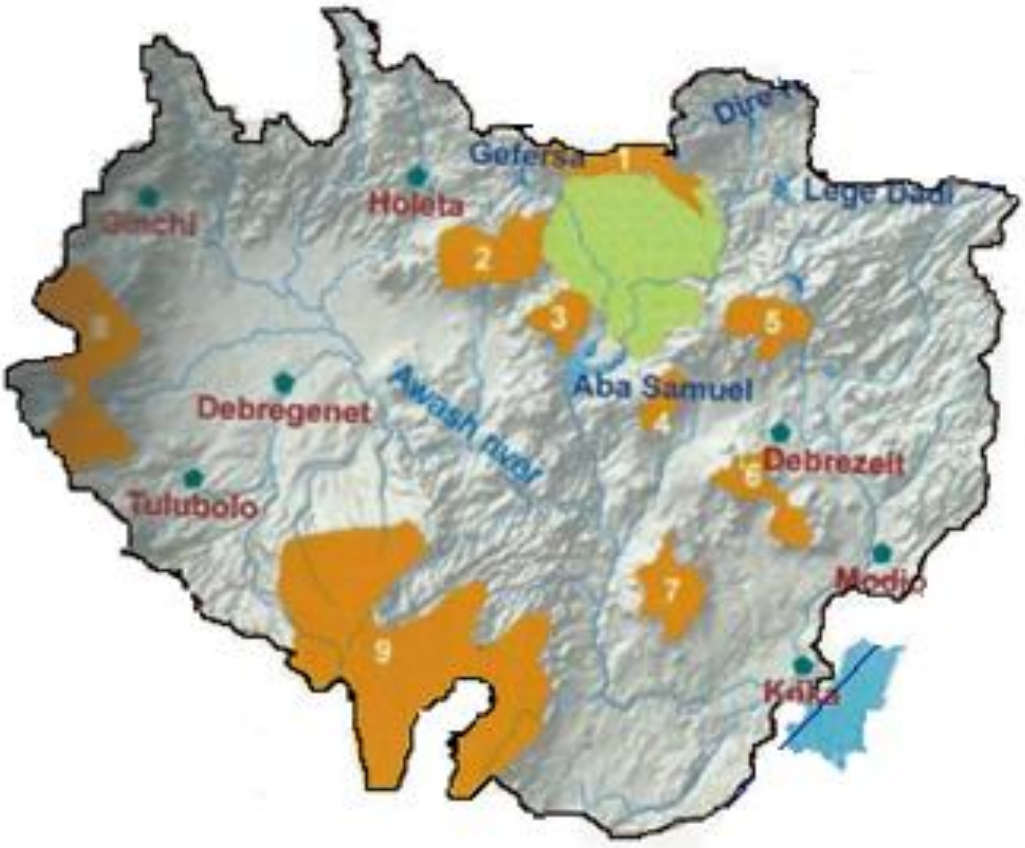
Background Information for a Program Approach

Challenges and Possible Cooperation between Dutch and Ethiopian counterparts



Integrated Water Resource Management

Upper Awash River Basin, Central Ethiopia

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waterschap Hollandse Delta
leefbaar land, leefbaar water

Velt en Vecht

WATERSCHAP ZUIDERZEE LAND

List of abbreviations and acronyms

AAEPA	Addis Ababa Environmental Protection Agency
AAWSA	Addis Ababa Water Supply and Sewerage Authority
ARBA	Awash River Basin Authority
BOD	Biological/Bio-chemical Oxygen Demand
CSA	Central Statistics Agency
EcoSan	Ecological Sanitation
EEPA	Ethiopian Electric Power Agency
EEPCO	Ethiopian Electric Power Corporation
EIA	Environmental Impact Assessment
ENGDA	Ethiopian National Ground water Database
EPA	Environmental Protection Agency
EU	European Union
EUWI	European Union Water Initiative
EWWCE	Ethiopian Water Works Construction Enterprise
FEPA	Federal Environmental Protection Authority
GDP	Gross National Product
MoH	Ministry of Health
MW&E	Ministry of Water and Energy
MoWR	Ministry of Water Resources
NGO	Non Governmental Organization
OEPLAUA	Oromia Environmental Protection and Land Administration and Land Use Authority
ORHB	Oromia Regional Health Bureau
OWMEB	Oromia Water Mineral and Energy Bureau
PET	Potential Evapo-Transpiration
TWSSEs	Town Water Supply and Sewerage Enterprises
UARB	Upper Awash River Basin
UNICEF WES	Untied Nations International Children's Emergency Fund Water and Environmental sanitation
VEI	Vitens Evides International
WSHA	Waterschap Hunze en Aa's
WSHD	Waterschap Hollandse Delta
WSVaVe	Waterschap Vallei and Veluwe
WSVeVe	Waterschap Velt en Vecht
WSZZ	Waterschap Zuiderzeeland
WWDDE	Water Well Drilling Enterprise
WWDSE	Water Works Design and Supervision Enterprise

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CHAPTER 1

1 Introduction

1.1 General

1.1.1 Objective

Ethiopia is one of the 15 core countries of International Development Cooperation of the ministry of foreign affairs in the Netherlands. Additionally it is one of the focus countries of 'Water Mondiaal' of the program 'Partners for Water'. The Partners for Water program has been commissioned by the Dutch Ministries of Economic Affairs, Agriculture & Innovation, Infrastructure & Environment and Foreign Affairs. The program is coordinated by NL EVD International (identifying and providing financial support to projects abroad) and the Netherlands Water Partnership (strengthening cooperation in the water sector).

A Dutch consortium has been established in order to work together with Ethiopian counterparts on Integrated Water Resource Management in the Upper Awash River Basin. This report gives background information about challenges and possible cooperation and will be used as input for setting up a program approach. With this program approach a coherent framework is aimed to be achieved for long term water cooperation (Ethiopian-Dutch) in the Upper Awash River Basin. This will facilitate the bundling of organizational capacity, long term coordination of activities, synergy capacity building (program level) and concrete activities (project level) and networking.

1.1.2 Dutch consortium

The Dutch consortium consists of:

- **5 water boards including:**
    - Waterschap Hollandse Delta
    - Waterschap Hunze en Aa's
    - Waterschap Vallei en Veluwe
    - Waterschap Velt en Vecht
    - Waterschap Zuiderzeeland (lead partner)

  Dutch waterboards are public governments next to the national government, provinces and municipalities. Water boards are decentralized governmental institutions with their own democratically elected board and own taxes to manage water within their districts.

- **Vitens Evides International**

  The drinking water company Vitens Evides International, based in Utrecht, offers local water companies technical, operational and management support, both in the short term

and longer term. The aim is to help water companies to become financially more healthy and to operate more efficiently with a minimum of water loss and non-revenues. In this way, Vitens Evides International is able to contribute to the improvement of drinking water supplies and sanitation in developing countries.

- **MetaMeta**

  The NGO MetaMeta, based in Wageningen, provides research and consultancy services in water governance, and offers specialized communication products geared to the international resource management & development sectors.

- **Water Governance Centre**

  The Water Governance Centre, based in The Hague, is a networking organization that aims to strengthen the role of water governance in water issues both in The Netherlands and abroad.

- **UNESCO-IHE Institute for Water Education**

  The UNESCO-IHE Institute for Water Education, based in Delft, carries out research, education and capacity building activities in the fields of water, environment and infrastructure.

1.1.3 Motivation

The Netherlands is internationally known for its knowledge about water management. The Dutch water boards signed the Schokland declaration in 2007 in order to contribute to the Millennium Development Goals. The consortium intends to increase international cooperation between the Dutch water sector and public institutions abroad.

1.1.4 Vision/Expectations

Long term vision: The first element of the program approach is a long term approach over a period around 10 - 20 years.

Cooperation: It should facilitate cooperation between Ethiopian organizations and institutional platforms, like between different states (Addis Ababa and Oromia) and between the water sector and related sectors in order to face challenges.

Decentralization: It should strengthen the process of decentralization and thus connect the central and local level.

Sustainability: For long lasting results.

Demand driven: Assessments and mutual accepted projects are needed.

Integrated Water Resource Management: By using a Catchment Approach.

Capacity building: As the employees of the different partners are known for their knowledge the consortium wants to contribute with Capacity Building rather than financial aid. Capacity building is also referred to as capacity development is a conceptual approach to development that focuses on understanding the obstacles that inhibit people, governments, international organizations and non-governmental organizations from realizing their developmental goals while enhancing the abilities that will allow them to achieve measurable and sustainable results.

Knowledge exchange: The program will focus on knowledge exchange between both Ethiopian and Dutch counterparts instead of the traditional one dimensional knowledge transfer. Cultural factors, different approaches and variation of circumstances influence working conditions. This is important for the Dutch and Ethiopian counterparts in order to develop new competences and space for innovation at both countries.

Topics: Within the program we want to focus on capacity building and knowledge exchange on the following topics:

- Integrated Water Resource Management using a Catchment Approach;
- Decentralized Governance;
- Drinking Water and Sanitation;
- Waste Water Management
- Water Quality and Emission Reduction (surface water and drinking water);
- Urban Water Management.

1.1.5 Benefits/Added value

- Coordinated approach: The activities will fit within a coherent framework and will give synergy between both Dutch and Ethiopian long term priorities, themes and activities.
- Coordinated approach: Collaboration between organizations to create added value through cooperation and networking.
- More success in acquiring funds (faster response, stronger consortia, better embedded in Ethiopian context and need).
- Focus on program level is on capacity building (‘building blocks’): This will ensure preconditions for activities on project levels.

1.1.6 Proposed Ethiopian Partners

Possible partners could be:

- AAEPA
- AAWSA
- ARBA
- EPA
- Local health offices
- Municipalities (Adama, Bishoftu)
- MW&E

- OEPLAUA
- OWMEB
- TWSSE's in Oromia (like Adama TWSSE, Bishoftu TWSSE, and others)
- Ripple

1.2 Ethiopia

Ethiopia, with a total area of approximately 1.13 million square km, is a landlocked country bordered on its western side by South Sudan, eastern side by Somalia, to the South by Kenya and to the North by Eritrea. It is the second most populous nation in Africa, with over 82.95 million people, according to the World Bank in 2010. Life expectancy is very low at about 56 and 59 for men and women respectively.

Ethiopia is often called the water tower of Northeast Africa. It has 12 catchment areas , 8 of which are River Basins, 1 Lake Basin and 3 Dry Basins. Almost all of the basins branch out from the central ridges that separate the Rift Valley from the highlands of Ethiopia to all directions out of the country. Rivers originates from the eastern part of the country drain in to the Indian Ocean while those originate from the western part drain into the Mediterranean Sea Basin.

The Awash River Basin is one of the 12 river basins of Ethiopia and found in the Oromia region. The Awash River Basin is situated in the central-east part of the country, between 8° 5' and 12° N and approximately 38° and 42° E. The Awash River Basin rises at an elevation of 3000masl over the central highland of Ethiopia about 150 km west of Addis Ababa and has a drainage area of 0.11 million sq. km. The river flows generally north eastwards along the Rift Valley and terminates in Lake Abe at an elevation of 250 masl near the Djibouti border.

1.3 Physical characteristics of UARB

1.3.1 Location and size of the Upper Awash River Basin

The location of the program area is in Upper Valley from Headwaters up to Koka Dam (3,000-1600 meters elevation). This sub basin is also called the Koka basin. The size of this catchment is about 10,841 square km. The basin is delimited on its western side by the Abbay River basin, to the south-west by the Omo-Gibe and Rift Valley Lakes Basin and to the south-east by the Wabi Shebele River Basin.

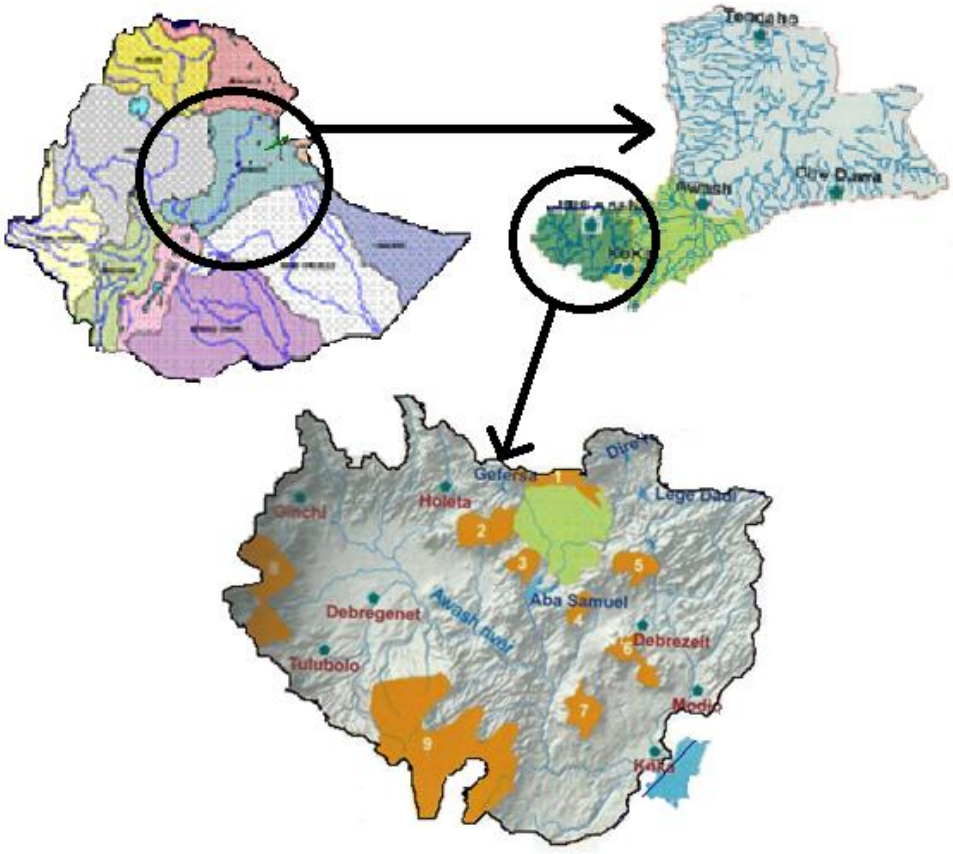

Figure 1:1: Map of Ethiopia, Awash River Basin and Upper Awash River Basin

1.3.2 Climate and Hydrology

The altitude of Upper Valley of the Awash River is about 3 km. and rises on the high plateau to the west of Addis Ababa. There is large elevation drops from western and northern part of the Upper Awash River Basin to its southern side. The total drop in elevation is above 1400m in a 100km distance from north to south. The Awash River first flows to east draining the Becho plains and then joined by a number of tributaries before it enters to Lake Koka. The major tributaries upstream of the Koka reservoir include Kebena, Great and Little Akaki and Mojo Rivers.

Generally, plateaus between 3000m and 2,500m receive 1,400 - 1,800 mm yr-1 and regions with altitudes ranges from 1600 to 2500m receive 1 000-1 400mm yr-1.The rainfall distribution is bimodal in this region, with a main rainy season from June to September and the short rainy period in March and April.

Although the rainfall intensity is high in the region, the potential evapo-transpiration (PET) in the Upper Valley is higher, for instance at Koka is 1810 mm almost twice of the annual rainfall.

The Koka Dam (11500km^2) was built in 1960. Mean annual runoff which enters to Lake Koka is approximately about 1660Mm^3. The mean annual stream flow is 1.9 m s^{-1} and mean annual temperatures range from 20.8 ^{o}C to 29 ^{o}C at Koka.

1.4 Environmental and Socio Economic conditions of UARB

1.4.1 Land use and population

In Ethiopia all land belongs to the government. Most part of the Upper Awash River Basin is urbanized and industrial. The main types of industries in the region include tanneries, steel, food and beverages, plastics, chemicals, pharmaceuticals and papers. Most of the mountainous areas of the basin are covered by forest. Large part of the basin is also used for agricultural purpose especially during the rainy season because of higher rainfall intensity. Main crops grown are teff, beans, wheat, barley and oil seeds. Other commercial farms produce fruits and vegetables.

The capital Addis Abeba is situated in the Western part of the Upper Awash River Basin. The urban population of Addis Abeba has grown from 0.5 to 3 million from 1950 to 2008, and is expected to rise to between 4.5 and 7.5 in 2030.

The total population of Oromia National Regional State was 27.16 million according to CSA, 2007. This number is 37% of the total population of the country. This number was projected to be 30.4 million according to the population and housing census report 2011.

1.4.2 Water and wastewater uses

In general the Oromia region is primarily an agrarian economy. According to the Oromia National regional state program of plan on adaptation to climate change report, 2011 agriculture, services and industry account for about 70%, 24% and 6%, respectively, of the regional GDP. The industrial water consumption in the Upper Awash River is enormous. Although ground water was not considered for irrigation developments due to the high investment and operational costs, at present quite large number boreholes are under construction in this area for irrigation purposes. Industries and agriculture are competing over water and are important stakeholders relation to water consumption and water pollution.

There are two dams in the Upper Awash River. The Aba Samuel dam was built in 1939 on the Upper Awash for electric generation. The Koka dam was built in 1960, also on the upper Awash, used not only for electric generation but also for irrigation development. Wastewater reuse, for instance urban wastewater from the city of Addis Ababa, is extensively used by poor people for vegetable production. High urban population growth is observed on the Upper Awash River Basin in the last decade. If it continues the similar fashion competition for water will increase and certainly use of (waste)water will expand.

1.4.3 Human Health and Ecology

Food shortage and poor economic performance results the low health status of the population of the Oromia region. In addition, lack of potable water supply and access to sanitation are other important factors which are considered for the negative health impact of the population.

Some of the common diseases which exist in the region include:

- ✓ Malaria
- ✓ communicable diseases [1] originating from waters and vectors[2] causing diarrhoea
- ✓ HIV/AIDS
- ✓ Schistomaisis
- ✓ Goiter, etc.

Malaria is one of the world most serious and complex public health problems. This is not any different for the Oromia region. Malaria is one of the region's foremost health problems concern. In Oromia region, prolonged droughts and increased temperature hazards led to increased distribution of the malaria-bearing mosquitoes and other vector-borne diseases, incurring health disaster to the poor and vulnerable rural farming communities to diseases. As of Oromia Regional Health Bureau five years report 65% of Oromia's population was troubled by malaria with 1 million clinical cases every year. Three quarters of the total landmass of the region, over 80 percent of the woredas are affected by malaria, and more than 19 millions of the total population in the region are at risk of malaria infections.

According to the Oromia National Regional State Program of Plan on Adaptation to Climate Change report 2011, in 2007, an Acute Water Diarrhea (AWD) out - break happened in 8 zones of the region and 3414 persons were affected and 68 were decased. The problem was caused by poor sanitation, water shortage and the use of polluted flood water.

The region has a total of 49 hospitals, 1,013 health centers, 259 health stations and 5,934 health posts. The potential health service coverage of the region in terms of health centers and health posts were 88% and 91%, respectively, by the end of 2008.

Based on the Oromia National Regional State Program of Plan on Adaptation to Climate Change report, intensive efforts were made by the regional government, resulting in the improvement of the health coverage of the region from its level of 53% in 2004 to 82% in 2008 (ORHB, performance report, 2010).

1.4.4 Socio-Economic conditions

A survey of the downstream population shows that people utilizing the Akaki River for drinking water purposes spend about 610 Birr/yr per household on health care, mainly for the control of

[1] A communicable disease is carried by microorganisms and transmitted through people, animals, surfaces, foods, or air. Communicable diseases rely on fluid exchange, contaminated substances, or close contact to

[2] From the perspective of infectious diseases, vectors are the transmitters of disease-causing organisms that carry the pathogens from one host to another.

water related diseases (OEPLAUA, 2004). This is a significant amount in comparison to the average yearly income of 950-1000 Birr/person in Ethiopia. Additional high financial losses also result from death and general poor health of the cattle and low milk production. Furthermore, as a result of the widespread health complications in the human and cattle population, it has become a requirement to hire farm labor and cattle, at a cost of 10 birr/day and 700-800 birr/ox/yr, respectively.

CHAPTER 2

2 Water Governance

2.1 General

According to the EUWI report (2006) on governance, "Governance is defined as the exercise of economic, political and administrative authority to manage a country's affairs at all levels. It comprises the mechanisms, processes and institutions, through which citizens and groups articulate their interests, exercise their legal rights, meet their obligations and mediate their differences". Water governance in this context refers to the range of political, social, economic and administrative systems that are in place to develop and manage water resources, and the delivery of water services at different levels of the society. Sustainable development of water resources and effective governance are inseparable.

Several systems exist to regulate the development and management of water resources and provision of adequate, safe and reliable water supply services. The fact is that inadequacies and incompetence of institutional arrangements and legal frameworks do seriously affect water governance. The weaker the stance of water governance, the deeper is the crisis in water resources management and development. Governance generally embraces the entire framework of a decision-making process. It stipulates who makes what kinds of decisions, when, and according to what criteria, norms and operational values. Such decisions range from those that are made at lower governmental institutions, which mainly deal with day-to-day operational and functional issues, to those that are made at higher levels.

Successful implementation of water policies, strategies, programs and projects are dependent on all the stakeholders working at different levels. These are stakeholders sharing a common vision regarding sustainable development and management of water resources. Effective governance can only be then realized through the existence and proper functions of relevant public, private, NGOs, international development partnering agencies and community based organizations. Integrated Water Resource Management on a program level can help to create correlation between various stakeholders and projects in order to increase effectiveness of taken measures and actions.

Presently there are several institutions, organizations and agencies or authorities in the Upper Awash River Basin that have the mandate and responsibilities for water resource management. This is an opportunity for the sector. However, sometimes this situation creates conflict of jurisdiction and inter-institutional rivalries which often hinder and slow down the rational use, development and management of the basin water resources. It becomes, therefore, indispensable that modern legislative processes are put in place, a precise definition of the relationship between the different Federal Ministries, authorities, agencies, institutions and organizations and regional bureaus.

2.2 Institutional Framework

The institutions that exist at federal level are directly or indirectly involved in the development and management of water resources. The institutions that are to be mentioned in this regard are:

- Ministry of Water and Energy (MoWR)
- Ethiopian Electric Power Corporation (EEPCO)
- Ethiopian Electric Power Agency (EEPA)
- Ministry of Agriculture and Rural Development (responsible for small-scale Irrigation)
- Ministry of Federal Affairs
- Ministry of Health
- Environmental Protection Authority
- Ministry of Infrastructure
- National Meteorological Service Agency
- Ministry of Mines and Energy
- Geological Survey of Ethiopia
- Water Resources Development Fund Office
- Ethiopian Social Rehabilitation and Development Fund (engaged in water supply and small-scale irrigation development activities)
- Addis Ababa Water supply and Sewerage AuthorityWater Works Design and Supervision Enterprise (WWDSE)
- Ethiopian Water Works Construction Enterprise (EWWCE)
- Water Well Drilling Enterprise/WWDDE)
- Awash Basin Water Resources Management Authority

2.3 Challenges

- Ensuring that the Upper Awash River Basin water resources management is strategically directed, supervised and integrated with other social, economic and environmental sectors.
- Ensuring effectiveness of the water policy and the legislative framework already put in place by allowing people and competent organizations to be involved in development and management of water resources.
- Ensuring Upper Awash River Basin functional and operational full capacity as it is planned, designed and formulated in the water act (facilities, staff, budget, strategic planning, financial management). : Identifying problems and constraints of policy implementation, and knowing what aspects of the policy have been implemented efficiently and effectively: and suggesting possible recommendation.
- Ensuring fast and accurate water sector basic information for strategic planning and governance of water resources in the basin.
- Encouraging and capacitating private institutions that are involved in the development and management of water resources in the basin.
    - Encourage participation of the public.
    - Improve an integrated management information system (MIS).

- Improve Legislative aspects:
  - Sectoral nature of legislations;
  - Gaps in existing environmental legislation;
  - Lack of water quality standards.

- Improve institutional capacity:
  - Management issues;
  - Coordination;
  - Institutional stability;
  - Distinct mandates.

- Capacity and financial assistance.

2.4 Ongoing Projects

2.5 Possible areas of cooperation

- Introduce Integrated Water Resource Management on a program level in order to create clear correlation between different stakeholders and projects to increase the effectiveness of these projects.
- Enhance implementation capacity programs.
- Capacity building within water systems operation, water use monitoring and management, Basin Authority Institutionalization, strategic planning, financial management and improved governance of water were spotted as possible areas of cooperation.
- Develop a Management Information System (MIS) in the water sector (both in quantity and quality). This should include data collection, monitoring, processing and dissemination to the water sector (i.e. creating platform for sharing information and knowledge establishment of new and capacitating of the existing training center)
- Create new and capacitate water sector training centers.
- Improve knowledge generation, distribution and awareness creation programs in the basin.
- Capacitate the private sector within the water resource development.

CHAPTER 3

3 Water Supply

3.1 General

All of Addis Abeba surface water sources for water supply are reservoirs situated in rural landscapes. Water is being supplied from three reservoirs (80%) and one well system (20%) with a total volume of 210,000m 3 day $^{-1}$ or 77 Million Cubic Meters (MCM) yr-1. The reservoirs supplying Addis Abeba are called Legadadi and Dire Dams (~30km Northeast of Addis Ababa), Gafersa Dam (~20km Northwest of Addis) and the Akaki Wells (10km South of Addis Ababa). The reservoirs are fully allocated for water supply to Addis Ababa and all the available water is being used. In the last 15 years, little capital investments were made in urban water supply, As a result, water demand in Addis Ababa has remained suppressed, with a current supply demand gap of about 40-50% (World Bank 2005, Tekle 2008). Although plans were made to start withdrawing water from the neighbouring Abbay Basin by constructing two dams, called Sibilu and Gerbi Dam (30km North of Addis Ababa) (Tahal, 2005), there is no activity observed for realization of the project.

3.2 Stakeholders in the Water Supply Implementation

- **Ministry of Water Resources**: coordinates programs, evaluate and monitor the implementation, respond to questions related to policy and capacity building and search for finance. In general it will closely follow up the program and take the necessary corrective measures for a better implementation of the program.

- **Water Resources Development Fund**: appraises the water and sanitation projects of towns that are identified as capable of implementing the cost recovery principle, sign loan agreement with towns that fulfill the requirements. Upon entry to implementation, it will provide loan for the execution of the projects, follow up the implementation, and make sure the loan has been refunded on its maturity date. In general, it will administer the finance of water and sanitation projects that will be implemented through cost recovery principle.

- **Regional Water Bureaus**: have the responsibility of preparing and administering programs, coordinating the projects in their respective regions, follow up and evaluating their implementation. Regional water bureaus also have the responsibility of encouraging and coordinating contractors and building the capacity of water boards. They will also support boards by designing and appraising business plans for towns.

- **Town Water Boards and** Water Supply Utilities (Addis Ababa Water Supply and Sewerage Authority, Adama Water supply and sewerage Authority, Bishoftu Water supply office): will prepare the business plan and administer the water schemes. They

also sign different agreements to improve water and sanitation services. They are also expected to prepare town business plans and monthly reports of project implementation processes.

- **Town water service providers**: is an institution with a legal status headed by an autonomous general manager who is accountable to the Town Water Board. They are in charge of operating water supply systems and signing agreements with the Water Resource Development Fund. Effectiveness of the water and sanitation services of towns is expressed through the strength and efficiency of these bodies.

3.3 Challenges

- Ensuring water use efficiencies in all water consuming sectors.
- Improving the harmonization and coordination among the institutions involved in water supply sector.
- Ensuring fast and accurate water supply information for efficient and effective water allocation for users and for planning.
- Ensuring an enabling environment for operation and maintenance capacity of utilities.
- Increasing water supply coverage for rapidly expanding and growing towns and making the society benefit from water supply and sanitation services.
- Building capacity of consultant engineers and contractors in the sector.
- Ensuring appropriate effective asset management strategies.
- Ensuring efficient and effective bill collection system for effective and full cost recovery
- Ensuring skilled manpower for the critical issue of all sector institutions. Every regional government has identified this constraint as most limiting to the fulfillment of its five years plan. Moreover, inadequate office and shop facilities, insufficient vehicles and enabling environment are also some of the elements of capacity problem.
- Securing and raising funds/budget for capacity building and construction, a maintenance of water schemes : Water sector development projects require high level of investments. Lack of sufficient funding has imposed limits on the quantity and quality of outputs & services of the sector.
- Standardizing equipments: Several NGOs participate in constructing and developing water supply schemes mainly for the rural communities. These NGOs bring numerous types of pumps and generators in the projects undertaken by them. In the process of operation, when the equipments fail to function obtaining spare parts is getting difficult. Hence, setting standards in the types of equipments to be used in water sector projects that will be undertaken by NGOs appears to be necessary.
- Increasing Community Participation: Community participation in project identification, construction, operation and maintenance of schemes is low. For water sector development activities to be effective, obtain adequate commitment from stakeholders, and securing socially acceptable action, participatory and consultative approaches need to be adhered.

- Increasing capital investments: In the last 15 years, little capital investments were made in urban water supply, As a result, water demand in Addis Ababa has remained suppressed, with a current supply demand gap of about 40-50%.

3.4 Ongoing projects

- In Bishoftu and Mojo additional boreholes are under construction to alleviate the water shortage problems due to rapid population growth and expansion of industries in these towns.
- The Ada'a and Becho project: In this project 150 new boreholes are under construction for the purpose of irrigation.
- Plans exist to start withdrawing water from the neighboring Abbay Basin by constructing two dams, namely Sibilu and Gerbi Dam (30km North of Addis) (Tahal, 2005).

3.5 Possible areas of cooperation

- Improve water use efficiencies in all water consuming sectors.
- Improve the harmonization and coordination among the institutions involved in water supply sector.
- Establish fast and accurate water supply information for efficient and effective water allocation for users and for planning.
- Create an enabling environment for operation and maintenance capacity in the utilities .
- Increase water supply coverage for a rapidly expanding and growing towns and make the society benefit from water supply and sanitation services.
- Build capacities of consultant engineers and contractors in the sector.
- Establish effective asset management strategies.
- Develop efficient and effective bill collection system.
- Improve manpower for the critical issue of all sector institutions.
- Secure and raise funds/budget for capacity building, construction and maintenance of water schemes.
- Improve community participation and awareness.

CHAPTER 4

4 Water Quality

4.1 General

The Awash River Basin is the most utilized and developed basin in Ethiopia so far. As a result of enormous industrial and agricultural activities in the Awash Basin, Awash River is the most polluted river in the country. On top of this, the limited capacity to enforce laws and regulations concerning the protection of the water quality of the rivers has exacerbate the problem (Teklehaimanot, 2005). Different studies and reports clearly show the headwaters of the Awash River which are located in and around the capital city of Ethiopia, Addis Ababa, are heavily polluted from domestic, commercial and industrial discharges. One of the major problems of the availability of sufficient clean water is the pollution of water bodies by contaminants from different sources. In addition to the industrial and agricultural purposes, Awash River is used as a drinking water source for the city of Adama and other rural towns within the basin. Adama, better known as Nazret, is one of the very populated cities in the Oromia region with a population of more than 415,000 people. Unless protecting measures of surface water quality are undertaken, the polluted rivers will probably contaminate the ground water, which is the main drinking water supply source in most of the Upper Awash River Basin (UARB).

4.2 Drinking water quality

The concentrations of fluoride at the upstream of Adama are acceptable by WHO standards. For this reason upstream of Adama is the main source of drinking water for several cities, such as Addis Ababa, Debre Zeit and Modjo, and various rural areas. In the past ground water was the water supply source for the city of Adama, but it is no more used due to its negative impact on the public health as a consequence of high fluoride concentration present in the bore holes. The Awash River is prone to various types of pollution with wastewater, of which most originates from the urban agglomeration of Addis Ababa, but is still being used as a drinking water source for the city of Adama.

4.3 Water quality for agricultural purposes

Farmers inside and downstream of Addis Ababa are depending on water that originates from urban drainage and wastewater generation. The cultivated area in and around Addis Ababa that is being irrigated with (a mix of stormwater and) wastewater is estimated approximately 400 ha (Kebede, 2008). This area is in use by farmers that are registered at the bureau of agriculture. It is assumed that total irrigated area (including all peri-urban lands) is much higher.

In the agricultural sector, pesticides in drainage waters and obsolete stockpiles can threaten the aquatic environment and human health (PAN, 2006). The Akaki River is an important source of

water for small scale farmers in and around Addis Ababa who are producing vegetables and fodder for livestock.

4.4 Surface water quality

Various studies clearly point up the Awash River basin and the Rift Valley Lakes have severe water quality problems. The Awash River is exposed to almost all types of pollution from the headwaters. The Akaki River is one of the tributaries of the Awash River. The Little and Great Akaki rivers which converges at the Aba-Samuel lake are the two major branches. The little Akaki, western side of the river begins from the Wechacha mountain (north-west of the basin) flows 40 km before it joins the lake. The Great Akaki river, eastern side of the river, rises north-east of Addis Ababa and joins the reservor after 53 km. Most of the industries in Ethiopia are situated in Addis Ababa. Majority of the industries discharge their effluent to the Akaki River without any treatment. In addition quite large part of the urban waste (both domestic and commercial) from the city of Addis Ababa without being treated ends at the Akaki River. These pollution sources together with contamination of leachate from solid waste alter the quality of the river to that of raw sewage.

Another main tributary of the Awash River is Mojo River. Many industries, tanneries in higher number, belong to Mojo town. Like that of the industries in Addis Ababa these industries dispose their effluent to Mojo river and then to the Koka lake without appropriate treatment.

Previous investigation showed higher level of nitrate (>10 mg L-1) in the river water and higher Arsenic (As) and zinc (Zn) concentrations in the soils irrigated (Girma, 2004). Unfortunately the Akaki River is used for various purposes such as irrigation and drinking water source for the city of Adama and too many rural towns which belong to the basin. Thus; the negative impact on human health and the ecosystem as a result of the elevated level of a number of pollutants and irrigation products such as vegetables will ultimately affect the people that depend on the river water.

4.5 Ground Water quality

It is well known that high fluoride concentration is a natural phenomenon in the Great Rift Valley. Fluoride problem is much of a concern in the middle and lower Awash River basins, and at the downstream ends of the Upper Awash River basin. Although, in the past ground water was the water supply source for the city of Adama, it is no more used due to its negative impact on the public health as a consequence of high fluoride concentration present in the bore holes. Dental fluorosis and skeletal fluorosis are the major public health problems related to excess fluoride concentrations (Reda, 2005).

4.6 Challenges

- Monitoring and evaluation of surface water quality. In Ethiopia there is no continuous and structural monitoring and evaluation of surface water quality. However; some water/environmental agencies, such as Federal EPA and AAEPA, monitor the water quality of Upper Awash and the tributaries at different period/years. In addition a number

of researchers generate quite large amount of surface water quality data as part of their research. Unfortunately, there are not solid efforts made by the water agencies to collect and store all the data in a proper database.

- Improving communication and networking between various stakeholders. Generally, in Ethiopia, it is hard to say there is structural and coordinated linkage between water sectors, NGOs and domestic and foreign consultants that are involved in the water related activities. The mechanisms of indirect information flows and linkages between water sectors are mainly via reports. In addition, horizontal and vertical communications between ministries and bureaus belonging to different sectors is seldom common. There are hardly any information flows and linkages between sectors that are not apparently related. This is mainly due to the lack of Integrated Information Management System. In addition; this can be also attributed to lack of knowledge about the strong value of information and networking, lack of responsibility, commitment and distrust.

- Monitoring of ground and surface water quality. Different study reports mentioned the practical difficulties concerning the monitoring of ground and surface water quality. These include:

    - Neither the MW&E nor the FEPA and MoH follow a structured or even coordinated approach.
    - There are no financial resources, partly because of poor logistics.
    - Too few human resources.
    - Inadequate laboratory equipment.
    - Limited availability of reagents at the regional level.
    - Although the role of each ministry in water-quality monitoring and surveillance is formally defined, vertical and horizontal interaction and exchange of information is poor.
    - There is a logistics problem in most areas in accessing the few established water quality laboratories.
    - Little understanding of the importance of regular water quality monitoring
    - The spatial distribution of the sampling points is random.
    - The water sources are not sampled at the same times of the year.
    - Storage and transportation of samples to the laboratory is often inadequate.

4.7 Ongoing projects

- In recent years AAEPA is closing factories/industries which do not obey the effluent pollutant standards set by the government. In the Ada'a and Becho plain (located Upper Awash River Basin) irrigation project 150 new wells are under construction. Data loggers will be installed for test/observation wells and thereby to understand and monitor the ground water quality.
- The MW&E is also trying to establish a national ground water database, which is called Ethiopian National Ground Water Information System (ENGWIS).

Previously, the MoWR used to have a national ground water quality database called ENGDA, which was established in 2005.

- In addition, Addis Ababa University, particularly, Faculties of Earth Sciences and Environmental Sciences, is active in doing researches on Upper Awash River Basin as part of their post graduate programme in ground water and surface water. All thus activities certainly strengthen the current water quality monitoring.
- The capacity building project by VEI, WSZZ and WSVaVe on water resources protection in Upper Awash River Basin is another project that strengthens the water monitoring situation.
- The Ada'a and Becho project: In this project 150 new boreholes are under construction for the purpose of irrigation. Data loggers will be installed for test/observation wells and ground water quality data will be generated.

4.8 Possible areas of cooperation

- Strengthen the coordination mechanism of different stakeholders who are involved in the water quality management for continuous and structural monitoring and evaluation of surface and ground water quality in Ethiopia.
- Build water quality database for better management and flow of information and water quality mapping.
- Create awareness on the importance of water quality management.
- Increase responsibility and commitment of the water sectors which are involved in the water quality issues.
- Build a solid strategy for the follow up of water quality monitoring (sampling location, frequency, methods).
- Increase capacity on the water quality.
- Provide laboratory equipments and reagents.
- Solve common logistic problems.

CHAPTER 5

5 Sanitation and Hygiene

5.1 General

Improved sanitation and hygiene is met when people demand, develop and sustain a hygienic and healthy environment for themselves by erecting barriers to prevent the transmission of diseases, primarily from faecal contamination.

Sanitation coverage and hygiene practices in Ethiopia are one of the lowest in the world. Ethiopia's major health problem is the spread of disease caused by poor water and the lack of adequate sanitation. A number of children are dying from diarrhea associated illnesses in Ethiopia. Hand washing practices with soap after defecation and/or any contact with faeces are not strong traditions in Ethiopia. This can be attributed to intermittent water supply (chronic water shortages), lack awareness of the consequence and absence of surplus cash to purchase soap.

5.2 Sanitation means

5.2.1 Sanitation coverage/Latrines

Although there are regional variations, it is thought that latrine access ranges between 9% in rural areas to 72% in the urban areas. This gives a national average of 18% which consists mainly out of traditional pit latrines made from locally available materials. Some of the traditional pit latrines do not address expressed concerns about smell, rising gas, structural collapse, fear of falling in, flies, privacy and shelter from the elements. Improving traditional pit latrines with a variety of concrete slabs has been essentially a donor and NGO initiative. The percentages of coverage of flush toilet, pit latrine, containers, open defecation and other means of sanitation for urban and rural areas are presented in Table 5.1.

Table 5.1: Percentages of toilet facilities for urban and rural areas in Ethiopia

Facility	Country %	Rural %	Urban %
Flush Toilet	1.7	0.8	7
Pit Latrine	16.3	8.1	64.6
Container	0.1	0.0	0.7
Open Defecation	81.5	90.7	26.9
Other	0.5	0.8	0.8

Source: CSA 2000

In Addis Ababa 74% of the households have toilet facilities. However as a result of the financial burdens and the topography of the region, only 12% of the inhabitants are provided by a centralized sewerage system. A big percentage of the households is served by sanitary facilities connected either to septic tanks, wet or dry pit latrines. Overflow from septic tanks is a major problem, as the sewage collection and transportation service is intermittent in the city. Apart

from this, illegal connections to the drainage systems designed for other purposes are used as sewer lines.

The sanitation coverage of the city of Adama is only 51% in 2011. About 70% of the households in Adama centre use pit latrines (in majority permeable pit latrines: effluent infiltrates into ground (water)), 5% use a septic tank and the remaining 25% have no sanitary facilities at all. In peri urban settlements around Adama Centre over 80% of the households have no sanitary facilities at all or limited access to permeable pit latrines.

Only a small percentage (less than 40%) of sludge produced from the cities, Addis and Adama, is collected and dumped in a pond located outside of the cities. The remaining is leaked into the drainage system. In addition, the solid waste produced in households, markets, industries and restaurants and hotels is hardly collected. This result in large open heaps of garbage dumped as well as the collection of solid waste in (open) drains. As the state of the drains is poor they are prone to overflowing. The hygienic situation is even worsened during and after heavy rains as the solid wastes with hazardous constituents and faecal matter is spread throughout the neighbourhoods. There is an increased exposure to pathogens, viruses and water borne diseases since the (waste)waters from the cities are used downstream for urban agriculture and drinking purposes. Thus vegetables cultivated are polluted with pathogens and carcinogenic toxics. These health risks result in an increase in the spread of diseases and eventual (child) mortality.

Although urban sanitation figures generally far outstrip rural access, it is widely known that the poor, unplanned, densely populated areas are badly underserved. This density therefore poses a greater risk of contamination than thinly populated rural areas. Greater high contamination risks are much severe in schools, universities, public latrines, bus terminals and other institutions.

5.2.2 EcoSan and Biogas

There are already many technologies/options which have a wide-ranging long-term benefits, which do not require the high initial investment and considerable donor subsidy needed for successful scaled-up implementation. Toilets linked to biogas digesters have been successfully applied in institutions such as prisons, hotels and schools as well as private and public latrines. There are successful examples of organic waste being added to biogas digesters in Addis Ababa. A number of EcoSan latrines converting urine to fertiliser and faeces to compost are in use.

5.2.3 Solid waste disposal

A considerable amount of urban solid waste is contaminated with human and animal faeces making safe disposal and management an important domestic priority in rural areas, and a civic or communal responsibility in towns. It is known that municipal solid waste is the major environmental issue in Addis Ababa. This is obvious since there are inadequate disposal facilities thus leading to the dumping of household waste in the vicinity of the rivers. In addition the daily waste generation is increasing dramatically in big cities like Addis Ababa and Adama. This can be attributed to high population growth as a result of migration to the big cities associated with better job opportunities. The source for the solid waste are mainly generated from domestic, commercial, street sweepings, industrial, hotels, and hospitals. High amount of solid waste

generated combined with the inefficient means of collection is also the source of pollution of the rivers since leachates transported by runoff during the rainy season ultimately end up in the river.

5.3 Challenges

- Improving appropriate sanitation facilities and there by high health risks.
- Improving management capacity and finance of the municipality and the water and sewerage enterprises.
- Decreasing persistent drought conditions in order to decrease poverty and indebtedness.
- Increasing funds available for water, latrines and soap. The environmental health department has limited resources to promote latrine construction and hygiene, and has largely depended on donor and NGO support. It has been estimated by the UNICEF WES section that only one percent of the health budget is available for sanitation and hygiene promotion.
- Empowering women as men remain dominant in dictating domestic priorities making it difficult for women to voice their special personal hygiene needs and sanitation priorities. (Men perceive latrine construction with scepticism)
- Integrating approaches. Water has tended to be supplied in relative isolation as an end in itself and not as a means to promote improved environmental health.

5.4 Ongoing projects

- Ministry of Water and Energy is undertaking some activities under the WASH (Water, Sanitation And Hygiene) program.
- Addis Ababa city administration together with French Development Agency (AFD) is undertaking to improve the solid waste management and infrastructure. The main activities of the project (construction of four transfer solid waste dump stations and treatment plants) are excuted by DEVEX international, a company from France.
- Proposal (Concept note) to improve sanitation coverage and situation for the city of Adama is submitted to EU.

5.5 Possible cooperations

- Increase sanitation coverage.
- Increase awareness by actively involvement of schools.
- Improve environmental conditions by safely managing liquid and solid waste.
- Improve living conditions: sustainable sanitation coverage / behaviour change.
- Improve public health: reduction in risks and threats of contaminating diseases.
- Increase human dignity: better living standards, (entrepreneurial) capacity.
- Improve community cohesion: ownership and participatory actions.
- Increase income opportunities for uneducated and poor inhabitants: sanitation chain jobs.
- Construction of new Ecosan infrastructure: demonstration units, capacity development develop legislation; replication of the approach.
- Rehabilitate existing sanitation infrastructures.

- Set-up of waste treatment structures analysis, construction, product testing.
- Empower local communities and setting up of small sanitation chain businesses.
- Stimulate advocacy, education, hygiene promotion, behavior change.
- Implement a safe drinking water chain from collection through to storage and consumption.
- Practice food hygiene and environmental cleanliness.
- Increase women empowerment.

CHAPTER 6

6 Wastewater

6.1 General

With respect to its orgin wastewater can be divided into two categories:

- Municipal wastewater (Domestic and Commercial), produced by the individual households and (very) small economic activities, large institutions such as hotels, restaurants, hospitals, prisons, etc.
- Industrial wastewater, which is generated from industries (both small and big).

The population in built-up cities such as Addis Ababa, Adama and Debrezeit, is rapidly expanding as a result of urbanization. One of the important basic needs of its growing population is water. The higher water needs and consumption as a result of population growth and living standard is resulting in a higher wastewater production. In addition 80-90% of the industries in Ethiopia are located in the city of Addis Ababa and Dukem town. All the effluents, unfortunately, tend to end up in the headwaters (Little and great akaki rivers) of the Awash river. As a consequence of this, rivers in the Upper Awash River Basin are extremely polluted. The high BOD measured values in these tributaries of Awash River indicates the anaerobic feature of the rivers. High levels of metals and other toxic compounds in both the Great and Little Akaki rivers aggravate the problem. As a result of this, the rivers do not/hardly contain any aquatic species such as fish. Worms are the only species which can live under low oxygen concentrations. Although the situation is worse in the Little Akaki river, both rivers have similar physical characteristic with sewage (observation). This can be attributed to the discharge of domestic and industrial wastewater from the city of Addis Ababa and the industries located in the Upper Awash River Basin.

6.2 Wastewater/Pollution sources

6.2.1 Domestic

One of the major sources of pollution for the Awash River is untreated domestic discharge from the city of Addis Ababa. Domestic wastewater is well known with its high concentration of pathogens which are harmful to human health. One of the major problems of the availability of sufficient clean water is the pollution of water bodies by contaminants from different sources. In addition to the industrial and agricultural purposes, Awash River is used as a drinking water source for the city of Adama and other rural towns within the basin.

Less than 12% of the urban area in the city of Addis Ababa is sewered while in the major part of the remaining area pit latrines are used that dispose their wastewater in the stormwater drainage

network. The sewage from the cities like Addis Ababa and Adama is partially collected by septic tanks and wet pit latrines, transported by vacuum trucks and disposed on ponds. Unfortunately most of these ponds are not functioning well as a result of poor designs and poor operation and maintenance.

6.2.2 Industrial

The establishment of a modern industrial sector has only one hundred years of history in Ethiopia. Leather products, textiles, distilleries, breweries, food processing, paper and metallurgies dominate the output. However, in recent years the leather industry has been developing fast due to the large demands of the world market for semi-finished Ethiopian leather. Most of the industries in Ethiopia are located in Addis Ababa and the nearby town of Akaki such as Dukem, in the Upper Awash River Basin. Unfortunately, most industries in the region discharge their waste directly into the headwater tributaries of the Awash River, the Little and Great Akaki rivers without any/appropriate treatment.

The reason for the discharge of untreated industrial effluent in Ethiopia is not because there are not environmental impact assessment proclamations and effluent standard guideline values. Rather it is because EIA regulations are hardly practiced and there is a lack of enforcement of these laws. A small percentage of industries has wastewater treatment plants and laboratories which seem equipped with chemicals/reagents for the analyses. Unfortunately, most of them are fake or show cases, which are not functional. Or if they are, this is done without the involvement of any of the EPAs (Environmental Protection Agencies). In addition; the focus of the regional EPAs are very much on land use/spatial planning issues.

It is alarming that in recent years industrial activity is extending beyond the Addis and Dukem areas to towns like Mojo, Debrezeit and Adama increasing the influence of industrial and domestic pollution to the Awash and the Mojo rivers; and Lake Koka.

6.2.3 Agricultural

In addition to industrial activities in the Upper Awash River Basin, there are also intensive crop production and animal husbandry activities. Animal husbandary is a predominant activity especially in the surrounding parts of the urban cities such as Addis Ababa, Adama and Bishoftu (Debre Zeit). These cattle are either reared in the compounds of the individual owner or in the open spaces and along the river banks. As a result of these activities, it is expected that a significant amount of organic waste is generated. In the rural areas the predominant agricultural activity is crop production using small plots of land.

One of the major pollutants with regard to agriculture is associated to erosion of the soil in the upper catchments of the river. This is especially intense in the rainy season when there is high surface runoff. As a result of soil erosion chemical fertilizers added to increase productivity also enter the streams. This in turn contributes to the eutrophication of the streams. One of the main components of chemical fertilizer in Ethiopia, i.e. urea, is a major polluter of groundwater systems. This is evident with the elevated nitrate levels in the shallow groundwater, for instance around Lega Dadi area in Addis. High Levels of nitrate around Lagadadi is possibly associated with the extensive use of fertilizers in the surrounding farm land which are highly affected by

erosion. This has thus forced the Addis Ababa Environmental Protection Authority (AAEPA) and Addis Ababa Water Supply and Sewerage Authority (AAWSA) to undertake an extensive rehabilitation of the sub catchment.

6.3 Wastewater collection

Currently, sewage collection in the city of Addis Ababa is majorly based on vacuum trucks (wet pit latrines and septic tanks) and dry pit latrines; and partially on a centralized sewerage system (up to 12%). On the other hand in other cities which belong to the Upper Awash River Basement, there are not any sewerage systems and the main collection system is pit latrines (e.g. about 70% dry pit latrines for the city of Adama) and small percentage by septic tanks. However, all of these domestic wastewater systems do not cover the whole area. That means the sewage collection system is incomplete and results pollution of surface water bodies (field observations).

6.4 Wastewater disposal/or treatment

The main sewage treatment plant in the city of Addis Ababa, is located in Kaliti, northeast of the Akaki water well field. A similar treatment plant is also functional in the eastern side of the city at Kotebe. The type of the wastewater treatment of Kality is Oxidation ditch with extended aeration. This means that treatment undertaken here essentially involves circulation of sewage in various ponds for a total of about 30 days. The plant was designed to serve a population of 50,000 inhabitants treating up to 7,600m3 of sludge per day. Although the plant is operating under its capacity (4,600 m^3/day), poor treatment efficiencies for long durations are frequently happening. This can be attributed to the discharge of industries which has high toxic compounds concentrations and their consequence on the activated sludge (micro-organisms who do the treatment).

6.5 Challenges

- Improving human health in downstream communities. Related to the pollution of the Akaki River and the Upper Awash River and its utilization for drinking purposes of animals and human beings, impacts on human health is serious in downstream locations. In addition, the use of the highly polluted rivers for irrigation of horticultural crops is resulting in health problems such as diarrhea.
- Improving water supply accompanied with wastewater collection, disposal and treatment to alleviate environmental and health problems downstream.
- Increasing wastewater collection and treatment capacity and facilities in the Upper Awash River Basin.
- Enforcing EIA laws to control the untreated discharges from the industries.
- Appropriate measuring to control industrial effluent discharges which has compounds of chronic and acute toxic effects.

6.6 Ongoing projects

- Clean Rivers Trust, consultant from UK, will also take actions to help the development of wastewater collection system and treatment infrastructure for the city of Addis Ababa. The Ethiopian government has commissioned the Clean Rivers Trust to find the funding

and prepare the scheme for the implementation. If funds are granted, sewerage systems will be constructed and all houses which are not connected to the sewer lines will be connected. In addition a wastewater treatment plant, particularly wetlands, will also be constructed. If this happens, there will certainly be an improvement of the surface water quality of the Awash River and its tributaries such as the Akaki River. As urban wastewater discharge from the city of Addis Ababa is one of the main sources of pollution for these rivers.

6.7 Possible areas of cooperation

- Improve the quality of Akaki and Awash rivers and thereby enhancing the health situations of the people and cattle located in the downstream areas.
- Satisfy irrigation water quality standards to cultivate healthy crops.
- Provide wastewater collection, disposal and treatment facilities to alleviate environmental and health problems downstream.
- Enforce EIA laws to meet effluent standards.
- Take appropriate measures of industries for those who do not satisfy the effluent standards.
- Build capacity in the area of wastewater treatment and water quality analysis.
- Provide necessary equipments and reagent for wastewater sample analysis.

CHAPTER 7

7 Conclusions and recommendations

7.1 Conclusions

Ethiopia is one of the 15 core countries of International Development Cooperation of the ministry of foreign affairs in the Netherlands. Additionally it is one of the focus countries of 'Water Mondiaal' of the program 'Partners for Water'. The Awash River Basin is the most utilized and developed basin so far. As a result of enormous industrial and agricultural activities in the Awash Basin, the Awash River is the most polluted river in the country. On top of this, there is limited capacity to enforce laws and regulations concerning the protection of the quality of the rivers. The headwaters of the Awash River which are located in and around the capital city of Ethiopia, Addis Ababa, are heavily polluted from domestic, commercial and industrial discharges. One of the major problems of the availability of sufficient clean water is the pollution of water bodies by contaminants from different sources. In addition to the industrial and agricultural purposes, Awash River is used as a drinking water source for the city of Adama and other rural towns belongs to the basin.

The water supply and sanitation coverage in the Upper Awash River Basin is very low. This problem is mainly associated with poor governance and management practices, high population growth, inefficient and ineffective systems and methodologies, lack of human resources management and low community participation in the project identification, operation and maintenance of water supply and sanition schemes. Water institutions play a vital role in managing and sustaining water resources thereby enhancing economic development and poverty alleviation efforts. The institutional arrangements regarding water issues generally in Ethiopia and particularly in Oromia region are fairly clear. The mandates, tasks and responsibilities of the institutions are defined. The policies and laws in place have also clear objectives and some have developed strategies and policy instruments to meet these objectives. However, there are overlaps in mandates and responsibilities between organizations and practical implementation of defined objectives and duties seems to lack, which can be attributed to lack of enforcement of laws and regulations. In addition, different ministries, agencies and other stakeholders involved in water and environmental related issues are marked by frequent restructuring and re-organization and cooperation in between can be improved.

A consortium, consisting out of five Dutch water boards (Hollandse Delta, Hunze en Aa's, Vallei en Veluwe, Velt en Vecht and Zuiderzeeland), drinking water company Vitens Evides International, the NGO Meta Meta, the Water Governance centre and knowledge institute UNESCO-IHE, is capable in assisting the Ethiopian counterparts with capacity building and is interested in knowledge exchange considering Integrated Water Resource Management.

7.2 Recommendations

- In the separate chapters of this report several possible areas of cooperation are described; however, priorities should be given and a step by step approach has to be followed in order to tackle the challenges.

- Implement Integrated Water Resource Management on a program level in order to increase correlation between different projects.

- Select the exact partners within the various stakeholders within the water sector, NGOs and consultants in order to establish and execute vital water related projects.

- Successful implementation of water policies, strategies, programs and projects is needed in order to enhance proper coordination between stakeholders which have a common vision regarding sustainable development and management of water resources.

- Use a decentralized approach for cooperation, rather than a centralized approach, in order to benefit larger groups of the community and to enhance the sustainability of the projects.

- Increase the capacity and opportunities for practitioners and students for successful and sustainable project management and implementation.

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