

SFD Promotion Initiative

Bahir Dar Ethiopia

Final Report

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SFD Report Bahir Dar, Ethiopia, 2016

Produced by:

Oscar Veses

Haile Dinku

Eshetu Assefa

Andy Peal

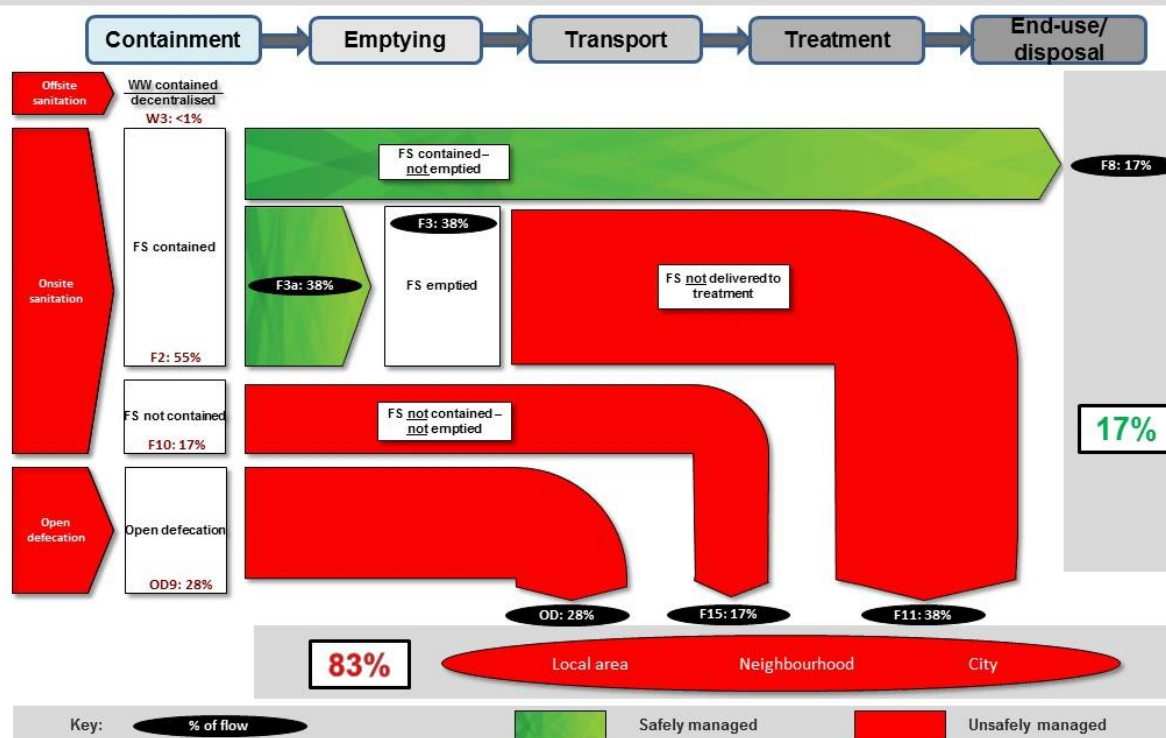
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1. The Diagram

Bahir Dar, Ethiopia, 04 July 2016
field-based assessment



2. Diagram information

Desk or field-based:

The SFD was generated from field-based work.

Produced by:

University of Leeds (UoL) with support from Mr. Haile Dinku, WaSH capacity building consultant from WaterAid Ethiopia and from Mr. Eshetu Assefa, chair of water supply and sanitary engineering of the Bahir Dar Institute of Technology.

Collaborating partners:

WaterAid Ethiopia, Municipality of Bahir Dar, Bahir Dar Town Water Supply and Sewerage Service Enterprise, Organization for Rehabilitation and Development in Amhara (ORDA).

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3. General city information

Bahir Dar is a city located northwest Ethiopia with a tropical savannah climate. According to the Town Administration, the population is 318,429 people, where 85% live in the urban

and 15% in the peri-urban and rural areas of the city (data from 2012) (BD, 2016b). The average annual temperature is 19.6 °C and the rainfall averages 1419 mm (WWL, 2015).

In the rainy season, flooding is likely to occur and the risk of communicable disease outbreaks and malnutrition following flooding are greatly increased (MoH, 2006).

Economic activities include an expanding textile industry as well as rapidly growing agro-industries. The potential for tourism and real estate development is great in the city due to its naturally attractive environment (EC, 2015).

Groundwater from the nearby well-field and springs are the main source of drinking water of the city (Tana, 2015). Lake Tana is used for dumping industrial and municipal waste from Bahir Dar city and its surrounding settlements (Goshu et al. 2010). The city of Bahir Bar has no solid or liquid waste treatment plant to treat any waste, all waste streams end up in an open field with no treatment at all. Very few institutions have waste stabilization ponds to treat their liquid waste (BD, 2016b).

4. Service delivery context

The Federal Democratic Republic of Ethiopia included the protection of public health in the 1995 National Constitution. The Article 90.1 states that “to the extent the country’s resources permit, policies shall aim to provide all Ethiopians access to public health and education, clean water, housing, food and social security”.

At national level, a seven-year program (2013-2020) under the name of One WASH National Program (OWNP) was launched in September 2013 by the Government of Ethiopia with additional support of UNICEF with a total budget of more than USD \$2 billion (Goyol and Girma, 2015).

In order to meet national and global commitments, the GoE developed in 2013 the Sanitation and Hygiene Strategy, Sanitation Protocol, Strategic Sanitation Action Plan. This plan was created to facilitate changes in the sanitation and hygiene situation in Ethiopia and promote improved sanitation (MoH, 2013).

Despite there being rules and regulations (proclamations) provided to the city administration from the Federal Government regarding liquid and solid waste management, the city administration does not enforce them (BD, 2016b). Consequently, emptied faecal sludge is disposed of in an open field with no treatment at all. The lack of awareness of people and governmental and local institutions also influences in this inadequacy of regulation.

There is currently a local program being held by Organization for Rehabilitation and Development in Amhara (ORDA) to deliver sustainable and integrated sanitation services for the urban poor in the city (BD, 2016a; BD, 2016b; BD, 2016c). Some by-laws have been developed and approved by the city administration and are planned to be introduced to the community to practice in the near future (BD, 2016b).

The Health Extension Program (HEP) is an essential service providing advice to families and improving sanitation and waste management practices at household level (BD, 2016b; BD, 2016c).

The Bahir Dar Town Water Supply and Sewerage Service Enterprise (BDTWSSSE) is the organization that should be in charge of the sewage management. However, the municipality is currently in charge of faecal sludge management in the city. Both the municipality and the private sector provide emptying services to customers (after payment of a tariff for the service) but there is a lack of monitoring of service standards (BD, 2016a; BD, 2016c; BD, 2016f).

It is also known that illegal dumping occurs in Bahir Dar, especially in areas located next to Lake Tana. However, there is a lack of law enforcement (BD, 2016a; BD, 2016c).

5. Service outcomes

In Bahir Dar, pit latrines are the main sanitation technology option and used by the majority of the population. Around 15% of the population use pour flush toilets (locally known as WCs), mainly found in high-income households and hotels. Around 28% of the population practice open defecation (CSA, 2007). As per the data obtained from the Amhara Region Health Bureau, currently, 15% of the population in the urban centre of Bahir Dar city practise open defecation.

All solid wastes, including faecal sludge, are unsafely disposed of in an open field in the outskirts of the city with no treatment at all (Figure 1). No capacity building has been provided for the private sector to increase the efficiency of their service provision (BD, 2016b). The construction of a sanitary landfill for the city is planned to be started in October 2016, this will be located around 8 km southwest of the city (BD, 2016b).



Figure 1 Open field used as a dumpsite for all wastes (photo credit: Oscar Veses)

Water supply in Bahir Dar comes from three springs and 11 deep wells (and more under construction). Service coverage according to a water consumption of 80 litres per capita and per day is around 57% (BD, 2016a; BD, 2016b; BD, 2016c).

According to the general manager of BDTWSS, the lowest water table is 8m. All wells are protected by a fence and located away from waste disposal sites, latrines, septic tanks. However, there is no buffer zone protection and some cross-contamination due to agriculture and farming activities carried out nearby might occur (BD, 2016a).

The situation described above is reflected in the SFD which shows that 83% of the excreta generated is considered to be 'unsafely managed'. Although no data is available on the percentage of pit latrines that are covered when full, it is estimated 17% of the total faecal sludge generated could potentially be considered to be safely disposed of, as shown on the SFD.

There is a national program to construct a sewerage system and wastewater treatment plant for Bahir Dar, it is reported that this will be completed in 5 years' time in (BD, 2016a; BD, 2016c).

6. Overview of stakeholders

Main stakeholders are outlined in Table 1. The municipality of Bahir Dar is currently in charge of the management of the faecal sludge produced and the water utility (BDTWSSSE) is in charge of managing the water supply in the city.

HEWs are the main actors in advising people at household level to carry out good WaSH practices.

The municipality, the University of Bahir Dar and five private companies are responsible for providing emptying services in Bahir Dar. The budget for WaSH sector is provided by government at regional level and international funding.

KII were conducted to stakeholders from the municipality, the BDTWSSS, the University of Bahir Dar, ORDA and private emptier. In addition to that, five more KII were conducted to people from several institutions at national

level such as the MoWIE and the Ethiopian Institute of architecture, among others to provide with a general view on the WaSH situation at a country level.

Key Stakeholders	Institutions / Organizations
Public Institutions	Municipality of Bahir Dar Water Utility (BDTWSSSE) Health Extension Workers Regional Office (ORDA)
Private Sector	5 private emptier
International organizations	Japan International Cooperation Agency (JICA)

Table 1 Key stakeholders

7. Credibility of data

The main data sources included published reports regarding the policy and implementation of WaSH in Ethiopia at national level. Most of the data at city level were not available online and were collected during the field visit. The city had very few documents available on the internet. The visit was essential to collect data and to have access to unpublished reports. The visit was also essential to gain knowledge about the current situation of sanitation in Bahir Dar as well as for having access to the future plans for the WaSH sector in the city.

The main uncertainty of the data is the census on the percentage of people using the on-site technologies and the percentage of latrines that are covered and safely abandoned when they get full.

8. Process of SFD development

All data were collected by unstructured key informant interviews. The unstructured interviews were useful to have access to unpublished reports, first-hand information on the drinking water monitoring procedure, a regional program from ORDA to contribute to poverty reduction of the urban poor and the project on a new wastewater treatment plant, among others.

Some of these interviews were conducted jointly with different stakeholders. This allowed for open discussions on the needs and challenges for WaSH sector in Bahir Dar.

KII were conducted to the primary stakeholders in the city from the municipality, the BDTWSSSE, ORDA, private emptier and academia. In addition to that, five more KII were conducted to people from several institutions at national level such as the MoWIE and the Ethiopian Institute of architecture, among others to provide with a general view on the WaSH situation at a country level.

After collecting all necessary data, the SFD was produced using the Excel calculation tool and shared with the stakeholders that collaborated in the data collection (WaterAid Ethiopia).

9. List of data sources

BD, 2016a. Interview with Abiy Sisay, general manager of the BDTWSSSE.

BD, 2016b. Interview with Eshetu Assefa, chair holder, water supply and sanitary engineering from the Bahir Dar Institute of Technology.

BD, 2016c. Interview with Endegenia Shifenomo, capacity building officer of ORDA-Whole sanitation program.

BD, 2016f. Interview with Zelalem Getamu, Bahir Dar city administration.

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WWL, 2015. <http://www.whatstheweatherlike.org/ethiopia/bahir-dar.htm>

Bahir Dar, Ethiopia, 2016

Produced by:

UoL, Oscar Veses

UoL, Barbara Evans

UoL, Andy Peal

WaterAid Ethiopia, Haile Dinku

Bahir Dar Institute of Technology, Eshetu Assefa

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On behalf of Federal Ministry for Economic Cooperation and Development

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Abbreviations

BDTWSSE	Bahir Dar Town Water Supply and Sewerage Service Enterprise
CSA	Central Statistical Agency
CSO	Civil Society Organization
EEPA	Ethiopian Environmental Protection Authority
ETB	Ethiopian Birr
EWRMP	Ethiopian Water Resource Management Policy
FMHCAC	Food, Medicine and Health Care Administration and Control
GTP	General Growth and Transformation Plan
GTP II	General Growth and Transformation Plan II
GoE	Government of Ethiopia
HEP	Health Extension Program
HEWs	Health Extension Workers
KII	Key Informant Interview
JMP	Joint Monitoring Program
MDG	Millennium Development Goal
MWA	Millennium Water Alliance
MoE	Ministry of Education
MoFED	Ministry of Finance and Economic Development
MoH	Ministry of Health
MoWIE	Ministry of Water, Irrigation and Energy
SNV	Netherlands Development Organization
NPHOSS	National Protocol for Hygiene and “On-Site” Sanitation
NWI	National WaSH Inventory
ORDA	Organization for Rehabilitation and Development in Amhara
OWNP	One WaSH National Program
UAP	Universal Access Plan
UNICEF	United Nations Children's Fund
WASH	Water Sanitation and Hygiene
WIF	WaSH Implementation Framework
WRDF	Water Resources Development Fund
WASH	Water Sanitation and Hygiene
WHO	World Health Organization

1 City context

Bahir Dar is a city located northwest Ethiopia with a tropical savannah climate (Figure 1). According to the Town Administration, the population in Bahir Dar is 318,429 people, where 85% live in the urban and 15% in the peri-urban and rural areas (data from 2012) (BD, 2016b). The average annual temperature is 19.6°C and the rainfall averages 1,419mm (WWL, 2015). The rainy period lasts from May up to and including October. The maximum rainfall occurs during summer season (June to August) whereas the short rainfall takes place in spring season (September and October). The rainy season accounts for nearly over 96% of the total annual rainfall (Kibret and Tulu, 2014).



Figure 1: Location of Bahir Dar. Adapted from (Lindfors, 2011) and (OPS, 2016).

In the rainy season, due to the prolonged and intensive rainfall, flooding is likely to occur. The risk of communicable disease outbreaks and malnutrition following flooding are greatly increased. Diarrhea, malaria, acute respiratory illnesses, measles, and relapsing fever are diseases that can be spread in a flooding event (MoH, 2006).

Economic activities include an expansion of textiles as well as the rapid growth of agro-industries such as flower, oil-seed, and fruit production. Construction material and the cobblestone sectors are getting important as well. The potential for tourism and real estate development is great in the city due to its naturally attractive environment (EC, 2015). The type of industries and their scale are outlined in Table 1 (BD, 2016b).

In addition to that, there are 2 private and 2 governmental hospitals, 23 of private medium clinics and diagnosis laboratories, 49 hotels, 146 pensions, 3 lodges, 3 resorts, 149 restaurants, 3 research institutions and universities, 70 educational centres (schools, colleges and training centres), 191 financial institutions (governmental and non-governmental bureaus, insurance companies and banks) and 6205 commercial centres (garages, shops, market centres) (BD, 2016b).

Table 1 Number, types and scale of industries operating (BD, 2016b).

Type	Number	Scale
Textile	1	Large
Leather	2	Large
Agro	2	Large
Food complex	6	Large
Tannery	2	Large
Plastic	1	Large
Printing	1	Medium
Woodwork	3	Medium
Furniture	8	Medium
Wood and Metal	3	Medium

Groundwater from the nearby well-field and springs are the main source of drinking water of the city. It covers more than 3,000km² of the total drainage area of 15,32km² above the outlet. More than 40 rivers feed the lake, of which Gilgel-Abay, Ribb, Gumera, Megech, Gelda and Infranz contribute more than 95% of the inflow. The only surface water that drains the lake is the Blue Nile (Tana, 2015).

Lake Tana was proposed to be the source of water supply for the city starting from 2020 (Tropics consultant, 2009). However, the lake is currently used for dumping industrial, municipal and waste from Bahir Dar city and its surrounding settlements. Solid and liquid waste from hotels, homes, the regional prison, Felege Hiwot hospital, factories and other installations is discharged untreated into the lake (Goshu et al. 2010).

In 2002, one study revealed that the groundwater level varies from 1 meter above sea level to 30 meters above sea level. Besides, groundwater flow direction is towards Lake Tana and is controlled by the morphology of the area (Tana, 2015).

2 Service delivery context analysis

2.1 Policy, legislation and regulation

2.1.1 Policy

The basis for the Environmental Policy of Ethiopia are articles 92.1 and 92.2 of the 1995 Constitution of the Federal Democratic Republic of Ethiopia, where the protection of public health is included:

1. Article 92.1: "Government shall endeavour to ensure that all Ethiopians live in a clean and healthy environment".
2. Article 92.2: "Government and citizens shall have the duty to protect the environment.

Besides, the Article 90.1 states that "to the extent the country's resources permit, policies shall aim to provide all Ethiopians access to public health and education, clean water, housing, food and social security".

Since that time, several documents have been redacted to guide the implementation of national policies regarding water and sanitation (WaSH) developed by the government. The main ones are listed as follows:

- Ethiopian Water Resource Management Policy (1999).
- Universal Access Plan for Water and Sanitation (2005).
- Universal Access Plan for Water and Sanitation (2005).
- National Sanitation and Hygiene Strategy (2005).
- National Protocol for Hygiene and “On-Site” Sanitation (NPHOSS) (2006).
- Needs Assessment to Achieve Universal Access to Improved Hygiene and Sanitation by 2012 (2007).
- National Sanitation and Hygiene Implementation Guideline (2011).
- Urban Sanitation Universal Access Plan (2011).
- One WaSH National Program (OWNP) (2013).
- National Sanitation Marketing Guidelines (2014).

The Ethiopian Water Resource Management Policy (EWRMP) developed in 1999 by the Ministry of Water Resources, currently the Ministry of Water, Irrigation and Energy (MoWIE), aimed to promote the development of adequate management of water resources in Ethiopia to contribute to the accelerated economic growth of the country.

In 2002, decentralization of powers and functional responsibilities from federal to local government was a major step toward the development of WaSH infrastructures (WaterAid, 2013). In 2006, The National Protocol for Hygiene and “On-Site” Sanitation (NPHOSS) was produced by the Ministry of Health (MoH) to “follow the national strategy for hygiene and sanitation improvement with its focus on universal access (100% hygienic and sanitized households) in primarily rural or peri-urban environments” (MoH, 2006).

In 2010, the General Growth and Transformation Plan (GTP), developed by the Ministry of Finance and Economic Development (MoFED), is the first phase to attain the goals and targets set in the Millennium Development Goals (MDGs) at a minimum, including those related to WaSH. Although water and sanitation are seen as priority areas, the only goal set is to have “better and closer access to safe water and sanitation facilities”, with no other specification whatsoever (MoFED, 2010).

A seven year program (2013-2020) under the name of One WASH National Program (OWNP) and the related WaSH Implementation Framework (WIF), was launched in September 2013 by the Government of Ethiopia (GoE) with additional support of UNICEF with a total budget of more than USD \$2 billion, the largest ever developed in the WaSH sector in Ethiopia (Goyol and Girma, 2015). The Program will be carried out in seven years and accomplished in two phases; Phase I from July 2013 to June 2015 and Phase II from July 2015 to June 2020. This program is the main tool of the GoE to achieve the targets for sanitation and hygiene proposed in the Universal Access Plan (UAP), outlined in section 2.2.1.

Liquid and solid waste management are regulated by Proclamation. No. 300/2002: Environmental Pollution Control Proclamation and Proclamation. No. 513/2007: Solid Waste Management Proclamation, both developed by the Federal Government of Ethiopia (BD, 2016b). Despite these proclamations exist at national level, the city administration of Bahir Dar does not properly bring them to the ground (BD, 2016b). The actual strategy is to collect the faecal sludge and dispose it in an open field with no treatment at all. The lack of awareness of people and governmental and local institutions also influences in this inadequacy of regulation. As it will be stated in the following sections, there is a local program currently under development to deliver sustainable and integrated sanitation services for the urban poor in the city (BD, 2016a; BD, 2016b; BD, 2016c).

Besides, the Health Extension Program (HEP) is an essential service providing advice to families and improving sanitation and waste management practices at household level (BD, 2016b; BD, 2016c). Thus, there needs to be more coordination among the institutions and a clear strategy to address urban sanitation in Bahir Dar.

2.1.2 Institutional roles

The institution in charge of monitoring sanitation and hygiene interventions in Ethiopia is the Ministry of Health (MoH) with more than 38,000 Health Extension Workers (HEWs). They work at community and household levels to promote the use of improved sanitation facilities and eradicate open defecation (Jones, 2005).

The Ministry of Water, Irrigation and Energy (MoWIE) is responsible for water policy, coordination and monitoring whereas the Ministry of Education (MoE) tries to build an education and training system which assures quality and equity education. The Ministry of Finance and Economic Development (MoFED) is responsible for budgeting and managing economic resources in both federal and regional governments.

In recent years, profound dialogue and collaboration between the MoWIE, MoE and MoFED have been carried out to monitor and report the status of WaSH in the country including the launch of the OWNPN, among others (Jones, 2005). There are five divisions in terms of governance and administration of the WaSH sector in Ethiopia (Girma and Suominen, 2013):

1. Federal Government, with its capital in Addis Ababa.
2. Nine Regions and two city administrations (each with a Water Bureau).
3. Over 70 Zones (Some of the Zones are important for ethnic reasons, and have autonomous status. These are called “Special Zones”).
4. 805 Woredas (Districts). Each Woreda has a Water Office.
5. Around 16,000 administrative Kebeles (comprising several villages or “peasant associations”).

A summary of the institutional roles of each WaSH structure is presented in Table 2.

Table 2 Summary of the duties and responsibilities of WaSH structures. Adapted from (GoE, 2013a).

Institution	Duties and Responsibilities
National WASH Steering Committee	-Reviews and endorses the National WASH Strategic Plan and Annual WASH Plans -Oversees the proper functioning of the WASH Program
National WASH Technical Team	-Regularly monitors program implementation -Designs programs for experience-sharing within and outside the country
National WASH Coordination Office	-Preparation of manuals, guidelines and generic training materials -Maintains national WASH management systems and records -Promotes and facilitates national networks among WASH actors
Regional WASH Steering Committee	-Ensures the establishment and functioning of WASH structures in the region
Regional WASH Technical Team	-Facilitates inter-sectoral communication and cooperation -Regularly monitors program implementation and provides guidance
Regional WASH Coordination Office	-Ensures Woredas have consolidated WASH plans -Maintains regional WASH management systems and records
Woreda WASH Team	-Prepares consolidated Woreda WASH plans (strategic and annual) -Review and monitor WASH program implementation at woreda level -Support training and engagement of artisans in the private sector

The organizational arrangements of the OOWNP are depicted in Figure 2.

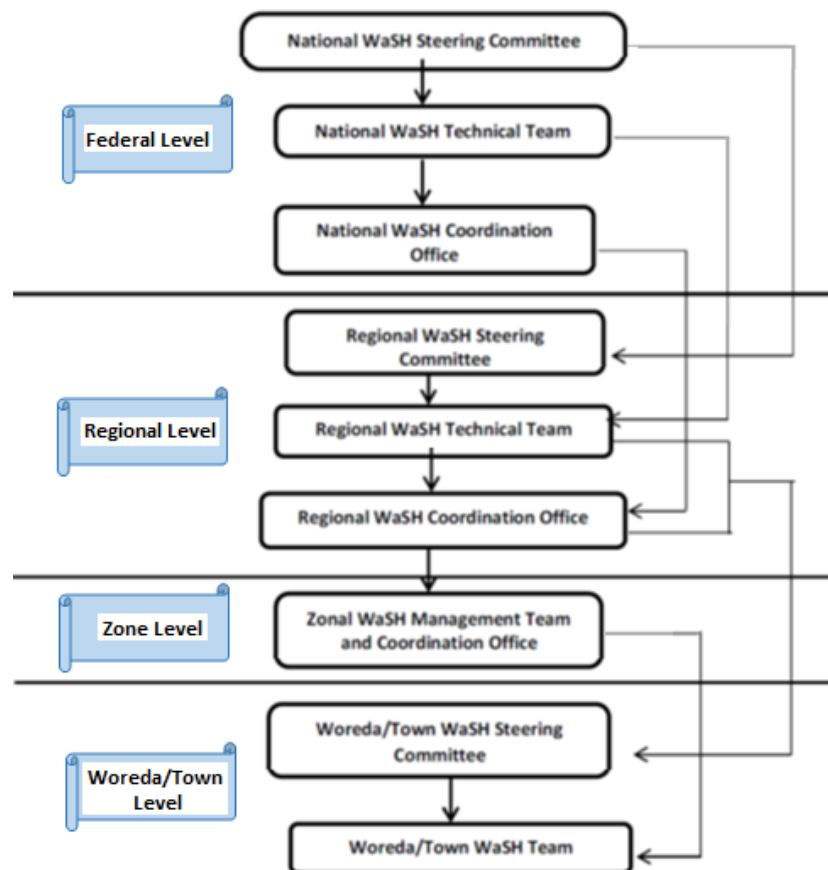


Figure 2: Organizational arrangement for OOWNP implementation. Adapted from (GoE, 2013a).

In addition to those institutions, about 100 Civil Society Organizations (CSOs) work in water and sanitation service delivering, hygiene promotion, piloting new approaches and reaching remote areas and groups. CSOs have also created the Water and Sanitation Forum to coordinate planning and implementation of WaSH activities even in conjunction with the Millennium Water Alliance (MWA) (GoE, 2013a).

Finally, The Urban Health Extension Program (UHEP) targets the well-being of urban populations through selected high-impact interventions, which include improving sanitation and waste management services and practices (BD, 2016a; BD, 2016b; BD, 2016c). There are 56 HEWs directly addressing the community on sanitation and hygiene education and promotion based on 16 health packages (BST, 2016d; WaterAid, 2013).

2.1.3 Service provision

Except for Addis Ababa, which is equipped with a sewerage system to serve part of the city and an ongoing project to expand it (ETP, 2016a; ETP, 2016c), the rest of the cities in Ethiopia have onsite sanitation systems. Service provision is maintained by the following institutions (Stolz et al. 2013; ETP, 2016e):

- Sewerage utilities. Septage collection, treatment and disposal are mainly conducted by the utilities. They are also responsible for technical interventions, operation and maintenance, customer services and financial and administrative aspects.
- Sanitation and beautification agencies. They administer public latrines.
- Municipality. In some cities, municipalities provide septage collection, treatment and disposal.

The Bahir Dar Town Water Supply and Sewerage Service Enterprise (BDTWSSSE) is mandated to provide sewerage and faecal sludge management services. However, the municipality is currently managing the faecal sludge in the city with a signed agreement with the private sector (BD, 2016a; BD, 2016f).

There are 5 private companies with a total of 6 vacuum trucks. The municipality has 5 vacuum trucks and the Bahir Dar University has 1 vacuum truck, making a total of 12 vacuum trucks to provide emptying services of faecal sludge in the city through a tariff for the service provision (BD, 2016f).

2.1.4 Service standards

Following the Ethiopian Constitution, The Food, Medicine and Health Care Administration and Control (FMHCAC) issued the Proclamation No. 661/2009 to address waste handling and disposal and the availability of toilet facilities in articles 30 and 31, respectively (Table 3).

Although there are national quality standards regarding the maximum concentration of several chemicals that can be discharged into the receiving waters for several industries such as tanneries or processing of steel, among others (EEPA, 2011), there are no quality standards set for wastewater or sludge disposal.

However, in the “Guidelines for Social, Environmental and Ecological Impact Assessment and Environmental Hygiene Impact Assessment and Environmental Hygiene in Settlement

Areas”, a draft from the Ethiopian Environmental Protection Authority (EEPA) from 2004, it is stated that “latrines should be connected to digesters to produce both biogas and slurry as organic fertilizer. As a minimum, they should be connected to a compost pit and the human waste should be used to produce compost”.

Reports related to socio-economic aspects of Bahir Dar, water quality assessments and local plans to improve sanitation in the city were not published online and were only accessible locally. However, both the municipality and the BDWSSSE provided any document, study or report if it was requested, always collaborating in the process of data collection.

Table 3 Articles related to WaSH in Proclamation No. 661/2009.

Waste handling and disposal (art. 30)	Availability of toilet facilities (art. 31)
<p style="text-align: center;"><u>30/1.</u></p> <p>“No person shall collect or dispose solid, liquid or other wastes in a manner contaminating the environment and harmful to health”</p>	<p style="text-align: center;"><u>31/1.</u></p> <p>“Any institution providing public service shall have the obligation to organize clean and adequate toilet facilities and keep it open to its customers”</p>
<p style="text-align: center;"><u>30/2.</u></p> <p>“Any wastes generated from health or research institutions shall be handled with special care and their disposal procedures shall meet the standards set by the executive organ”</p>	<p style="text-align: center;"><u>31/2.</u></p> <p>“Any city or rural administration shall be responsible for providing public toilet and ensuring its cleanliness”</p>
<p style="text-align: center;"><u>30/3.</u></p> <p>“It is prohibited to discharge untreated waste generated from septic tanks, seepage pits, and industries into the environment, water bodies or water convergences”</p>	----

At the local level, there is a lack of data availability and reliability regarding the percentage of people using onsite sanitation technologies. However, at national level, the CSA conducted a survey in 2007 where this information could be extracted (CSA, 2007). Unfortunately, there was no recently updated data on this information.

Although there is an agreement between the municipality and the private sector for providing service on the faecal sludge management, there is a problem in terms of lack of monitoring of service standards. During the interviews carried out to people from the municipality, the BDTWSSSE and ORDA, the problem of the improper final disposal of the faecal sludge was presented and discussed, showing a willingness to increase the communication and coordination between all organisms to address the issue (BD, 2016a; BD, 2016c; BD, 2016f).

Some illegal dumping might occur in Bahir Dar, especially in areas surrounding Lake Tana, but there is a lack of law enforcement (BD, 2016a).

2.2 Planning

2.2.1 Service targets

Ethiopia's water and sanitation coverage was reported as 19% and 5% respectively in 1990 (Defere, 2015). Since that time, important progress has been achieved. The Millennium Development Goal (MDG) target was to achieve a 56% of people with sanitation coverage. According to the National WaSH Inventory (NWI), in 2011 national access to water supply and sanitation was 52.1% and 63%, respectively (GoE, 2013b), suggesting almost a complete accomplishment of the MDG target.

Despite that improvement, those numbers indicate that the practice of open defecation (37%, over 35 million people from 2011 data) result in a risk of disease infection and/or transmission. However, there are differences between people living in rural areas practicing open defecation (43%) and people living in urban areas (8%) (Jones, 2015).

The GoE developed the Universal Access Plan (UAP), a document setting the following targets for sanitation and hygiene within the government's policy (Girma and Suominen, 2013):

- 98.5% access to water supply, and reduction of the proportion of non-functioning facilities to 10%.
- All Ethiopians will have access to basic sanitation by 2015.
- 77% of the population will practice hand washing at critical times.
- Safe water handling and water treatment at home.
- 80% of communities in the country will achieve open defecation free status.

Targets after 2015 and the following years, proposed by the World Health Organization (WHO), the Joint Monitoring Program (JMP) and UNICEF have also been set and are outlined in Table 4 (JMP, WHO/UNICEF, 2013).

Table 4 Proposed targets for WaSH within the years 2025-2040.

	Water	Sanitation	Hygiene
2025		*Open Defecation Free (ODF) status.	
2030	*Universal basic drinking water in schools and health centres. *Universal basic drinking water at home.	*Universal adequate sanitation in schools and health centres.	*Universal adequate handwashing and MHM in schools and health centres. *Universal adequate handwashing at home.
2040	*Progress towards intermediate drinking water at home.	*Universal adequate sanitation at home. *Progress towards safe management of excreta.	

In Bahir Dar, as soon anybody at any level needs to empty a pit latrine or a septic tank (lined tank with impermeable walls and open bottom), either the municipality or any of the private companies provide service for the population in the city in terms of faecal sludge management after paying a tariff. According to the survey carried out by the CSA in 2007 (CSA, 2007), the percentage of people practicing open defecation is around 28%, a number far from the final objective of reach an open defecation free status in the city.

As stated by the BDTWSSSE, there is a national program to construct a sewerage pipeline system followed by a wastewater treatment plant that is projected to be made in 5 years' time (BD, 2016a).

In addition to that, proper access to drinking water needs to be improved to meet the proposed targets for WASH within the years 2025-2040 since the water supply coverage is around 57% of the population, as it will be showed in section 3.7.

2.2.2 Investments

The OWNP objective is “to contribute to improving the health and well-being in rural and urban areas by increasing water supply and sanitation access and the adoption of good hygiene practices in an equitable and sustainable manner” (GoE, 2013b). The total budget is distributed in four main components: Rural and Pastoral WaSH, Urban WaSH, Institutional WaSH and Program Management and Capacity Building. The cost of these components is shown in Table 5.

Table 5 Distribution of the budget designated for WaSH in the OWNP.

Component	Destination	Water supply ¹	Sanitation and hygiene ¹
1	Rural and Pastoral WASH	USD 1.03 billion	0.4 billion
2	Urban WASH	USD 786 million	USD 95.7 million
3	Institutional WASH	USD 545.7 million	
4	Program Management and Capacity Building	USD 178.8 million	

¹Dollars in 2013

Urban WaSH budget designated to sanitation and hygiene is mainly assigned to desludging equipment and facilities and management of wastewater and public toilets in selected locations. Institutional WaSH budget is designated to improve water supply, sanitation facilities and hygiene practices at health institutions and schools (GoE, 2013b).

USD78.6 million (out of USD178.8 from the component 4) are designated for urban WaSH program management and capacity building, including training, post-construction management support, equipment, tools, and support to monitoring and reporting. Finally, there is also an amount of money from the project designated to train WaSH professionals (GoE, 2013b).

Apart from the OWNPN, the GoE created in 2002 the Water Resources Development Fund (WRDF) to promote the development of viable and sustainable urban water supply and sanitation services throughout the country (GoE, 2013b). International aid funding plays an essential role in funding WaSH activities since 61% of water budget and 70% of sanitation budget is financed by external agencies such as donors and NGOs (Girma and Suominen, 2011). Donors involved in the WaSH sector include the Department for International Development, the European Development Bank, the World Bank and the Government of Italy. International NGOs such as WaterAid, Netherlands Development Organization (SNV), Plan International and about 70-100 local NGOs are active in the sector (Stolz et al. 2013).

At local level, total budget designated for WaSH comes from three different Offices: Amhara National Regional State Government, Water Supply and Sewerage Enterprise and the Japan International Cooperation Agency (JICA) as seen in Table 6 (BD, 2016b).

Table 6 Total budget assigned to WaSH sector in Bahir Dar (BD, 2016b).

Office	Budget for WASH (US\$)	Purpose
Amhara National Regional State Government	12,238,000	Expansion and rehabilitation
Water Supply and Sewerage Enterprise	4,238,000	Operation and maintenance (including staff salary)
Japan International Cooperation Agency	19,047,620	Expansion and rehabilitation

Finally, the promotion of activities related to the WaSH sector at household level mainly lies on the Health Extension Workers (HEWs).

2.2.3 Policy and Program Initiatives

A further revision of the GTP, currently under development (GTP II), includes a target to increase the proportion of households using latrines to 93% in all Ethiopia by 2017 (Jones, 2015).

2.3 Reducing inequity

2.3.1 Current choice of services for the urban poor

There is no sewerage system in Bahir Dar and thus, no off-site sanitation options available. All people use on-site sanitation facilities.

Although there is an obligation for each new household to have a pit latrine, there are many without a facility that rely on communal or public latrines. Neither the government nor the municipality provide any funding for private latrine construction (BD, 2016a; BD, 2016c).

2.3.2 Plans and measures to reduce inequity

The OWNPN states that it is necessary to identify and target areas with low access to safe water or improved sanitation and once they are identified, propose priority action plans to reduce inequity in the areas identified. In concordance with this, reducing regional and social disparities in access to safe drinking water and improved sanitation must be accomplished.

Gender disaggregated indicators are to be used to track gender equity in roles and benefits (GoE, 2013b).

The budget for the OOWNP clearly prioritizes the water supply over sanitation and hygiene both at rural and urban levels (Table 4). This is in concordance with previous reports where different policies in developing countries have been assigning higher budget and thus, more importance, on water supply over sanitation and hygiene over the last years (Sandec/Eawag, 2015).

In Bahir Dar, there is one on-going program (2012-2017) under the name of “MDG-Sanitation: Whole Sanitation Chain for Poor in Urban and Peri-Urban of Amhara” with a total funding of 3,333,400 euros provided by the European Union, German Agro and Amhara National Regional State Health Bureau, being the project holder the Organization for Rehabilitation and Development in Amhara (ORDA). The objective of this program is to contribute to poverty reduction and sustainable development in Bahir Dar city administration by improving the health and socio-economic status of 137,000 persons through the provision of sustainable and integrated sanitation services (ORDA, 2015). The specific objectives of the program are as follows:

1. Halving the population without access to sanitation facilities in the area in an environmentally friendly way.
2. Enhance commitment and support for sanitation by all actors at all levels.
3. Building the local capacity to initiate, plan, implement, monitor and sustain sanitation interventions.

Some of the major achievements of the program so far have been made in different action areas such as:

- Construction of sanitation facilities. Construction of VIP and EcoSan toilets in schools, as well as renovating public and communal latrines and building a bio-digester to produce biogas from faecal sludge for energy production in one hospital of the city.
- Safe water supply. Expansion and construction of deep wells for drinking water supply.
- Capacity building and material support. Sanitation training has already been provided for HEWs, supervisors, primary health care officers, etc.
- Hygiene and sanitation promotion. Campaigns on public toilet cleaning and hand washing, provision of basic materials for schools and hygiene promotion through religious leaders have been conducted. Besides, production and distribution of documents and materials on hygiene promotion has also been achieved.

One of the major problems, not only in Bahir Dar but also in all Ethiopia, is the lack of awareness of people (and also the local authorities) regarding WaSH (BD, 2016a; BD, 2016b; BD, 2016c; ETP, 2016a; ETP, 2016d). For that reason, the Urban Health Extension Program (UHEP) “targets the well-being of urban populations through selected high-impact interventions, which include improving sanitation and waste management services and practices (ACIPH, 2015)”.

All HEWs in Bahir Dar are females, previously trained as nurses, becoming HEWs after training according to the policy developed by the Federal Ministry of Health (WaterAid, 2013: BD, 2016b; BD, 2016c). HEWs provide advice and capacity building on how to make a latrine, how to manage properly solid and liquid wastes at household level, good hygiene practices, etc.

There are a few initiatives to produce biogas from faecal sludge in Bahir Dar and to promote the use of EcoSan toilet facilities in schools and at household level. However, the total sludge designated to these purposes is low, as shown in section 3.6.

2.4 Outputs

2.4.1 Capacity to meet service needs, demands and targets

The municipality has provided training to the vacuum truck operators on safe operation and maintenance procedures. However, the private sector operators have not received training or any capacity building to increase the efficiency of their operations (BD, 2016b).

2.4.2 Monitoring and reporting access to services

Before 2004, all WaSH interventions in the country were project-based and therefore, there was no integration between water supply, sanitation and hygiene. However, GoE's policy on the WaSH sector is now being addressed jointly. That is the reason why MoH, MoWIE, MoE and MoFED share the responsibility for achieving WaSH targets set by the GoE's policy (GoE, 2013b). The OWP entitled the MoH to operate a monitoring system to develop one plan, one budget and one report for the WaSH sector (Jones, 2015). Table 7 shows a summary of the monitoring responsibilities from organizations at different levels currently being taken by the WIF under the frame of the OWP.

Table 7 Summary of monitoring responsibilities at different levels. Adapted from (Jones, 2015).

Institution	Responsibilities
<i>Kebele WASH Teams</i>	<ul style="list-style-type: none"> - Study data and complete analysis of Kebele WASH situation - Prepare monthly, quarterly and annual WASH progress reports and send the Woreda - Conduct quarterly WASH progress review meeting with WASH stakeholders
<i>Woreda WASH Team</i>	<ul style="list-style-type: none"> - Conduct technical assessment every 3 years - Prepare monthly, quarterly and annual WASH progress reports and send the Zone/Regions - Conduct quarterly WASH progress review meeting with WASH stakeholders
<i>Region/ Zone Coordination Office</i>	<ul style="list-style-type: none"> - Prepare Regional Annual WASH Plan - Prepare monthly, quarterly and annual WASH progress reports and send the National WASH Coordination Office - Conduct quarterly WASH progress review meeting with WASH stakeholders
<i>National WASH Coordination Office</i>	<ul style="list-style-type: none"> - Prepare and propose investment plan, loan/grant applications and national annual WASH plan - Prepare monthly, quarterly and annual WASH progress reports

Between 2010 and 2011, a National WaSH Inventory in all regions (Somali region was later added in 2014) was carried out by the MoWIE with financial support from the World Bank and UNICEF (ETP, 2016b). This has provided the country with a first baseline of the WaSH sector at a national level. Furthermore, a successful initiative between UNICEF and Akvo (a

not-for-profit foundation) used mobile phone software (Akvo FLOW) to collect WaSH inventory data in the Somali region in 2014 has the potential to open new possibilities for future data gathering and analysis (Jones, 2015).

It can be said that both the development of OWP and NWI has strengthened the monitoring and reporting activities of the WaSH sector in the country but needs further follow-up (Jones, 2015).

Despite the municipality and the private sector provide service on the faecal sludge management in Bahir Dar, there is a problem in terms of lack of monitoring of service standards (BD, 2016a; BD, 2016c; BD, 2016f). Both the municipality and the BDTWSSSE are aware of the problem of the improper final disposal of the faecal sludge and stated that they are willing to increase the communication and coordination between those two organisations (BD, 2016a; BD, 2016c; BD, 2016f).

HEWs monitor that people apply the guidelines and good practices related to WaSH at household level (BD, 2016b; BD, 2016c).

2.5 Expansion

2.5.1 *Stimulating demand for services*

Although there is little experience in sanitation marketing in Ethiopia, part of the national budget for OWP is assigned to urban WaSH program management and capacity building as mentioned in section 2.2.2. The responsibility of promoting household sanitation and good hygiene practices lies in the town health office under the town/city administration. The idea of using trained HEWs for sanitation and hygiene promotion at household level was launched by the GoE and increased the WaSH promotion in the country (Stolz et al. 2013).

The GoE developed a National Sanitation Marketing Guideline to foster sanitation marketing and promote, with the participation of the private sector, the use of different technologies to assess sanitation issues. The guideline also includes approaches including micro and small enterprise development agencies, microfinance institutions and technical and vocational education and training in the woredas to identify and develop appropriate environments for the private sectors (MoH, 2013).

In order to meet national and global commitments, the GoE developed in 2013 the Sanitation and Hygiene Strategy, Sanitation Protocol, Strategic Sanitation Action Plan. This plan was created to facilitate changes in the sanitation and hygiene situation in Ethiopia and promote improved sanitation (MoH, 2013).

The lack of law enforcement constitutes also a challenge in order to address urban sanitation in Bahir Dar since there are no compensations given by the municipality to avoid illegal dumping (BD, 2016a; BD, 2016c; BD, 2016g). As previously stated, the HEWs are the main actors in order to advise people on the importance of having an adequate WaSH practices at household level.

2.5.2 *Strengthening service provider roles*

The OWNP includes a section to promote and strengthen private sector capacity by generating information, training and business opportunities in the WaSH sector (GoE, 2013b). According to Stolz et al. (2013), there are several individual consultants and consultancy companies doing capacity building activities in the WaSH sector. However, there is no policy framework for private-sector engagement on faecal sludge management or any particular government institution responsible for promoting private-sector engagement in urban waste management (ACIPH, 2015).

The National Hygiene & Sanitation Strategic Action Plan for Rural, Peri-Urban & Informal Settlements in Ethiopia is a guideline that includes several targets such as capacity building of the private sector, the creation of lines of credit, development and promotion of products and services that respond to consumer preferences (GoE, 2011). However, it is only targeted for rural, peri-urban and informal settlements, not for urban areas (GoE, 2011).

According to the head of the BDTWSSSE, there is a plan from ORDA to improve the water supply system in Bahir Dar due to the high leakage levels of the pipeline network (BD, 2016a).

All wastes, including faecal sludge, are unsafely disposed of in an open field in the outskirts of the city (BD, 2016a; BD, 2016b; BD, 2016c).

3 Service Outcomes

3.1 Offsite technologies

There is no sewerage system (BD, 2016a) in the city. There is a plan to build sewerage followed by a wastewater treatment plant within 5 years, see section 3.6.

3.2 Onsite technologies

Bahir Dar has no solid or liquid waste treatment plant to treat any wastes. With no sanitary landfill either, all waste is either discharged to the city's rainwater drainage network or to an open field with no treatment at all (BD, 2016a; BD, 2016c; BD, 2016f).

3.2.1 Flush toilets

Flush toilets are found in high-income households and hotels. All flush toilets are connected to septic tanks (designed and constructed to be watertight but in practice, they have lined tanks with impermeable walls and an open bottom, locally referred as septic tanks). These tanks are constructed to infiltrate the liquid into the surrounding soil. As time passes by, the pore space of the soil around the tank gets clogged, resulting in the frequent filling of the tank which needs frequent desludging/emptying by vacuum trucks (BD, 2016b). Septic tanks constructed for the condominium houses in the city are watertight and have soak-pit for the treatment of the effluent from the tank. However, as the density of population is high, the generation rate of liquid waste is greater than the rate of infiltration of the soil below the soak pit which results in an overflow in the soak-pit and in the septic tank itself (BD, 2016b).

3.2.2 Pit latrines

These latrines mainly consist of a squatting slab over a pit. Pit latrines are used by the majority of the population (BD, 2016b; BD, 2016c).

3.2.3 Ventilated Improved Pit latrines (VIP)

People who can afford to build a ventilated improved pit latrine to reduce fly and odour nuisance by ventilating the pit by means of a pipe, use this type of latrine (BD, 2016b; BS, 2016c). The outside of a private latrine (VIP) can be seen in Figure 3.



Figure 3: Outside of a private latrine (VIP) (photo credit: Eshetu Assefa).

3.3 Usage

On average, a total of 420m³ of faecal sludge per day is collected and disposed of in the open field (BD, 2016b). In 2007, the CSA conducted a survey on sanitation and ended up with the percentage of people using different of on-site technologies in Bahir Dar (Table 8). Since there was not possible to access to updated figures on those percentages, data from this 2007 survey will be used for the SFD production in section 3.8.

Table 8 Percentage of people using different sanitation technologies (CSA, 2007).

	%
	CSA (2007)
No toilet	28
Flush toilet	15
VIP	11
Pit latrine	46

3.4 Categories of origin

Categories of origin can be classified as households, shared or communal latrines, public toilets and institutional toilets. A brief description of each origin is presented as follows.

3.4.1 Households

The majority of people rely on pit latrines (Table 8). There are shared and communal pit latrines in Bahir Dar. People with less economic resources who cannot afford to build a latrine use shared or communal latrines (Figure 4).



Figure 4: Inside and outside of a shared latrine in Bahir Dar (photo credit: Oscar Veses).

As seen in Figure 4, residues such as toilet paper can be found on the inside of a shared latrine while in the outside, plastics and organic wastes can be observed, indicating a poor maintenance of the sanitation facility.

3.4.2 Public toilets

There are four public toilets in Bahir Dar (Figure 5). People are charged 25 ETB cents for their use. There is also a possibility of using a shower in these public toilets. In that case, an extra of 3 ETB is charged to the users. Public toilets open from 5a.m. to 10p.m. on a daily basis. Usually, between 50 and 100 people use these toilets daily.



Figure 5: Inside and outside of a public toilet in Bahir Dar (photo credit: Oscar Veses).

In the dry season, emptying of the latrines is made once every 6 days while in the rainy season this frequency rises up to once every 4 days. However, users do revert to open

defecation when these toilets are closed – most commonly by putting their excrements into a plastic bag and throwing it nearby (Figure 6), a practice commonly known as “flying toilets” (BD, 2016b; BD, 2016c).



Figure 6: Practice of “flying toilets” (photo credit: Oscar Veses).

3.4.4 Institutional toilets

A) There are currently five public schools in which the EcoSan system is being constructed. This system diverts the urine from the faeces, as seen in Figure 7. Urine is collected in a jerrycan in the bottom compartment and is intended to be used in agriculture according to guidelines related to dilution rates.



Figure 7: Inside and outside of an EcoSan in a public school (photo credit: Oscar Veses).

Faeces are collected in the bottom department, separated from urine. Straw or wooden ash is added to facilitate the composting of the faeces, with a final intention to be used as an organic soil conditioner in agriculture. When that compartment gets full, there is another compartment in the back of the structure that can be used for this purpose. This completes a closed loop with a total waste re-utilization of both faeces and urine.

There are 570 households with this EcoSan system currently under construction in Bahir Dar (ORDA, 2015; BD, 2016b).

B) In Felegehiwot referral hospital, a 40m³ bio-digester with a capacity of treating the faecal sludge produced by more than 800 people per day is currently operating (ORDA, 2015; BD,

2016b). The digester is buried (Figure 8a) while this biogas is used for energy production – cooking in the hospital kitchen (Figure 8b).



Figure 8: a) Bio-digester covered in soil. b) Biogas used for cooking purposes in the Felegehiwot referral hospital (photo credit: Oscar Veses).

3.5 Motorised Emptying

There are five private companies operating in Bahir Dar with a total of six vacuum trucks with a capacity ranging from 7 m³ to 11.5 m³.

The municipality has five vacuum trucks and the Bahir Dar University has one vacuum truck (only providing service for the University itself), making a total of 12 vacuum trucks to provide emptying services of faecal sludge in the city (BD, 2016a; BD, 2016c; BD, 2016f).

Motorised emptying is the main option used to empty the pit latrines or the septic tanks (lined tanks with impermeable walls and open bottom). When emptying septic tanks, faecal sludge contains both the semi-liquid and the effluent (supernatant) of the tanks since the vacuum trucks empty the whole content of the septic tanks. One interview was made to the owner of one of the companies (BD, 2016h). This company has one truck with a capacity of 10m³ (purchased in 2015 with a final cost of \$72,430US (Figure 9a).



Figure 9: a) Vacuum truck owned by one of the private companies. b) Latrine emptying using a hose (photo credit: Eshetu Assefa).

The owner highlighted that most of the crew members are not willing to work for a long time even though their salaries are high as compared to the salaries of other organizations. Another issue pointed out in this interview is that only one of the private companies is vat-registered. Due to this reason, there is a price variation for desludging per trip ranging from USD \$29–38. This creates problems for the vat-registered private company which requests USD \$38 per trip (BD, 2016h). Two photographs of faecal sludge being discharged from vacuum trucks are shown in Figure 10.



Figure 10: a) Faecal sludge discharge into an open field (photo credit: Eshetu Assefa).

Finally, it was stated in that interview that there is some misunderstanding between the truck crew members and the customers owing VIP and pit latrines. When the latrines are used for a long period, the lower part of the latrines content becomes solid and cannot be desludged by the vacuum truck. However, some customers are trying to push the crew members to desludge the solid (BD, 2016h).

3.6 Treatment, end-use and disposal

The disposal site (an open field) is situated on the outskirts of the city, near the road that leads to the Blue Nile waterfalls. All solid and liquid wastes are dumped into this site with no treatment at all (Figure 11a). Solid waste is collected once per week by private companies at household level, charging 8 ETB per month (BD, 2016a; BD, 2016f). The road to the desludging site is in very poor condition, causing problems on the spare parts of the vacuum trucks. Spare parts of the trucks frequently get damaged, creating interruption of the service and add more expenses to the private companies (BD, 2016h). Faecal sludge is disposed of in the open field until it is dried and then taken to the main site, located just next to it (Figure 11a, b). As seen in Figure 11b, the sludge drying bed is not properly designed and operated, with a difficult access for removing the sludge, especially during the wet season (BD, 2016h). Liquid wastes coming from industries, households, and public and private institutions end up on this site.



Figure 11a, b: a) Space dedicated for faecal sludge disposal next to the dumpsite. b) Dumpsite (photo credit: Oscar Veses).

There is no fence protecting the site or any proper design. People were observed scavenging in the garbage (without any kind of protection) to recover valuable materials (metals) (Figure 12). There is a strong and extremely offensive odour in the site and smoke can be seen coming out (Figure 11b, Figure 12).



Figure 12: a) People scavenging for valuable materials inside the dumpsite. b) Liquid waste from septic tanks discharged into the dumpsite (photo credit: Oscar Veses).

There are several human settlements next to the dumpsite. It is reported that in the rainy season flooding occurs with the runoff water discharging into a stream, which is in turn connected to the Blue Nile River. This serves as the water supply for numerous people (BD, 2016b; BD, 2016c). Infiltration of the dumpsite leachates into the groundwater and runoff from the sludge drying bed during the wet season could potentially pollute local water resources and pose a risk to public health. In addition, the animals that have free access to drink and swim in the sludge drying bed could also potentially result in public health risks (BD, 2016h).

Water runoff is collected in a drainage system distributed through the city with no treatment at all. This network can also serve as grey water collection points and even for improper solid waste disposal as seen in Figure 13.



Figure 13: Drainage system (photo credit: Oscar Veses).

It is reported that construction of a sanitary landfill for the city is planned to start in October 2016. This will be located around 8 km southwest of the city (BD, 2016b). There is a national program to construct a sewerage system followed by a wastewater treatment plant within 5 years' time. This project involves the city of Bahir Dar but also major cities such as Hawassa, Mekele and Adama, among others (BD, 2016a; BD, 2016c).

3.7 Drinking water supplies in the city

Water supply in Bahir Dar comes from three springs and 11 deep wells (and some more under construction). Service coverage according to a water consumption of 80 litres per capita and per day is around 57% (BD, 2016a; BD, 2016b; BD, 2016c). In Figure 14, two of the three springs used for drinking water supply in Bahir Dar are depicted.



Figure 14: a) Tiqurwuha spring. b) Areki spring (photo credit: Eshetu Assefa).

Chlorination is performed by adding sodium hypochlorite to two different water sources (BD, 2016b):

At three springs: Chlorine is added to the storage reservoir but not in a scheduled and planned way. The dosing system is not working, meaning that chlorine is added manually, creating an erratic concentration of residual chlorine in the distribution system (Figure 15). Customers just near to the storage reservoir are complaining about the excess residual chlorine and nearly zero concentration is reported in areas located away from the storage reservoir.

At 11 deep wells: Not chlorinated at all. Malfunctioning of the chlorine dosing plant is the reason for the bad performance of these wells.



Figure 15: a) Chlorine manual dosing tank. b) Storage reservoir for Tiqurwuha, Lome and Areki springs (photo credit: Eshetu Assefa).

There is no legal responsibility to protect water sources and some problems have been reported due to some business interests in the location of these water sources and constituting another additional problem, as pointed out by the head of the BDTWSSSE (BD, 2016a).

In some deep wells (Figure 16), only a fence separates the well from agricultural activities with no buffer zone protection.



Figure 16: Borehole at Cherechera wellfield (photo credit: Eshetu Assefa).

The BDTWSSSE has its own laboratory to perform water quality tests including physico-chemical and biological test (Table 9). These tests are carried out on a daily basis and around six to seven samples are tested at different sampling points and times. Two technicians and one water specialist staff the laboratory.. There is a plan from the BDTWSSSE and ORDA to build a new laboratory to increase their capacity (BD, 2016c).

Table 9 Parameters/tests used to assess water quality.

Type	Parameter/test
Physico-chemical	pH, Temperature, Odor, Taste, Total Dissolved Solids, Conductivity, Turbidity, Fluoride, Alkalinity, Aluminium, Ammonia, Ammonium, Hardness, Copper, Iron, Nitrate, Nitrite, Potassium, Sulphide, Sulphate, Zinc, Free chlorine
Bacteriological	Total Coliform

There is no control or monitoring of the presence of organic compounds in the water but some cross-contamination might occur (especially from organic matter coming from farming activities or even pesticides/herbicides that are used in agriculture in the area).

3.7.1 Ground water pollution assumptions

There are different soil types in the location of the ground water wells but no further information was available (BD, 2016a). According to the general manager of BDTWSSSE, the lowest water table is 8m. All wells are protected by a fence and located away from waste disposal sites, latrines, septic tanks. However, there is no buffer zone protection and some cross-contamination due to agriculture and farming activities carried out nearby might occur (BD, 2016a).

3.7.2 Levels of uncertainty

The main uncertainty of the data is the census on the percentage of people using the on-site technologies and the percentage of latrines that are covered and safely abandoned when they get full. The lack of reliable data, especially in the latter, was solved by taking a few assumptions, as stated in section 3.8.

3.8 SFD Matrix

The data outlined in Table 8 shows the percentage of people using onsite sanitation technologies. As stated previously, there are some initiatives to produce biogas from faecal sludge and to promote the use of EcoSan toilet facilities in schools and at household level. However, the total sludge disposed to these purposes is low and less than 1% from the total faecal sludge collected. Thus, these initiatives have not been included in the SFD.

Since there is no data on emptying, the following assumptions were made:

For pit latrines:

Assuming that humans produce an average of 1 l/day of excreta (around 0.8 l of urine plus 0.2 l of faeces) (Franceys et al. 1992), the total sludge produced per day by the 85% of the total population would be:

$$\frac{1L}{day * person} * 270,665 person * \frac{1m^3}{1,000L} \approx 271m^3/day$$

For flushing toilets:

It is assumed that a toilet consumes 6 litres per flush (WWG, 2016) and each person flushes the toilet 3 times per day (BD, 2016b) and thus, the total production of the 15% of the population using flush toilets would be:

$$\frac{6l}{flush} * \frac{3flush}{day * person} 47,764 person * \frac{1m^3}{1,000L} \approx 860m^3/day$$

Adding up those figures gives an estimation of the total sludge collected of 1,131m³/day. According to the municipality, a total of 420m³/day of faecal sludge is collected. Therefore, around 711 m³/month (62%) of faecal sludge remains unaccounted for.

From that 62%, 28% is coming from open defecation practices, leaving a 34% of the sludge unaccounted. Since there is no available data regarding the percentage of people who abandon their latrines when full, it is assumed that this unaccounted for faecal sludge (34%) is managed in this way.

Due to the lack of data that indicates how much of this faecal sludge is safely buried and how much is not safely buried, it is assumed that 50% of the faecal sludge is safely buried (i.e. the latrines are safely abandoned) and 50% of the faecal sludge is not safely buried (i.e. the latrines are not safely abandoned). Therefore, it is estimated that 17% of the total population uses pit latrines that are never emptied but abandoned when full and safely covered with soil – i.e. excreta is safely managed. While 17% of the population use pit latrines that are never emptied but abandoned unsafely i.e. excreta is unsafely managed (e.g. pit latrines that are failed, damaged or collapsed, etc.). Of the remainder, 38% of the population uses pit latrines and septic tanks that are emptied and the faecal sludge discharged to the dumpsite.

Table 10 summarizes the types of the sanitation containment systems currently in use. This table shows the description of the system, how it is defined in the SFD calculation tool and its reference and the percentage of people using each system.

Table 10 Estimation of the containment systems for the SFD matrix calculations.

SFD system description	SFD calculation tool reference	SFD system reference	% of population using system
Open defecation	T1B11C7TOC9	L20	28

Containment (septic tanks and pits) failed, damaged, collapsed or flooded - connected to water bodies, or open ground or 'don't know where'	T1B10C7TOC9	Reference L18	17
Pit (all types), never emptied but abandoned when full and covered with soil, no outlet or overflow	T1B7C10	Reference L12	17
Lined pit with semi-permeable walls and open bottom, no outlet or overflow	T1A5C10	Reference L11	30
Lined tank with impermeable walls and open bottom	T1A4C10	Reference L11	8

4 Stakeholder Engagement

The municipality of Bahir Dar was contacted ahead to gain permission to undertake this study. Eight Key Informant Interviews (KIIs) were conducted to primary stakeholders in relation to faecal sludge management. A telephone call was made upon arrival in Ethiopia to the municipality of Bishoftu (Mr. Haile Dinku from WaterAid kindly did that call in Amharic) to explain the project and to arrange the days of the field trips. Those KIIs included stakeholders from the municipality, ORDA and BDTWSSSE. All interviews were conducted either in the offices of the stakeholders or during the visits to different places of interest such as the dumpsite, the groundwater wells, etc. Moreover, Mr. Eshetu Assefa, from the Bahir Dar Institute of Technology, was of great help in getting information on private company emptier, as well as on gathering additional information on the city background, total WaSH budget and for providing pictures on vacuum trucks, latrines, wells, springs, etc.

In addition to those interviews, five more KIIs were conducted to different stakeholders in Addis Ababa in order to provide with an overview of the sanitation situation in Ethiopia. Previous to the field visit, an introduction letter explaining the project was sent through email to the different stakeholders in Addis Ababa to explain the project and to set up a day for the interview. Those KIIs included stakeholders from the MoWIE, the Ethiopian Institute of Architecture and the Addis Ababa Water and Sewerage Authority, among others.

The city had very few documents available on the internet. The visit was essential to collect data and to have access to unpublished reports. The visit was also essential to gain knowledge about the current situation of sanitation as well as gaining insight into the WaSH sector plans.

Another benefit from the visit was to have first-hand data on the emptying systems used by the emptying service providers and tariffs charged to people for their services. This increases the quality of the data collected and provides with a better understanding of the working capacity, responsibilities and quality of the emptying service provided.

4.1 Key Informant Interviews

All data were collected by unstructured KIIs. The unstructured interviews were useful to have access to unpublished reports. Some of these interviews were conducted jointly with different stakeholders. For example, the interview with the general manager of the BDTWSSSE was

conducted jointly with the Chair Holder, Water Supply and Sanitary Engineering from the Bahir Dar Institute of Technology and the capacity building officer of ORDA-Whole sanitation program. This was helpful to cross-check data regarding the current condition of the dumpsite and the type of treatment given to all wastes (in this case, no treatment at all but with a plan to build a sewerage system followed by a wastewater treatment plant within 5 years). Finally, just to mention that all interviewed people answered any question asked and they are willing to participate in further discussions and projects in the future.

4.2 Focus Group Discussions

Unfortunately, focus discussion groups were not carried out since the field visit lasted only one week and it was difficult to set up a convenient day for the main stakeholders due to their tight schedules. However, as mentioned in section 4.1, some interviews were conducted jointly with different stakeholders, allowing for an interchange of opinions and views regarding the sanitation situation and for data triangulation. Moreover, vivid discussions on the main challenges that need to be addressed in Bahir Dar were taken during these jointly-made interviews. It is suggested for the future that all the primary stakeholders in the city such as the municipality, the BDTWSSSE, the private sector, among others could celebrate a meeting (maybe on a monthly basis) to share their views and interests on the WaSH sector and to address jointly the main problems and challenges of this sector in Bahir Dar.

4.3 Observation of service providers

Several observations of service providers included the visit to the dumpsite, visits to public and institutional toilets and interviews with different stakeholders. The field visit to the dumpsite helped to understand how the faecal sludge is disposed of and make a visual assessment of the current situation of the disposal site (there was an opportunity to see how the faecal sludge is dumped in the open field). The visits to the public and institutional toilets were useful to understand how the sanitation technologies operate and how they contain the faecal sludge. Besides, some KIIs were conducted during these visits. This allowed for cross-checking of data and also to take photographs to provide with more credibility on the observations.

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- BD, 2016d. Interview with Haileyesus Guadie, water quality technician of BDTWSSSE.
- BD, 2016e. Interview with Tesfanesh Sisay, water quality technician of BDTWSSSE.
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- ETP, 2016b. Interview with Tamene Hailu. Coordinator of the national WaSH inventory from the MoWIE.
- ETP, 2016c. Interview with Ato Yared. Addis Ababa Water and Sewerage Authority.
- ETP, 2016d. Interview with Kassahun Bedene. WaSH Project Coordinator from the Horn of Africa Regional Environment Centre and Network.
- ETP, 2016e. Interview with Birhanu Genet. Senior Environmental Health Advisor, JSI.
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7 Appendix

7.1 Appendix 1: Stakeholder identification

Name of organisation	Name of contact person	Position	Influence (high/medium/low)	Interest (high/medium/low)
BDTWSSSE	Abiy Sisay	General manager	High	High
Bahir Dar Institute of Technology	Eshetu Assefa	Chair holder	High	High
ORDA-Whole sanitation program	Endegenä Shifenomo	Capacity building officer	High	High
BDTWSSSE	Haileyesus Guadie	Water quality technician	Medium	High

BDTWSSSE	Tesfanesh Sisay	Water quality technician	Medium	High
Municipality	Zelalem Getamu	Sanitary manager	High	High
Municipality	Simegnesh Yimer	Technician	Medium	Medium
Private company	Anonymous	Private owner	High	High
Ethiopian Institute of Architecture	Tesfaye Hailu	Chair holder of infrastructure design and construction	Low	High
MoWIE	Tamene Hailu	Coordinator of the national WaSH inventory	Low	High
Addis Ababa Water and Sewerage Authority	Ato Yared	Engineer	Low	High
Horn of Africa Regional Environment Centre and Network	Kassahun Bedene	WaSH Project Coordinator	Low	High
JSI	Birhanu Genet	Senior Environmental Health Advisor	Low	High

7.2 Appendix 2: Tracking of Engagement

List stakeholder that was directly engaged in the study	Date of Engagement	Purpose of Engagement	Maximum 100 word summary of outcomes
Aby Sisay	05/02/2016	Introductory call to gain permission to do field work	Interview conducted to provide a view on the WaSH situation in Bahir Dar
Eshetu Assefa	14/12/2015	Introductory email was sent to him to see the willingness to participate in the project	Interview was conducted to gain knowledge about the WaSH situation in Bahir Dar
Eshetu Assefa	05/02/2016	To know about the WaSH situation and solid waste situation	Field-trip organized to provide a view on the sanitation technologies used in Bahir Dar
Endegenia Shif enomo	05/02/2016	Situation of HEWs and their work	Field-trip organized to provide a view on the sanitation technologies used in Bahir Dar
Haileyesus Guadie	05/02/2016	To know about the water supply in the city	Information about the drinking water supply and plans to increase the capacity, leakage, water coverage, etc.
Tesfanesh Sisay	05/02/2016	To know about the water supply in the city	Information on the groundwater wells: situation, capacity, etc.
Zelalem Getanu	05/02/2016	Situation of HEWs and their work	Information on the work of the HEWs was obtained: training, monitoring, etc.
Simegnesh Yimer	05/02/2016	To know about the WaSH situation	Information on the WaSH situation in Bahir Dar
Anonymous	04/06/2016	To know about the private sector situation	Interview conducted to provide a view on the liquid waste situation of the private sector
Tesfaye Hailu	16/12/2015	Introductory email was sent to him to see the willingness to participate in the project	Interview was conducted to gain knowledge about the WaSH situation in Ethiopia on national level.
Tesfaye Hailu	14/01/2016	Introductory email was sent to him to see the willingness to participate in the project	Interview was conducted to gain knowledge about the WaSH situation in Ethiopia on national level.
Tamene Hailu	02/12/2015	Introductory email was sent to him to see the willingness to participate in the project	Interview was conducted to gain knowledge about the WaSH situation in Ethiopia on national level.
Tamene Hailu	15/01/2016	Introductory email was sent to him to see the willingness to participate in the project	Interview was conducted to gain knowledge about the WaSH situation in Ethiopia on national level.
Ato Yared	29/01/2016	Introductory email was sent to him to see the willingness to participate in the project	Interview was conducted to gain knowledge about the WaSH situation in Ethiopia on national level.
Kassahun Bedene	16/12/2015	Introductory email was sent to him to see the willingness to participate in the project	Interview was conducted to gain knowledge about the WaSH situation in Ethiopia on national level.
Kassahun Bedene	14/01/2016	Introductory email was sent to him to see the willingness to participate in the project	Interview was conducted to gain knowledge about the WaSH situation in Ethiopia on national level.
Birhanu Genet	25/11/2016	Introductory email was sent to him to see the willingness to participate in the project	Information about the organizations in charge of WaSH in Ethiopia was acquired

7.3 Appendix 3: SFD matrix

