together with climate parameters. Since observatories like Anjeni, Andit Tid and Maybar have more than 30 years record, it could be used for model development and model regionalization for representing similar areas. Trend analysis for runoff and sediment for Mayebar, Andit Tid and Anjeni observatories indicated that runoff is decreasing while sediment load show variation in response to soil and water conservation (SWC) intervention in the river catchment. At the beginning after construction of SWC structures, the sediment drastically decrease and after some time increase slightly until it become steady for a while. In some observatories like Anjeni, shift in sediment peak from August to June and July is also observed, which needs further investigation to know the cause.

Based on the recent data analysis for Anjeni observatory indicated that highest rate was recorded (115.6 mm) during 2017. This is very high compared with what was recorded in 1995 (87 mm) since 1984. This indicated that rainfall amount increment could be associated with an increase in intensity. However, this must be studied in detail in the future to make a conclusive statement. On the other hand, the mean one-day rainfall analysis based on recent data shows that, it is quite stable and similar with the long year analysed data.

Figure 2.3. Long year rainfall trend at Anjeni (a) and Andit Tid(b), highest one-day rainfall at Anjeni (c), mean daily rainfall at Anjeni(d)
Recent established observatories like Yecheraka, and Low Jinbar (Semien) also show a slight decrease in discharge and sediments loss since 2013. This could be associated with the result of SWC intervention works applied in the watershed (fig 2.3).

Recent discharge and sediment data from Yechereka and Lower Jinbar observatories revealed the decreasing of discharge as well as sediment during the analysis period.

![Figure 2.4. Discharge and sediment at Yechereka (a) and Lower Jinbar (b) observatories](image)

**Water quality monitoring**

WLRC is also engaged in continuous monitoring of water quality of water bodies with the intention of understanding how human activities are affecting water quality. Water quality monitoring is being conducted in Awash Basin, particularly in the upper part of the basin. It is known that the upper part of the basin is characterised as hotspot area for industrialisation and large farms that pollute the river through chemicals discharged from the industries and farms. In this regard, water quality monitoring is being conducted for nonpoint source pollution in the upper Awash/Melka kuncture watershed in a monthly basis from February 2020 to February 2021(fig 2.5). Parameters which are collected are Temperature, pH, EC, TDS and DO (in situ measurement), NO$_3$, NO$_3$-N, NO$_2$, NO$_2$-N, NH$_4$, NH$_4$-N, PO$_4$, PO$_4$-P and Turbidity (Nutrient test), CO$_3$, HCO$_3$, and CaCO$_3$ (Alkalinity test) and Total Suspended Sediment.
The other basin the centre engaged in is the Abbay Basin, particularly the Kunzila watershed, which is found at the periphery of Lake Tana. The water quality monitoring being conducted in Kunzila watershed is as part of the Kunzila Integrated Landscape Management and Wash project, which is implemented in the area (Figure 2.6).
Water quality is monitored four times in a year specifically, during dry season, beginning of the rainy season, during the rainy season and after the rainy season. In this water quality monitoring activities, three water sources: shallow groundwater, lake and river were considered (Table 2.2).

Table 2.2. Source of water samples and parameters being analysed for Kunzila watershed

<table>
<thead>
<tr>
<th>Water source</th>
<th>No of samples</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shallow Groundwater</td>
<td>48 samples from protected hand dug well &amp; open hand dug well</td>
<td>E. Coli, Faecal coliform, Heavy metals, Residual Chlorine, Temp, TDS, Dissolved Oxygen, pH, EC, TSS, Total Alkalinity, Nitrate, Nitrite, Ammonia, Phosphate, Sulphate, Chloride, Sulphate</td>
</tr>
<tr>
<td>Lake</td>
<td>90 samples</td>
<td>Temp, TDS, Dissolved Oxygen, pH, EC, Biological oxygen demand (BOD), Nitrate, Nitrite, Ammonia, Phosphate, Sulphate, TSS, Pesticides</td>
</tr>
<tr>
<td>River</td>
<td>12 samples</td>
<td>Temp, TDS, Dissolved Oxygen, pH, EC, Nitrate, Nitrite, Ammonia, TSS, Phosphate, Sulphate, Chloride, Pesticides</td>
</tr>
</tbody>
</table>
Some results of the water quality analysis in Kunzila watershed are summarized as the ground water samples are positive for total coliforms and for faecal coliforms (Fig 2.7b). Heavy metals like Cd and Ni were also found in the ground water though the source should be investigated in the future. Apart from heavy metals, ground water samples are subjected to above permissible level of phosphate, nitrate and total hardness. With regard to river water, it is found that phosphate; total alkalinity and total soluble salt are above permissible limit. Lake water samples which were taken from Lake Tana close to the Kunzila watershed showed biological oxygen demand values above the recommended level and reflect high burden of organic pollution on the shore of Lake Tana (Fig 2.7a). High $\text{PO}_4^{3-}$ values was also found in the lake samples which is above the EU guidelines for drinking water, and the total hardness of water samples analysis confirms that the Lake shore were found to be moderately hard.

Figure 2.7. Biological oxygen demand at Lake Tana (a), FC and TC from ground water (b), physico-chemical analysis of Lake Tana (c) and sampling water from Lake Tana (d)
2.2.3 Soil and water conservation measures and ecosystem restoration

Apart from data on hydro-sedimentology and climatology, monitoring of long-term SWC impacts on land use, land management and productivity of the observatories has become one of the continued practices of the Centre. Smaller research observatories (with the size 1 - 7 sq. km.) established between 1981 and 1988 throughout the highlands of Ethiopia as part of the Ethiopian Soil Conservation Research Program (SCRP) with the support of the Swiss Agency for Development and Cooperation (SDC) were include – Maybar/ Wello (moist Weyna Dega/ Dega, established 1981), Andit Tid/Shewa (moist Dega/high Dega, established 1982), Hunde Lafto/ Hararghe (moist Weyna Dega, established 1982), Gununo/Wolayta (moist Weyna Dega, established 1982), Anjeni/Gojam (wet Weyna Dega, established 1984) and Dizi/lllubabor (wet Weyna Dega, established 1988) (Figure 2.1). Since 1981, data and knowledge on the management of land and impacts of SWC measures have been accumulated from these observatories.

Moreover, in an attempt to strengthen evidence-based research supporting the on-going effort to mitigate land degradation, recently, the resource centre established nine new observatories: one meso scale, one high altitude, and seven small scales) observatories in Amhara region. The meso-scale observatory, Gerda Watershed near Dembecha town was established mid-2013 and high-altitude observatory at Semien Mountain National Park were established to address and respond to the huge national gap on hydro-sedimentology and climate data related to larger watersheds and high-altitude areas. Whereas, the small scale observatories being established (construction underway for three of them) in Kunzila watershed, North Achefer are part of the continued efforts of the centre to support national land management efforts by developing appropriate soil and water conservation measures, scientific monitoring and building local and international capacity in the field of research. Establishment of these small observatories, namely: Dingay Wuha, Bubu, Lower Merfi, Upper Merfi, Denteba, Lower Tikur Wuha, and Upper Tikur Wuha) were supported by the Embassy of the Kingdom of Netherlands in Ethiopia.

However, due to lack of appropriate institutions and lack of organised database system as well as dissemination mechanisms, such massively generated data and knowledge from the long-term monitoring in these observatories were under limited utilization, while deemed necessary under the current Global Change in the Earth’s system.

Accordingly, six of the previous SCRP research observatories were institutionalized with the respective regional Agricultural Research Institutes (Hundelafto within Mechara Agricultural Research Centre/ Oromia, Dizi within Bedele Soil Research Centre / Oromia, Gununo within Areka Agricultural Research Centre /SNNP, and Maybar, Andit Tid, and Anjeni within Amhara Region Agricultural Research Institutes). While the resource centre is in its final stage of negotiation with Eastern African Partnership Program (ESAPP) to rehabilitate and took over the technical management of the three SCRP observatories (Hundelafto, Dizi and Gununo) in collaboration with regional government institutes, for the remaining three observatories (Maybar, Andit Tid, and Anjeni) which have already institutionalized within ARARI, WLRC took the mandate to
rehabilitate the infrastructure, instrumentation and continue the research work in an enhanced way in collaboration with institute. To this effect, the three observatories have been rehabilitated (including instrumentation) that make them fully operational and reactivated data collection/logging.

On the other hand, all the newly established nine observatories (Meso scale near Dembecha, high altitude at Semien Mountain, and small size observatories at Kunzila) are fully managed by the centre. These efforts enabled WLRC to apply simulation modelling, SWC techniques and to extrapolate findings from plot and smaller watershed level to larger areas through specialized studies. Building on these experiences, it is intended to ultimately expand the activities of the resource centre to serve as a regional knowledge hub facilitating national and transboundary decision support for sustainable, equitable, and rational use of water and land resources in the country and Eastern African sub-region.

**SWC structures and sustainability: emphasis on Anjani**

Various soil and water conservation measures were predominantly used across observatories often in combination. These measures have included physical (also termed mechanical or technical); biological (also termed vegetative) measures; and agronomic measures (sometimes called best management practices). This is increasingly considered as reasonable because merely technical approaches are often not successful, especially without participation of the local farmers, forest managers, etc. It has also been recognized that under modern circumstances traditional measures alone may often be insufficient to conserve the vital soil and water resources and have to be supplemented by modern practices to achieve a sustainable resource management. These measures were further supported by of nursery site establishment, frequent maintain of conservation measures, and silt harvesting for degraded lands.

Accordingly, carefully designed terrace structures such as soil bunds, stone bunds, graded Fanya Juu (throwing the soil uphill so that the basin is below the embankment), water ways, diversion ditches, check dams in combination with biological measures such as grass strips, tree planting on steep slopes, grass on the bunds were used to conserve the agricultural land and reclaim gullies. The conservation approach involves negotiating with the communities as well as providing social infrastructure for soil conservation approach by which the local communities agreed to exercise conservation practices on their land in exchange of social infrastructure (such as clinic) as an incentive. In doing so, open grazing system was abandoned by the local communities in the watershed with some reforestation and area closure practices, and the conservation measures have been very successful to date.
2.2.4 Land use and land cover

The centre regularly collects data related to land use/land management changes both in the observatory catchments and learning/model watersheds. The aim of monitoring changes on land use/land management practices is to document and quantify the extent and distribution of NRM interventions and their respective impact on ecosystem services such as reduction of soil loss, sediment trapping, enhancing soil fertility etc. Field observation, ground survey, remote sensing imageries and interviews are important tools to monitor land use and land management changes. Appropriate indicators such as extent and coverages of SWC, as well as indices like NDVI, EVI, LAI, etc. are measures used to assess land use/land cover changes and their impacts.

Since the inception of the SLM interventions on the learning watersheds, the land use systems study and geo-informatics division of the centre has been doing land use change monitoring. All types of interventions are geotagged and mapped so that any change could be monitored. Accordingly, all information required to monitor land use changes are documented in every watershed. Figure 2.8 presents an exemplary physical SWC mapping and change monitoring made in one of the learning watersheds i.e. Aba Gerima).

Figure 2.8. Comparison of vegetation cover change due to gully management, closure and fodder plantation on bunds before (left) and after (right) watershed interventions
In the reporting period, the centre conducted a specialized scientific assessment on one of the learning watersheds, using multi-year collected data for monitoring of land use changes, as developed by Gumma et al. (2021). The research was carried out in one of the learning watersheds of the Centre, Aba Gerima watershed considering the pre- and post-intervention years (2002, 2013, and 2019). The findings of the study revealed that, the implemented interventions have brought substantial LULC changes and in turn resulted in improved on-site soil and vegetation systems.

Figure 2.9. Vegetation cover and percentage change in vegetation cover from the start of the interventions in 2013
Figure 2.10. Sediment retention in soil conservation bunds (left) and changes in LULC (right) attributed to sediment storage.
Such specialized studies are critical as they are sources of transformative knowledge. Knowing the importance of such specific researches, the centre is continually monitoring land use changes and their impacts on all observatories and learning watersheds. Besides monitoring changes within the model/learning watersheds, to generate more transformative knowledge, the Centre is also applying such specific researches including non-intervened watershed. By doing so, differences in terms of conserving and not conserving a landscape will be more easily understandable. The results of the research will present in the next annual report.

**2.2.5 Socio-economic governance**

The current natural resource situations such as land degradation, resource conservation and utilization of the country, in the main, are results of the cumulative and dynamic changes of the socio economic situations as well as the dynamic situation of various policies and institutions of the country, in which by themselves are the result of the interplay of multitude of natural, ideological and global drivers and factors. Hence, long-term monitoring of selected socio-economic factors is important in order to understand the deriving factors and the magnitude of their influence.

Monitoring the dynamic changes in socio-economics (e.g., demography, wealth, social and physical infrastructure, etc.) and governance systems (the legal frameworks and their enforcement; planning and decision making) of natural resource management is the integral part of the Centre’s development oriented research. Some of the major activities in this line include:

- Repeating socio-economic surveys at different time interval on the same watersheds to detect and reconstruct changes on the situations before and after watershed interventions;
- Conducting retrospective cross sectional socioeconomic surveys to reconstruct the before and after situation;
- Monitoring specific selected indicators of socio economic situations such changes in the income of households, feeding changes, assets formation, and the like in the six learning watersheds and now is started in the newly started at Kunizila ILM and WASH project;
- Monitoring the crop yield on each crop season on the fixed and randomly selected plots in Anjeni, Maybar and Andit Tid hydro sedimentology observatories since their establishment in early 1980s;
- Midterm evaluations of socio-economic responses of integrated watershed management.

The synthesis of the outcome of lessons drawn from the above methods in the period 2011 to 2019 was under way during the reporting period and results will be presented in the 2020/2021 annual report.
2.3 National level synthesis

2.3.1 Climate monitoring at national scale

National scale climate monitoring is very essential to understand the climate dynamics of the country thereby plan economic development in one hand and address climate risks on the other hand. In this regard, the National Meteorological Agency has established and operating more than 1200 surface stations, two upper air stations, and one satellite receiving station across all the country (fig 2.11a). The data collected from these stations should be processed and analysed for different application areas including land and water management which is the main thematic areas of WLRC-AAU. WLRC works towards strengthening the national climate monitoring activity through processing of up to dated climate data and generate evidences to inform policy makers. The centre collected, cleaned and organized daily climate data form 107 stations found in A wash basin, Abbay Basin and Central Rift valley basin. Currently, the data collected from these stations being processed and analysed to understand the spatio-temporal climate dynamics of the basins and its impact on water and food securities.

Apart from stations data, the centre organizes and process freely available gridded global data sets like CHIRPS v2, CRU and ERA Interim for different climate analysis and modelling works. Such kind of datasets is very easily used for quick climate analysis and understanding recent development in the climate condition of the country (fig 2.11b).

![Climate station distributions over Ethiopia (a), CHIRPS gridded decadal rainfall amounts for 2021 Belg and Kirmet seasons over Ethiopia (b)](image)

2.3.2 Hydro-sediment monitoring at National scale

Like the climate monitoring, hydro-sediment data is monitored at national scale at 409 river gauging stations spread over the 13 major river basins of the country. The Ethiopian Ministry of Water, Irrigation, and Energy (MoWIE) is the main responsible body for operating these river gauging stations (fig 2.12).
Out of the 409 river gauging stations, only very few have relatively well-recorded data on sediment concentration and runoff discharge. Collecting, organizing and synthesising of these data quite important for water related development planning and ecosystem based interventions. In this regard, WLRC tries to contribute through processing of hydro-sediment data collected over different basins in the country for informed decision. Currently, the centre collect, organize and synthesising over 104 runoff discharge data from Abbay Basin, Awash Basin and Central Rift Valley Basin with the intention to contribute on characterizing hydrologic characteristic of the basins for water security issues. The centre is also downloading, organizing and make available globally available dataset related to hydro-sediment to use for different applications including for modelling and risk analysis.

2.3.3. National level LULC monitoring

Land Use and Land Cover (LULC) information is vital for sustainable natural resources management. However, this vital information is critically missing at a required scale and extent in Ethiopia. Often, LULC maps were produced to fulfil specific project objectives because they are produced by short-lived projects with limited budget and under a fragile institutional setting. Most importantly, national scale LULC map production has never been a research agenda; the available national LULC datasets, if any, have never been well documented, produced using different imageries with different classification techniques, and thus, it was difficult to take the lesson on their failure and success for any subsequent mapping attempts.

The Centre has been striving to produce multi-year national level LULC maps with 5 years’ interval since 2015. So far, the Centre has successfully completed national level LULC maps for the years; 1985, 2000, 2010, and 2015. In the planning year (2019), the Centre had started the production of 2020 LULC map of Ethiopia using Sentinel 2A satellite imageries. The produced LULC maps (see Figure 2.13 a, b, c) play a great role in addressing the quest for natural resource potential assessment as well as land degradation assessments (soil erosion, deforestation) and further proposing appropriate land use/land management interventions.
Figure 2.13. (a) Second level LULC map of Ethiopia for the year 2015

Figure 2.13. (b) Monitoring cultivated landscapes of Ethiopia. A subset of land use/land cover change assessment result made between 1985 and 2015
2.4 Monitoring invasive species and their impacts

2.4.1 Prosopis

Monitoring invasive species is one of the areas WLRC is engaged in. Study is being conducted in Afar areas of Ethiopia intending to help the mitigation of the effects of woody invasive species on biodiversity. A research project is designed on, “Woody IAS in East Africa: assessing and mitigating their negative impacts on ecosystem services and rural livelihoods”. The overarching goal of this project was to help mitigate the effects of woody IAS on biodiversity, ecosystem service and human well-being in East Africa. This project was designed and implemented in three Eastern Africa countries (Ethiopia, Kenya and Tanzania) from 2015-2021. The project had two phases: generate and share knowledge on invasion processes and on context-dependent effects of woody IAS (2015-2018) and implementation phase (2018-2021), which was to test sustainable control measures and develop and document Sustainable Land Management (SLM) strategies that mitigate the negative impacts of woody IAS. The coverage and genetic make ups of the Prosopis and Lantana in Ethiopia were compared to origin species from Latin America and their local socio-economic and livelihood impacts, environmental and water use impacts were studied. Furthermore, different technologies...
were tested in collaboration with CABI-International, Water and Land Resource Centre of Addis Ababa University, Haramaya University and Werer Agricultural Research Centre. So far, more than 12 scientific papers were published on internationally reputable journals from the information generated. The knowledge generation phases were very successful and presented holistic studies from genetic makeups to environmental impacts. One of the studies also examined some important demonstration of IAS management. Some of the results from the study summarized as the rate of Prosopis invasion was estimated at 31,127 ha per year (Fig 2.14). Negative net changes were found for grassland, bareland, bush-shrub-woodland, and natural forests. According to the local community representatives, the four most important drivers of LULC dynamics were climate change, frequent droughts, invasive species and weak traditional law. Based on two different ESVs estimations, the ecosystem changes caused by LULC changes resulted in an average loss of ESVs in the study area of about US$ 602 million (range US$ 112 to 1091 million) in the last 31 years. With an increase in area by 965,000 ha, Prosopis-invaded land was the highest net change during the study period, followed by grassland (599,000 ha), bareland (329,000 ha) and bush-shrub-woodland (327,000 ha). The study provides evidence that LULC changes in the Afar Region have led to a significant loss in ESVs, with serious consequences for the livelihoods of the rural people.

Figure 2.14. Land use land cover maps in 1986, 2000 and 2017
Further current fractional cover gradient of invasive trees of the genus Prosopis in the Afar Region, Ethiopia, was estimated to identify drivers of its invasion. Accordingly, it is found that within 35 years after its introduction, Prosopis has invaded approximately 1.17 million ha at different cover levels in the Afar Region (12.3% of the surface) (Fig 2.16). Normalized difference vegetation index (NDVI) and elevation showed the highest explanatory power among the 17 variables, in terms of both the invader’s overall distribution as well as areas with high cover. Villages and linear landscape structures (rivers and roads) were found to be more important drivers of future Prosopis invasion than environmental variables, such as climate and topography. In the case of the study area Prosopis is likely to continue spreading and increasing in abundance if it is left uncontrolled. It discussed that how information on the fractional cover and the drivers of invasion can help in developing spatially-explicit management recommendations against a target invasive plant species.
2.4.2 Water Hyacinthine

Figure 2.16. Fractional cover of Prosopis juliflora in Afar region
The largest lake in Ethiopia, Lake Tana, is severely threatened by an invasive South American weed, the water hyacinth. Since 2011, the weed is posing a grave threat to the Lake. Several efforts have been exerted and various techniques tested to control its expansion and then remove the weed from the lake. But the weed is still posing its adverse effect on the lake and its environs. WLRC believes that scientific knowledge about its manifestation and expansion are critical in responding to the quest for controlling the weed. In fact, before water hyacinth became a national agenda, WLRC was pioneer in producing the first spatial evidences on water hyacinth manifestation on Lake Tana. This happened in 2012 when experts from WLRC have been conducting extensive ground survey around Lake Tana.

In 2019, WLRC again made multi-temporal satellite-imageries-based comparison of water hyacinth manifestation over the years 2016 and 2019. The Sentinel-imageries-based assessment results revealed that, the spatial and temporal occurrences of the weed are extremely unpredictable, especially its manifestation on the water body. At one time, the weed largely expands on the water body; at another time, it extensively manifests on other terrestrial landscapes, such as the wetlands, grasslands and sometimes croplands.

According to the spatio-temporal dynamics assessment findings made over six years (2015-2020), fascinatingly, the extent of manifestation on the lake area has been considerably reduced, even sometimes disappears during the dry seasons. In fact, this could be attributed to the efforts exerted to remove the weed. Amazingly, however, the weed reappears on the water body upon the onset of the rainy season and gradually expands during the spring season. The lesson learned from this pilot assessment is that, if someone takes the dry season images (between January and June) and makes assessments accordingly, one can simply conclude that there is no water hyacinth manifestation on the Lake. But, the manifestation of the weed gets worse year-after-year, which disproves the claim that the efforts exerted to remove the weed played great role in clearing the weed at least during the spring periods. Figure 2.17 show the inter and intra annual dynamics of water hyacinth manifestation.

However, given that various factors are linked with the dynamics of the weed itself, the Centre has found it very difficult whether to associate the dynamics to the efforts exerted to remove the weed. Justifying this, the issue requires further comprehensive investigations.
WLRC appreciates the efforts so far exerted by various stakeholders to control the weed; it also believes that the manifestation of the weed on the water body has become more prominent in the years after the commencement of weed removal. Recognizing the importance of scientific knowledge and information about the spatio-temporal variability of the weed, in the reporting period 2019/20, the Centre framed a pragmatic platform that could allow monitoring the weed. The platform uses Sentinel imageries and screen the manifestation, expansion or reduction of the weed every 5 days. This monitoring system is a breakthrough that all responsible stakeholders need to support and use it for successful control of the weed.

Figure 2.17. Inter and intra annual dynamics of water hyacinth manifestation in Lake Tana
CHAPTER 3
WATER RESOURCES MANAGEMENT FOR SUSTAINABLE DEVELOPMENT

3.1 General introduction

Ethiopia may be endowed with a substantial volume of water resources, but water security status in space and time is highly variable. Seasonal, inter-annual and spatial rainfall variability is substantial. Around 70 – 80 percent of the rainfall is concentrated in three to four months in a year. East flowing rivers in particular have high inter-annual rainfall variability (CV reaching as high as 30 percent). Only three of the west-flowing basins (Abbay, Baro-Akobo, Omo-Gibe basins) covering around 30 percent of the landmass contribute over 77 percent of the total 122 BCM surface water potential in the country. This spatial and temporal variability is compounded with climate change and still limited infrastructure development to tame hydrological variability.

Water available in rivers and groundwater cannot be considered as available unless it is harnessed though hydro-infrastructure – dams, diversion, or boreholes development. The total amount of water stored in rivers is only about 33 BCM; groundwater development is still rudimentary. The flood and drought related problems have become more frequent and pollution due to untreated industrial and municipal wastewater is a growing water resource management challenge.

Recently, growing commitment towards water resources development is evident from national flagship projects such as GERD and smaller dams. To effectively utilize such water resources, reliable empirical evidence will remain vital. WLRC has a number of research undertakings targeted towards efficient and effective management of the country’s water resources. The following section provides a brief highlights these water resource management research undertakings.
3.2 Water security

3.2.1. REACH – Improving Water Security for the Poor

The program is funded by the UK Department for International Development (DFID) and led by Oxford University, UK. The programme is operationalised into projects being implemented in Ethiopia on three water security observatories, namely, Sustainable Development in Awash River Basin, Managing Fragile Environments in the Blue Nile Basin, and Sustainable Human Development in Small Towns in Northern Ethiopia, as well as in Kenya and Bangladesh. By the end of the year 2019, the programme components were re-coined in alignment with the New Global Research Impact Strategies of DFID: water quality, climate resilience, inequalities and governance.

The project targets the poor not only to improve the livelihood status of the poor but also to reduce risks attached to water management. It aims to improve water security for 5 million poor people in the participating countries by integrating science and practitioners in the frame of the project.

REACH has aims to create a more comprehensive understanding of water insecurity elements (climate, water pollution, groundwater-surface water interaction) and equitable institutional and governance development. It is working in close collaboration with stakeholders, mainly with the Ministry of Water, Irrigation and Electricity (MoWIE); Awash Basin Authority (AWBA); and UNICEF-Ethiopia aiming to excel governance of water security by identifying key development and natural problems that affect water security for the poor. During the reporting period, the research project had progresses in all the components of the project.

a. Sustainable development in Awash River Basin: Water security has been a challenge in Awash Basin in different forms. REACH project was engaged in different activities to address these challenges. Activities accomplished in the report period are outlined in Table 3.1.

Figure 3.1. Awash Basin Map showing the REACH research areas including urban and rural areas
**Water Quality modelling using INCA:** Using the Integrated Catchments Model (INCA), a water quality modelling software has been testing for its application in Awash Basin. Results of the test will be in process and will be notified in future reports. For the modelling work, data were taken from urban and industrial pollution sources as indicated in Figure 3.1.

**Knowledge sharing with Awash Basin Authority:** REACH project availed training and capacity building opportunities to experts working in Awash Basin Authority. A PhD student from the Basin authority is recruited to be supported by the project. In addition, a training on application of INCA model was organized and facilitated specifically to AWBA and other respective experts in February 2020 (Figure 3.2).

![Figure 3.2. INCA modelling trainees feature with the training facilitators and organisers, Feb. 2020](image)
Climate and surface-groundwater interaction and allocation: Surface-groundwater interaction is basic in understanding to manage and plan the sustainable utilization of water in the Basin. Researchers successfully improved the usability of Water Evaluation and Planning (WEAP) model for water allocation. Research on WEAP modelling have been ongoing; however intermediate results are showing groundwater potential is one of the untapped sources of water in the Basin (Fig 3.3). Training was facilitated on the improved version of the model to be delivered to stakeholder experts and collaborators.

b. Fragile environments in the Abbay (Blue Nile) Basin: Most of REACH’s activities in Abbay Basin were concluded during this reporting period. Researchers and PhD students worked on impacts of Sustainable Land Management (SLM) on hydrological processes in the Abbay Basin. Sustainable Land Management (SLM) and the Productive Safety Net Programme (PSNP) are interventions in enhancing water security and aiding pathways out of poverty. Those interventions found to increase the recharge and water retention capacity of the soil, which renders to help the water security problems of the area. Working papers and research articles were published and some being in process for publication (see Table 3.1).

c. Small towns development pathways: Water supplies in small towns lack capabilities to mitigate impacts of climate change, and then liable to operational and water security problems at local level. Wukro, a small town in North Ethiopia, has been the focal research area of this theme. The following major activities were accomplished during the reporting year.

- **Analysis of climate change impacts on water utilities:** Trend of water availability for water supply was analysed. The analysis showed that water availability would decline in the coming years.

- In collaboration with Mekelle University, we facilitated capacity building training to local experts on water safety plan.

- Policy briefs on water utility with safety planning, improving water supply, including tariffing and addressing impacts of small businesses were published. A paper on climate resilience in urban water security was published.
### Table 3.1. Summary of REACH activities undertaken in 2012 E.C. (June 2019 – July 2020)

<table>
<thead>
<tr>
<th>Project components</th>
<th>Activities</th>
<th>Outputs/results</th>
<th>Participating divisions/personnel</th>
<th>Resource allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Component 1:</strong> REACH-WLRC Official activities</td>
<td>LOG-Frame Reports (3)</td>
<td>3 LOG-Frame Reports sent to OU/UK</td>
<td>REACH-WLRC</td>
<td>OU/UK, WLRC</td>
</tr>
<tr>
<td></td>
<td>Preparing detail 2020-2024 work plan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Arranging Steering Committee meeting</td>
<td>Steering Committee meeting held</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Arranging REACH-Ethiopia follow-up virtual meeting</td>
<td>A virtual meeting held to follow up progress of REACH-Ethiopia</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Contribution to the general REACH report</td>
<td>A summary of REACH-Ethiopia report sent</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Component 2:</strong> Sustaining Growth in Awash Basin</td>
<td>Co-authoring (WLRC) Awash Synthesis Report</td>
<td>Draft completed</td>
<td>OU/UK, Tena</td>
<td>OU/UK</td>
</tr>
<tr>
<td></td>
<td>Water quality sampling</td>
<td>Samples collected and analysed at OU/UK</td>
<td>Paul (OU/UK), Endaweke, Yosef (AWBA)</td>
<td>OU/UK, WLRC</td>
</tr>
<tr>
<td></td>
<td>Published papers</td>
<td>On use of 222Rn and δ18O-δ2H isotopes in detecting origin of water</td>
<td>Kebede, S. et al.</td>
<td>OU/UK, WLRC</td>
</tr>
<tr>
<td></td>
<td>Finalized papers</td>
<td>On natural and anthropogenic stresses on surface water</td>
<td>Behailu et al.,</td>
<td>OU/UK, WLRC</td>
</tr>
<tr>
<td></td>
<td>Validation workshop on Awash Basin</td>
<td>On Groundwater modelling in Middle Awash</td>
<td>WLRC, OU/UK, AWBA, MoWIE</td>
<td>OU/UK, WLRC</td>
</tr>
<tr>
<td></td>
<td>Water quality modelling training</td>
<td>Workshop held</td>
<td>Paul (OU/UK) at WLRC</td>
<td>OU/UK, WLRC</td>
</tr>
<tr>
<td></td>
<td>Prepare metadata on climate and water security Awash Basin</td>
<td>Database now at WLRC being arranged to pass to AWBA</td>
<td>OU/UK, Tena, Solomon</td>
<td>OU/UK, WLRC</td>
</tr>
<tr>
<td><strong>Component 3:</strong> Managing fragile environment in the Abay (Blue Nile) Basin</td>
<td>Publish papers</td>
<td>On Evaluating CMIP5 ensemble in Ethiopia</td>
<td>Ellen et al. (2019)</td>
<td>OU/UK</td>
</tr>
<tr>
<td></td>
<td></td>
<td>One Streamflow response to climate change in fragile environments</td>
<td>Hirpa et al. (2019)</td>
<td>OU/UK, WLRC</td>
</tr>
<tr>
<td></td>
<td>Finalize papers</td>
<td>On SLM impacts on hydrological processes</td>
<td>Berihun et al.</td>
<td>WLRC</td>
</tr>
<tr>
<td><strong>Component 4:</strong> Sustainable human development on small towns</td>
<td>Publish papers</td>
<td>On climate resilience on water security: Urban poor</td>
<td>Gransham et al.</td>
<td>OU/UK</td>
</tr>
<tr>
<td></td>
<td>Working paper</td>
<td>On SLM and its effect on water security and poverty</td>
<td>OU/UK, IFPRI</td>
<td>OU/UK</td>
</tr>
</tbody>
</table>
d. Challenges and situation response: REACH project passed through a couple of challenges. For about five months after the abrupt evacuation of the previous coordinator, the research project ran without a staff heading the programme at the Centre. Some of the project activities, specifically office routine tasks were pended to November 2019. The other challenge was the inconveniences posed by the Covid-19 global pandemic. As REACH is an action-based interdisciplinary research project, its field and collaborative activities were stranded by the global pandemic COVID-19. However, the project strived to deliver outputs and handled stakeholder meetings. In the reporting period, more than 1 million people were benefited with improved water security.

3.2.2. Water Security and Sustainable Development HUB (UKRI-GCRF GCRF – Funded)

Water Security and Sustainable Development HUB project is funded by the UK Research and Innovation of Global Challenges Research Fund (UKRI-GCRF) and implemented in Colombia, Ethiopia (WLRC and IWMI), India and Malaysia in collaboration with UK institutes (University of Leeds, Oxford University) head quartered at University of Newcastle, UK. Water and Land Resource Centre is responsible to lead and coordinate the Ethiopian Collaborator
segment of the project, which is implemented with International Water and Management Institute (IWMI). The GCRF project in Ethiopia is framed to generate innovative knowledge and improve governance system for sustainable water security in Ethiopia. The project is implemented in collaboration with International Water Management Institute (IWMI) where the research focuses in three basins namely called Abbay, Awash Rivers and the Central Rift Valley (CRV) basins of Ethiopia (Figure 3.4). The project is implemented by the leading role from the WLRC in collaboration with different stakeholders in water and related sectors such as the Federal MoA, MoWIE, EFCCC, EIWR, ACEWM, ARI’s, AAWSSA, Regional Bureaus, Basin authorities (Abbay, Awash and CRV) and Universities in the basins.

**Project Objectives**

The overall objective of this project in Ethiopia is to generate innovative knowledge and improve governance system for sustainable water security in Ethiopia, focusing on the Abbay and Awash River basins and the Central Rift Valley (CRV) basins of Ethiopia. The specific objectives at river basin level are to:

- Assess water quality status, considering point and non-point source pollutants, their impacts, and risks in the downstream ecosystems at upper Awash River basin.
- Improve water governance in the CRV basin, and thereby contribute to improving water governance at national level as well as advancing knowledge in water use and management, which involve water risk management and water values mapping.
- Unleash the potential of rain-fed agriculture in unimodal rainfall areas through improved green water management to ultimately bring sustainable development in the Abbay River Basin.

**Basin’s description related to water scarcity issue**

**i. Awash Basin (Upper Awash):** Water security issues related to water quality mainly water pollution linked to urbanization and industry. Most people living in the rural parts of Ethiopia rely on water from unprotected sources such as rivers, including Awash River, streams and wells that are not safe to drink and domestic use. Although water quality problem is apparent to most Ethiopian rivers, Awash leads in the extent of impairment due to its service as a sink for the basin-wide urban, industrial and rural wastes. Awash River is exposed to almost all types of pollution from the headwaters. The water of Awash Basin is used for various purposes that include domestic and ecological uses, irrigation, recreational and industrial uses. These uses are, however, under threat due to pollution of surface and ground waters of the basin from point and nonpoint sources. The major pollutants are sediments, nutrients, biodegradable organic wastes, salinity, heavy metals, and pathogens. The major sources of pollution include runoff from agricultural and urban areas, and discharge of untreated domestic and industrial effluents. Although there are policy and legal tools relevant to water pollution control, their enforcement was weak.

**ii. Abbay Basin (Blue Nile Basin):** Water security issue links to seasonality of rainfall, which causes high runoff – erosion/ degradation and moisture shortage due to long dry season (up to 8 months).
iii. Central Rift Valley Lakes Basin: Water Security risk issues linked to unregulated abstraction and water pollution, mainly due to industry and horticulture production. Setting up an appropriate water allocation system for an equitable, efficient, and sustainable water use benefits has been considered as a fundamental precondition for tackling the critical issues of water security in the CRV basin. During the reporting year, desk-based comprehensive Water Systems Analysis was undertaken for the basin; historical trends of legal frameworks were assessed; gaps were identified; and improved framework was recommended. Accordingly, two review documents are prepared for publication.

Research Components

This project operates by categorizing different research themes in different work streams namely WS3 (Risk), W4 (Value) and WS5 (Governance). Research activities in all the Abbay, Awash and CRV basins are concentrated under the risk work stream (WS3). Work Stream (WS5) focuses on governance and main research activity has started to be undertaken at CRV, which will be translated to the other basins and even at the national level. Values (WS4) mainly handled by the IWMI team with some contribution from the WLRC-CRV research team leader.

Basins Research Objectives

Abbay Basin Research

The researches in the Abbay Basin aim to:

- review climate induced water security risks on agriculture and green water management practices in Abbay River basin (WS3);
- characterize the spatio-temporal hydro-climatic variability, climate change, and hydrologic regimes of Abbay River basin (WS3);
- evaluate the impact of climate induced water security risks and green water management practices on hydrology and crop production using modelling approach and scenario analysis (WS3);
- identify interventions that enhance water use efficiency/ agricultural water productivity in the basin (WS3); and
- review gaps in policy and strategies in relation to agricultural water management and recommending improved framework (WS5).

Awash Basin Research

The general aim of researches in this specific basin is to bring a comprehensive understanding of the State of Upper Awash River Basin in terms of water quality and contribute to the knowledge base on the state, source and dynamics of pollution and its impact on water security. They assess the water quality status focusing on point and none point source pollutants, their impacts, and risks in the downstream ecosystems. The specific objectives of the researches in the Awash Basin are to:

- document comprehensive review and database on water quality on works undertaken and gaps identified;
- characterise and evaluate the state of water pollution from industrial sources at the two Akaki rivers along the river courses;
• characterise the spatio-temporal variability of toxic elements, physio-chemical parameters and nutrients of wastewater disposal form selected industries in Addis Ababa;

• document and evaluate the impact of Awash River systems water pollution on health and ecosystem; and

• assess the existing water quality monitoring protocols, strategies and gaps, and develop manuals and guidelines.

CRV Basin Research

The objectives of the Water Security Hub research undertakings in the CRV Basin are to:

• conduct comprehensive water systems analysis in the Central Rift Valley Basin (CRV) of Ethiopia. Specifically, it aims to:
  o analyse and characterise issues and problems of water resource management in the CRV;
  o conduct integrated water supply and demand assessment using WEAP; and
  o analyse the surface and ground water interaction in the area.

• make comprehensive water-governance-related socio-cultural assessments and stakeholder analyses across scales (identification, analysis of interest, roles and influence, and collaboration trend);

• evaluate the impacts of future scenario options on water availability and demand based on policy actions, stakeholders’ perspectives, and environmental flows assessment;

• conduct trend analysis of legal frameworks and identify gaps; and

• facilitate the formulation of improved legal framework that enhances sectoral and institutional collaborations and linkages both vertically and horizontally.

Accomplishments in 2019/2020

Stakeholders Consultative Workshop: One of the major activities carried out under the project in the reporting year (2019/2020) was conducting stakeholders’ consultative workshop aimed at helping to identify and prioritize major problems affecting water security in the three river basins and to notify stakeholders about the overall objective of the GCRF project in Ethiopia. The workshop was conducted on 18 November 2019 (9:00 a.m. – 2:00p.m.) at Beshale Hotel, Addis Ababa, Ethiopia. The workshop brought together 48 participants from 31 Federal and Regional institutions and international NGOs.
Internal and external meetings: The nature of the project demands the project team members to gather for weekly and monthly multi-level meetings. Hence, during the reporting year, several activities were conducted to develop documents such as: Theory of Change (ToC), Collaboratory Outcomes Table and Log frame.
Annual HUB Assemblies

a) The 1st annual hub assembly was successfully held in Malaysia (23 – 26 September 2019 at Hotel Jen Puteri Harbour, Johor Bahru, Malaysia). A total of 76 participants have attended the 1st Water security and sustainable development Hub Annual Assembly in Malaysia from across the hub (UK, Colombia, Ethiopia, India and Malaysia). That Assembly was attended by 15 participants from two institutions (11 and 4 team members from WLRC and IWMI, respectively) of the Ethiopian Collaborator. The purpose was to gain understanding of the specific water security context in Malaysia and how the GCRF Water Security and Sustainable Development Hub (the Hub) can work together to address these issues, refresh and re-energise partnerships across the Hub, facilitate the formation of new connections and partnerships across the Hub among Early Career Researchers (ECRs) and other stakeholders, and finalise the Work Stream plans for the upcoming 12 months, with outline plans to the mid-term of the programme and outline plans for impact around Work Stream activities.

Figure 3.7. Photo of the 1st annual hub assembly meeting participants, Johor, Malaysia

b) The 2nd annual hub assembly was successfully held in Ethiopia (24 – 28 February 2020) at Hilton Hotel, Addis Ababa. The assembly aimed to guide and refine the global level project activities and evaluate the performance at hub level. Research discussions were held on the topics: Systems approach to water security; Development, and supporting application of data and scenarios of change (climate, socio-economic); IIT Delhi Campus Serious Game potential drone mapping; Johor River Basin Game potential drone mapping; Review of data collection exercise; Costing of data gathering strategies; Use of global datasets to complement existing and planned observation networks; Citizen science to complement observations and surveys; Water quality observation networks and modelling, WASH Questionnaire and survey design, Multi-spectral health indicators - use as advocacy tools for changing sanitation and water use practices; Education programmes; Values: Literature Review Discussion; WS4 – next steps; Institutional mapping and analysis review; WS5 (Governance) – next steps; Qualitative and participatory methodologies; and Water-centric planning and Resource recovery.
**Basin level research - accomplishment**

Below listed are the preliminary research planning activities accomplished during the reporting year. The COVID 19 global pandemic was one of the big challenges that affected the pace of the project, esp. its field works (Table 3.2).

i. **Abbey Basin activities**

   a) Preparation and development of action plan and proposal on climate and hydrology of the Abbay Basin were completed during the reporting period.

   b) Two reviews of scientific documents were prepared. One of the reviews recapitulated works that assessed climate-related water security risks in the basin, and the second reviewed works about the extent of green water management in response to water security problems in the basin. The reviews were shared to experts of the projects for comments and inputs. The enriched documents are submitted to the WLRC publication unit to be published as working papers.

   c) Input data collection was started. Different climate data on the river basin were collected and organized for future use in climate characterization, in preparing homogeneous unit, and as input for modelling work. The planned assignment to undertake reconnaissance survey that helps to assess water security issue in the basin was not undertaken in 2022 E.C due to the inconveniences imposed by the State of Emergency that was meant to contain spread of the COVID-19 pandemic.

ii. **Awash Basin activities**

   a) Preparation and development of action plan and proposals. Two proposals were developed for the Akaki catchment, which goes down to Aba-Samuel Lake and for the non-point sources of pollutant assessment at Melka-Kunture catchments, which is western part of the Upper Awash River basin.

   b) The main water security dimension in the Awash River basin is water pollution. To this end, data were collected and prepared for water quality monitoring in Addis
Ababa and downstream up to Koka dam is completed.
c) Review papers were prepared on the following topics. Two review documents were prepared on evaluation of models, which can be used for water quality modelling and comprehensive review on the extent and magnitude of pollution and water quality in the Awash River basin.
d) Input data collection was started. In this regard, non-point source water and sediment samples were taken with the intent to analyse and simulate water quality of the Basin.

iii. CRV Basin activities

a) Action plan and proposals were prepared and developed. Detailed action plan was prepared based on the project’s scope, core principles, values and time frame. Accordingly, four research proposals were prepared on: Optimal water allocation planning for sustainable use and management of water resources in the Central Rift Valley basin of Ethiopia; Characterization of wetland and structural-controlled water bodies in Ketar catchment; Characterization of wetland and structural-controlled water bodies in Meki catchment; and Assessment of ground water in CRV.

b) Review papers were prepared on the following topics:

- Processes, methods and tools for water allocation decision making and management to minimize water security risks
- Water resources management and use in the Central Rift Valley, Ethiopia
- One review paper on water governance in Ethiopia entitled ‘The geography of governance and the governance of geography: Water security and management in contemporary Ethiopia (WLRC in

Collaboration with IWMI)’ was prepared and ready to be published as a working paper
- Water Governance and Management in the CRV Basin, Ethiopia: An Overview -Assessing the existing system of policy, legal frameworks and institutional arrangements, identifying major water governance gaps, challenges and problems, research need assessment.

c) Input data collection has been started on:
- **Spatial**: geological and hydrogeological maps of CRV were updated; data for terrain processing was collected; basemaps preparations and the data frame structure were established.
- **Land use and soil parameters**: The required variables were determined considering the available good quality data from WLRC, and the required data format was prepared according to the agreed upon spatial classification of the CRV.
- **Meteorological**: Data were recorded from stations and preliminary analysis of some of the already obtained data revealed inconsistencies. But, the result would have to be verified on the bases of more data from more number of stations.
- **Population**: Preparation of spatial-based population data was completed.
- **Borehole, dug-well, and spring inventory**: Inventories were taken from case study catchments within CRV. Also, water quality was checked, and the data were integrated.
- **Water quality**: water quality data were collected and data integration and basemap preparation are underway.
- Baseline data collected and map prepared for the planned basin-wide survey.
<table>
<thead>
<tr>
<th>Basins</th>
<th>Activities</th>
<th>Expected outputs/results</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abbay</td>
<td>Finalise reviewing research and project works on hydro-climatology and its impacts on agriculture, focusing on major crops in the unimodal high rainfall areas of the Abbay Basin</td>
<td>Gaps in water security identified for future research</td>
<td>Status: Most of these activities are ongoing and will be completed in the coming years.</td>
</tr>
<tr>
<td></td>
<td>Finalise systematic review and meta-analysis on unimodal high rainfall induced land degradation, runoff, and dryness. This task includes reviewing journal articles; reports from relevant government and non-government entities</td>
<td>Systematic review and meta-analysis on unimodal high rainfall induced land degradation, runoff, and dryness finalised and review documents prepared</td>
<td>Challenges: The challenge encountered during the reporting period was the COVID 19 pandemic prevention lockdown that forced the researchers to work from home and hugely affect field works.</td>
</tr>
<tr>
<td></td>
<td>Finalise generating reliable and high-resolution historical climate data and spatially explicit high resolution inter-seasonal hydro climate characterization of the Abbay Basin</td>
<td>High resolution projected climate dataset prepared for national use and characterisation of the spatial-temporal dynamics of hydro-climate variables and spatially explicit homogenous rainfall and hydrology units</td>
<td></td>
</tr>
<tr>
<td>CRV</td>
<td>Finalize desk review of works on Water resources management problems and issues, review of key documents (policy, institutional and legal arrangements) as well as stakeholders’ analysis</td>
<td>Desk based comprehensive CRV Water Systems Analysis conducted</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Finalize the literature review on historical trends of legal frameworks (documents analysed, grey literature survey conducted)</td>
<td>Historical trends of legal frameworks understood, gaps identified, and improved framework recommended</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Finalise conducting stakeholders’ analysis and mapping of their interest, roles, influences, etc. across scales (including stakeholders who are utilizing, planning, developing, managing, making decision, etc.) on water resources and those stakeholders who are affected by those activities</td>
<td>Stakeholders and institutional analyses finalized, including vertical and horizontal linkages (structure, gaps, linkages and collaboration)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Finalize reviewing on river water quality/water quality issues in Ethiopia</td>
<td>Comprehensive review and database on water quality and on the works undertaken documented and gaps identified.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Finalize compilation of a database and synthesis of existing knowledge on water pollution in and around rivers of Addis Ababa</td>
<td>Database and synthesis knowledge on water pollution in and around Addis Ababa compiled</td>
<td></td>
</tr>
<tr>
<td>Awash</td>
<td>Finalize undertaking reconnaissance survey of the study area to create acquaintance and gather relevant baseline information</td>
<td>Familiarity with the study area created and baseline information obtained</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Finalise evaluation and identification of the state of spatio-temporal variability of Awash River water quality in terms of nitrates, phosphates, and sediments) along the river course</td>
<td>The state of spatio-temporal variability of Awash River water quality evaluated and identified</td>
<td></td>
</tr>
</tbody>
</table>
3.3 Energy-water-food Nexus

3.3.1 The DAFNE approaches to Water-Energy-Food nexus

DAFNE was an ambitious four-year project funded by the European Union under the Horizon 2020 Research and Innovation Action Program implemented with fourteen European and African partners where WLRC-AAU was one among them. The project aimed to investigate how water, energy, food and the environment can be managed in complex and transboundary river basins by developing a novel framework to explore options for present and future sustainable and integrated management of the basins together with basin stakeholders. The DAFNE approach to the nexus highlights the interdependence of water, energy and food security and the natural resources that underpin that security. Based on the interdependence of water, energy and climate policy, this new approach identifies mutually beneficial responses and provides an informed and transparent framework for determining trade-offs and synergies that meet demand for resources without compromising sustainability.

The DAFNE project advocates an integrated and adaptive water resources planning and management approach that explicitly addresses the water-energy-food (WEF) nexus on a novel participatory and multidisciplinary perspective that includes social, economic, and ecologic dimensions (Fig 3.9). In two cross-boundary case studies, the Zambezi River Basin (ZRB) and the Omo-Turkana Basins (OTB), the WEF nexus has been quantified and the trade-offs between conflicting objectives analysed, such as hydropower production versus irrigation or land exploitation versus conservation. The project approach was based on the principles of Participatory and Integrated Planning and Management of Water Resources, which emphasizes the role of stakeholders throughout the process of formulating and selecting the most interesting and sustainable development pathways. In general, DAFNE generates and explores alternative planning and management solutions based on the cooperation of public and private stakeholders, which fosters the profitable but equitable use of resources without transgressing environmental limits or creating societal conflicts.
WLRC has been involved in various DAFNE project activities since the commencement of the project including but not limited to participation in higher level management decisions at the general assembly meetings and in a series of monthly DAFNE PI meetings; basin level scientific studies (such as hydro sedimentology assessment of the Omo basin, monitor the situations of the Delta area in Lake Turkana, the Gibe III dam filling stage, and landscape assessment in the Gojeb catchment among others). Several fieldwork activities were carried out in the Omo-Gibe basin including data collection and sharing to partner researchers; and supporting partners in collecting data related to irrigation schemes for DAFNE pathway analysis. Moreover, WLRC organised various meetings and negotiations such as DAFNE Simulation Negotiation Lab (SNL) meetings; participation in DAFNE Summer School Teaching; responding to routine communications demands about DAFNE; presenting WLRC’s activities in DAFNE General Assembly; and reporting detailed narratives (technical and financial). Furthermore, scientific studies were undertaken by WLRC on ecosystem service efficiency & values of sediment & nutrient retention capacity of Omo Basin; and risk assessment of Omo-Mago-Tama Mega- habitat and biodiversity complex as part of basin wide ecosystem assessment.
CHAPTER 4

RESEARCH FOR TRANSFORMING ENVIRONMENT AND LIVELIHOODS: EXPLORING FRONTIERS OF ILM

4.1 General introduction

The conventional sectorial approaches to food production, conservation and development initiatives as a strategy to address the forefront international agenda and most pressing global challenges of land degradation, food insecurity, poverty alleviation, climate change, and biodiversity loss have remained to be unsuccessful over the last decades. The perusal of sectorial approaches to land management in itself alone is no longer seen as a viable and sustainable strategy to address these often-inter-connected issues. Thus, an alternative strategy that involves an integrated approach and thinking between multi stakeholders to best manage multiple uses of land at a landscape scale, called Integrated Landscape Management (ILM) approach, has been developed in various forms over recent decades.

While ILM balances competing demands on land through the implementation of adaptive and integrated management systems as well as strengthening measures to mitigate and adapt to climate change, it mainly requires integrating policy and practice for multi land uses within a given area, to ensure equitable and sustainable use of land, including the
4.2. Piloting transformation

This section of this Annual Report focuses on WLRC’s accomplishments in transforming the environment, NRM and improved livelihoods using the ILM approaches.

4.2.1. Synthesis of results of the LWs (Status)

Learning Watersheds (LW) initiated by WLRC, AAU aim to support and strengthen technical, institutional, and knowledge management of integrated watershed development efforts. Model LWs are therefore, an entry point used as a live learning platform for implementing integrated watershed management practices and agricultural technologies, and up-scale, extrapolate, and documentation of lessons learnt from the LWs. It involves active participation and collaboration of land users, local community organizations, extension agents, researchers, and policy makers at all stages of watershed

Hence, considering the need for synthesis of the current evidence base on landscape approaches to sustainable natural resources management and a knowledge hub on resource and research in Ethiopia and the eastern Nile sub-region, WLRC included ILM as one of its main approaches for development implementation, scientific monitoring and research interventions across areas where it flags its best practices. ILMWA, FOLU, PES, SUCCESS, and Land scale are few among a range of projects implemented by the centre in coalition with many stakeholders, collaborators and global partners. To this effect, observatories and learning watersheds that had been established in numerous locations, with a wide range of altitude, agroecology, farming systems, geology and catchment size, are providing adequate date for the interventions. While observatories and learning watersheds continued to serve as a platform for scientific monitoring, learning and disseminating knowledge, many stakeholder and partner ILM-focused projects let the centre lead evidence-based development interventions to address most pressing national challenges.
development. It aims to integrate goals for natural resources conservation, agricultural production, and livelihood improvement by demonstrating best practices, approaches and coordinated actions among actors; and monitoring and documenting processes and impacts on environment, livelihoods and sustainability, which since then showed major changes both biophysically, and livelihoods of communities.

Six nuclei watersheds in the country were identified and establishment of model LWs was initiated by the WLRC, AAU since January 2012, which include- Atari Mesk – 210ha / South Wello-Dessie Zuria (Dega / Woina Dega), Aba Gerima – 900ha / West Gojam - Bahir Dar Zuria (Woina Dega), Debre Yakob – 325ha West Gojam-Mecha (Woina Dega), Gosh – 490ha / West Gojam - Denbecha (Woina Dega / Dega), Debre Mewi – 770ha / West Gojam- Yimana Densa and Bahir Dar Zuria (Woina Dega), and Birakat – 5228ha/ West Gojam- Mecha (Woina Dega) (Fig 4.1). In these watersheds, soil conservation practices, homestead management, income generating activities, and technology promotion have been accomplished since 2012.

Figure 4.1. Spatial distribution of the LWs in Amhara region
Key achievements

Physical SWC measures: a total of 3397.9 ha of cultivated land was treated with bunds and 81 ha of land affected by gully was treated with gully reshaping, levelling and check dams. Nearly 262 ha of degraded hillsides were closed and protected from free grazing. For the implementation of physical soil and water conservation measures a sum of 684,233-person days have been invested across all the LWs.

Significant improvement in gully rehabilitation, area closure and farm bunds with vegetative cover/ green biomass have been evident. In Debre Yakob LW alone, change in land use (from degraded, bare and gullies) towards conservation based economically productive land was estimated to be 7%, while improvement in average vegetation cover of degraded lands in across the LWs was in the range of 10.5 of 14% (Fig 4.2). Disaggregated by LW, Atari Mesk revealed the highest improvement in vegetation cover of degraded lands (20.5%), followed by Debre Mewi, and (13.7%) and Gosh (7.5%). Considerable improvements in vegetation composition of shrub and shrub/tree species were observed across the exclosure and adjacent grazing lands of the LWs. Most of these vegetation are economically important woody species for several purposes by the local people such as animal fodder, fuel wood, erosion control, timber, shade, food (fruits), bee forage, fencing, construction etc.)

![Figure 4.2. Vegetation cover change in learning watersheds](image)

Soil fertility has also considerably improved in the LW. For instance, in Aba Gerima watershed, higher organic matter, nitrogen and phosphorus content, has observed in the enclosure than the adjacent grazing land in various soil depth, and the grazing land displayed significantly higher soil pH than the enclosure.

Biological SWC measures/ nursery development: about 3379.9 ha of bunds on cultivated land were treated with grasses and multipurpose vegetative cover with soil fertility, forage, and soil conservation values such as Grevillea, Acacia Decurrens, Tree Lucerne, Rhamuns, and Sesbania. Planted seedlings from the established nursery sites were transplanted on 228.97 ha on closed
degraded hillsides and on 67.47 ha gully areas. Moreover, about 322,776 fruit seedlings such as coffee, mango, avocado including Rhamuns were planted around homesteads across all the LWs.

Generally, LWs have exemplified that building trust and involving community in the decision-making process at every stage of the NRM implementation can ensure empowerment and sustainability to the end of external support. Well targeted provision of continuous training and advisory services to farmers on the utilization and management of fodder species planted on bunds is not only a means to control erosion and increase forage development capacity but also could bring an added economic value to farmers in the implementation of soil and water conservation practices. Moreover, experiences from the LWs prove that formulating enabling mechanisms for collective actions in the implementation and protection of the vegetated graded bunds is an essential element of ensuring sustainability in watershed management practices.

4.2.2 Kunzila Integrated Landscape Management and WASH Project (KILMWA)

Figure 4.3. Kunzila Integrated Landscape Management and WASH (Kunzila ILMWA) project site map

Background of the project

In 2019, the Amhara National Regional State (ANRS) and the Embassy of the Kingdom of Netherlands (EKN), in partnership with the Dutch Horticultural Investors, started dialogues that led to an inception of a flagship project for sustainable development of the Kunzila area (see Figure 4.3). To this end, The Netherlands Embassy and the Ethiopian Horticulture & Agriculture Investment Authority signed a Memorandum of Understanding (MOU) to ensure the sustainability of the investment by making cooperative efforts toward attaining broader and sustainable development in Kunzila area. The Netherland Enterprise Agency (RVO.nl)
was commissioned to prepare an elaborated commonly shared Partnership for Action, Commitment and Transformation (PACT) proposal. After in-depth assessment and iterative consultations with different stakeholders in the area and in the region, RVO.nl proposed the implementation of Kunzila Integrated Sustainable Development Plan (KISDP) that had been initiated earlier focusing on five thematic pillars. Along that line, the Amhara National Regional State Government, investors operating in Kunzila area including the Dutch-based Horti-Pact, EKN, and the Ethiopian Investment Commission (EIC) agreed to work in an open, transparent, and cooperative manner by signing a Partnership for Action, Commitment and Transformation (PACT) agreement. The PACT identifies the key intervention areas under the five thematic pillars, and defines the responsibilities of each partner and stakeholder. Kunzila Integrated Landscape Management and Water, Sanitation, and Hygiene (Kunzila ILMWA) project was thus proposed as part of the various interventions proposed in the PACT.

4.2.2.1 Objectives of the Project

As mentioned earlier, Kunzila Integrated Landscape Management and WASH (Kunzila ILMWA) is a five year (2020 - 2024) project designed in alignment with existing initiatives and programs in the area. The project is implemented by WLRC in partnership with SNV. The project was approved with a budget of about 16 million Euro (of which about 12 million to finance development interventions related to ILM activities that are implemented by WLRC and the remaining 4 million Euros to finance WASH activities that are implemented by SNV. In addition to implementing the ILM activities of the project, WLRC is responsible for the overall management and administration of the entire project. The process to signing of the agreement took nearly two years of proposal development and negotiations with donors and finally it was signed on the 15th April 2020 (Miazia 7, 2012).

The project comprises several components aimed to contribute to realisation of prosperous and healthy population in Kunzila Watershed, together with other relevant projects, programs in alignment with the appropriate local, regional, and national policies, strategies and plans.

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The overall objective of the project is to contribute to a more prosperous and healthy population in Kunzila Watershed, in alignment with the other relevant projects and programs and national policies and plans. More specifically, this project aims to contribute to:
• improving income of at least 75% of the community members in the watershed (through agricultural support and capacity development);
• create employment opportunities for youth (males and females);
• improve institutional capacity for sustainable landscape management and utilization;
• improve rural communities’ access to market places and roads;
• ensure sustainable access to basic water supply and sanitation services in rural areas;
• improve institutional capacity to deliver safe water supply and sanitation service in Kunzila town; and
• generate scientific evidence on the interventions for upscaling.

4.2.2.2. Project Components

The project has three phases: inception, implementation and consolidation phases. The different activities of the project to be implemented during these three phases are categorized into nine components. These components are:

Component 0: Inception phase
Component 1: Strengthening of community watersheds management
Component 2: Strengthening of agricultural productivity of smallholders
Component 3: Strengthening of local capacities
Component 4: Strengthening of rural WASH services
Component 5: Strengthening capacity for improved urban WASH services Kunzila town
Component 6: Strengthening of multi-stakeholder coordination under woreda leadership
Component 7: Scientific monitoring
Component 8: Project management and programmatic monitoring, evaluation and learning (MEL)

The performance of the project during the inception phase, from March 2020 to June 30, 2020, is presented as follows.
4.2.2.3 Accomplishments during inception phase

The inception phase of the project is the major component of the project planned to be implemented during the current year. This component is a preparatory phase that lays the necessary ground for launching the project. The main activities of the phase include: (a) setting up project management and establishing project offices, (b) undertaking in-depth assessment of the baseline situation, (c) establishing essential stations (nurseries) and producing key inputs, and (d) developing a detailed five-year’s plan of the project. Accordingly, in the year 2012 E.C. (2019/2020), WLRC did several preparatory works for the project implementation.

A) Project Management Setup

WLRC embarked on creating awareness about/introducing the project, drawing the project management set up, recruiting project staff; office establishment and other preparatory activities leading to the preparation of development plans and the official launching of the project.

Awareness creation: The inception phase of the project was started with efforts to create shared understanding among people who are in the leadership positions at Woreda and Regional levels. Accordingly, 18 – 20 March/2020, kick-off and briefing meetings and inception workshops were held with the presence of top government officials of the region including the President, Vice President, heads of different Bureaus of ANRS, and Woreda level officials.

Figure 4.4. Awareness creation workshop at Bahir Dar
Office Establishment and Staffing: The other key activity of the early steps of the inception phase was to organise the management of the project. Accordingly, the consortium organizations (both WLRC and SNV) established a regional office in Bahir Dar. In addition, both organizations established project offices at their respective Head Quarters. Project managers for both WLRC and SNV regional offices and one Hydrologist for WLRC’s regional office were recruited through head hunting. While SNV assigned a manager for the project from the existing staff, WLRC hired a Project Manager based at the Head Quarter. Furthermore, for the WASH components, five project staffs who were working with SNV WASH project; Sustainable Sanitation and Hygiene for All (SSH4A) were transferred to this project to use their experiences and capacities. The newly recruited staff by the respective offices got induction about ILMWA project. Additional staffing need for the project was identified and vacancies advertised to recruit 4 senior experts for ILM, 7 administrative staff for the two regional offices, and about 40 technicians and facilitators at kebele, watershed and community levels for both ILM and WASH activities.

Procurement of different office facility like photocopy machine, chair, table, and table cabinet were done for both Regional and Federal Project offices of WLRC and SNV. In addition, SNV made office arrangement for WASH field workers at Kunzila Health Centre.

Kebele and Watershed Facilitator’s Office Establishment: the project planned to establish small offices for facilitators at Kebele and Watershed levels. Accordingly, office design, bill of quantity, and site selections were completed.

Project Implementation Manual (PIM) Preparation: A Project Implementation Manual (PIM) was prepared and shared among executive partners and the funding organization of the project to provide detail guidance on the implementation of the project.

Web-based Monitoring and Evaluation (M&E): the project will use a web-based M&E system to ensure proper and timely implementation of activities of the project and to enhance knowledge about the project. The web-based M&E system enables the participants of the project at all levels to upload, read, print, edit and analyse information according to the authorization set up of the project administrator. Accordingly, applications of the system have started by setting up the activities planned during the inception phase.

Strengthening/establishment of WASH Management structure: Steering and Technical Committees were established at the woreda and in seven kebeles of the project. The Woreda WASH Steering Committee is constituted heads of the N/Achefer Woreda offices of Water, Health, Education, Finance & Economic Development, TEVDO, Women & Youth And it is chaired by the Woreda Administrator. The Woreda WASH Technical Team is composed of experts from the above-stated woreda offices and would be headed by the Woreda Health Office. To strengthen the task teams, a kebele WASH Team was also established in all the seven project kebeles.
B) Baseline surveys

The baseline survey was launched on 28th May, 2020, just a month after the agreement was signed. The surveys aimed to provide basic information about the project area and the people that help to guide the overall activities of the project. Specifically, the aims of the baseline surveys were to:

- establish and quantify baseline levels for selected biophysical and socioeconomic outcome indicators;
- characterise the area using scientific research evidence;
- take inventory of available resources and capacities;
- identify key development challenges and opportunities;
- identify key stakeholders; and
- generate basic input that would inform ILMWA development plan preparation.

To this end, two crews were organised to undertake detail socioeconomic, biophysical and ecological surveys in the project areas. The consortium members collected detailed and high quality information by deploying well experienced multi-disciplinary teams of experts. The data collection instruments used included key informant interviews, focus group discussions (FGD), structured interviews, field visits, expert observations, inventory recording, laboratory tests, GPS/GIS assisted surveys, house-to-house survey. The data were captured by using structured checklists, questionnaires, TORs, interview and discussion guides, indicators, etc.

The baseline surveys carried out during the inception phase can fall into the following three categories:

i. biophysical surveys;
ii. socioeconomic survey; and
iii. WASH survey.

iv. Biophysical surveys

Biophysical survey by WLRC: this focused on studying the biological and physical environments of the project areas. Detail information was collected on nine areas of investigations: land use and land cover (LULC) dynamics, biodiversity and biomass production, crop production, livestock production, land degradation and land management, land tenure and administration, soil survey, surface water resources, and ground water survey. The first seven biophysical surveys were carried out by WLRC whereas an independent consultant organisation was hired to carry out the last two surveys, soil survey and ground water survey. Attention was given to the type of data needed for future management and development interventions relating to the objectives and ultimate goal of the project.

A thorough investigation of existing data, including a preliminary plan of action, was made by each sub-team before the commencement of the actual survey. Moreover, in order to gear focus of efforts to the collection of relevant information, each sub-team prepared numerous checklists and questionnaires considering disciplinary and inter-disciplinary (trans-disciplinary) oriented evidence/fact. Attention was given to the data needed for future management
and development interventions relating to the objectives and ultimate goal of the project. The survey was made using the 12 micro-watersheds as sampling frames. Diverse maps, profiles, indicators, and summary information were produced from the survey which includes: base map, topographic maps, soil map, slope map, livestock feed sources and quality map, livestock density map, cropping pattern, water resource map, land capability and land suitability map, existing and past land use and land cover maps, vegetation cover and biomass production and carbon storing potential maps, land tenure maps, land degradation maps, and infrastructure and social services map (e.g. Figure 4.5).

Many senior experts from various organizations including, 18 experts from WLRC, 12 from Kunzila Woreda Office of Agriculture, 24 agricultural extension agents from the 6 kebeles and a number of local informants participated in the assessment.

Figure 4.5. Some of the maps generated using the biophysical survey data
In addition to different aspects of biophysical baseline surveys made by WLRC that are reported above, surveys on two more biophysical aspects, soil survey and groundwater survey, were also started by the independent consultant, ACACIA.

**Soil baseline survey by ADSWE:** this survey was conducted to obtain information to be used as a basis for integrated landscape management of 12 agricultural micro watersheds in the Kunzila Integrated Landscape Management project area. The Amhara Design and Supervision Works Enterprise (ADSWE) was commissioned for this task. Accordingly, a team of experts were mobilised to the project site after the necessary desk review and base map was prepared. Soil samples were collected following the parallel grid of 500 m apart along the east and 600 m to the north. With this scale, a total of 378 auger points were identified in the total 11,232.97 ha of the project area. From these, 16 auger points fell on buildings and Lake Tana. Thus, a total of 362 samples were collected, approximately one auger observation per 31 ha. The auger observation goes to the depth of 1.2 m, unless obstructed.

Using the information collected, the team produced preliminary survey results. Accordingly, separate soil map on major soil types and soil depth were prepared for the entire project area. In addition, the soil samples collected from the first 20 cm of the auger were properly coded and labelled and submitted to ADSWE laboratory for organic carbon analysis. The next step was to undertake profile pit observation. Nevertheless, this activity was postponed due to the increase of rain intensity.

**Groundwater baseline survey by ACACIA:** One important task of the project is to establish groundwater-monitoring network. To this end, ACACIA (a Dutch Company) was hired. Accordingly, baseline survey was carried out to collect preliminary data and to analyse the groundwater potential and drilling sites of ground water (including 3R potential map).

i. **Socioeconomic survey**

The socioeconomic survey tried to address the social, economic, institutional, infrastructural, and technological aspects of the project area. The survey covered three socioeconomic aspects: household survey, gender assessment survey, and institutional capacity assessment survey.

**Household survey:** The survey was conducted by using structured questionnaire and the SurveyCTO data collection platform using tablets. Data was collected from 720 sample households drawn from the six watershed kebeles, using proper sampling techniques and frame. The questionnaire covered wide and diverse aspects of households and their environments. The questionnaire was transformed into digital questionnaire using SurveyCTO data collection platform and the interview was administered using tablets. Ten competent and well-experienced enumerators and two supervisors were deployed after intensively trained on the tools and techniques of data collection. Furthermore, SurveyCTO also provided strong monitoring tools, including automatic emailing of periodic summary and analytical report, test for inconsistencies, outliers, voice recording of the interview (without the knowledge of
the enumerator), sound level, sound pitch. Thus, the whole survey process and daily submissions were closely monitored and evaluated on daily basis.

Institutional Capacity Assessment: the assessment covers technical, technological, organizational, infrastructural, regulatory, etc. capacity of the various project executive partners, stakeholders and the communities. It is intended to determine the capacities of the various organisations to determine the gap and identify the key areas of intervention in order to fill the capacity gaps. The assessment covers diverse public and private organizations at all levels of the regional administrative tier, such as community, kebele, woreda and regional levels. The assessment uses key informant interviews and discussions using checklists and by collecting the available secondary data from reports.

Gender Analysis: the TOR was under preparation to hire independent consultant for the task.

WASH-related survey (SNV): Baseline household socioeconomic survey was done on both rural and urban households. The baseline information sought included household basic information, household demography, wealth index, sanitation, access to water (see Figure 4.6, for example), hand-washing practices, solid waste management, and other WASH related activities both in Kunzila town and in the six rural kebeles. The survey covered 1608 households in these project areas. Institutional WASH baseline survey was also conducted in 15 schools and 8 health care facilities (HCFs) in Kunzila watershed kebeles. In this survey, seven government employees and four SNV staffs were engaged.
**Small-scale Dam and Diversion Canal Assessment:** potential sites were identified via preliminary assessment of SS dam and diversion canal.

**C) Preparation of a five-year development plans**

The inception reports of the ILM and WASH components of project were prepared based on the survey results and in consultation with the communities and other stakeholders and shared. Preparation of the development (action) plan for the rest of the project period is in progress.

**D) Other development activities implemented during the inception phase**

As per the project document, it was planned to carry out certain critical works before the official launch of the project. Accordingly, several development activities that are critical for future implementation of the project are implemented during the inception phase. These include: the establishment of nurseries, the establishment of scientific monitoring sites and productionupplying of key inputs that are scarce in the market. Furthermore, some selected development activities are also implemented during the inception phase as a quick-win strategy of attracting the community. Accordingly, the following activities were implemented.

- Establishment of nurseries;
- Establishment of scientific monitoring sites; and
- Quick-win development interventions

*Nursery establishments:* the implementation of Integrated Landscape Management interventions
requires the supply of large number of seedlings of trees, fruits and grass splits. This requires establishment of nursery sites. It was planned in the project document to establish one nursery site for each of the six project kebeles. Accordingly, sites were identified and discussions held with the kebele administrators and local communities in the six sites. Land transfer, fencing, and purchase of some materials were done in three of the sites as well negotiations were underway for the remaining sites.

Establishment of scientific monitoring stations: scientific monitoring of the status of natural resources and climatic conditions is one of the key and innovative components of the project. To this end, the project has planned to establish several monitoring stations. Accordingly, the identification of seven meteorological, hydrological and sedimentation monitoring stations was completed. Installation works were completed for three rain gauge stations and one meteorological station.

Quick-win development interventions: homestead fruit production is the most important of the many interventions planned for the project area. Accordingly, the following activities were implemented during the reporting year.

Planting of fruit trees: 8000 seedlings (5000 avocados and 3000 banana) were distributed to, and planted on homesteads of, 422 model farmers (see Figure 4.7 for how the seedlings were transported).
In order to facilitate the implementation of fruit planting, practical training was given to 113 model farmers on fruit tree planting and management, including avocado food preparations. 32 development agents and N/Achefer Woreda Agricultural Development Office experts were also trained on the production, management, grafting approaches and challenges in the extension of avocado and banana.

*Forage seed multiplication:* Forage improvement is a critical intervention that directly improves the livelihood and productivity of households and watershed management practices. Despite these, however, forage shortage is one of the critical problems in the livestock production of communities. Thus, in order to create a sustainable forage seed source for the upcoming development intervention and SWC works, the following activities were undertaken:

- WLRC tentatively accessed 120 hectare land from the investment site for forage crop seed production;
- selection of ecologically sound variety (#11), mapping their source, procurement and transportation (27.6 quintal of seeds and 150,000 grass splits) were done.
- Procured and transported 180 quintals of fertilizer and 50 litters of post-emergence systemic herbicides.
- By employing 80 women (youth) for sowing, 95.6 hectares (Rhodes grass 31, Cow Pea 28, Lablab 12, Trifolium spp 11, Vetch 8, Desmodium 4, Pigeonpea 1.6) of land was covered with seeds and additional 280 women were employed for weeding and related forage crop management activities;
- Additional 10 hectares of land was prepared for two perennial grass splits and 100,000 grass split was planted (see Fig. 4.8, for example).

![Figure 4.8 Forage crops production/seed multiplication](image-url)
**Jobs created:** During the reporting period, temporary jobs were created for 398 people (280 females and 118 males). In addition, preparations were made to employ 66 fixed contract-based nursery workers for the six nursery sites (11 nursery workers per site) (Fig 4.9).

**Extra community services:** The project also did some extra community services like settlement of the dispute between Horti-Park and the community. There had been a dispute between the investors and the community due to the communities’ misconception of the flower investment and the companies. The Kunzila ILMWA project staff resolved the dispute by organising traditional conflict resolution mechanism through local institutions.

![Nursery workers on duty](image)

*Figure 4.9. Nursery workers on duty*

**4.2.2.4 Challenges encountered**

During the reporting year, the Kunzila ILMWA project faced the below-listed challenges:

- Land acquisition and availability problems,
- Little knowhow on the part of the communities about avocado fruit crop, its use and management,
- Damages done to the flower investment and time taken to resolve the dispute between the investors and the communities,
- Inconveniences and restrictions that followed the COVID-19 global pandemic. While the emergence of Covid-19 has affected the running of the project activities, efforts were made to carry out the planned activities without compromising the necessary precautionary measures consistent with the national Covid-19 protocol issued by Ministry of Health.
4.3 Harnessing Agricultural Transformation Efforts with NRM

4.3.1 FOLU

One of the accomplishments of the Centre in the past year is the completion of the project called the Food and Land Use Coalition (FOLU), a project started in 2017. FOLU was a community of organisations and individuals committed to transform the way we produce and consume food and use our land for people, nature and climate. FOLU used to support science-based solutions and help build a shared understanding of the challenges and opportunities to unlock collective ambitious action. One of the gaps identified to secure fund from FOLU was lack of a system that allows the implementation of spatial planning that simultaneously considers agricultural commercialization technologies, land restoration interventions, and agroforestry in selected woredas within Agricultural Commercialization Clusters (ACCs).

WLRC identified the gap and signed a research project agreement with FOLU aiming at developing a system that integrates spatial-based planning in ACC approach so as to improve its impact on agricultural transformation in the country. The main tasks of the assignment were: mapping biophysical and socio-economic aspects of two selected case woredas and assessing the challenges to efficiently implement ACC concepts; developing system in producing planning units below woreda level, called Farmers Production Clusters (FPCs); and conducting crop suitability assessment using spatial modelling techniques and determining the type and number of suitable commodities that can be grown in a woreda. WLRC, AAU took also the responsibility to produce comprehensive spatial data for use in the planning process, also helping to identify potentials and constraint maps for each commodity, restoration opportunities, and technological interventions.

Approach

The overall research effort was divided into four major activities:

1) assessing existing ACC in two selected woredas. This activity had many sub-activities, such as: i) understanding ACC mapping below woreda level; ii) understanding how participant farmers (called Farmer Production Clusters (FPC) are organized under each ACC and within each woreda; iii) understanding how the FPCs are functioning (from planning, implementation and monitoring and evaluation perspective); and iv) what database is available about the FPCs in each woreda and how it is organized.

2) analysing the broader biophysical, socio-economic and institutional contexts of the two ACC woredas. The project assessed and mapped biophysical and socio-economic constraints and opportunities in implementing the ACC in a systematic way.

3) conducting land suitability assessment for major commodities and comparing to current practices in the two woredas; and

4) suggesting standardised spatial mapping procedures and methods for ACC, including database required to be applied for each ACC in the country.
Selection of representative woreda: As indicated in the introduction part, FOLU emphasises developing a demonstration spatial-based plan taking few FPC woredas as case study sites. Thus, the envisioned system (spatial-based demonstration plan) was proposed to be established on two systematically-selected woredas. Initially, for the selection of model woredas, relevant criteria were set and thoroughly discussed with all stakeholders. WLRC also suggested picking FPC model woredas only from Amhara region. Accordingly, Womberima and North Mecha were selected to represent model woredas of FPC.

Assessed the challenges and opportunities of ACC in the case study woredas: The overarching objective of this study was to develop a system for integrating spatial based planning in ACC approach to improve its impact on agricultural transformation in the country. This requires comprehensive assessment of the challenges and opportunities to implement ACC effectively. It includes assessment of existing ACC implementation strategy, assessment of the economic constraints and potentials that affect FPCs (mixed farming and crop rotation), assessing the biophysical constraints and opportunities (land degradation and suitability of crops). The assessment allows producing comprehensive spatial data for use in the development of a system that informs the planning process. The findings of the assessment eventually allow to find the best suiting spatial planning units (below woreda level), where the concept of Farmers Production Clusters (FPCs) can be implemented with minimal constraints.

Developed a system to implement ACC in the case study woreda: This study strove to develop a system that can maximise potentials and minimise challenges by taking the merits of spatial technology and integrating the data, which had been collected during the assessment phase. Prior to the development of the system, addressing the identified gaps primarily requires comprehending and analysing the following issues: What are the adoptability and scalability challenges of cluster-based farming (FCC) to sustain the practice? What are the ways-out to overcome the challenges? What are the roles of geospatial data and techniques to support FCC? What important spatial analysis can help to address the challenges identified in the planning, implementation and monitoring of FCC practices? What specific geospatial data are needed for such purpose? Where to get them, how to produce and at what scale? How to conduct cluster-mapping survey for already implemented commodities, and how better clusters develop systematically? How to make suitability analysis and how experts can easily use the outputs to establish new clusters or adjust existing clusters? What are the challenges of practicing cluster based farming sustainably in continually degrading landscapes? How to make land restoration activities (other than farming practices) compatible and integrate it with cluster based farming? The system is a framework that guides how to address all the above issues.

Demonstrate the implementation of the developed system: The Centre extended its research intervention in addressing the identified research gaps after developing the framework/system, demonstrating how the developed system/framework can be implemented. The findings of the assessment indicated that implementation of the system needs to follow watershed logic.
WLRC believes that defining the minimum spatial planning units properly for the demonstration and implementation of FPC and other missed opportunities is one of the important aspects for sustainability of the technology. In the selection of the model watersheds, the model woredas were first divided into smaller micro-watersheds (as seen below). However, properly defining appropriate spatial units (size of the watershed) was the basic task. In each model woreda, using DEM and GIS tools, the boundaries of the watersheds were defined taking 500 - 1000 ha as the minimum and maximum threshold areas for one micro-watershed. Figure 4.10 portrays the generated micro-watersheds in one of the model woredas. As can be seen in the map, it is not simple to get appropriate size of watershed in one run of spatial analysis. The size of the watersheds may be large or small depending on the topographic settings. The demonstration requires only one watershed in each model woreda, used to demonstrate/test all the recommendations in to action. After generating the micro-watershed in each model woreda (see Figure 4.10) using a reasonable area, it was imperative to select one model watershed in each woreda. The appropriate size of the watershed was determined based on the biophysical settings (slope, altitude, drainage network, level of degradation, rainfall, and temperature) and socio-economic condition (population density, farming system, land holding size, land use types) (see Figure 4.11).

Figure 4.10. Overall view of generated micro-watershed for Womberima woreda

Taking several factors into account, WLRC needed to select one model watershed in each of the selected model woredas and demonstrate how the identified gaps can be addressed and implement the system following recommendations extracted from the study in a real practice.
Produced appropriate development/intervention plan: Implementing the system requires well developed intervention plan based on the established framework. As indicated above, developing appropriate intervention plan is one of the means to ensure adoptability, scalability and sustainability of any innovative agricultural technology. The envisioned plan encompassed the recommendations of the study and the components missed in the FPC as well as all the activities of the FPC. With this aim, a one comprehensive intervention plan was developed in each selected woreda. The plan was developed by disaggregating the different activities to be implemented by type, costs and time so that effective planning, implementation and monitoring can be ensured.

Issues of the study, such as constraint, opportunity and requirement evaluation outputs are exhaustively assessed in the plan. The plan was prepared with full participation of government officials, experts and the community at large. The plan was informed also by physical observation, interviewing of farmers, and secondary data. Spatial technology was intensively used in the whole planning process. All aspects of land restoration that can enhance productivity such as greening of the area by introducing nurseries for biological material production (e.g., tree seedlings, fruit (grafted), forage and other income generating biological materials suitable to the area) were included in the intervention plan.

The plan also considers possible indigenous technologies that could be easily integrated with the land restoration and FPC activities. In addition, recommendations of human and institutional capacity development were core elements of the integrated intervention plan. The plan anticipated labour to be contributed by the community without any payment. Options that can enhance youth employment and rural transformation are envisioned to be part of the plan. Eventually, a guiding document that highlights the overall planning process, (identification of useful methods, planning approach), required budget, time, to finalize a particular intervention was produced.

Mapped the next steps towards implementation of proposed development plan following the developed system: Once
the model micro-watersheds were selected and appropriate plans were developed, the next step is implementing the proposed interventions; but, implementation was beyond the scope of the research project. Thus, WLRC was waiting for the approval of the second phase of the research project.

**Prepared to develop a guiding manual for implementation of the FPC:** Findings of the assessment showed that the overall issues of adoptability, scalability, and sustainability of FPC are linked with lack of guiding manual. It is strange that such innovative technology is being implemented at national level without any legal ground, principles and written guiding manual. As learned from the woreda experts, the key challenge they faced to implement FPC effectively was lack of legal ground. They also indicated that except very few workshops given to few experts, there was limited knowledge and information flow to all stakeholders on how to implement the technology. No one knows well about the principles of FPC. The majority of the woreda experts had insufficient information and knowledge about the FPC itself. Therefore, there was need for awareness creation training about the FPC and its principles.

### 4.4 Exploring Investment for Watershed Services

#### 4.4.1 Payment for Ecosystem Services (PES)

**Gojeb Project:** Payments for Ecosystem Services (PES) is a payment for environmental benefits to the community as an incentive for managing their land to sustain these ecological services. Alternatively, PES can be defined as “investment for watershed services”.

World Resource Institute (WRI) in collaboration with Ethiopian Environment, Forest and Climate Change Commission (EFCCC) and Water and Land Resource CentreWLRC planned to work on PES over two watersheds, Gojeb watershed at Omo-Gibe Basin, and Koka watershed at Abbay Basin. The PES has many serious activities and engages many stakeholders such as service providers (sellers), service buyers (users), intermediators (mediators), and supporters (technical and knowledge). The upper catchment stakeholders are service providers or service sellers while the downstream stakeholders are the buyers.

WLRC is responsible to explore the potential of the watershed, particularly Gojeb watershed. WLRC has conducted: (1) land use changes and associated ecosystems service values, and (2) sediment loads to the Gibe III Hydroelectric Dam. The results of these analyses was submitted and presented to stakeholders and high-level meeting.

One of the outputs from this analysis was land use transformation and associated ecosystem service values. The summarized LULC classes are: bare land, cropland, grassland, forest, plantation, settlement, shrub, waterbody and woodland. Forests had the highest cover (> 423,000 ha ~ 60%) in 1986 but it reduced to 317,000 ha (~ 45%) in 2016. About > 56,000 ha of forests were changed to cultivated land, and > 105,000 ha to different classes. Cultivated land increased to > 258,000 ha (~ 37%) in 2016 compared to 150,000 ha (~ 21.5%) in 1986 (Table 4.1).
### Table 4.1. LULC transformation/dynamics within the last 30 years

<table>
<thead>
<tr>
<th>Major Land use cover types</th>
<th>1986 Area (ha)</th>
<th>1986 %</th>
<th>2016 Area (ha)</th>
<th>2016 %</th>
<th>Change between 1986 and 2016</th>
<th>Annual change rate (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bare land</td>
<td>14.5</td>
<td>0.002</td>
<td>1,412</td>
<td>0.2</td>
<td>1,397</td>
<td>0.2</td>
</tr>
<tr>
<td>Cropland</td>
<td>150,144</td>
<td>21.4</td>
<td>258,394</td>
<td>36.8</td>
<td>108,251</td>
<td>15.4</td>
</tr>
<tr>
<td>Grassland</td>
<td>23,149</td>
<td>3.3</td>
<td>22,518</td>
<td>3.2</td>
<td>-631</td>
<td>-0.1</td>
</tr>
<tr>
<td>Forest</td>
<td>423,055</td>
<td>60.3</td>
<td>317,308</td>
<td>45.2</td>
<td>-105,747</td>
<td>-15.1</td>
</tr>
<tr>
<td>Plantation</td>
<td>969</td>
<td>0.14</td>
<td>4,670</td>
<td>0.67</td>
<td>3,701</td>
<td>0.5</td>
</tr>
<tr>
<td>Settlement</td>
<td>161</td>
<td>0.023</td>
<td>383</td>
<td>0.06</td>
<td>223</td>
<td>0.03</td>
</tr>
<tr>
<td>Shrub</td>
<td>20,491</td>
<td>2.9</td>
<td>51,011</td>
<td>7.3</td>
<td>30,520</td>
<td>4.4</td>
</tr>
<tr>
<td>Swamp</td>
<td>971</td>
<td>0.12</td>
<td>822</td>
<td>-0.14</td>
<td>-149</td>
<td>-0.02</td>
</tr>
<tr>
<td>Woodland</td>
<td>82,791</td>
<td>11.8</td>
<td>44,929</td>
<td>6.4</td>
<td>-37,862</td>
<td>-5.4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>701,745.5</strong></td>
<td><strong>99.985</strong></td>
<td><strong>701,447</strong></td>
<td><strong>99.72</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The ESVs were evaluated for each LULC based on these LULC classes. The sub-basin had ESVs of US$ 2.52 billion in 1986 but decreased to US$ 1.97 billion in 2016; losing about US$ 0.551 billion within the last 30 years (annual loss rate of US$ 18.4 million). Potential drivers would be agricultural expansion, land degradation/erosion, landslide and deforestation. That indicate the need for concerted efforts to restore and manage landscapes for sustainable socio-ecological and economic uses (Table 4.2).

### Table 4.2. Major LULC types and corresponding ESVs (US$) within the last 30 years

<table>
<thead>
<tr>
<th>Land Use types</th>
<th>Area (ha) 1986</th>
<th>Area (ha) 2016</th>
<th>Change (area) 1986-2016</th>
<th>ESVs 1986</th>
<th>ESVs 2016</th>
<th>Net change 1986-2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bare land</td>
<td>14.5</td>
<td>1,411.8</td>
<td>1,397</td>
<td>33,932,449</td>
<td>58,397,137</td>
<td>24,464,688</td>
</tr>
<tr>
<td>Cropland</td>
<td>150,143.6</td>
<td>258,394.4</td>
<td>108,251</td>
<td>3,932,449</td>
<td>58,397,137</td>
<td>24,464,688</td>
</tr>
<tr>
<td>Grassland</td>
<td>23,148.6</td>
<td>22,517.7</td>
<td>-631</td>
<td>96,437,193</td>
<td>93,808,863</td>
<td>-2,628,329</td>
</tr>
<tr>
<td>Forest</td>
<td>423,055.2</td>
<td>317,308.1</td>
<td>-105,747</td>
<td>2,276,882,925</td>
<td>1,707,751,925</td>
<td>-569,131,000</td>
</tr>
<tr>
<td>Plantation</td>
<td>969.8</td>
<td>4,669.5</td>
<td>3,701</td>
<td>-105,747</td>
<td>-149</td>
<td>-0.02</td>
</tr>
<tr>
<td>Settlement</td>
<td>160.6</td>
<td>383.4</td>
<td>223</td>
<td>1,069,490</td>
<td>2,553,827</td>
<td>1,484,337</td>
</tr>
<tr>
<td>Shrub</td>
<td>20,490.5</td>
<td>51,010.5</td>
<td>30,520</td>
<td>20,224,104</td>
<td>50,347,334</td>
<td>30,123,230</td>
</tr>
<tr>
<td>Waterbody</td>
<td>822.1</td>
<td>970.6</td>
<td>149</td>
<td>10,284,489</td>
<td>12,143,647</td>
<td>1,859,158</td>
</tr>
<tr>
<td>Woodland</td>
<td>82,790.8</td>
<td>44,928.7</td>
<td>-37,862</td>
<td>81,714,539</td>
<td>44,344,647</td>
<td>-37,369,893</td>
</tr>
<tr>
<td><strong>Total/net</strong></td>
<td><strong>701,594.80</strong></td>
<td><strong>701,594.70</strong></td>
<td></td>
<td><strong>2,520,545,189</strong></td>
<td><strong>1,969,347,380</strong></td>
<td><strong>-551,197,809</strong></td>
</tr>
</tbody>
</table>

Annual ESVs change (US$/year) - 18.4 million

Annual rate per ha (US$/ha/year) - 26.2
This study is meaningful for management of natural resources in the catchment, improvement of hydropower production and lifespan of the hydropower reservoir besides improving land productivity for smallholder farmers as hydrological cycles and biodiversity components of the catchment can be improved. This study assists policy makers in designing evidence-based programs such as payment for ecosystem services in the study area and elsewhere.

**Modelling Hydro-Sediment of the Gojeb**

Knowledge of sediment yield and loading into a reservoir can help to assess the potential impact on dam performance. Mapping where sediment yield is highest can also help inform land management decisions. A calibrated 33-year hydro-sediment assessment of the Gojeb using SWAT was the key analysis underlying this scoping process. The SWAT study aimed to assess hydrological processes in the Gojeb, estimate sediment yield in the catchment and downstream loading to Gibe III, identify hotspot areas for intervention, and simulate scenarios to identify land management measures with impact on sediment reduction.

![Figure 4.12. Sediment yield hotspot areas by woreda (WLRC)](image)
The SWAT is a physical process-based model used to simulate continuous-time landscape processes at a catchment scale. SWAT was selected for a number of reasons: the tool has been successfully applied for water quantity, quality and sediment yield issues for a wide range of scales and environmental conditions, even with limited or no monitoring data (e.g. stream gauge data); its ability to characterize complex watershed representations to account for spatial variability; and its ability to show the effects of different land management practices on surface runoff and sediment yield. Simulation was performed using ArcGIS10.2, Arc SWAT 2016 or SWATCUP 2016 while uncertainty analyses, calibration and validation were done with SWATCUP 2016.

The major model inputs include topography, weather, soil characteristics, LULC and land management practices. For watershed delineation as a topographic data input, a 30-meter resolution Digital Elevation Model (DEM) of the catchment was extracted from Shuttle Radar Topography Mission (SRTM), processed and used. DEM was used to define watershed boundary, sub-watersheds, and Hydrological Response Units (HRUs). Since SWAT works on a sub-watershed basis, the entire Gojeb catchment was divided into 117 sub-watersheds. Then, sub-catchments were divided into 2041 HRUs based on soil type, land use and slope class. SWAT predicts the hydrology at each HRU is using the water balance equation, including daily precipitation, runoff, evapotranspiration, percolation and return flow components. Depicting erosion prone areas at this HRU level helps feature erosion hotspots and can better inform catchment management planning.

The major baseline findings of a 33-year simulation of sediment production in the Gojeb have shown an increasing trend and indicate that the catchment is under serious threat from erosion. The average annual catchment specific sediment loading is 20.7 t ha\(^{-1}\) yr\(^{-1}\), which is equivalent to an annual sediment influx of 14,469,102 tons to Gibe III downstream. This value represents an estimated 32 percent of the total sediment entering the reservoir, even though the Gojeb watershed represents less than 8% of the total catchment area for the dam. Temporally, the maximum amount of sediment transported out of the catchment is from June to September and the minimum in February. A clearly defined trend is observed between precipitation and sediment load as well as surface runoff and sediment load in the landscape. Moreover, spatially, maximum sediment transported out of the catchment is from agricultural landscape units with slope of over 50%, annual precipitation above 1592 mm, and surface runoff 151 mm, confirming that a combination of steep slopes, vegetation loss and high rainfall increase erosion and the subsequent sedimentation. The northern, eastern and southern parts of the catchment are hotspot areas given high surface runoff, steep slopes, recurring landslides, and susceptibility to erosion. Soil loss was very high in some woredas and relatively low in others. The woredas of Menjiwo and Dedo (> 82 t ha-1) followed by Omonada, Ela (Konta), Isara, and Gera (46 – 83 t ha-1) are experiencing the highest soil loss resulting in high sediment yield (Fig 4.12). Given erosion and degradation rates affect livelihoods of smallholders in these woredas and the storage capacity of Gibe III, these hotspot areas should be the priority for intervention in the Gojeb.
4.4.2 SUCCESS: Sustainable Utilization and Conservation through Compensation for Eco-System Services in Tekeze

About SUCCESS

Appropriate land use system based on land capabilities and suitability, on the one hand and the use of appropriate technologies, governance system and approaches, on the other are key areas that need to be appropriately planned and executed to foster sustainable land management. These overarching elements, however, are seldom property undertaken in many land use and management activities in Ethiopia. The Tekeze river basin is one case in point.
Agriculture affects both the quantity and quality of water available for other uses, and under current production systems in the Tekeze Basin the impact is often negative. Integrated land management (ILM) practices can foster a better use and conservation of available resources and increase agricultural productivity, while reducing environmental impact from sedimentation of hydropower storage structures and regulating flows serving downstream communities. One of the key barriers to adoption of practices such as soil conservation, gully protection, area closure, and others, is the high upfront cost associated with their implementation and which act as a disincentive to poor farmers. Most renewable energy sources, such as hydroelectric power, are derived from ecosystems and depend on the nature’s ability to maintain them. Hydropower relies on regular water flow as well as erosion control, both of which depend on intact ecosystems. These ecosystems are equally vital to food production, yet there is pressure to increase cultivated land and agricultural outputs in the short-term at the expense of ecosystems’ long-term capacity for food production. Intensive use of ecosystems to satisfy needs for food and fuel wood can erode ecosystems through soil degradation, water depletion, and biodiversity loss. The gap is sustainable financing of ILM activities.

To address such gap WLRC partnering with HELVETAS Swiss Inter-cooperation (Ethiopia Office) and Ministry of Water, Irrigation and Energy developed this project which is entitled as “Sustainable Utilization and Conservation through Compensation for Eco-System Services (SUCCESS) in Tekeze River Basin”. The project will implement its innovative concept in six micro watersheds that will be selected from three woredas in WagHimira Zone of Amhara National Regional State (Fig 4.13). For its purpose, the project proposal has already won grant from EU RESET plus Innovation –ICCO fund, which is going to be implement for two years.

Figure 4.13 Location map of the project area
This project aims to introduce and adapt a financing tool, Payment for Ecosystem Services (PES), thereby lowering the cost barriers to increased ILM implementation and improving rural livelihoods, and at the same time contributing to the lifespan of critical renewable energy infrastructure. PES has been used and approved in multiple contexts. What is innovative about this project is to introduce this financing tool in the context of hydropower and watershed management institutions and thereby improving ecosystem health and resilience of farming communities. Figure 4.14 shows the conceptual framework that this project intends to implement. A tool can be sustainably embedded in existing community structures such as watershed management committees and can be systemically scaled in the watersheds through the River Basin Councils.

**The project has two objectives:**

1) To develop based on cross-sectoral collaboration and negotiation, a system for compensation for ecosystem services (CES) and to formulate an enabling operational and institutional framework for applying a PES-based financing mechanism for enhanced watershed (landscape) management and hydropower in the Tekeze Basin.

2) To implement environmental rehabilitation and climate change adaptation activities for resilience building and enhanced livelihood improvement in selected (6) pilot micro-watersheds of three woredas of Wag-Hemra zone; Dehana, Sahala and Ziquala.

![Figure 4.14. The conceptual framework that this project intends to implement](image-url)
The project will use the following four key intervention strategies:

- Selection of 6 micro-watersheds in sub or major watersheds where soil loss is critical;

- Development and testing of tools and guidelines for compensation and/or payment for ecosystem services in collaboration with Community Watershed Committees and Ethiopian Electric Power (EEP) Administration of Tekeze Hydropower Station;

- Implementation, based on co-funding, of a package of sustainable land management measures and the verification of these on sediment yield in streams and rivers;

- Documentation and endorsement by the Basins Development Authority (BDA), the Ministry of Water, Irrigation and Energy (MoWIE) of the tools, guidelines and approaches for replication in the Tekeze Basin and possibly beyond.

The project will build on and put into practice the forthcoming proclamation of the Ethiopian Government related to user charges for water resources in river basins as per the Ethiopian Water Resources Management Policy. For that, the project will be closely working together with the BDA.

In its lifespan of 2 years the project will achieve the following:

- Develop tools, guidelines and approaches in operationalising payment for ecosystem services in a water basin setting and have these endorsed by the MoWIE.

- Apply these tools, guidelines and approaches in a multi-stakeholder setting encompassing community organisations, federal, regional and zonal government entities, and the private sector.

- Improve livelihood, through increased crop productivity and diversification of income sources for approximately 2,700 households in selected micro-watersheds with a replication potential in the wider sub-watersheds of the upper Tekeze Basin.

Activities performed

Activities undertaken in the year 2012 E.C. are summarized in Table 4.3.
Table 4.3. SUCCESS activities undertaken in the year 2012 E.C

<table>
<thead>
<tr>
<th>Component 1: Project proposal development</th>
<th>Activities</th>
<th>Expected outputs/results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Review NRM activities and challenges in Wag-Himera zone, Tekeze Basin</td>
<td>Problems identified</td>
</tr>
<tr>
<td></td>
<td>Identify the problem and set project objectives as per the project proposal call by REST</td>
<td>Objectives set</td>
</tr>
<tr>
<td></td>
<td>Develop the concept note for the call in iterative bases and with intense discussion bring the Ministry of Water Irrigation and Energy on board after conducting detailed discussion with the State Minister in charge of Basin’s development</td>
<td>5-pages succinct concept note is prepared and submitted</td>
</tr>
<tr>
<td></td>
<td>Develop full proposal based on the shortlist award from the funder</td>
<td>Full proposal developed and submitted for final competition</td>
</tr>
<tr>
<td></td>
<td>Present the concept and defend the proposal</td>
<td></td>
</tr>
</tbody>
</table>

After such intense work in the preparation of the proposal, it was accepted the project will be commenced as planned in the next fiscal year.
CHAPTER 5
GOVERNANCE AND SOCIO-ECONOMICS FOR NRM

5.1 General Introduction

There is huge stress on natural resources, mainly on renewable resources of the country amidst rapid increase of population, changes in demand and consumption behaviour of the people, rapid economic growth of the country, climate change and variability and other global changes. Sound and adaptive governance of the natural resources is important to meet the demands of the growing population on the one hand and to counteract the stress on the natural resources and address different negative changes on the other. Pertaining to managing and utilization of the natural resources, particularly the renewable resources such as the soils, water, forest, pasture, biodiversity resources of the country, adaptive and responsive governance mechanisms are required.

WLRC, as centre of excellence in water and land resource management (both for research and practices), is testing, developing and implementing best practices of natural resource management in the search better ways of managing and governing the natural resources. This section presents the different activities performed in the attempt to fulfil the aforementioned objectives.
5.2. Water and Land Resources Governance and Implication to Ethiopia

5.2.1. Learning watersheds

LWs are an innovation in integration, participation and upscaling of integrated watershed/landscape management. WLRC has established six learning watersheds in 2011 (later added one) and managing them in collaboration with the ANRS Bureau of Agriculture and the community residing in the respective watersheds until 2019 with full scale and since then it continued monitoring and backstopping different activities to ensure their sustainability.

The “learning watershed” (LW) is a new philosophy and approach that WLRC initiated for integrated watershed management that supports and strengthens technical, institutional, and knowledge management of integrated watershed development efforts. LWs are learning sites for implementing integrated watershed management practices and improved agricultural technologies, as well as for documentation of lessons for scaling-up. The approach involves active participation and collaboration of multiple stakeholders: land users, local community organisations, extensionists, researchers and policy makers - at all stages of watershed development. Inherent to the approach, the integration of agricultural practices for improved productivity and sustainable natural resource management and climate change adaptation with income generating activities linked to homestead development packages. The approach demonstrates how to streamline scaling-up of integrated watershed approaches. It ultimately ensures sustainable natural resource management and improves more resilient environment and livelihoods. (Refer many reports of WLRC on learning watersheds and publications supporting sustainability of watershed development).

The experience and learning acquired from these learning watersheds, upscaling is initiated into several places. The first upscaling is conducted laterally where the neighbouring watersheds to the existing learning watershed expanded and very well taken up by huge number of stakeholders including the woreda, zonal and regional administrations. Several experts visited the sites to emulate how are these watersheds are performing and operating. These sites are still continued to be the learning sites in which several visitors are visiting every year.

With the experiences and lessons gained from the learning watersheds a bigger upscaling

began in 2019/20 in North Achefer Woreda of Western Gojam Zone (Abbay Basin) with its name “Kunzila ILM and WASH project”. The grant for the project already acquired and the detailed biophysical and socio-economic baseline studies have been undertaken, development plans prepared and the upscaling activities are under full swing (refer sub chapter 4.3 under the heading “Kunzila Integrated Landscape Management and WASH Project (KILMWA)” in this volume).

5.2.2 SLM knowledge management information system development for better NRM governance (a project proposal submitted and funded by MoA)

Proper and innovative knowledge and information system in SLM is one key instrument for better natural resource governance (to ensure transparency, accountability through timely monitoring and evaluation, to track performance of planned activities, and to properly document and disseminate knowledge). With this general philosophy, the Ethiopian Federal Ministry of Agriculture (MoA) has gone through the development of integrated information system under its umbrella project entitled as “Developing and Managing the Knowledge Base for the Natural Resources (NR) and Sustainable Land Management (SLM) in Ethiopia”. As one of the components of this project, WLRC as a consultant developed a web-based SLM Knowledge Management Information System. The objective of the knowledge management information system development part was to develop a systematic and user-friendly knowledge management for planning, reporting and documenting generated knowledge with spatial and non-spatial integrated data of SLM activities. Consequently, WLRC was invited to prepare a proposal with the objectives of making the existing system functional; and developing additional modules to be integrated within the existing system. The ultimate goal is to make the system comprehensive enough that supports planning, decision making and monitoring and evaluation activities of sustainable land management.

By accepting the invitation and award for developing user friendly SLM KMIS a proposal was developed. The proposal has the following specific objectives:

- making the existing Web-based SLMP KM Information System operational and enabling the system fulfil multi-year, annual and quarter level planning and reporting functions;
- up-grading the existing system to include Monitoring and Evaluation (M&E) module, and Mobile/Tab application for data collection module;
- enhancing non-spatial micro watershed data linkages with corresponding spatial units;
- providing capacity building and skill trainings for experts and project management team at different levels (Federal, Regional and woreda level); and
- providing periodical backstopping support and conducting system maintenance service.

After intensive need identification and discussion with the client finally the proposal accepted and funded for the implementation. The project will be implemented in the next three years.
Contribution to the Natural Resource Management (NRM) policy revision of the country

The agricultural and rural development policy that was developed and enacted by the council of Ministers three decades ago was undergoing revision by the Ministry of Agriculture. One of the major gap observed and identified by the ministry was NRM policy elements that were not considered as one of the major pillars in the agricultural sector development, though huge investment is made towards NRM in the country for the last several decades. Many of these activities were performed by different actors and with less coherence and with low synergy among different sectors. In addition, many of the activities were dispersed in different sub sectors. Cognizant of this gap, the NRM main department of the MoA invited an expert from the WLRC to contribute towards the revision of the NRM sub-section (pillar) of the Agricultural and Rural Development Policy. In this work, the Centre using its huge database and experience contributed in the write up of the policy imperatives and strategic issues of the NRM that to be implement over the next decades.

Contribution in the development of the ten-year perspective plan of SLM activities of the country

Long term and short term plans are means to guide systematically the country’s development path. While all line ministries were developing their ten year’s perspective plan, the Ministry of Agriculture was also charting its ten year’s perspective plan. For this activity, WLRC was contributing in the endeavour of developing the Natural Resource Management sub-sector of the Ministry of Agriculture.

Consortium member for initiative: “Integrated Landscape Development in Abbay Basin for Enhanced Wellbeing of Communities and Addressing Sediment Challenges of GERD (One Plan One Report)

WLRC is a consortium member for “Collaborative and Integrated Landscape Development in Abbay Basin”, to which Ministry of Water, Irrigation and Energy (MoWIE); Ministry of Agriculture (MoA); Environment, Forest Climate Change Commission (EFCCC); PHE and Grand Ethiopian Renaissance Dam Public Coordination Office are members. The Committee works to enhance livelihoods of communities and address sedimentation challenges of the GERD with a collaborative engagement under the approach of “One Plan One Report”. In this work, development of a collaborative proposal, identification of pilot major watershed, identification of clear outline of activities, estimation of budget and development of the working organogram has been performed. This proposal, after endorsed by the national steering committee, is already submitted for the Basin’s High Council and is expected to be approved.

Water Governance Research in Central Rift Valley (ongoing research project)

Under the general theme “water security and sustainable development” (see also sub section 3.3 of this report), this particular research is aiming at “improve water governance in the CRV Basin, and thereby contributing to improve water governance at national level as well as to advance knowledge in water use and management, which involves water risk management and water values mapping”.
In the last one year, the following activities were performed the historical evolution of water policies and institutions of Ethiopia was reviewed (draft review paper is prepared and planned to be published at the end of 2021).

In this review the history of water related laws and institutions of the country since the Monarchical regime has been assessed from different perspectives. The assessment includes: the use of different sources of water over time and space, development of water infrastructure, water conservation and management, water institutions (both indigenous and modern; informal and formal)), and the like. In the review lessons and gaps identified, which will be taken to come up with recommendations for better water resource management in the future.

Review on CRV water governance problems and issues (where a draft report is prepared and will be developed into working paper for publication). The following is an excerpt from the report:

The Central Rift Valley Basin (CRV) Water Governance problems and issues: Major findings and recommendations from the review:

The problems and issues related to water resources management in the CRV are diverse and complex at an overwhelming scale. The institutionalization efforts for sectoral coordination and improved water governance through the establishment of the basin development office provide a good start. Greater efforts are needed, however, in terms of having policy revisions, strengthening and solidifying of the necessary legal frameworks so as to maintain a clearly defined and demarcated institutional mandates and accountable, separate institutional establishment for regulatory and operational mandates, as well as an extensive and continual awareness raising activities, and in due course, firming up the autonomy of the basin development office. The ongoing basin plan preparation is also a key step forward to address the diverse and complex issues of water resources development and management in the basin. Nonetheless, in the absence of reliable data and a comprehensive information system it is very unlikely that the natural/hydrological and socio-economic processes could be sufficiently represented to provide the vital information needed as a foundation for decision making, water resources planning and actions. Finance needs to be mobilized from various external donors as well as public and private partners so as to aid implementations and in-depth actions throughout the basin and dealing with the full scale of the problems and issues, as the need for action is high and urgent in the CRV Basin. Building up on existing efforts and potentials as well as taking along lessons from the past and sharing external experiences is vital. A particular example of such prominent initiatives and already ongoing projects in the CRV can be the project: Ziway Shalla Basin in Balance: piloting irrigation water use efficiency.

By and large, some of the key research areas and recommendations with regard to improving water resources governance, development and management in the CRV basin are listed as follows:

- An array of administrative, legal and institutional barriers needs to be overcome in order to clarify the mandates of key institutions and ensure sectoral coordination in policy planning and implementation of water resources development and management endeavours.
• Enabling a coordinated action at local level is a critical step that needs to be taken through organizing prominent stakeholders particularly in areas of biodiversity and ecological hotspots and risks of conflict because of water scarcity.

• Building trust among the basin community and key stakeholders, especially regional bureaus and line offices at local level needs to be the primary focus of the basin development office, for it to be able to exercise its legitimate responsibilities of leading effective coordination and engagement of stakeholders.

• There is a need for the realization of systems thinking and a profound understanding of co-dependency of sectors and actors in their undertakings as regards water resources planning and implementations are critically needed.

• Approaches and mechanisms needs to be identified and framed in order to support the RVBDO in tailoring its approach to align with the impetuses and interests of the diverse stakeholders. All interactions, dialogues and plan of actions by the RVBDO to engage stakeholder should be reflecting the uniqueness of each sector and seeking for the best strategies capable of addressing a number of benefits to be shared, and challenges to be tackled by all sectors and actors.

• Effective platforms for stakeholders’ participation and regular dialogues needs to be identified and established by the RVBDO in order to exchange ideas, discuss problems and solutions as well as share knowledge and experience among other basins’ development offices throughout the country.

• Research and development with regard to the setting up of a comprehensive basin management information system is needed. The required quality and extent of data collection that determines the extent of investment needed in terms of financial resources and expertise must be clearly assessed and defined for the establishment of a reliable quality of information system.

• An integrated and holistic basin plan in account of existing and future water demands, planned infrastructures and management options as well as water resources availability needs to be developed.

• An integrated basin-level permit system in accordance with the basin plan needs to be evaluated and implemented.

• Appropriate multi-tiered water tariff should be determined and introduced to promote water use efficiency and valuation of water as an economic good. This might also be a way of incentivizing the RVBDO to leverage more investments in water management through the income generated from user fees collection. Likewise, a more stringent fines and charges to technical violations, such as pollution charges, ought to be enforced.

• Given the heavy/complete reliance of small-holder farmers and local communities on direct services of the ecosystem, including endangered and vulnerable areas of the basin, alternative means of livelihood need to be explored, evaluated and introduced.
5.3 Socio-economic aspect of watershed management: the uptake from major socio-economic surveys conducted from 2011 to 2019

5.3.1 Learning Watersheds

It is known that land degradation is a physical process which includes deforestation, soil erosion, gully formation, water depletion, etc. However, land degradation is either caused or accelerated and driven by human actions. The human actions, in turn are driven by underlying social, economic, political and cultural activities and practices. Hence, understanding the socio-economic situations is very important. To this end, WLRC has been conducting different kinds of socio-economic surveys at different parts of the country whenever new land management research and practices initiated. In some cases, it is also undertaken to track changes as well. The tracking is basically to see the responses of watershed management efforts to the ecosystem functions improvement on the one hand and the livelihood changes of the community on the other. To date there are large number of reports on the socio-economic situations of watershed/landscape management. From this large number of reports, synthesis of the socio-economic situations is started to draw lessons, trends and gaps from these reports. Some examples of the socio-economic reports are listed below.

Some socio-economic studies conducted in the centre in which synthesis is underway for up-taking lessons

- Aba Gerima Learning Watershed Baseline Survey Report, 2012
- Atari Mesk Learning Watershed Baseline Survey, 2012
- Debre Mewi Learning Watershed Baseline Survey, 2012
- Debre Yackob Learning Watershed Baseline Survey, 2012
- Gosh Learning Watershed Baseline Survey Report, 2012
- Resource Availability Assessment Methodology (RAAM) for Land and Water Related Interventions in the Wabi-Shebelle and Genale – Dawa Basins of Ethiopia
- Garduba Watershed Baseline Survey Report, Oromia Regional State. 2013
- Landscape Transformation in Chefa Wetland and Its Implication on Local People’s Livelihoods, North-Eastern Ethiopia, 2014
- Landscape Transformation in Tana Wetland and Its Implication on Local People’s Livelihoods, North-Western Ethiopia, 2014
5.3.2 Synthesis from the different baseline surveys

Socio-economic study of Kunzila ILMA

Under the bigger umbrella integrated landscape management and WASH project of Kunzila area of North Achefer Woreda, West Gojam zone, detailed socioeconomic survey (WLRC) was undertaken in the summer of 2020. Its analysis is now underway. This survey focused on the social, economic, institutional, infrastructural, and technological aspects of the project area. The survey was conducted by using structured questionnaire and the SurveyCTO data collection platform using tablets. Ten competent and well-experienced enumerators and two supervisors were deployed after intensively trained on the tools and techniques of data collection. Data was collected from 720 sample households drawn from the six watershed kebeles, using proper sampling technique and frame. The questionnaire covered very wide and diverse aspects of households and their environments.

- Ethiopian learning landscapes and actors’ dialogue, 2015
- Assessing sustainability of watersheds developed through the community mobilization in Ethiopian highlands: does land tenure play a role? (land 002) final report, 2016
- Estimating willingness to Pay for watershed Management program using contingent Evaluation approach, 2017
- Socio-economic Characteristics and Baseline Report of Watersheds under Bale eco-region, 2017
- Assessment of Socioeconomic and livelihood options to implement IWM in Upper Sululta Watershed, 2018
- Socio-economic study of Kunzila Integrated Land Scape Management (ILM) and WASH, 2019
- Other specialized watershed performance studies.
CHAPTER 6
TRANSFORMATIVE KNOWLEDGE FOR SUSTAINABLE WATER AND LAND RESOURCES DEVELOPMENT

6.1. General Introduction

In times of unprecedented global challenges that seriously threaten the Earth’s capacity to further sustain human existence, societies must pursue equally unprecedented future strategies. Transitioning from the conventional towards integrated/improved and justifiable land use system is considered as a powerful approach to combat current trends of unsustainability. Although to date, the concept of integrated/improved and justifiable land use system has been widely perceived as a predominantly technical endeavor, it is not sufficient and will not tackle the global challenges of sustainability. Because problems can’t be solved by using the same kind of thinking when they are created; contextually-designed
natural resources management strategies fundamentally require a shift in mindsets to design and follow more sustainable pathways. This requires transformative thinking and action. In view of ensuring sustainable natural resource management, the Knowledge Management and GIS Research directorate of WLRC has been striving for the last 10 years to create transformative knowledge and actors. The motto is ‘building knowledge bases and creating transformative knowledge and information to ensure natural resources sustainability’.

6.2. Generating knowledge sources and building knowledge bases

Knowledge bases are databases and/or information from which transformative knowledge can be created. Considering the importance of creating transformative knowledge, WLRC has been generating wide-spectrum of knowledge bases for natural resource management. The Centre has three major knowledge bases: Geospatial database (known as EthioGIS), Soil and Water monitoring database (known as SCRP database) and other ecosystem services monitoring databases. These knowledge bases have been flagship outputs for the Centre. Alike the other reporting years, building, updating and improving these knowledge bases had been among the core activities of the KM & GIS Research Directorate in the year 2019/20.

6.2.1 EthioGIS

Knowing the significance of establishing knowledge base for NRM, the then SCRP, a predecessor of WLRC, had established a national geospatial database, the first of its kind, known as Ethio-GIS. The first version (EthioGIS–I) was developed and released for public use in 1999. The database has been extensively used by a wide range of users for the last two decades. To fulfil the wide ranges of geospatial data needs in the country, WLRC and CDE have been improving and updating EthioGIS databases using the state of the art technologies (RS and GIS). The second version of EthioGIS was released in 2015 and the WLRC had planned to release the third version in 2019; but, due to continuous improvement and updating of EthioGIS with all its maximum capacity; the third version will be released in 2021.

In fostering the knowledge bases, the Centre has been doing various activities in the year 2019/20. The following are worth mentioning:

1) updating the geospatial layers already included in the previous versions of EthioGIS; e.g. producing LULC map of Ethiopia using Sentinel 2A for the year 2020;

2) creating new knowledge bases by identifying missing datasets from the previous versions. This could be done either by generating the new layers from scratch or by integrating existing datasets and creating new information set using modelling and spatial analysis techniques, e.g. producing soil erosion maps using modelling.
The importance of geospatial datasets and information sets as sources of transformative knowledge to tackle challenges of sustainable natural resources utilization has become very clear since the realization of EthioGIS database. However, building huge knowledge bases doesn’t mean anything unless the knowledge reaches to those who need it and bring impact and create a transformative society. Since 2015, WLRC has developed two data dissemination platforms; online and offline. Using the online system with user-friendly interface data dissemination web-platform called WALRIS, some aspects of the datasets could be accessible online and can reach a wider user. But it requires a broadband internet. The center had been providing the Ethio-GIS database to all users for free using CD’s and digital data storing devises, such as floppy and memory stick to encourage use of the platform, for over a decade. The later system uses external Hard disk or any digital data storing devices. But, for several reasons, such as security issues, large file size, the dissemination of some datasets demand special data-sharing protocols. As a result, the Centre has been providing some data to users after signing a user responsibility agreement. Based on the feedbacks obtained from the data users, the Centre tried to improve and develop its information-sharing and knowledge management systems. Some of the developed data and information sharing as well as knowledge management platforms are presented below.
6.3.1. SLMP-KMIS

Finalizing the knowledge management system (KMS)

It is known that knowledge in SLMP is managed in traditional manner. This affects the overall performance of the project from resource management and achievement perspective. To overcome this, they outsourced the project to WLRC. Then Knowledge Management System, which contains watershed management module, planning and achievement monitoring module, document management module, GTP monitoring module, Spatial Engine, Geonetwork, web based user manual and different systems that report aggregates from woreda to federal level were developed for SLM. The system performs more than collecting information and feeding it into a data-base. It ensures individuals at all levels of an SLMP office have access to the system and the information they need to accomplish their tasks while also helping the projects to fulfil overall goals. The access to the developed system has strict security procedure so that unauthorized access to the system is protected.

The system has to go through different stages before it becomes ready for use. One of this is to go through different testing stage. WLRC IT team is performing functionality testing, inter-operability, performance, scalability, reliability, component, integration, system, acceptance, stress, load and stability testing on the system. Based on the assessment made until now, the system has scored above the expected standard.

Conduct Training for the responsible units from the SLMPCU and received comments

- WLRC has conducted training for selected users from SLMP. In order to deliver the training the following activities were successfully conducted.

  - Training manual for system operators: Training manual with possible system troubleshooting techniques is provided for system administrators.
  - Training manual for end users: Training manual with sample data is prepared for the users, so that they can insert the data in the system with the procedures indicated to adopt themselves with the system.
  - System Training: If the end users are not trained on how to use the system, it is probable that the knowledge management will end up in going back to follow the old way. The training was conducted on some of fundamental points in the system like planning and achievement assessment and monitor.
  - Training assessment report: The team assessed the level of satisfaction and level of understanding.

Redesign the KMS based on comments from the training

Based on the feedback collected from the training the following activities were done at the planning and designing phases:

- efforts were made to improve the available dashboard for end users and decision makers, allowing them to plan, track, gather, monitor, visualise, analyse and export processes, and provide them with actionable insights.
- provided improved documentation that enables users to better utilise the system and developers and administrators to gain better insight in the system design and implementation.
Assessed the SLMPCU network and server environment for system migration:
System deployment goes through a standard procedure. One of the procedures is analysing the deployment environment and making the necessary recommendation for better performance and smooth transition of the system from development environment to the real environment, where users will be able to access the system. The following technical aspects were assessed and the necessary recommendations were given.

Assessed the network infrastructure: of the Ministry office where the KMS would be deployed, including hardware and software components in the ministry, regional and woreda offices. The hardware included switches, access points, and cables whereas, software included firewalls, applications, and operating systems. This has even lead us to change our deployment approach and enforced us to plan to develop offline version.

Assessed backup environment: WLRC has been conducted an inventory on the existing backup environment in the Ministry and made the necessary recommendation.

Assessed network cybersecurity vulnerabilities: Cybersecurity vulnerabilities can easily be taken as an advantage by hackers and malicious actors, with the intention of gaining access to the network. These vulnerabilities can exist in software and/or hardware. The WLRC team assessed how the network infrastructure in the Ministry collects, stores, and accesses confidential information.

Assessed network bandwidth demands: The available bandwidth that has greater impact on the success of the system in the ministry was assessed.

6.3.2 WALRIS

Finalised WLRC Website and uploaded and updated WALRIS: It is known that technological advancement is happening rapidly and, that demands continuous upgrading of WLRC’s communication platforms accordingly. WLRC website is one of the communication platforms we improved the interface by using the state of the art technology, which can be supported by any server, (especially on HostPpoint).

We shared data: primary and secondary as well as spatial and non-spatial data were given on WALRIS, freely to researchers and different interest groups. The weekly average number of viewers was 3026 (see Fig. 6.2).

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Figure 6.2. Demographic overview of WLRC website and WALRIS visitors
Monitored email flows, security of the website, WALRIS and other online systems: One of the day-to-day activities of the ICT unit is to monitor and take the necessary action on email flows, security of the website, WALRIS and other online systems. Accordingly, we did the following during the reporting period:

- monitored cyber threat that could have harmed the centre’s data;
- assessed our system’s vulnerability to any threat that could incur negative impacts on the centre;
- monitored the likelihood a threat could occur and data loss;
- followed system or application downtime and took the necessary remedy immediately.

protected the organization from impersonation, which is misuse of the Centre’s credentials, which are often acquired through social engineering attacks or brute-force attacks.

Participated in IATI training given by the Embassy of the Kingdom of Netherlands and completed the necessary registration for WLRC: IATI is an online platform used to publish reports. The team participated on the first training and made the necessary registration for WLRC.

Other WALRIS-related activities

During the year, the ICT team also did the following:

- develop online recruitment system for KILMWA Project to manage application and make the necessary filtration for screening job applications for KILMWA project;
- designed a project management system for KILMWA project, with the following basic features (see also Fig. 6.3):
  - enabling to organise activities at a glance within the allocated time;
  - powerful dashboard, using charts and calendar generated automatically from the system;
  - enables share collaboration within team members and make changes in real time;
  - manage photos and reports within the project;
  - helps to track progress and goals.

Figure 6.3. Project management system for KILMWA project
provided the following office technical support services to create smooth working environment for WLRC:

- checked the status of all systems software, application software and hardware;
- responded to help requests from staff members;
- installed and configured new systems software, application software and hardware;
- replaced malfunctioning or damaged hardware;
- learnt about updates and new technology and updated our computers when needed;
- managed and troubleshoot network problems; and
- supported the roll-out of new applications.

### 6.3.3. MAPSERVER

WLRC has been doing capacity development at various levels since its inception. During a series of training and consultation workshops, stakeholders clearly indicated that users were facing difficulties in getting the required data by using the existing data accessing options (WALRIS). Also the user requirement assessments conducted in 2018 revealed that much of the datasets were only accessible to officials. Moreover, the datasets in the EthioGIS package were not easily usable; they needed a moderate technical skill and strong internet connections. Besides, the Centre realised that the larger number of users of the database are government and public authorities and institutions, and they are more interested in getting cartographically designed and prepared digital or hard copy maps than the raw datasets. Drawing on those realisations, the Centre felt the need for two things: 1) preparing digital maps with all required thematic layers would be more useful so that non GIS specialists can exploit the benefits that could be obtained from the accumulated knowledge bases of the Centre; and 2) keeping information sets in a system that shall be easily accessed by the wide range of users was important. The Centre thus embarked on developing the MAPSERVER platform which can support activities aiming to acquire knowledge and information in the country (see Fig 6.3 for the interface).
The application contains three main web-based services that enable:

1) to access pre-processed maps,
2) map selected information layers using simple web mapping applications based on user preference; and
3) download open geospatial data.

The following are some of the major activities the we did in the year 2019/20 with MAPSERVER project:

1. revised and identified the main target groups/beneficiaries: “Ministries of the Ethiopian government, the development actors, NGOs working on humanitarian aid and the civil society”;
2. identified most relevant datasets that would be appropriate to the stated objective of the MAPSERVER platform;
3. host the platform in a more secure place as well as in an institution that has dependable and fast internet connection;
4. followed-up the download rate (addressing who downloaded for what purpose and how many users did download the data, what are the feedbacks?) All these were evaluated to take appropriate actions.

The main lesson learned through the implementation of MAPSERVER project is the indispensability of creating transformative knowledge and information by using well-designed and prepared digital maps that not only harness the sustainable management of rural resources but also assist humanitarian aid for refugees, war or conflict victim societies and environmental hazard victim communities.

### 6.3.4. Swiss Universities Development and Cooperation Network (SUDAC): Academy 2030

One of the challenges to achieve the SDGs is the problem in the way education is given to students at different levels. Academy 2030 aims to apply a didactic teaching approach to show the interactions among SDGs. The ultimate goal of the SUDAC (Academy 2030) project is to develop an online-teaching platform to enhance societal dialogue and support the implementation and mon-monitoring of the 2030 Agenda through collaborative partnerships between five Swiss higher education institutions and two partner institutions from Kenya and Ethiopia and their multi-themed and multi-stakeholder networks. The approach is simple: designing spatial data browser and viewer to visualise data concerning certain SDGs and to understand trade-offs and co-benefits within the land-conflict-health nexus.

In the year 2019, WLRC in collaboration with all its partners, framed to develop the envisioned web-based teaching platform. WLRC identified and elected issues taking Lege Denbi Gold mining project as show case for land use-health-conflict nexus. Furthermore, WLRC also provided useful spatial datasets and information that could show the SDG interactions using data and metadata already available from the Centre’s knowledge bases as well as data obtained from different institutions. A comprehensive literature review was carried out and numerous data were collected. Geotagging and collecting metadata of publications on land, conflict, and health were done. The collected data and reviewed literature were used to assess the interactions between the different pillars of the SDGs. We have planned to use them in the envisioned online platform teaching.
6.4. Outreach and communication

Uptake, use and impact of research and development undertakings and their results can be optimised through effective outreach and communication engagements. During the reporting period, WLRC had carried out a number of outreach and programmatic communication activities, the below listed being the most notable ones.

Knowledge sharing and contribution in policy development

Contribution to the Natural Resource Management (NRM) policy revision of the country: The agricultural and rural development policy that was developed and enacted by the Council of Ministers three decades ago was undergoing revision by the Ministry of Agriculture. One of the major gaps observed and identified by the Ministry was NRM policy elements that were not considered as one of the major pillars in the agricultural sector development, though huge investment was made towards NRM in the country for the last several decades. Cognisant of this gap, the NRM department of the MoA invited an expert from WLRC to contribute towards the revision of the NRM sub-section (pillar) of the Agricultural and Rural Development Policy. The Centre, using its huge database and experience, contributed in the write up of the policy imperatives and strategic issues of the NRM that would be implement over the next decades.

Seminars, Workshops, Conferences

During the year 2019/2020, esp. during the before-COVID-19 period, WLRC took part in a number of seminars and conferences. Notable among those were Kunzila ILMWA inception seminars with representatives of the funding agency, Assemblies on DAFNE project, GCRF-UKRI Consultation Workshop (November 18, 2019), GCRF-UKRI Water Security and Sustainable Development Hub partners meeting (February 22-29, 2020), and WLRC BoT Meeting (March 24, 2020). There had been many other seminars and conferences held virtually as the conventional fora were disfavoured to limit the spread of COVID-19.

DAFNE Project: Omo-Turkana Basins 2nd Negotiation Simulation Lab (NSL) meeting: The meeting was held in July 2019 in Addis Ababa, Ethiopia with 11 participants. The participants explored different pathways that were formed from the combined action points that had been identified in the first NSL and simulated on the main design indicators by the DAF model. A version of the multi-perspective visualization tool (MPVT), which mainly aimed to show the impact of the selected pathways on a larger number of indicators was presented to stakeholders. Although the full results were not yet available, the tool allowed the users to test its functionality on a sample of data. Dr Yilikal Anteneh from WLRC took part in the session and presented the scientific findings of the recent developments in Omo-Gibe Basin.

Took part in the DAFNE 4th General Assembly: DAFNE General Assembly, the highest decision-and strategy-making body of the project, composed of one representative per partner, ultimately validates the major decisions concerning the project, and issues concerning the proper operation of the consortium by meeting annually. Dr. Yilikal Anteneh from WLRC took part in the General Assembly held 9 – 11 September 2019 in Berlin, where different project-based decisions were made. He also presented results of Omo-Gibe basin NRM assessment study:

- flood-recession agriculture trend assessment and monitoring in the lower Omo basin
- environmental Situation assessment of the Delta Area in Lake Turkana since 2015
- water quality and Dam characteristics of Gibe III
Participated in and presented at the capacity building workshop on PES. The workshop was convened 28-31 October 2019 in Addis Ababa jointly by WRI, WLRC and the EFCCC and it take stock of existing PES schemes in Ethiopia and worldwide, map watershed dependencies, and examined lessons learned and enabling factors. Dr. Yilikal Anteneh represented WLRC and presented scientific results on PES. This activity responded to an appeal from the EFCCC to strengthen institutional capacity for developing and implementing PES in Ethiopia.

The participants were from the EFCCC, the Ministry of Water, Irrigation and Energy (MoWIE), forestry institutes, and regional environment, forest, and climate change commissions and agriculture bureaus, local and international research and donor institutions, and NGOs engaged in conservation and environmental protection. As the event also aimed to facilitate in-depth discussion and group work around planning for PES schemes in the two EFCCC priority sites (Koga and Kafa/Gojeb), a number of participants were invited from Amhara and SNNPR and from the surrounding zones and woredas. A workshop report providing a review of the event and sessions was prepared and presented for consultation. Dr Yilikal Anteneh took part in the session and presented the scientific results/findings of SWAT on...
“Modelling the hydrological processes, sediment yield and conservation scenarios of the Gojeb watershed, Ethiopia”

**Participated in the High-Level Meeting on Watershed Restoration for Energy and Livelihood Security, held at Kuriftu Hotel, Bishoftu, Ethiopia on 14 December, 2020.** A scoping project in the Gojeb River Watershed of Ethiopia’s Omo-Gibe Basin—jointly promoted by the Environment, Forest and Climate Change Commission (EFCCC), the World Resources Institute (WRI), and the Water and Land Resource Centre, Addis Ababa University (WLRC, AAU)—aimed to explore the conditions for a PES scheme based on water-related ecosystem services. One of the primary beneficiaries was the Gilgel Gibe III Hydropower Dam located downstream of the watershed. The preliminary biophysical and economic analyses were conducted in order to help the assessment of the risk, value, and opportunity of a PES scheme, relating to land conversions and estimation of sediment yield and runoff in the watershed, and a cost assessment of the potential impacts of sedimentation focusing on implications for reduced reservoir capacity and lost power generation at Gibe III. The aim was to provide insight on environmental degradation trends and whether the sediment-hydropower link warrants an intervention and financing of an upstream watershed restoration intervention by
dam operators and Ethiopian Electric Power.

In that meeting, WLRC was represented by Dr Yilikal Anteneh who participated in the session of Scoping a Payment for Ecosystem Services (PES) Scheme in the Gojeb River Watershed of Ethiopia and presented scientific results/findings of the various intervention scenarios of best management practices (BMP) to retain and capture sediments in upland areas before in fluxing into the Gibe III reservoirs.

**Participated in DAFNE Project: Omo-Turkana Basins 3rd Negotiation Simulation Lab (NSL) meeting:** The meeting was held on Sept 24-25, 2020, in a hybrid modality (i.e. both virtually & at Hyatt Regency, Addis Ababa). The partners and some of the stakeholders representing the Omo Basin met in a hotel in Addis Ababa in late September while the stakeholders and partners representing the Turkana basin joined virtually with the European partners. WLRC was represented by Dr Yilikal Anteneh who took part in the session and presented the scientific results/finding of the work accomplished in the Omo Basin, and findings from time-series monitoring of the situations of the Delta area in Lake Turkana.

**Trainings, product/service promotion, and on-site demonstration**

Most of WLRC efforts have relevance to grassroots application/practice, decision, policy and research in the areas of water and land resources management and development. But, much is technical and requires proper trainings and practical demonstrations served to the target beneficiaries. Accordingly, WLRC conducted trainings for selected users in the areas of knowledge management systems for sustainable land management (SLM). The list below outlines what went on during the year:

- prepared training manual with possible system troubleshooting techniques for system administrators;
- conducted training on the fundamental points in the system like planning and achievement assessment and monitoring;
- assessed an inventory on the existing backup environment and made the necessary recommendation;
- assessed how the network infrastructure in the ministry collects, stores, and accesses confidential information;
- availed different primary and secondary, as well as spatial and non-spatial data on WALRIS platforms for free for researchers and different interested groups; and
- made WALRIS easily accessible to viewers. As a result of this the average weekly viewers became 3026.

The outreach activities under the newly starting Kunzila ILMWA project are many and diverse. In fact, the architecture of this mega project dominantly requires outreach and grassroots communication effectively coordinated and monitored from above. Although the project was at its inception phase during 2019/20, a number of outreach activities were carried out alongside the preparatory phases. Here are some of them:

- **Strengthening/establishing WASH Management Structure:** Steering and Technical Committees were established at N/Achefer woreda and in seven kebeles of the project.
• **Establishment of nurseries:** sites were identified and discussions held with the kebele administrators and local communities in the six project kebeles. Land transfer, fencing, and purchase of some materials were done in three of the sites as well negotiations were underway for the remaining sites.

• **Establishment of scientific monitoring sites:** preparations were made for the establishment of scientific monitoring sites.

• **Quick-win development interventions:** promoting homestead fruit production is the most important of the many interventions planned to be undertaken in the project area. The following quick-win activities were carried out in the reporting period:
  
  o **Planting of fruit trees:** 8000 seedlings (5000 avocados and 3000 banana) were distributed to, and planted on homesteads of, 422 model farmers. Practical training was given to 113 model farmers on fruit tree planting and management, including avocado food preparations. Thirty-two development agents and Woreda Agricultural Development Office experts were also trained on the production, management, grafting, and the approaches and challenges of avocado and banana.

  o **Forage seed multiplication:** in order to create sustainable forage seed sources of Rhodes grass, Cow Pea, Lablab, *Trifolium* spp., Vetch, Desmodium, Pigeon pea for the upcoming
development intervention and SWC works, the project multiplied various grass and forage tree species on 120 hectares of land tentatively accessed from Hortic-park investment site.

- **Employment creation:** During the reporting period, temporary jobs were created for 398 people—280 engaged in weeding, 80 in planting, 13 in seedling management, 21 in loading unloading, and 4 in Guarding.

- **Brokered local peace and conflict resolution:** WLRC played roles in the settlement of the dispute between Hortic-Park and the community.

WLRC released MapServer, one of the tools to reach the non-professional group or policy makers to easily access and use readymade maps through the web but also at the same time to reach out and enable professionals prepare their own maps as well as make the necessary GIS-based analyses. We also disseminated all our knowledge products such as guidelines, research reports, maps to a range of stakeholders.

**Made a number of PPT presentations and briefings**

- PPT presentation on “Integrated Watershed Development in Abbay Basin for Enhanced Livelihoods of Communities and Addressing Sediment Challenges of GERD (One Plan One Report) (Dec, 2019 at Mekele in the 3rd annual stakeholders consultative meeting for GERD Public coordination)

- Presentation at GCRF meetings (several)

- Presentations for ILM in Abbay Basin, one plan one report initiative

- SLM KMI training for NRM experts of MoA.
7.1. General Introduction

As Douglas North and others have conceptualised it, institutions provide the permits, incentives and restraints that govern human behaviour and shape organisational culture. As such, institutions are much beyond organisations, and thus they matter a lot in determining both the present and future of an organisation, its employees and roles. Mindful of the indispensability of invincible institutions, WLRC undertook a range of institutional development activities mainly through the Executive Office and to some extent through the Centre’s other entities including Human Resources, Finance, and Administration; the technical divisions and cross-cutting functions.

The institutional development activities implemented during the reporting period focused on resource mobilization (including writing grant proposals and hunting for new grants and programs); building image and visibility (say through media engagements and corporate communication) of WLRC; ensuring the timely planning, monitoring and evaluation of activities; ensuring responsibility and accountability in works and resource management, esp. financial system health; networking and creating strategic partnerships, i.e. linking up (with the Board and other higher organs) and below (with the staff) and networking laterally with like-minded organisations. Other important institutional development activities during the year were aligning with and working through other institutions such as the MoA, MoWIE, EFCCC; human resource need assessment and staff development, staff wellbeing and safety (esp. in relation to responding to emergencies like COVID-19), maintaining and nurturing a healthy social and work environment, and providing guidance and oversight on the overall running of the Centre, by providing proper leadership and checking on the efficacy of the governance structure.

7.2. Institutional development and organizational strengthening

The institutional development efforts are largely linked to creating enabling environment for staff so that they focus on their job; engagement in mobilising resource to run the different activities of the centre (as the centre is entirely dependent on self-financing arrangement through national and international competitive project grants); outreach, networking and oversight of the overall functioning of the centre. The following are brief accounts of selected key institutional development activities accomplished during the reporting period.
7.2.1 Resource mobilization (including new projects)

As the year was where the eight years’ project supported by SDC was concluded, the management was aggressively working on mobilising additional resources through aggressive engagement of competitive project grants. Our efforts yield good results in few key projects such as Kunzila ILMWA (which is our current mega project). On some others, we are awaiting decisions. Table 7.1. describes the different projects we were involved in and their current status.

Table 7.1. Projects WLRC is involved in and their current status.

<table>
<thead>
<tr>
<th>No</th>
<th>Project name (short acronym)</th>
<th>Collaborators</th>
<th>Financier</th>
<th>Current status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>KILMWA (Kunzila Integrated Landscape Management and WASH)</td>
<td>SNV</td>
<td>The Kingdom of the Netherlands Government</td>
<td>Approved on March 2020, and baseline survey started</td>
</tr>
<tr>
<td>2</td>
<td>SUCCESS (‘Sustainable Utilisation and Conservation through Compensation for Ecosystem Services in Tekeze’)</td>
<td>HELVETAS and BDA of MoWIE</td>
<td>EU</td>
<td>Submitted and waiting for approval</td>
</tr>
<tr>
<td>3</td>
<td>PES-Gojeb River</td>
<td>CfEFCC</td>
<td>WRI</td>
<td>Approved and being implemented</td>
</tr>
<tr>
<td>4</td>
<td>SLM-KMIS</td>
<td>None</td>
<td>WB through MoA</td>
<td>Approved and being implemented</td>
</tr>
<tr>
<td>5</td>
<td>Biodiverse</td>
<td>CDE</td>
<td></td>
<td>Submitted</td>
</tr>
<tr>
<td>6</td>
<td>Trade-offs in SDGs</td>
<td>Wageningen University (lead) and many universities in other countries</td>
<td></td>
<td>Submitted</td>
</tr>
<tr>
<td>7</td>
<td>1000 Landscapes for one billion people</td>
<td>Eco-Agriculture (lead) and many international partners</td>
<td>Consortium of financers</td>
<td>Submitted</td>
</tr>
<tr>
<td>8</td>
<td>TRANFORM</td>
<td>CDE</td>
<td>SDC</td>
<td>Development ongoing</td>
</tr>
<tr>
<td>9</td>
<td>Training on Functions of Integrated Water Resource on the Basin Level, and Principles, Procedures, and Approaches of basin Planning and water allocation planning</td>
<td>None</td>
<td>MoWIE</td>
<td>Waiting</td>
</tr>
<tr>
<td>10</td>
<td>Land Consolidation in Ethiopia</td>
<td>CDE and GIZ</td>
<td></td>
<td>Development ongoing</td>
</tr>
<tr>
<td>11</td>
<td>Water Research Collaboration in the Eastern Nile</td>
<td>SIWI, Universities in Sudan and Egypt</td>
<td>SIDA</td>
<td>Seed money granted but project development stopped because of COVID</td>
</tr>
<tr>
<td>12</td>
<td>WATDEV</td>
<td>Many organizations in Italy, Netherlands, Kenya, Sudan and Egypt</td>
<td>The Italian Government</td>
<td>Submitted</td>
</tr>
</tbody>
</table>
7.2.2. Networking and strategic partnerships

This was also the year where arranged for the release of our MapServer application after getting clearance from the regulatory bodies in the government. MapServer is one of the tools to reach the non-professional group or policy makers to easily access and use readymade maps through the web but also at the same time to reach out and enable professionals prepare their own maps as well as make the necessary GIS-based analyses. Many of us in the centre also participated on different international forums, seminars and workshops as a resource person or participant.

Internationally, we tried to strengthen our network and partnership with our key partners such as CDE of University of Bern, Oxford University, Newcastle University, WRI, Eco-Agriculture Partners, GLP, and CETRAD from Kenya. Nationally, we strengthened our partnership with MoA, MoWIE, CfEFCC, Embassy of the Kingdom of Netherlands, Basin Development Authority and river Basin Development Offices, AAU and other universities and many of the regional governments.

7.2.3. Regulatory and Oversight functions

The regulatory frameworks such as the Human Resources, Procurement and Financial manuals had been designed to make sure they support efficiency (help save time and resources) and accountability. The management always tried to make sure that the regulatory body for each employee is not his/her boss but the work itself and the quality of their deliverables. This is the principle we followed in running the centre and its staff. This year also we followed this same principle and we were successful in many fronts.

7.2.4. Teaching and Supervision

Besides their research and development engagements at the Centre, many of the WLRC staff also made substantial contributions by teaching a number of graduate (MSc and PhD) courses at Addis Ababa University where they also supervised over 17 Masters and PhD researches and guided students in writing theses and dissertations. They also examined a number of theses and PhD dissertations, served in different technical committees in the University, and participated in community service activities.

These directly mean that WLRC is making multi-dimensional contributions to the socio-economic development, environmental well-being and human capital formation in the country, which in turn enhance the relevance and effectiveness of its work on sustainable integrated management of water and land resources.

7.2.5. Staff capacity development and engagement

The Centre has a long tradition of building internal staff capacity. In 2019/2020, it supported four post-doctoral research fellows, three doctoral students and let one of its staff enrol in a doctoral programme. All the fellows and the staff student were working and researching on themes related to WLRC’s research and development projects. Few other colleagues were allowed to attend their graduate studies under continuing and evening programs.

The post-doctoral fellows were actively engaged in field research activities of the projects they work on. Besides, in collaboration with other staff in the respective divisions, they wrote and submitted six
articles for publication in referred journals and extracted some research reports into five working papers. The PhD candidates prepared some articles for publication as part of the requirements to graduate with a PhD.

### 7.3. Human Resource and Administration including HR profiles

The quantity, quality and inspired engagement of human resources is one of the important determinants of institutional development and organisational effectiveness of any company, more so of organisations like WLRC, which does applied and action researches. In 2019/2020, WLRC, AAU had a total of 33 staff, composed of 24 (72.7%) males and 9 (27.3%) females. Among the staff, 13 (39.4%) are researchers or research managers with Ph.D. degrees and post-doctoral research fellowships; 33.3% are well experienced experts and researchers with Masters, and 9.1% of the staff held Bachelor’s degrees and 12.1% were with a diploma or less (Graph 7.1 and Table 7.2). About 55% of the staff were regular WLRC employees, while the remaining 45% were on project-based employment. Years of total work experience range from 10 years to above 35.

Job descriptions were developed and advertised on different media to invite applicants for many new job positions. Over 675 applications were processed to employ appropriate candidates for about 30 posts under the Kunzila ILMWA project, a PhD student and a PostDoc research fellow under GCRF and a Project Manager for REACH. Staff size had generally increased compared to the previous year.

![Graph 7.1. WLRC, AAU staff by qualifications, and sex](image)
### Table 7.2. Staffs of WLRC

<table>
<thead>
<tr>
<th>No</th>
<th>Name</th>
<th>Qualification</th>
<th>Position at WLRC</th>
<th>Contact address</th>
</tr>
</thead>
<tbody>
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<tr>
<td>No</td>
<td>Name</td>
<td>Qualification</td>
<td>Position at WLRC</td>
<td>Contact address</td>
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<td>29</td>
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<td>Diploma</td>
<td>Office Care I</td>
<td>+251-911309082</td>
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<td>HQ Program Manager (Kunzila)</td>
<td>+251-911424348 <a href="mailto:fekadu.g@wlrc-eth.org">fekadu.g@wlrc-eth.org</a></td>
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<td>Endager Getnet Yalew</td>
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<td>33</td>
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<td>+251-920249292 <a href="mailto:tekebaa.t@wlrc-eth.org">tekebaa.t@wlrc-eth.org</a></td>
</tr>
</tbody>
</table>

**7.3.1. Administration, event management and office regular duties**

Organisational efficiency highly depends also on the quality of the administration of staff and contracts, finance and property. Accordingly, employment contracts of the staff members were renewed upon discussions and mutual consent between the employees and the Centre and new contracts were prepared for new staff and promoted staff. Office and field vehicle rents were handled duly and regular office management activities done properly. Travels to the field and abroad were facilitated and monitored. Events facilitated, organised and managed during the reporting period include: the GCRF Consultation Workshop, November 18, 2019; GCRF-UKRI Water Security and Sustainable Development Hub partners meeting, February 22-29, 2020; and WLRC, AAU Board of Trustees meeting, March 24, 2020. Information and knowledge about WLRC, AAU and staff were documented, managed and archived properly.
8.1. General Introduction

In times of shifting funding priorities, mobilising financial resources increasingly testing the sustainability of many organisations, including those engaged in R&D. Not only that, also proper, transparent and responsible financial management is among the most important predictors of organisational health and firm growth. WLRC did a lot in resource mobilisation and optimum use of finance.

8.2. Fund Mobilization and Finance Use

WLRC takes fund mobilisation (mainly winning big grant) and efficient financial utilisation as its high priority strategic areas of institutional development. During the reporting period, conditions were facilitated for signing of new project agreements for Kunzila ILMWA and SUDAC-COFER Projects.

We had a very efficient financial utilisation. We also checked through documents and followed up day-to-day activities of the finance section, mainly budget transfer, payments, and posting. To promote transparency and accountability in finance use, receipts and financial reports were scanned and shared to donors every quarter for GCRF, REACH, REACH Ground Water and SUCCESS Projects; and so was annual financial report (Jan – Dec. 2020) on CABI - R4D Project.

8.3. Audit

A timely and independent financial audit is one of the key steps organisations and consoling agency take to check whether financial management and use follow predefined, agreed upon and acceptable standard procedures, rules and practices. Financial audit results are among the key indicators of the status of organisational health and the future of organisations. Aware of such a tremendous importance of financial inspection, WLRC initiated and facilitated for a timely and independent audit of its financial management and use during the reporting period.

By the end of the reporting period, WLRC, AAU received and managed 72,969,332.71 ETB in project grants and spelled expenditure of 29,841,471.65 ETB. Its balance by the end of the reporting period was 59,594,740.61, including ETB 16,466,879.55 brought forward from the previous year.
The audit results established clean status of WLRC in the management and use of finance. We have also received useful pieces of advice on how to further improve documentation and posting.
8.4. Publications

**Valuing Science**


**Water Resource management for Sustainable Development**


**Research for Transforming Environments and Livelihoods: Exploring the Frontiers of ILM**

Governance and SE for NRM


Transformative Knowledge for Water and Land Resource Development

Publications from REACH project


Vivid Economics, 2016. Water resources and extreme events in the Awash basin: economic effects and policy implications, report prepared for the Global Green Growth Institute, April 2016


Research brief: Hydro-climatological analysis for Wukro and implications for water management, Aug 2018

Webinar on Small town WASH services: meeting the needs of the urban poor, Apr 2018: https://vimeo.com/265380294

Poster UNC Water and Health Conference, October 2018: Recognising the needs of the poor in small town WASH. Charles, Grasham, Doss, Johnson, Korzenevica- Proud, Godfrey & Alemseged


Blog on Where will you get your water today? Sep 2016 https://reachwater.org.uk/where-will-you-get-your-water-today/


