UNIVERSITY OF GOTHENBURG

Department of Human and Economic Geography
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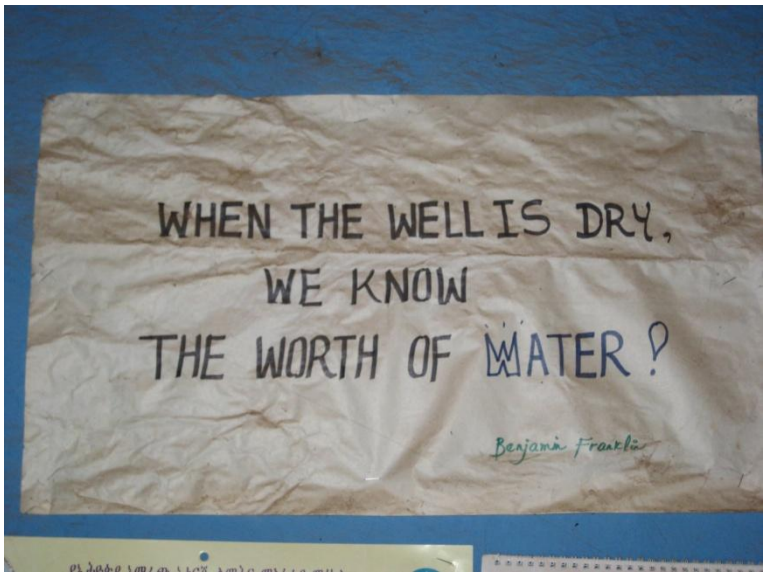
WATER SECURITY

A STUDY OF WHENCI WOREDA IN WEST SHOWA ZONE ETHIOPIA



MAGISTER THESIS: 15 hp

Magister Thesis in Geography

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September 10 2012

Abstract

Even though access to water has been recognized as a human right and is important for human development, still in the year 2008 about 884 million people lacked access to improved water sources. Most of these people live in the developing regions of the world. This study will be focusing on an area in west Showa zone in Ethiopia. The purpose is to study the status of water security for households in Chitu, its surrounding areas and Mete Walga kebele. The point of departure is the analytical framework of the Millennium Development Goals, Howard and Bartram's water service level and the Rapid Assessment of Drinking Water Quality method for sanitary risk inspections. This offers a framework when examining the water security in the studied area. By combining both quantitative and qualitative methods the study aims at providing a deeper knowledge about the water situation. Water sampling, GPS mapping, sanitary risk inspections, a quick question survey and semi-structured interviews are all methods used.

The findings show that the study area has a basic access (i.e. consumption should be assured) to water according to Howard and Bartram's service level in relation to time spent on walking to the water source. With regards to the quantities of water used the people using Meti well have no access according to Howard and Bartram´s service level. Five improved water sources were located in Chitu and three improved water sources were located in the rural area. One unimproved water source was identified and studied. At the time of the study there was no water quality problems in the area that could cause any health problems when the water was consumed by the population. However there can be a water quality problem during the rainy season. It was the water sources in the rural areas that had the highest sanitary risk scores. In relation to the Millennium Development Goal seven to "*halve, by 2015, the proportion of people without sustainable access to safe water and basic sanitation*" and how it is measured it is apparent that more aspects needs to be included when defining water access e.g. water quality and water quantities per capita a day. If the access to drinking water should be sustainable and safe in the long run, more than just the distance to an improved water source is important. This study has also showed that an improved water source can have water quality problems and an unimproved source might not have water quality problems.

Keywords: Water, MDG, Ethiopia, water security, water accessibility, RADWQ, water quality and sanitary risk factors.

Acknowledgements

I would like to express my deepest gratitude to my supervisor Margareta Espling for her support, guidance, honesty and optimism; each provided when most needed.

My greatest appreciation goes to the respondents in the Wenchi area and the informants who all made this thesis possible, Thank you.

I would also like to thank Margit De Boer who has helped me in this process in so many ways. Your comments, feedback and encouragement have been much needed.

Last but not least I would like to thank my family, and especially Michael and my mother, for their love and support.

Jenny Laesö Buch
Gothenburg, September 2012

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List of Acronyms and Abbreviations

FMOWR	Federal Ministry of Water Resources
HM	Household Members
ITCZ	Inter-Tropical Convergence Zone
MDG	Millennium Development Goals
ODA	Official Development Assistance
PRSP	Poverty Reduction Strategy Paper
RADWQ	Rapid assessment of drinking water quality
SDPRP	Sustainable Development and Poverty Reduction Paper
UNDP	United Nations Development Program
UNICEF	United Nations Children's fund
WB	World Bank
WHO	World Health Organization

1. Introduction

This thesis is based on field work in Oromia, west Showa zone in Ethiopia. My field research was sponsored by the Swedish International Development Agency (Sida), through a Minor field study scholarship. This chapter will start with an introduction and background of the research problem, which is followed by the purpose and research questions. Further this chapter will also provide a presentation of the essential concepts for this thesis, limitations, thesis relevance as well as the disposition of this thesis.

1.1 Background and research problem

"*When people are denied access to clean water at home or when they lack access to water as a productive resource their choices and freedoms are constrained by ill health, poverty and vulnerability. Water gives life to everything, including human development and human freedom"*[1].

Clean water is a very powerful driver for human development and it is essential for nearly every human endeavor.[2] Clean water helps creating a virtuous cycle of improving health; it enhances dignity and extends opportunities. Still 884 million people lacked access to improved water sources in 2008, according to the United Nations Development Programme (UNDP).[3]

Approximately 87% of the world's total population is using improved sources of drinking water. In the developing regions 84% of the people get their drinking water from such sources. However almost all of the 884 million people who do not use an improved source of drinking water lived in the developing regions in the world in 2008. The region in the world that faces the greatest challenges in relation to improved sources of drinking water is sub-Saharan Africa. Sub-Saharan Africa stands out and a third of the 884 million people lacking safe water live in this region. According to the UNDP, basic needs for water vary, but the minimum threshold is approximately 20 liters of water per person a day. Most people out of the 884 million people without access to an improved water source only use about 5 liters a

[1] UNDP,(2006) p 18
[2] Cunningham, W & Cunningham, M (2008)
[3] UNDP, (2006)

day per person. This can be measured against the more than 200 liters a day on average per person in Europe or the whopping 400 liters a day per person in the US.[4]

The Millennium Development Goals (MDG) are eight goals that all relate to the belief that through investment in their citizens, countries can gain social and economic development. The MDGs in goal seven have recognized the human right to access safe drinking water and it calls for countries to "*halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation"*[5].

Ethiopia is the second most populated country in Africa with over 91 million inhabitants, most of which live in the rural areas.[6] According to international conventions and underlying government laws, all citizens in Ethiopia have the right to have access to safe domestic water for their basic human needs. Ethiopia´s goal is that 100% of the population in urban areas and 98% in rural areas will have access to safe drinking water by 2015.[7] However in 1994, 76% of the country's population used "unsafe" water, i.e. unimproved water sources.[8] Roughly 24% had access to safe water through piped (tap) water or from other improved water sources.[9] These numbers remained almost the same in 1998.[10] In Ethiopia in 2001 the Federal Ministry of Water Resources (FMOWR) estimated that 24% of the rural population and 72% of the urban population had access to safe drinking water and was using improved water sources. Still in 2001 about 63% of the population in the country was using sources that were unimproved.[11]

In developing countries most people have access to some sort of water source. However this water source may present a risk to their health due to its water quality. An average person in the developing countries waste as much as one tenth of their productive time being sick from water related diseases.[12] Consumption of contaminated water could cause health problems

[4] UNDP,(2006)
[5] http://www.wssinfo.org/about-the-jmp/introduction/
[6] http://www.theodora
[7] Interview Tamene Hailu – rural wash coordinator at the Ministry of water – 2012-03-28
[8] Unimproved water sources are; unprotected spring; unprotected dug well; surface water; tanker-truck; cart with small drum/tank and bottled water.
[9] An explanation of improved water sources is provided in the terminology
[10] United Nations Educational, Scientific, and Cultural Organization World Water Assessment Program (2004)
[11] Tadesse, et al. (2010)
[12] Margaret Ince & RADWQ-Nigeria Technical Sub-Committee (2006)

like e.g. cholera, diarrhoea or typhoid.[13] Diseases that are associated with poor water quality is still a major problem in developing countries. In 2003, 1.6 million deaths per year were ascribed to poor sanitation, unsafe water and lack of hygiene.[14] In Ethiopia the FMORW acknowledges that comprehensive and systematic water quality control is lacking in the country.[15] The studies and reports, e.g. the rapid assessment of drinking water quality (RADWQ), have shown that in the country´s river basins there is no significant water pollution problem. However different regions in the country have problems such as the presence of high concentrations of iron or chlorine in the water.[16] Also the poor performance of Ethiopia's child and maternal health indicator may be connected to poor water and sanitation.[17] Since water quality is important for human health and since systematic quality control is deficient in the country a more quantitative study of the water quality situation is needed.

This thesis will focus on an area in the Oromia region which is located in the west Showa zone of Ethiopia. In 2001 the population in the Oromia region´s overall access to improved water sources was 31.2%. In the rural areas only 25% of the population had access to safe drinking water and in the urban areas these numbers were approximately 76%.[18] Still today in 2012 there is a chance that not all citizens in Ethiopia or in the Oromia region have access to safe water so that their basic needs can be met. More research is needed to investigate people's access to water and their perspectives related to their daily domestic water situation. Trough the perspectives of the people a lot can be learnt about the status of the water access in this area and the water status related to the Ethiopian government's goal for 2015.[19]

1.2 Purpose and research questions

The purpose of this study is to explore the status of water security of the households in Chitu and its surrounding area and Meti in Mete Walga Kebele. This will be done by exploring water quality and water safety as well as domestic water access. By doing so, the aim is to create a deeper understanding through local people's views on water quality, water safety and access to drinking water in the studied area.

[13] Ibid.
[14] Hutton, Guy & Haller, Laurence (2004)
[15] Water Supply and Sanitation Inputs for Ethiopia Full PRSP (2002)
[16] Tadesse, et al. (2010)
[17] Water Supply and Sanitation Inputs for Ethiopia Full PRSP (2002)
[18] United Nations Educational, Scientific, and Cultural Organization World Water Assessment Program (2004)
[19] IMF (2011)

My research questions are

A. *What access do households have to water used for domestic purposes?*

- In relation to the households´ accessibility to the water it is important to investigate what water sources exist within the study area.
- After locating the water sources the service level for the households helps creating an understanding of the access to safe drinking water for domestic use.
- It is also important to research other factors that influence people´s accessibility, e.g. is there a price for the water? Are there any restrictions on the source that prevent people from accessing the water?

B. *What is the quality of the drinking water?*

- The quality of the water affects the households, e.g. household members might get sick from the water. People might also choose not to use one water source if they perceive the quality to be bad at that source.
- In relation to this people's perceptions and experience of water quality, for example health problems related to the drinking water, contribute to the overall understanding of this question and will also be studied.

C. *What are the sanitary risk factors at the drinking water sources?*

- This question affects the current water quality state but also future water quality state of the water source, e.g. contaminated surroundings around the water source might affect the water quality. This question is related to the present condition of the infrastructure and its surrounding area i.e. the water safety.
- Again people´s perceptions of the water safety about the drinking source or sources they use will contribute to a deeper understanding of this question.

1.3 Concepts

Since this thesis uses a few different concepts i.e. water security, water access, water service level, water safety and water quality a definition of these concept will now be presented.

Water security is a more comprehensive term than household service level or water access and includes the concept of water access as well as a water safety assessment.[20] When all of these criteria have been studied it becomes possible to estimate the household security level.

Water access or access to safe water for my research is defined by the Joint Monitoring Programme (JMP) definition of improved water sources.[21] Improved water sources are as follows; piped water to plot/yard; piped water into dwelling; public tap or standpipe; borehole or tubewell; rain water; protected dug well and protected spring.[22] The household *water service level* estimates the water access for domestic use by including the number of liters of water collected per person and the time or distance to fetch the water in order to determine if the service level i.e. access to water for the household is good or bad.[23]

Water safety relates to the present state of the infrastructure i.e. water source and its surrounding areas, e.g. are the source leaking? Is there a crack or is there a latrine near the water source?

Water quality means the state of the water source regarding its water quality. According to the World Health Organization (WHO) water is safe for drinking when it does not present any danger for the human health when consumed.[24]

1.4 Limitations

In this study the water access as well as the water quality of the identified water sources in the studied areas will be investigated. Further the condition of the water source and its surrounding area is also explored along with people´s thoughts about their water access and the water quality. However this study does not make any claims to represent the water security in the whole of Ethiopia or the whole Oromia region. Additionally, this study does not claim that the water quality, safety and access are the same in other areas. This study is geographically limited to the area of and around Chitu and Meti in Mete walga kebele.

[20] Bartram, J Howard, G (2003)
[21] http://www.wssinfo.org/definitions-methods/introduction/
[22] http://www.wssinfo.org/about-the-jmp/introduction/
[23] Bartram J Howard G (2003)
[24] WHO (2004)

In relation to the MDG goal of safe drinking water, this study is only focusing on the access of water in relation to domestic use. That is why access to water for agricultural purposes has not been studied. In relation to the measuring of the water quality only water quality tests measuring pH, conductivity, temperature and iron were conducted. Conductivity, pH and temperature are good overall indictors of the water quality.[25] Tests on chlorine, bacterial coli form, turbidity etc would have helped make a better estimate of the water quality for the studied area. However, since my research question went beyond water quality to also include water access and safety, I decided to keep the parameters limited to these four. Furthermore some of the instruments needed in order to measure other parameters are expensive and I had no previous experience of how to use those instruments.

1.5 Relevance

Investigating the water access, quality, safety and how people perceive water quality and water safety provides a more holistic view of people's water situation in Ethiopia and the Oromia region for the present day. Through this thesis I hope to create a better understanding and insight regarding water security in the studied area. Many smaller research projects may in the end contribute to creating a theory[26] and my work may contribute to both quantitative and qualitative studies.

1.6 Disposition

While chapter one has provided a background and introduction to this study, the proceeding chapters will be divided as follows: in chapter two the analytical framework for the study will be presented. This chapter has the purpose to set the frame for the following chapters and that is way it is placed in the beginning of this thesis. In chapter three the geographical setting of Ethiopia will be presented. This is placed after the analytical framework in order for the reader to have a basic understanding about the Ethiopian context before reading the following chapters. Chapter four explains through previous literature the background of all the involved factors in the concept water security. The reader is in this chapter provided with deeper knowledge regarding water access, safety and quality. This chapter is placed before the method chapter i.e. chapter five so that the reader is able to follow how this thesis will be

[25] Tadesse , et al. (2010)
[26] Creswell, W John (2009)

carried out. In chapter five which is the method chapter both the quantitative[27] and qualitative[28] research methods will be presented. The results and analysis of this study starts with a presentation of the water access in chapter six. This is followed by the water quality in chapter seven. The last results are provided in chapter eight about water safety. Chapter nine which is the final chapter brings the empirical findings into the final discussion of this study.

[27] Water sampling, assessment of sanitary risks, GPS mapping and quick question survey
[28] Semi-structured interviews

2. Analytical framework

This chapter will provide the framework for this study. A presentation of development history and theories leading up to the Millennium Development Goals will first be presented. This is followed by Howard and Bartram´s service and security level matrix followed by the Rapid Assessment of Drinking Water Quality (RADWQ) sanitary risk inspection method. In the end of this chapter it will be presented how these sections contribute to the analytical frame for this thesis.

2.1. Development history leading up to the MDGs

During the last decades the concept of development has been widely discussed and a number of theories trying to explain development have come about. The MDGs has its roots in this development theorizing and the will to create better lives for humans all over the world, especially in developing countries.

It was within the time period of pre-1950s and the 1950s that development theories and the international institutions that would dominate aid up until today came about.[29] The modern era of aid giving is often said to have begun in the final years of the 1940s. However aid had been provided to governments even before this, e.g. in the 1930s the United States Department of Agriculture was funding agricultural research in Latin America. The UN was established in 1945, several under organizations were created the following years and the Universal Declaration of Human rights was completed in 1948.[30]

There have been a number of development theories and thinkings´ emerging under the past 50 years and only a few will be mentioned here. Different development theories started to emerge in the pre-1950s e.g. in 1943 Paul Rosensteine-Rodan promoted the idea of the "big push" and in 1957 Walt Rostow and M.F Millikan identified two specific roles for aid in how to enhance the economic growth rates.[31] In the 1960s the main theory was still, widely believed that knowledge and investment would spur economic growth in developing

[29] Odén, Bertil (2006)
[30] Ridell, C Roger (2007)
[31] Ibid.

countries. In the end of the 60s there was a distinction and a problematization between growth and development.[32] Structuralism was strong during this era and its adherents they believed that development involves changes in underlying economical and social structures.[33] The dependency school slowly evolved from the Latin American structuralism in the 1970s.[34] The focus for aid in the 1980s would no longer be on poverty reduction but on macro economical stability and reforms.[35] Neoliberals view the "*process of capitalist development (…) as leading inexorably to the desired result of modernization, with no need for any kind of international development*"[36]. Neo-classical economics was prevalent everywhere and it was not a question about theories. Instead the question was about "get the price right".[37] In the 1990s the neoliberal thinking was weakened and there was a new view on the role of the state. Theoretically it is still the neo classical national economy thinking that is dominant.[38] This development history has led us up until today and the 21 century and believes of this era. In the 21 century there has been a greater consensus amongst academics and world leaders that there is a need for non-market interventions alongside the global industrial capitalism. This view have some things in common with structuralism e.g. the main way to regulate the market has been through state interventions and that the structural contradictions inherent in capitalism is recognized. Their difference, however, lies in the fact that they seek to combine the market and state, not replace the market.[39]

This development and the world development during the last 50 years lead up to the creation of the UN world declaration witch then lead up to the Millennium Development Goals. The MDGs were created in 2000 after an initiative by the former United Nations General of Secretary Mr Kofi Annan. In September that same year the 189 members of the United Nations endorsed the 8 goals formulated in the MDGs. In 2010 the world recommitted itself to these goals. The Millennium Development Goals contain 8 goals and 18 sub-goals that are to be reached in 2015. The MDGs are based on the belief that a country can reach economic and social development if the country's resources are invested in the development of its citizens.[40] The 8 goals are; 1, eradicating extreme poverty and hunger; 2, achieving universal

[32] Odén, Bertil (2006)
[33] Allen, Tim & Thomas, Alan (2000)
[34] Odén, Bertil (2006)
[35] Ibid.
[36] Allen, Tim & Thomas, Alan (2000) p 43
[37] Odén, Bertil (2006)
[38] Ibid.
[39] Allen, Tim & Thomas, Alan (2000)
[40] http://www.wssinfo.org/about-the-jmp/introduction/

primary education; 3, promoting gender equality and empowering women, 4, reducing child mortality rates; 5, improving maternal health; 6, combating HIV/AIDS, malaria, and other diseases; 7, ensuring environmental sustainability and 8, developing a global partnership for development.

The importance and the human right to water have been recognized in the Millennium Development Goals. In goal 7, the MDGs calls on countries to "*halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation*"[41]. If current trends will continue there is a good chance the world will reach this target or even exceed it. So far four regions have already reached the goal, North Africa, East Asia, South – East Asia and the Caribbean and the Latin Americas. But even if the drinking water target in the MDGs is reached by 2015 it still means that about 700 million people will be without access to safe drinking water. Especially rural areas have a problem with access to safe water and eight out of ten people that still do not have access to safe drinking water lives in rural areas.[42]

2.2 Water service level matrix

The importance of safe drinking water has been recognized by the world and the MDG includes a target as described above to halve the proportion of people without access to safe sustainable drinking water by 2015. However the MDG does not have a minimum of quantities for safe domestic water included in the target. The United Nations Children´s Fund (UNICEF) and the World Health Organization (WHO) have developed this and describe reasonable access as being "*the availability of at least 20 liters per person per day from a source within one kilometer of the users dwelling"*[43].

According to Howard and Bartram, water quantities are also important in relation to health gains and it is interlinked with other targets of the MDG, e.g. poverty reduction, child mortalities and maternal health.[44] Access to safe water, water quantities and sanitation is essential for so many aspects e.g. it is important in addressing gender inequalities, improving the livelihoods, health and education of the poor and eradicate hunger. For example, any human being who spends a lot of time collecting water has less time to earn money from an

[41] Ibid.
[42] http://www.un.org/millenniumgoals
[43] Howard, G & Bartram, J (2003) p1
[44] Ibid.

occupation or go to school. Further persons who have access to small quantities of water might get sick and lose their strength to support themselves or their family.[45] Trough the recommendations of the WHO and UNICEF and an extensive document review about needed quantities of water for domestic use, Howard and Bartram have developed a service level matrix for the WHO.

As others Howard and Bartram are focusing on the liters of water per capita and the walking distance or the collecting time in their matrix and it is through these data then possible to determine the service level, i.e. if there is no access, basic access, intermediate access or optimal access, (see table 2.1 below).

Table 2.1 Service level matrix

Service level	Access measure	Needs met	Level of health concern
No access (quantity collected often below 5 l per capita)	More than 1000m or 30 minutes total collection time	Consumption – cannot be assured Hygiene – not possible (unless practised at source)	Very high
Basic access (average quantity unlikely to exceed 20 l per capita)	Between 100 and 1000m or 5 to 30 minutes total collection time	Consumption – should be assured Hygiene – handwashing and basic food hygiene possible; laundry/ bathing difficult to assure unless carried out at source	High
Intermediate access (average quantity about 50 l/ per capita)	Water delivered through one tap onplot (or within 100m or 5 minutes total collection time	Consumption – assured Hygiene – all basic personal and food hygiene assured; laundry and bathing should also be assured	Low
Optimal access (average quantity 100 l per capita and above)	Water supplied through multiple taps continuously	Consumption – all needs met Hygiene – all needs should be met	Very Low

Source: Bartram, J Howard, G (2003) p 1

These service levels can also be understood using the term household water security. To be able to determine the household water security, the service level as well as an inclusion of water safety has to be provided in order to have a full description. The first group would then be; no household water security, then partial household water security and the last two stages would be sustained household water security. [46]

[45] http://www.who.int/water_sanitation_health
[46] Bartram, J Howard, G (2003)

2.3 Sanitary risk inspection method

In order to provide a broader understanding of the drinking water status in the world, the WHO and UNICEF developed a method for how to test the water quality more globally. Five countries, i.e. Jordan, Nicaragua, Nigeria, Tajikistan and Ethiopia, were selected for the initial Rapid Assessment of Drinking Water Quality (RADWQ). RADWQ uses a cluster method meaning that water supplies were geographically close to another. The method used is more or less the same for all the different countries with some adaptation to the specific contexts.[47]

They have recognized that the status of the water infrastructure also is important in order to see the sustainability of the water quality results. As an addition to the water quality testing WHO and UNICEF developed sanitary risk inspections. Sanitary inspections are visual assessments of the environmental surroundings. Risk factors that are identified are for example unsanitary conditions around the source and latrine near the water source. The scoring is categorized with 10 questions that are different depending on the type of water source (see Appendix 1) and each answer that complies gets 1 point. According to how many points a source gets it is possible to determine the sanitary risk:

- 0-2 a very low risk
- 3-5 a low risk
- 6-8 a medium risk or
- 9-10 a high risk. [48]

2.4 The analytical frame

This study explores different factors that relates to the overall understanding of the water situation in the study area in Ethiopia, i.e. the water security situation.

The study has its stand point in the MDG related to the right to access safe water and aims to create a deeper understanding through local people's views on water safety, water quality and accessibility to drinking water in the studied area. By exploring these factors the MDG goal related to water i.e. the access to sustainable safe drinking water is also examined. It is inherent in this thesis that safe sustainable drinking water should be available to all human beings on this earth.

[47] Ince Margaret & RADWQ-Nigeria Technical Sub-Committee (2006)
[48] Tadesse , et al. (2010)

Since I believe the MDG goal 7 of safe sustainable drinking water involves different arguments on how to measure the progress towards the goal, this study is framed by Howard and Bartram's service level matrix and the RADWQ method for sanitary inspection. The service level matrix is used in its totality when the accessibility to drinking water is studied. Furthermore this study also explores, trough the RADWQ method of sanitary risk inspections, the sustainability of the drinking water sources related to water quality. In order to create some comparability, even in the most humble way, the RADWQ method was used. In relation to Howard and Bartram's water security definition this study has included both water quality and sanitary risk inspections in the safety assessment. This was done in an attempt to create a comprehensive analysis of the water quality situation, now as well as in the near future.

3. Geographic context Ethiopia

In this chapter the geographical setting of the study area is presented. A deeper understanding of the Ethiopian context will be provided by describing the geology, demographic, administrative as well as development challenges and policies. Also the water situation and factors influencing the water in the country will be presented.

3.1 Geographical setting

3.1.1 Geography

Ethiopia is situated on the Horn of Africa. It is a landlocked country with a total area of 1.13 million square kilometers. The country shares its borders with Somalia, Kenya, Sudan, Djibouti and Eritrea. Ethiopia is the oldest nation in sub-Saharan Africa and it is one of the oldest in the world. The total amount of arable land in the country is 10.01 %.[49] The country has a very varied topography, with peaks in excess of 4 000 m to the Afar Dollol depression that is 125 m below sea level.

Figure 3.1, Showing Ethiopia in relation to Africa.

Source: http://www.worldvision.orgk

[49] www.cia.gov/library/publications/the-world-factbook/geos7et.html

The Great Rift Valley separates the eastern and southeastern highlands from the northern and the western high lands.[50] The geology of the country is a mixture of sediments of various age, ancient crystalline basement rocks and volcanic rocks associated with the east African rift system.[51]

Since Ethiopia has such geographical diversities the country consists of both cool and hot places. In the highland areas temperatures below 0 degrees Celsius is not uncommon during night time and in the low lands the highest mean temperature is about 40 degrees Celsius.[52] Most inhabitants live between 1 700 meter and 2 400 meter where the temperature varies between 16 to 30 degrees Celsius.[53]

3.1.2 Demography and administration

Ethiopia consists of 611 woredas, nine regions (Afar; Amhara; Benshangul; Gambella; Harari; Oromiya; SNNPR[54]; Somali and Tigray) and two administrative councils, the Dire Dawa administration council and the Addis Ababa council. The woredas[55] are further divided in to kebeles[56], which are small urban town associations or rural peasant associations.[57]

Ethiopia is estimated to have more than 93 million inhabitants by July 2012.[58] Most people in Ethiopia live in rural areas, more than 80% of the population and it is one of the world's least urbanized countries. In the country there are nine urban centers that have a population that exceeding 100 000 inhabitants and only Addis Ababa has a population of more than one million inhabitants.[59] The country has 11 major ethnic groups and the three largest groups are Oromo 34.5%, Amara 26.9% and Somali 6.2%. Most people in Ethiopia are Orthodox and the second biggest religion is Islam. Amharic is the official language but a large number of regional languages are spoken in the country as well. The average life expectancy for males is 53 years and for females 59 years.[60]

[50] http://www.mowr.gov.
[51] British geological survey(2001)
[52] http://www.mowr.gov.
[53] www.landguiden.se
[54] Southern Nations, Nationalities, and People's Region
[55] Is a third-level administrative level of Ethiopia (district)
[56] The smallest units of local government (neighborhood associations)
[57] Tadesse, et al. (2010)
[58] http://www.theodora
[59] www.water.org
[60] https://www.cia.gov/library/publications/the-world-factbook/geos/et.html

Since, 2001 the president of the Federal Democracy of Ethiopia is Girma Woldegiorgis and since 1995 the prime minister is Meles Zenawi.[61] The cabinet is selected by the prime minister and they are approved by the house of People's Representative. The president is elected for a six years period with a chance of a second term by the chambers of parliament. The next election will be held in October 2013.[62] Ethiopia's first multiparty elections were held across the country in May and June 1995. Before that Colonel Mengistu had ruled from 1974 until he fled the country in 1991.[63]

3.2 Development and policies

3.2.1 Development challenges & Poverty Reduction Strategy Papers

Ethiopia is a poor country that has faced many development needs over the last century. In 2000 the country had the lowest road density, the lowest primary school enrolment ration, and highest incidence of malnutrition in Africa. The country also had an overall low access for its population to safe drinking water. In 1997 Ethiopia had an estimated per capita Gross National Income of US$110.[64]

In November 2000 the Government of Ethiopia completed the Interim Poverty Reduction Strategy Paper (I- PRSP). And in 2001 the country entered Heavily Indebted Poor Countries (HIPC). This was an effort from the government to improve the economy and deal with development challenges. Ethiopia has since then completed its Sustainable Development and Poverty Reduction Paper (SDPRP) in 2003.[65] In 2005/06 Ethiopia started a new phase of their old SDPRP, the Plan for Acceleration and Sustained Development to End Poverty (PASDEP). PASDEP focused on human and rural development, capacity building and food security. New directions for the PASDEP include a focus on economic growth, scaling up efforts to achieve the Millennium Development Goals and the "urban agenda".[66] Recently Ethiopia finalized the latest Growth and Transformation Plan in 2011. Within the whole Poverty Reduction Strategy Paper (PRSP) process in Ethiopia accessibility to water has always been recognized as one of

[61] He died in August 2012. Deputy Prime Minister Hailemariam Desalegn will take over until election 2013.
[62] Ibid.
[63] http://www.nationsencyclopedia.
[64] Jeffery, Clark (2000)
[65] Water Supply and Sanitation Inputs for Ethiopia Full PRSP (2002)
[66] The federal democratic republic of Ethiopia (2007)

the priority areas.[67] How the government priorities access to water in different policies and PRSPs will be presented in the next section.

Seen to the last decade what have then happened after all these policies and PRSP papers? Some areas have improved for example the GNI per capita of 2010 was US$390. However some challenges still remain e.g. in 2011 the country only had a literacy level of 30% for its population. Child malnutrition is still a problem and 39% of the population are living below the country's own poverty line.[68] Ethiopia also faces security, food security and environmental problems, e.g. food production problems and a lot of people in the country remain unprotected from various internal and external conflicts and tensions. AIDS is another threat to the country's population and development.[69]

3.2.2 Policies about water

At the federal level it is the Federal Ministry of Water Resources that has the responsibility for water and sanitation in Ethiopia. The Federal Ministry of Health is also responsible for the surveillance and the quality monitoring of the water in the country. It is the department of Hygiene and Environmental Health who is in charge of the development of policy guidelines regarding water quality surveillance.[70] Due to a decentralization process in the country a large part of the decision making happens at the regional level, at the Regional Water Bureaus. In some larger regions there are also woreda water offices and the Ethiopian government will continue to strengthen this decentralization.

The Ministry of Water Resources has adopted a National Water Resources Management Policy in 1999 within the framework of the Constitution of the Federal Democratic Republic of Ethiopia. The overall goal with the policy is "*to enhance and promote all national efforts towards the efficient, equitable and optimium utilization of the available water resources of Ethiopia for significant socioeconomic development on sustainable basis*"[71]. This means that the main objective is to ensure that all Ethiopian citizens have access to water to satisfy their basic human needs. The key aspects of importance for the policy are as follows; financing, water pricing and cost recovery policies; technology and maintenance aspects; integrated water and sanitation policy; allocation of water resources and institutional framework for

[67] Water Supply and Sanitation Inputs for Ethiopia Full PRSP (2002)
[68] World Bank (2010)
[69] Jeffery Clark (2000)
[70] Tadesse, et al. (2010)
[71] The federal democratic republic of Ethiopia, Ministry of water resources (1999) p 1

management. The water policy also provides guide lines on e.g. the price of water. Water is recognized to have an economic value and it states in the policy that the price one has to pay for water should not be too high nor too low. In relation to water quality the policy states that a development of pollution prevention and control strategies should be adapted to the Ethiopian context. Furthermore, a water quality criterion for Ethiopia should be adopted and followed. Regarding gender issues the policy also tries to ensure that women are included in the planning, implementation etc of the water policies.[72] This water policy from 1999 is today still in use in its original format.

In 2003 in the SDPRP three priority areas related to water and sanitation were highlighted. These are as follows;

- to enhance access of the urban poor to sanitation, water supply and hygiene promotion;
- to enhance the overall sector capacity and
- to enhance the access in rural areas to safe water, hygiene and sanitation.[73]

In relation to the water priority areas of the 2003 SDPRP, the Ministry of Health developed a water supply measures extension package in 2004. This package is related to safe water and water quality. It brings up the fact that a lot of people suffer from water born diseases in Ethiopia. The purpose of this package is to create awareness about health risks that are associated to un-safe water in the communities. Further the package also aims to impart skills and knowledge on how the communities on their own can treat the water or make it safe with their locally available resources.[74]

In the Growth and Transformation Plan from 2011 one of the goals are to increase quality and access to safe drinking water and to improve sanitary services. The end goal for 2015 is that 98% of the population within rural areas will have potable water within a 1.5 km radius and 100% within urban areas have potable water within a 0.5 km radius.[75] The quantities of water per capita the Ethiopian government is trying to achieve before 2015 in rural areas is 50 liters

[72] The federal democratic republic of Ethiopia, Ministry of water resources (1999)
[73] Water Supply and Sanitation Inputs for Ethiopia Full PRSP (2002)
[74] Federal democratic republic of Ethiopia Ministry of health (2004)
[75] The federal democratic republic of Ethiopia (2007)

per capita per day and within urban areas 20 liters per capita per day.[76] For the annual goals of water access in percentages (see table 3.1 below).

Table 3.1, Ethiopia's water access goals

Indictor	Annual goal 2010/11	Annual goal 2011/12	Annual goal 2012/13	Annual goal 2013/14	Annual goal 2014/15
National water supply coverage %	75	81	87	93	98,5
Rural potable water service within 1,5 km radius %	73	80	86	92	98
Urban potable water service within 0, 5 km radius (%)	93	95	97	99	100
Reduce non functional rural water supply schemes (%)	18	16	14	12	10

Source: IMF (2011)

3.3 Water

3.3.1 Water sources

Ethiopia has twelve river basins, some artificial reservoirs and 14 major lakes.[77] Lake Tana which is the largest lake in the country is located in the highlands. Between 80 – 90% of Ethiopia's water resources are found in four river basins. These are the Baro Akobo, Tekeze (Blue Nile) Omo Gibe and Tekeze. These four river basins are all found in the south west and west part of Ethiopia and in this area the population is only 30 – 40% of the total population of the country. In the east and central river basins the population is about 60% and here the river basins are only 10 – 20%.[78] The total of renewable water resources in the country is 110 cubic km and out of this there is a fresh water withdrawal of 5.56 cubic km a year.[79]

The dominant source of water for domestic use is ground water. This is especially true in the dry areas. In the dry areas, e.g. the Somali region, the water is often seasonal and scarce. In many areas of the country there is a limited supply of groundwater. The limited supply is due to variable water-table depths and poor permeability of the crystalline rocks. The Precambrian rocks often have a low permeability and this affects the yields in the wells negatively. In and

[76] Interview Ministry of water resources Tamene hailu- rural wash coordinator – 2012-02-23
[77] http://www.mowr.gov.
[78] The federal democratic republic of Ethiopia, Ministry of water resources (1999)
[79] www.cia.gov/library/publications/the-world-factbook/geos7et.html

flanking the rift valley the permeability is varied, but often good due to the volcanic rocks. Variable ground water is also common in eastern, central and northern Ethiopia in the sedimentary rocks.[80]

3.3.2 Rainfall

Rainfall in Ethiopia also affects the available water. The rainfall is varied in the country but in general the lowlands receive less rain than the highlands,[81] the national average is 744 mm per year.[82] It is influenced by three mechanisms; the summer monsoon Inter-Tropical Convergence Zone (ITCZ); the local convergence in the red sea coastal region, and the tropical upper easterlies. During the "Bega" period, which is the winter dry season, the ITCZ is located south of Ethiopia. This causes it to rain only along the Red sea coast. In March the small rain period "Belg" occur due to the ITCZ. The ITCZ brings rain to the eastern, southern and central parts of Ethiopia. This is extra prevalent in the high ground in south- western parts of the country. The Egyptian high strengths and the northern movement of the ITCZ cause it to be a short dry period in May. In June the wet season "Kremt" starts and it last normally until north-easterly continental airstreams is re-established in the beginning of the fall. During "Kremt" the south-west air streams extends all over the country and the movement of the ITCZ to the north produce the rain season.[83]

3.4 Setting of the study area

The area of Wenchi is located in the region of Oromia and it is 47 456 hectare big. The total population is approximately 133 180 people with a little more females than men. More people live in the semi "dega" zone i.e. the middle zone, approximately 50.3% of the population. The remaining 49.7% of the population in Wenchi live in the "dega" zones i.e. the cool areas. Chitu has a population of approximately 2 500 people.

In the wenchi area there are 11 rivers, 434 springs and one lake. There are two aquifer systems in this area. One is shallow and it is located at 30 meters depth. The other system is located at 200 meters depth and it is fractured basalt water since the area is volcanic. It is easy to reach the basalt area for water when drilling for wells in this area according to the Manager

[80] British geological survey (2001)
[81] Tadesse et al. (2010)
[82] www.fao.org
[83] Conway, Declan (1999)

for the water works design and supervision enterprise.[84] The minimum rainfall is 900 mm per year and the maximum is 2 200 mm per year.[85] The soil in the area is good for agriculture, the only thing missing is water. The area needs two times more irrigation than it uses now.[86]
In Oromia the access to safe water in 1994 was 15.8% in rural areas and 76.2% in urban areas. In 1998 this figures had changed a little bit and in the rural areas 20.0% had access to safe drinking water and 85.8% in urban areas. In this region in 1998 the most common source of water was rivers and lakes with 49.2%.[87]

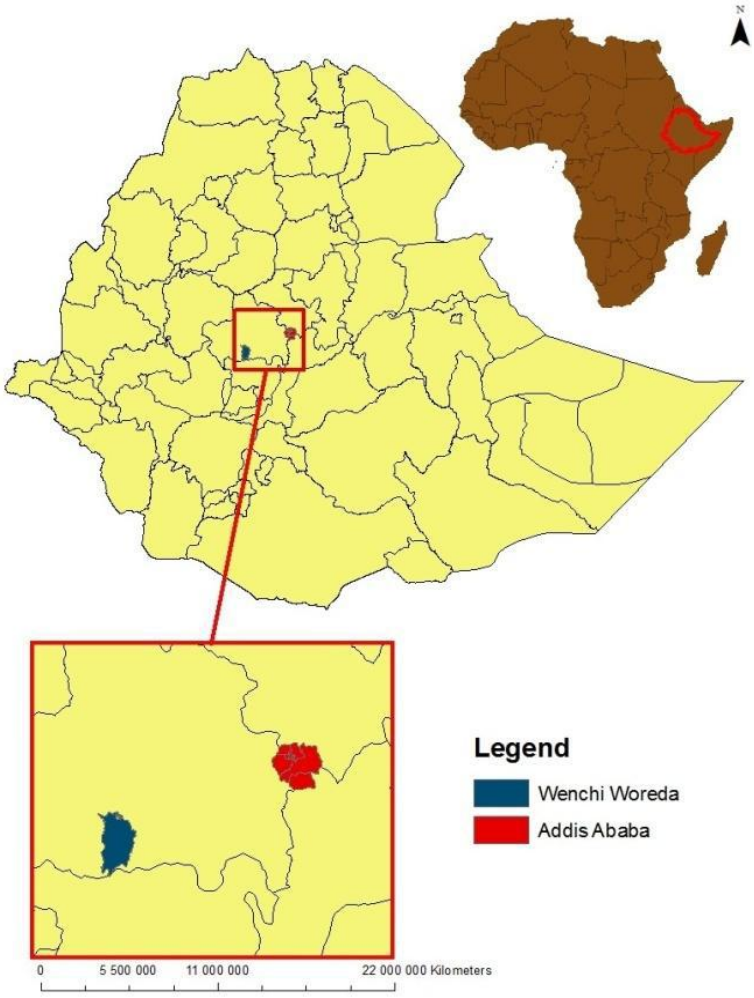

Figure 3.2, Showing Ethiopia in Africa and in frame Wenchi woredas location in Ethiopia

Source: Hultman & Näsström 2010

[84] Interview Manager for the water works design and supervision enterprise – 2012-02-23
[85] Information obtained from administration office Chito – 2012-02-18
[86] Interview Manager for the water works design and supervision enterprise-2012-02-23
[87] Water Supply and Sanitation Inputs for Ethiopia Full PRSP (2002)

4. Water Security

The chapter has been divided into topics that all relate to water security i.e. water access, water quality and water safety in one way or the other. First topics related to water accessibility are discussed. This is followed by a section on topics related to water quality. The last section explores the water safety.

4.1 Access to safe drinking water

4.1.1 Water access

The WHO and the UNICEF have trough the Joint Monitoring Program for water and sanitation defined improved water sources as being safe sources. When monitoring the MDG and access to safe water they measure access to improved water sources.[88] The 2011 WHO and UNICEF report states that approximately 884 million people lacked access to safe drinking water in 2008. At the current rate of progress towards the water MDG goal, still by the year 2015 about 672 million people would not use improved water sources.[89] Not having access to safe drinking water is interlinked with so many other aspects, e.g. reducing poverty, gender inequalities and child mortality. For example, the human development report for 2006 states that in Uganda access to an improved water source reduces the risk of infant mortality by 23% and in Ghana having piped water in the house lowers the occurrence by almost 70%.[90] People who live more than 1 km from the nearest safe water source also more often collect water from ditches, drains or streams than people who live within a range of 1 km.[91]

According to the official statistics in Ethiopia water coverage is among the lowest in the world, especially in rural areas. The Poverty Reduction Strategy Paper recognized that in rural areas only 18% of the population had access to safe water in 2002. In the urban areas 80% of the population had access. In urban areas consumption is often low and water is fetched from public taps. There is also a problem with reliability regarding breakdowns and quantity. In rural areas women are often concerned about the walking distance to fetch water. In a welfare

[88] http://www.wssinfo.org/definitions-methods/introduction/
[89] UNICEF & WHO (2011)
[90] UNDP, (2006)
[91] UNICEF & WHO (2011)

study from 1998 it showed that almost a third of the women in the country had to walk more than 1 km to fetch water.[92]

The optimal water service level for domestic use is piped water on the premises because it has most positive impacts on hygiene and health. Globally in 2008 only 57% of the population got its water from piped water and in developing countries only 49% of the population did. After piped water on the premises, borehole or tubewell were the most common drinking water sources in the developing countries.[93] In Ethiopia today the most common water supply sources in the country are; hand dug wells; dams; developed springs; ponds and shallow and deep-drilled wells.[94]

4.1.2 Water Quantities

Although the MDGs include a target to halve the proportion of people in the world without access to sustainable and safe drinking water, they do not mention any minimal quantity of water that the households should have access to. However water quantities are important since they affect public health.[95] According to the UN, people in developing countries who lack access to improved water sources often consume less water partly because they have to carry it.[96] Furthermore people who live further away from the water source than 1 km often consume less than five liters a day per capita. The basic requirement for a lactating woman who carries out any moderate physical activity is seven and a half liters a day. As an example, in rural areas in Uganda the average consumption is about 12 to 14 liters a day per person. However in the dry season this quantity normally drops sharply.[97]

Over the last decade there has been a wide debate about the relative importance of water quality, water quantity, hygiene and sanitation in improving health. Howard and Bartram point out that it is important to distinguish the quantities of water that are needed for domestic use and for other purposes, e.g. agriculture and industry etc. [98]

[92] Water Supply and Sanitation Inputs for Ethiopia Full PRSP (2002)
[93] UNICEF & WHO (2011)
[94] http://www.mowr.gov
[95] Howard, G & Bartram, J (2003)
[96] UNDP, (2006)
[97]UNICEF & WHO (2011)
[98] Howard, G & Bartram, J (2003)

4.2 Water quality

4.2.1 Water quality parameters

The **temperature** of the water is an important parameter to examine in relation to the water quality. If the temperature is high the growth and decomposition of organic material increase as well as the microbiological material increase.[99] No health based guide lines have been set by the WHO, but they state that high temperatures can increase problems with the taste, odour, color and corrosion. [100]

Electrical conductivity (EC) is an indicator of the taste or salinity of the water since it is a proxy indicator of dissolved solids in the water. Conductivity is a good indicator of water quality problems even though it does not provide information on which chemicals might be in the water. Furthermore there are no health risks for humans with high conductivity water, however high conductivity might indicate that the water is contaminated. High conductivity in the water gives the water a bad taste.[101] The guide lines for EC and good drinking water is in the range of 0 – 800 µS/cm.[102]

pH is a factor measuring the acidity of the water. It affects the animal life in the water and the chemical substances. If the pH value is low there is an increased risk for metals dissolving.[103] WHO has established that the optimum pH for drinking water is in the range of 6.5–8, but no health based guide lines have been set. In order to have an effective disinfection with chlorine the pH should be less than 8. Lower levels of pH i.e. 7 or less is more often corrosive.[104]

Iron in water gives the water a bad taste, color and smell and it exists naturally in the soil and bedrock of the earth. There are different ways iron can get into the ground water, e.g. from the use of iron coagulates, cast-iron and steel pipes in the distribution system etc. The iron bacteria come from iron and the bacteria can lead to a corrosion of the pipes.[105] According to the WHO, levels below 0.3 mg/l are good values. However they have no health based guide line value for iron.[106]

[99] Strömner, Lisa (2011)
[100] http://www.who.int/water
[101] Tadesse, et al. (2010)
[102] http://mrccc.org.au/
[103] Strömner, Lisa (2011)
[104] http://www.who.int/water
[105] Tadesse, et al. (2010)
[106] http://www.who.int/water

4.2.2 Water quality problems

Drinking water is said to be safe by the WHO when there is no or any significant health risks when it is consumed.[107] In developing countries diseases caused by poor water quality is a problem and according to a UN report one third of all deaths and about 80% of all diseases are caused by consumption of contaminated water.[108]

The British geological survey[109] as well as the Ministry of Water[110] state that there is little data on the general state of the water in Ethiopia.[111] The most common contaminants are from animal waste, flourmills, garages, human excreta, liquid waste from factories and pesticides.[112]

From Dec 2004 to April 2005 the RADWQ Ethiopian field teams visited 1815 sample sites in the whole country. Water was analyzed for a number of parameters e.g. conductivity, iron, fluoride and turbidity[113]. This provided a good snapshot of the status of chemical as well as biological water quality in the country. The study found high concentrations of iron in ground water supplies of Addis Ababa, Afar, Amhara, Benshangul, Gambella, Western Oromia and the SNNPR.[114] In Oromia and Addis Ababa the RADWQ tested 110 boreholes and 78.2% complied with the WHO drinking water guidelines. Regarding conductivity again 110 boreholes were tested in the Oromia region and 95.5% complied with the WHO standards.[115]

Another factor besides chemical and bacterial materials in the water that also affect the consumed water quality and that may cause diseases is e.g. the handling of the collected water during transport and its storage at the household.[116] If and how the households treat the water, e.g. boil or add cleaning chemicals, also affect the consumed water quality and may affect people's health status.[117]

[107] WHO (2004)
[108] Ince Margaret & RADWQ-Nigeria Technical Sub-Committee (2006)
[109] British geological survey (2001)
[110] http://www.mowr.gov.
[111] Ibid.
[112] Federal democratic republic of Ethiopia Ministry of health (2004)
[113] The haziness or cloudiness caused by individual particles (suspended solids).
[114] Southern Nations, Nationalities, and People's Region (SNNPR) see source Tadesse, et al. (2010)
[115] Tadesse, et al. (2010)
[116] Bartram, J & Howard, G (2003)
[117] WHO, (1993)

4.2.3 Perceptions of water quality

The user's perception is also important in relation to water quality, e.g. people often regard tap water as being safe. According to Doria, there are some factors that influence people's perceptions of the water quality, i.e. if people experience health problems caused by the water they may perceive the water as a risk; the human sensory perception of odor, taste and color; prior experience of water sources and color, taste etc, and the learning from both inter personal and impersonal experience e.g. media, government.[118]

4.3 Water safety

In Ethiopia one fifth of all water supplies were classified by the RADWQ as high risk. The RADWQ sanitary risk inspection results are for the whole country.

Related to piped water; distribution system the three most common problems were;

1) Unsanitary surrounding 52.6%,

2) There is a latrine or sewer within 30 m of any tap 49.3%,

3) Water is collected around the sampling site 30.8%.

Regarding borehole with mechanized pumping the most common were;

1) Animals could come within 50 m of the borehole 62.5%,

2) There is a sewer or latrine within 100 m of the pumping mechanism 52.9%,

3) There is a source of pollution within 50 m 34.6%, and also at 34.6% is the need for cleaning or the drainage channel is cracked or broken.

The most common sanitary risk for boreholes with a hand pump was;

1) Drainage channel is cracked, broken or in need of cleaning 77.1%,

2) Animals can come within 10 m of the borehole 68.1%,

3) Drainage is absent or faulty that allows it to be a ponding within 2 meters of the borehole 58.5%.

Household piped water had most related risk to;

1) Tap being located outside 78.9%,

2) Water being stored in container inside 73%,

3) Animals had access to the area around the pipe 69.8%.[119]

[118] Doria M.D.F(2010)

5. Method and Material

This chapter intends to describe the methodological approaches used in this thesis. This study is based on both primary and secondary data as this chapter will explain. Further, a discussion will be provided on the choice of method, the selection of the study area, field methods and aspects of working in a different context. The analysis, reliability & validity and the reflections of this study are presented at the end of this chapter.

5.1 Methodological approach

A mixed research approach is used in this study since the focus is about water security. Different methods will be used in order to understand the different aspects included in water security i.e. water access, water safety and water quality in the studied area. A mixed approach combines both quantitative and qualitative methods.[120] In the discussion on the research problem it shows that a quantitative study on the water quality is needed as well as a more qualitative study to explore the human experience of the access to water. When both approaches are used in a mixed method it often strengthens the research that is conducted.[121] I believe that only using a quantitative or a qualitative approach would affect the overall understanding of the research problem negatively, i.e. the best understanding of water security is provided when both approaches are used. The quantitative data on water quality and the quantitative sanitary risk factors will contribute to the qualitative interviews and enhance the overall understanding of the water security in the area.[122]

This thesis uses concurrent mixed methods procedure since the field research is conducted in one time period between February and April. Concurrent mixed method means that I will merge the qualitative and quantitative data in order to have a more comprehensive analysis. In concurrent mixed method one collects both forms of data at the same time and then in the end merge them together in the interpretations and overall results. The study will also take the form of a concurrent embedded strategy meaning that the qualitative research will be more

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[119] Tadesse, et al. (2010)
[120] Bryman (2004)
[121] Ibid.
[122] Creswell, W John (2009)

predominant[123] in the thesis. The two different research approaches will provide an overall composite assessment of the problem.[124]

5.2 Selection of the study area

Ethiopia has long struggled with people's access to safe drinking water and the water quality of the drinking water is not systematically controlled. This is why a study would help estimating the water situation for a small area of the country. Since the faculty of Earth Sciences GVC already had made studies in the west Showa zone of Ethiopia and more specifically in the area of Wenchi woreda this was a good place to conduct research due to previous knowledge about the area. The study area was selected after information from the faculty of Earth Sciences GVC and information from key informants at the administrative office in Chitu with was visited in a small reconnaissance trip. The faculty of Earth Sciences had knowledge about two wells in the whole Wenchi area, one in Mete Walga kebele and one in the village Daryan. During the reconnaissance trip it was clear that the Chitu also had wells. Since the starting point was to find an area that could be representative for both urban and rural population in this area in relation to water security, Mete Walga kebele and Chitu were good choices. Chitu is a small urban village and Mete Walga kebele is a rural are with scattered houses and farmland. Another factor was that both Chitu and the rural area of Mete Walga Kebele were accessible by the car that we had rented. See figure 5.1 below and a rough outline of the study area and roads. See also figure 3.2 for the location of Wenchi in Africa and Ethiopia.

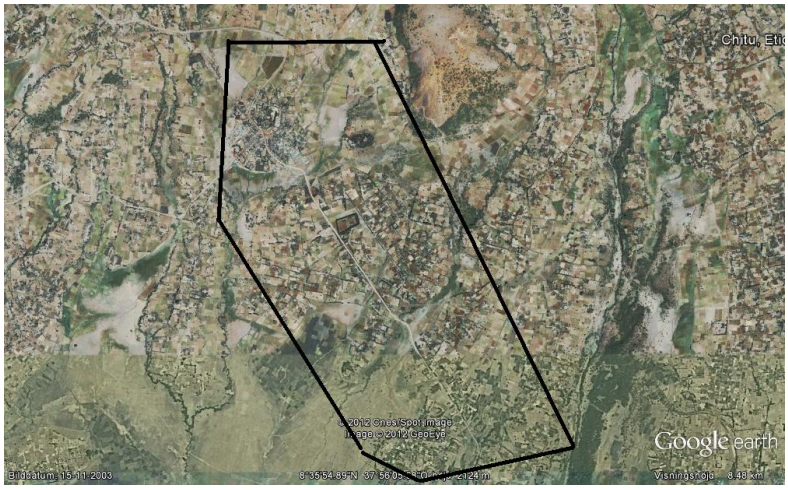


Figure 5.1, Map showing roughly the study area and roads

Source: Created by the author in Google Earth, however no scale was available

[123] Creswell, W John (2009)
[124] Ibid.

5.3 Quantitative Data Collection

5.3.1 Introduction

For the quantitative part both primary and secondary data have been gathered. This thesis focuses on the improved water sources used in the focus area and they will be classified using the Joint Monitoring Program (JMP) definition (see Appendix 2).

5.3.2 Water sampling

Water samples have been conducted to study the water quality. This was done with the help and supervision of Mats Olvmo, from the faculty of Earth sciences (GVC). He assisted with conductivity, pH and temperature measurements. Further I have measured pH, electrical conductivity, temperature and iron at nine water sources, as well as one unimproved water source. Sampling took place directly at the wellhead or the tap at the improved water sources. The water had most of the time been running for a few minutes before the sample was conducted due to the women fetching water who had the water running. This helped obtain better test results. Since the aim is to measure the quality of the drinking water for the population no filter has been used. pH was measured by using a Sigita pH meter and electrical conductivity by using an electrical conductivity meter. The electrical conductivity meter also provided the temperature of the water. The total iron amount in the water was tested by a "fotometer". A series of pilot measuring tests of iron and temperature was carried out before the real field test in order to learn the measuring tools in the sampling area.

5.3.3 Assessment of sanitary risks

Around all the eight located improved water sources used for drinking an assessment of visual sanitary risks was conducted. This was done in order to further understand the present and future possible sanitary quality risks that surround the water source. This inspection is complementary to the water quality measurements and the interviews regarding water quality and safety in order to further strengthen the results of this thesis. I have used the indicators that were developed by RADWQ in order to be able to compare the results with an earlier study made in Ethiopia in 2004 - 2005.[125]

For some of the risk assessment criteria's I asked the interpreter to ask questions to the person responsible for the well, e.g. if any leak had been reported recently, (see Appendix 1). A pilot

[125] Tadesse, et al. (2010)

sanitary risk inspection was also carried out before the actual risk assessments begun to get a deeper understanding of the questions and how to use them.[126] There are some elements of the researcher's interpretation of the questions developed by the RADWQ but most questions were clear, e.g. is there a crack or a leak in the water source. During my observation at least three photos from each sampling site were also taken something that is recommended by Mikkelsen.[127]

5.3.4 GPS mapping

A mapping of improved water sources in the study area was conducted by using a GPS to determine their positions. The coordinates for the drinking water sources was taken at least twice to increase the validity. The GPS was used to create a map over the study area with the water sources pointed out with the help of their position.

5.3.5 Quick questions survey

At six located wells four questions were asked in a survey to determine the respondent's name, numbers of liters collected every day, water collecting time and how many household members were sharing this collected water. All of these six were chosen since the population around the sources uses these wells regularly. At each located water source 10 people were asked, except for two wells.[128] A total of 60 people were asked at the water sources.

5.4. Qualitative data Collection

5.4.1 Introduction

The qualitative research in this study is the base to examine people's access to water and their perspectives on water quality and water safety. Both primary sources and secondary sources have been studied. There are two different types of interviewees for the primary data in this thesis, i.e. people collecting water and key informants. Because I want to reach a broader understanding of the water situation in this area it was important to not only have people's perspectives but also the perspectives and information from government officials. Three of five interviews with key informants and all the thirty-five interviews about water accessibility were done together with another student. The rest of the interviews, thirty five with

[126] Britha Mikkelsen (2005)
[127] Ibid.
[128] Due to human error the well B1 was forgotten, however semi structured interviews at this well give a good indicator of the conditions at the well. Well O1 was dry and therefore 10 people were not asked.

respondents about quality and safety and two with key informants, were conducted by me. This will be further explained in the following sections.

5.4.2 Selection of respondents

For this thesis a purposive sampling was used and the criterion used was to find the main responsible water collector or collectors in the households. Purposive sampling means, according to Berg, that the research tries to make sure that certain people with certain attributes are included in the study.[129] I have done this by asking respondents about their household responsibilities and then conduct an interview with the respondents who are responsible for fetching water. The overall majority of the respondents were women. Older children or teenagers responsible for fetching water have also been interviewed. Only women were interviewed in relation to questions about quality and safety. In relation to interviews about access to water five out of thirty-five respondents were men.

5.4.3 Semi-structured interviews

I wanted the interviews to be flexible but also to be able to ask more specific questions and semi-structured interviews suites this purpose. According to Bryman, semi-structured interviews *"typically refers to a context in which the interviewer has a series of questions that are in a general form of an interview guide but is able to vary the sequence of questions"*[130]. For these reasons I have chosen this type of interviews and not e.g. a survey.[131] In order to get information that could be sensitive for the participants, open-ended questions were used during the interviews, i.e. the question of money or family sickness might have been sensitive. Open-ended questions also provide in-depth data.[132]

As has been mentioned in the introduction for this section both interviews with respondents and key informants have been made. Different interviews were made in order to answer different research questions. The interviews with the respondents were all done in Oromo which is the local language of the region of Oromia. In all of these interviews I relied on the interpreters to provide me with the correct answers. The amount of time for the interviews related to people´s access to water was 6 – 12 minutes and a total of 35 people were interviewed (see Appendix 3). These interviews were conducted in collaboration with another

[129] Berg, B. L. (2009). .
[130] Bryman (2004) p 699
[131] Creswell, W John (2009)
[132] Bryman (2004)

student. The average amount of time for the respondents interviewed related to quality and safety but also some further questions about accessibility took about 20- 40 minutes each. These interviews were conducted by me and the interpreter and a total of 35 people were interviewed (see Appendix 4). Some of the interviews with key informants were conducted in English when the informant had a good knowledge of the English language. These interviews had an average time of 15 - 30 minutes and 5 key informants were interviewed. Three interviews were done together with another student and two were done by me and the interpreter our selves.

Most of the interviews regarding water quality, safety and further questions about accessibility were conducted at the respondent's house. Only four were not conducted at their home.[133] The interviews regarding people´s access to water were conducted at the water source and not at the respondent's home.

A few pilot interviews were conducted before I approached the respondents and informants. According to Willis, it is an advantage to test the questions on the interpreter in order to see if he or she understands the questions.[134] This was done for this study as well. The pilot interviews allowed me to make some changes in order to make the questions more clear. The interpreter also helped reformulate the questions about quality and safety in order for them to become clearer to the respondents.

5.5 Aspects of working in a different cultural context

5.5.1 Ethical considerations

Regarding ethical considerations, all informants were offered anonymity. Not all have chosen to be anonymous. Each interview started with an explanation of the purpose and who I am. Further the purpose of the interpreter and his role in the interview was also explained. In order to analyze the interviews each person was given a code so that I could identify them during this process. When allowed a tape recorder was used. The tape recorder allowed me to obtain as much information from the interviews as possible. The answers were always written down as well. The questions that were asked were divided into different themes in order to guide me and the interpreter. When formulating the questions I critically reflected upon on how my own expertise and views might come to influence the study. During the interviews I was also

[133] Willis, Katie (2006)
[134] Ibid.

careful not to make any remarks about my own expertise. Bryman amongst others highlight this to be important during interviews.[135]

Since some clothes can be seen as provocative, a reflection upon my clothing and attitudes and how this might affect the respondents and their perception of me was carried out. I learnt some common used phrases in the local language of Oromo and Amharic as e.g. hello and thank you and other courtesies so that I could show the respondents some form of respect. All these efforts were made in order to help me gain the respect and trust of the community. According to Binns, it is important to show respect in order to gain respect.[136] It was found to be important since both myself and the interpreters came from different social classes; we came from an urban area, me being white and an educated female etc and both the interpreters being male.

5.5.2 Working with interpreters

The field work was carried out with two interpreters. Both interpreters were hired on their good recommendations. The second interpreter worked for embassies in Addis Ababa as a translator and he could help validate the work done with the first interpreter. During the field work a good relationship with both the interpreters was established. According to Binns this is important.[137] I also had a strategy of talking to the interpreter every morning before the field work when we discussed the interview questions, purpose, how I wanted the translation to be done, strategies and what we both wanted for the day etc.

5.6 Analysis of data

As mentioned above a tape recorder was used when allowed during the interviews. Afterwards the interviews were transcribed on a verbatim basis, i.e. word by word. The transcribed interviews were then analyzed by a qualitative content analysis. According to Bryman, a content analysis is "*an approach to the analysis of documents and texts that seeks to quantify content in terms of predetermined categories and in a systematic and replicable manner*"[138]. Qualitative content analysis means that the researcher reads the text over and over again so that repeated patterns and themes emerge and can be extracted.

[135] Bryman (2004)
[136] Apentiik, R.A. Caesar & Parpart, L. Jane (2006)
[137] Binns, Tony (2006)
[138] Bryman (2004) p 275

The quantitative data also use a content analysis but the data is placed in a coding schedule.[139] Since the collecting time back and forth from the house to the well was estimated by the respondents and interpreter I will in the results add five minutes to the collecting time. Adding five minutes will help in order to not underestimate the water collecting time.

5.7 Reliability and Validity

Validity means that what is measured or researched reflects the reality or the truth and that it is accurate in its findings.[140] The researcher can check the accuracy of the findings by employing certain procedures. A good way to increase the validity and credibility of a study is to use multiple strategies. Triangulation is one such strategy and it means that more than one source of information is used for the evidence to support the researched fact.[141] In this study triangulation is used in order to create credibility of the analysis. Triangulation was done by checking respondent's answers, key informants answers etc with each other and with secondary data. Furthermore different data have been gathered in order to cross-validate[142] i.e. photos, interviews, observations, measurements and existing documentation.

Reliability means that "*repeated observations using the same instruments under identical conditions produce similar results*"[143]. The study needs to be consistent across different research and projects for it to have reliability.[144] During the measurements Mats Olvmo assisted and his experience helped making sure the data from the measurements were correct.

5.8 Reflections

The aim was to do most of the interviews at the respondent's house in order to try to eliminate the influence on the answers of other people's presence. But this proved to be a little bit harder than expected. People were often not home during the day and before dark we had to get back to the hotel. The interviews that were conducted at the water sources might have had an effect on the responses from these respondents. When interviews were conducted at the well 1 - 5 there were a lot of people listening to the conversation. Trying to be as private as possible around people was a challenge since people always kept coming closer and closer

[139] Ibid.
[140] Mikkelsen (2005)
[141] Creswell, W John (2009)
[142] Mikkelsen (2005)
[143] Ibid. p 185
[144] Creswell, W John (2009

even when asked to give us some privacy. At the water sources in Chitu the person responsible for the well was also present and this might also have affected the responses.

Another challenge that happened during the field work was with the first interpreter, e.g. even though the interpreter was asked to translate in first person he sometimes forgot and his own reflections and ideas could then have affected the answers. Also when using reformulated control questions to check an answer it happened a few times that a different answer in fact emerged. However he was the best one we could find in the beginning of the field work. Because of this a second interpreter was used during the end of the field work. If I were to do this research again several people would be interviewed before hiring someone in order to determine their skills but also their personality.

According to Robert Chambers, the study fits under his description of spatial bias.[145] The study also relates to i.e. dry season, personal, professional and security biases.[146] By focusing on areas that were accessible by car it is possible that water sources not easily accessible have been missed. Since we could not leave the car unattended, due to security issues, we could not walk to the other water sources in Mete Walga kebele. It is also plausible that it is wealthier people who live near the road and the water sources and that the poorest people in the study area have been missed. If people live far away from an improved water source they might use unimproved sources instead and in the rural areas of this study these people might not be accounted for. As will be presented later it is also possible that the results for this thesis would have been different if the study was conducted during the rainy season instead. It is often during this time of the year that people struggle the most with their daily lives according to Chambers and therefore the results could have been different.

[145] Chambers (2008)
[146] Ibid.

6. Access to water

In this chapter the water accessibility in the studied area will be presented. First a presentation of the water resources and their geographical positions within the studied area will be presented. Then institutional constrains and water accessibility in urban and rural areas in the findings will be presented. Also an examination of the rainwater usage will be provided as well as the findings of the water service level. Last in this chapter are the conclusions.

6.1 Water resources

In the studied area in and around Chitu[147] (five urban) and the area Meti in Mete Walga kebele (three rural) a total of eight improved water sources were located. All of the five urban wells located in Chitu are standpipes or public taps according to the JMP definition. The RADWQ defines them as piped water with supply tanks: distribution system. These wells all come from a deep bore hole located to the west outside Chitu. The original source is located near what is called well number 1 in this study. These wells are coded W 1-5. These wells were all built in 2006.[148] Further, 200 households in Chitu have piped water to the yard. Three of these households have been studied and they have the codes of H 1-3, (see Appendix 5).

Figure 6.1 W4: improved water source/ piped water

(Photographed by the author, Chitu, Feb 2012)

[147] Chitu is a small town that is very rural in its constellation, which is why Chitu sometimes in this thesis will be referred to as an urban village.

[148] Interview Water Office Chitu – 2012-03-09

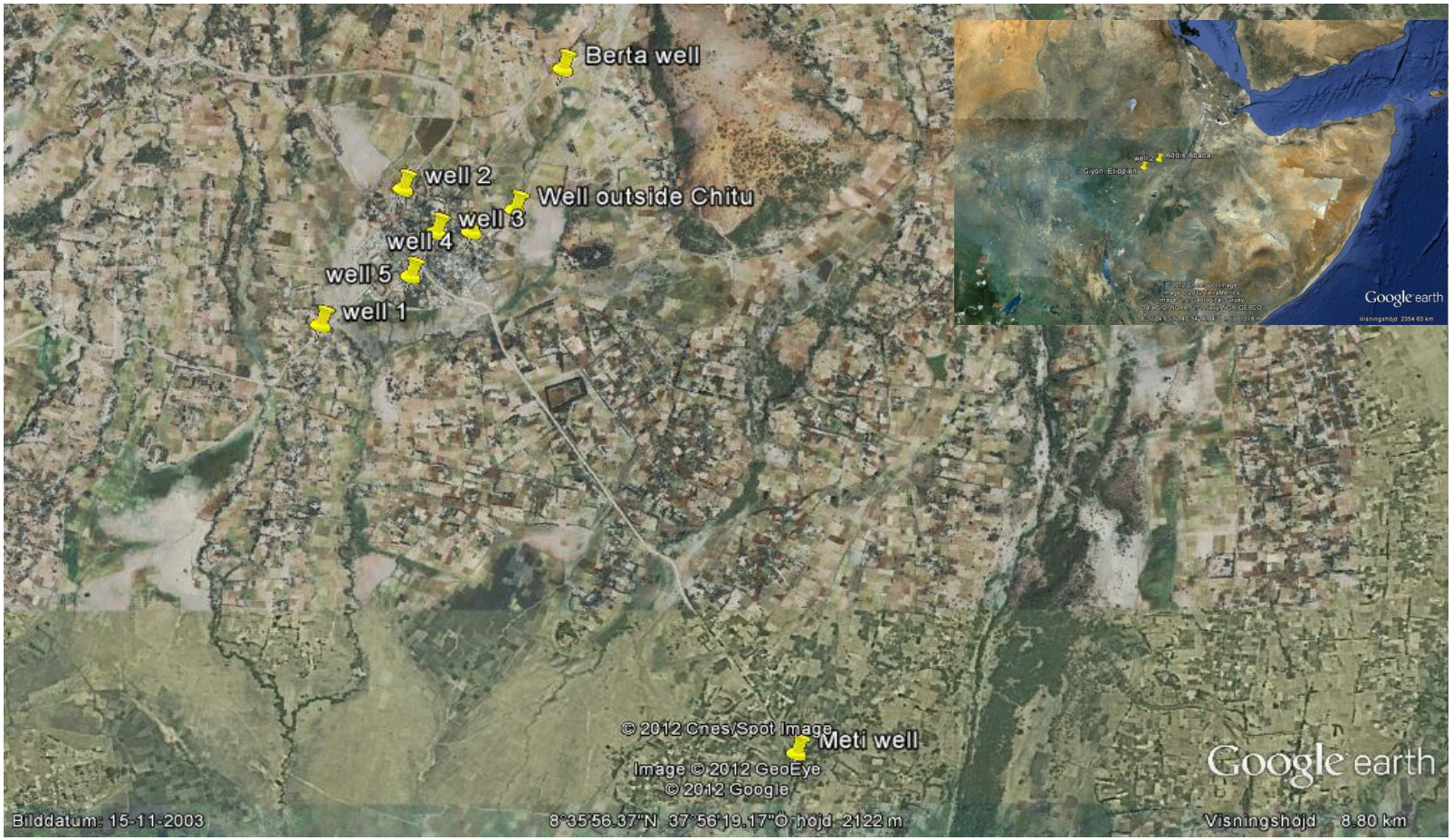
In the rural area of Mete Walga kebele there are two wells and one spring.[149] However, only one well was located and studied (code M1).[150] The located Meti well is a deep borehole with a mechanized pump and it is constantly flowing. This well was built before 1988.

Outside the village of Chitu there are two other wells (codes B1 & O1). Well O1 was dry during the whole filed study. This was a deep borehole with mechanized pumping as well and when it is not dry it is a constantly flowing well. The other well (B1) is called "Berta well" by the locals and it is a borehole with a hand pump. See figure 6.1 for a location of all the located improved water sources.

[149] Interview Water Office - 2012-03-09

[150] The other well and unimproved source was not accessible by car, see further discussion in methodolical reflections

Figure 6.1 Location of the water sources



Source: Created by the author from GPS coordinates in Google Earth.[151]

[151] No scale was available in Google Earth

While the federal government has certain criteria to decide if new improved water sources are needed in an area, it is the regional government who decides their priority. All the nine regions in Ethiopia have their own regional criteria as well. Sometimes a woreda can decide to build a water supply system themselves. The criteria used by the government for building water supply systems are as follows; in urban areas an improved water source should be located within 0.5 km from the home and each citizen should be able to obtain 20 liters of water per capita. In rural areas a water source should be located within 1.5 km from the home and each citizen should be able to obtain 50 liters per capita. This is part of the MDG: s and the goal for the government for 2015.[152]

The water works design and supervision enterprise is studying the Wenchi area on behalf of the Ethiopian government to examine the ground water potential. They are going to construct twelve wells in the whole Wenchi area, (see Appendix 6). These wells will be constructed 25 – 40 km away from each other. The enterprise will use existing boreholes as well as drilling new ones. In the first phase the enterprise will locate suitable areas for drilling and then drilling will commence. At the time of this study the enterprise was in the first phase. In the second phase further studies will be conducted in the area prospecting for more wells. Chitu is a prospect area for more wells. In phase three the wells will be completed. Some of these wells will be given to the villages and some will be monitored by the enterprise in order to see ground water and quality changes on behalf of the government. The water woreda office then decides if it should be a tap or a constantly flowing well.[153] This means that within the coming years there will be at least one or two new improved water sources in the studied area. Whether this or these water sources will be used only for monitoring or weather the population will be able to use it or them has not yet been decided by the enterprise/ government.

6.2 Institutional constrains

At all the five improved water sources in Chitu the cost is 10 cent per jerry can.[154] The water collector has to pay this directly to the person responsible for the well. The price is per jerry can and the size of it does not matter. The price is based on the operating cost for the wells i.e. salary for the person responsible for opening and closing the wells as well as maintenance of the wells. All the five water sources in Chitu have metal fences with barbwires around them

[152] Interview ministry of water and energy- Mr Tamene Hailu – 2012-02-23
[153] Interview Manager of the water works design and supervision enterprise – 2012-02-23
[154] 100 cent is 1 ETB and 1 ETB = 0,39 SEK 2012-06-18

in order to regulate access to the source. A household or a person can collect as many liters of water as they want within the opening hours of the well. Even people who are not residents in Chitu can collect as much water as they would like.

The minimum price for installing a tap in a house is 850 ETB. The additional cost depends on the length of the pipe that is needed. The price also depends on the needed fittings. When the pipe is installed the household pays 4.5 ETB per cubic meter of water that is used. The household pays every month.[155]

The five water sources in Chitu also have time constraints. This means that they are only open certain hours a day. The opening hours are based on the needs of the community together with the operating price so that the cost does not become too high. It is further based on the amount of available water in the aquifer at the original source. This is an attempt to prevent over-using the water sources capacity. A further presentation of my findings regarding opening hours will be presented in the next section.

Figure 6.3 People queuing to collect water at well 5 in Chitu

(Photographed by the author, Chitu, March 2012)

"The population in this area keeps growing and growing which results in a greater pressure on the existing water sources, however there are no new wells. (...)We need more wells and more collaboration with the regional offices".[156]

[155] Interview Water Office Chitu – 2012-03-09
[156] Ibid.

As Water Office personnel explained a problem related to the water sources is that the population in Chitu keeps growing. It is also a problem that the population has to pay for any new installation of pipes or taps that will be added to the already existing standpipes. For example well number 1 can still install more taps in order to reduce the queuing time for people collecting water. However the population cannot pay for it. Also if a water source break down it is again the population that has to cover any cost of buying new parts if necessary.

6.3 Water access

6.3.1 Urban

As described above, the five water sources in Chitu have different opening hours. A total of four different people are responsible for the opening and closing of these well. A female is responsible for the opening of well number 3, 4 and 5. A male is responsible for well number 2 and both a male and female are responsible for well number one. All of these people live in Chitu.

The water source that I refer to as **well number 1** is only open once a day in the morning. According to the respondents, it is supposed to be open between 9 and 10am every day. This well is the one in Chitu that is furthest away from the other four wells in the village. However as I noticed during the field study the opening hours can in fact vary from earlier in the morning to later in the day. A concern raised by some of the respondents at this well was that it is only open once a day and that the opening hour changes a bit. Half of the respondents who use this well frequently brought up that they wished for longer opening hours.

"In my opinion I would like the opening hours to be both in the morning and in the afternoon, one hour is not enough. We have only one hour so we have to fetch all the water then. When there is no water we fetch from the ditch."

(Female/ 45 years/ 3 Household Members (HM)/ daily activities not known)

Half of the respondents using well 1 said that they also collect water from a nearby river. However the river was dry at the time of the field trip. The dried up river is located within 10 minutes walk (one way) from well number 1.

According to the water collectors, at **well number 2** the opening hours were supposed to be 10 – 11 am and 4 – 5 pm. However during the field study none of these times were correct. Out of all the wells in Chitu this well was the water source that the respondents were most unhappy with. The opening hours were most of the time not correct and the person in charge of this well often neglected his responsibilities according to the respondents. This well often breaks down and the man in charge opens and closes as he finds best. One day when it was supposed to be open and it was closed we tried to locate the man. His wife then said that he had gone in to Giyon[157] already; he had opened a few hours earlier that day. A 25 year old female with four household members complained about the opening hours and thought it would be better if they paid more money so that the well could be open more often. Complaints were made by most respondents about the opening and closing of this well.

Well number 3, located near the centre of the village, also had two opening periods, from 8 – 9 am (sometimes 7 - 9 am) and 3 – 4 pm every day. Again these times varied a bit but not to the same extent as with well number two. This well always opened within an hour during the field study. The women in charge of this well were also in charge of well number four and five. A complaint that was made was that there is a need for more taps so people do not have to stand in line to get to the water.

Well number 4 has opening hours between approximately 10 – 11 am and between 4 – 5 pm every day. Again this well always opened close to the opening hours even though people had to wait some. Also at this well a majority of the respondents wished for more and longer opening hours.

Last but not least there is **well number 5**. The respondents said that this well was to be open every day from 8:30 – 9:30 am and 3:30 – 4:30 pm. Since it is the same women who open well number 3 and 4, these opening and closing hours were not always kept to. At this well a majority of the respondents expressed a concern about the long lines and queuing time to collect the water. Again they wanted more taps to reduce the crowdedness.

"We need more taps at this well, so many people".
(Female/ 17 years/ 5 HM/ daily activities not known)

[157] A bigger town in the area

"I want earlier opening hours since I go to work early, and since there are too many people fetching at the same time".

(Female /18 years/ 4 HM /daily activities not known)

All the respondents using the water sources in Chitu said that they believe they get enough water for them and their household's needs except when there are power cuts. Further, a majority of the respondents thought that 10 cents per jerry can was a fair price to pay for the water. All the people in Chitu that I saw collecting water were using a jerry can to collect the drinking water in.

Another concern that was brought to my attention was that there are often power cuts in Chitu and when there is, none of the wells in the village work. One person even said that there could be physical fights between people over drinking water when the power was out. Complaints about power cuts were made by a majority of the respondents in Chitu. When there are longer power cuts people have to collect the drinking water from rivers or streams, or from wells further away. Power cuts were said to happen several times a week. Most of the time the power comes back quickly but sometimes it happened that the power could be gone for days. Furthermore people pointed out that if the persons responsible for opening and closing are sick or if they neglect their responsibility, then there is no one else who opens and closes. People cannot find out if a well is opened that day until they arrive at the water source and wait.

In Chitu the population can also buy water from some of the people who have yard taps and sell water. This water can be collected during the whole day, even in the night, but the price for the water is higher. This water often costs 50 cent per jerry can. However this price could also change a bit up or down depending on e.g. family connections with the seller.

6.3.2 Rural

The Meti well that is located in Mete Walga kebele is constantly flowing. There are no opening or closing hours, so that people always have access to this well. Further people can collect as much water as they like and there is no price for this water. At this water source none of the respondents mentioned that power cuts affect the well. All of the respondents felt that they had enough water for themselves and their households' needs.

At the time of the field study the well **outside Chitu** was dry and had been dry for at least two months. The water was believed to come back when the rain season started. However when it is not dry it is a constantly flowing well and there are no opening or closing hours. The respondents said that this well often has a problem of being dry. The people interviewed were not happy about the fact that this well dries out, since it means they have to spend more time on collecting water. They have to walk to the nearest well in Chitu to fetch water or fetch from a ditch. As with the Meti well people do not have to pay to collect water here. A majority of the respondents answered that they got enough water from the well when it is not dry. When it is dry the respondents do not get enough water for their own or their households' needs.

The **Berta well** is opened and closed by the community. A lady living nearby is responsible for opening and closing the well. The well is normally opened in the morning and in the afternoon. However the respondents using this well gave more varied answers about the opening hours than respondents at other wells. Most answers indicate that the well is opened from approximately 7 until 10 or 11 am and between 5 – 6 pm every day. One respondent also said that the lady in charge can be late sometimes. This well has a hand pump and there is no price for fetching water here. Sometimes when the key is lost the community has to pay jointly for a new key. This well is not affected by power cuts. The respondents using this source also felt that they had enough water.

None of the respondents using any of these three wells expressed that there is a problem with people queuing by the water sources to collect water. This is a difference to the wells in Chitu that often had people queuing in order to collect water.

6.3.3 Rain water collection

Since rain water collection for drinking is a part of the JMP's definition of improved water sources it has been examined in the study area as well. A total of eleven out of thirty five respondents said that they collected rain water. All of the respondents that collected rainwater, both in the urban area and in the rural areas, collected rainwater from their iron roofs. Most of the thirty five respondents also thought that collecting rain water was a good idea.

In Chitu less than half of the respondents answered that they collect rain water. The collected rain water is for a majority of the respondents used for washing clothes and household

materials or themselves and family member's bodies. About one third of the respondents that collected rain water used it for drinking. Some also used the collected rain water for making alcohol.

In the rural areas however a majority of the respondents said that they collected rain water. A difference from the urban respondents is that a majority of the rural respondents said that they use the water for drinking as well as for washing clothes etc.

These results show that it is more common in the rural areas to drink collected rain water than it is in the urban area. Most people in the rural areas also collect the rainwater for drinking something most of the people in Chitu did not do.

6.4 Water service level

All the respondents in Chitu could make the round trip walking to collect water within 30 minutes. A majority of all the respondents using the wells in Chitu have less than 10 minutes one round trip collecting water. Regarding **W1 and W2** a majority answered that they collect between 60 – 80 liters of water for their household a day. The jerry cans used normally contained 25 or 20 liters of water. The walking time back and forth for collecting water for the households was about 30 to 40 minutes a day. This does not include the time spent to wait in line, wait for the bucket to be filled etc. For **W3** half of the respondents collected 40 liters of water for their household a day. The total regular walking time was less than 30 minutes a day and again other factors are not included in this time. At well number **W4** more than half answered that they collect 40 liters or less for their household a day. This means that the standard walking time for all the needed water was approximately 20 minutes a day. At **W5** a little more than half of the respondents said that they collect a total of 40 liters of water a day for themselves and for their household. At this well the average walking time round trip was about 20 minutes a day. In Chitu the 200 households that have a yard tap would have a service level of intermediate access. The average quantity of water per capita should be 50 liters a day according to Howard and Bartram. Whether or not this is correct this thesis cannot answer.

At the **Meti** water source again all of the respondents can collect water within 30 minutes round trip from their home. Half of the water collectors said that they fetch 20 liters or less a

day for their household. On average they spent about 20 minutes or less on one round trip walking to the water source.

The findings show that since the majority only collected about 20 liters of water or less in the Meti area, they spent on average the same time as the respondents in Chitu did on walking to the water source. A difference between the urban and rural respondents is that the rural respondents i.e. M1, B1 & O1 said that they collect less water in general than the persons living in the urban area i.e. W 1-5. In Chitu, Howard and Bartram´s definition of the service level of basic access and water quantities were often accurate. On average in Chitu respondents collected between 10 – 15 liters of water per capita a day. They often did not exceed twenty liters of water per capita per day. According to Howard and Bartram basic access means that consumption should be assured however hygiene could be compromised. Laundry may also occur away from home.

With regard to the distance the people using the Meti water source are classified as having the service level of basic access. However with regard to the likely numbers of water collected they have the service level of no access[158] since more than half of the respondents collect below five liters of water a day per capita. According to Howard and Bartram no access means that consumption of water cannot be assured, hygiene practices are compromised and basic consumption may be compromised. This is a difference between this study and Howard and Bartram who estimates that if you can make a round trip walking to the water source within 30 minutes you should have a basic access of around 20 liters of water per capita a day.

6.5 Conclusions

Based on these findings it is clear that there is a bit of uncertainty with collecting drinking water in Chitu, i.e. from W1-5. The uncertainty relates to the time spent every day on fetching water. Since it is often the women or girls who collect water they are the ones burdened the most by this uncertain and sometimes lengthy water collection time. It is also the poorer part of the population that spends most time on fetching water since the wealthier families can afford to have piped water to their yards.

[158] Bartram, J & Howard, G (2003)

One finding is that the water collectors in the village cannot count on a well to be open at predetermined times. This means that a consideration for earlier or later opening hours must be taken into account when planning the day. Further, since it could happen that the responsible person for opening does not come that day, there is always a chance that the people have to walk to another well in Chitu to collect the drinking water there. However, when there is more than one person that is responsible for the opening and closing of the wells the chances that at least one of the wells is open every day increases. Another finding in Chitu is that when there is a power cut none of the five wells in Chitu work. At some of the wells there can also be a waiting line before the water collector can fetch the water. The possible queuing at the water source and the absence of fixed opening hours also adds to the total time spent on collecting drinking water which especially affects women.

If and when a household needs extra water, e.g. when they need to wash clothes, then there is a time pressure to make it to collect more than one jerry can during that hour. If not they have to collect in the afternoon as well and/or maybe reduce water spent on drinking or cooking that day. Further, for the people using W1 there is an extra pressure since it is only open once a day. If they do not live nearby the water source they might not be able to collect enough water for their basic needs.

For all the examined rural wells, i.e. B1, M1 and O1, there is often no waiting time to collect water. None of the respondents using these sources had any concerns about waiting time or lines of people. Neither do they have to pay for the water. Only the Berta well had opening hours and it is plausible that people, again often women, collecting water from these sources have it easier to plan their days and the time it will take to collect water. Since the Meti well and the well outside Chitu do not have opening hours, people can collect during any time of the day. If they work early they can collect before work etc. Further, they do not have to worry about the person opening the well being sick or queuing at the water source. Also these wells are free of charge. Even the poorest families can collect as much water as they like.

Again at these water sources all of the respondents could make the round trip from their home collecting water within 30 min. However even though people can collect as much water as they like, people often collect less water from these water sources than from the ones in Chitu. It is believable that the on average 10 minutes extra walking time round trip, compared to respondents in Chitu, is the reason for this. However since they collect less water they end up

spending about the same time as the respondents in Chitu do in a day when walking to and from the water source. It is also more common for people using these sources to collect rainwater for the purpose of drinking. During the rainy season this might affect the quantities of water collected from the wells or water sources. However it did not rain during the field work for this study. A majority of the people collecting rain water in these rural areas said that the main purpose was for drinking. I believe this is connected to the longer time spent on walking to the water source. Further, I also believe this is interlinked with the sanitary status of the wells and the water quality, but more about that in the final discussion.

In relation to the research question about the water access for domestic purposes I find that people in Chitu, i.e. W1-5, have a service level according to Howard and Bartram of basic access and 200 households have intermediate access. According to Howard and Bartram this means that at least these households´ water consumption should be assured but that the hygiene might be compromised. The water source M1 is a bit different. With regard to the time spent in total walking time the respondents have a service level of basic access. Most of the respondents, whether they live in the urban or rural setting, did not spend more than 30 minutes (for one jerry can) in total walking time for collecting water. In Chitu they had five wells to choose between and the walking distance for all the people living there is shorter compared to most of the rural respondents, i.e. people using M1, B1 & O1. However again with regard to Howard and Bartram´s service level, the people using M1 in relation to quantities of water collected have a service level of no access. According to Howard and Bartram this means that basic consumption and hygiene may be compromised.

I believe the women in Chitu are more time constrained than the women in using M1, O1 and B1 because of all the insecurities with W1-5. Generally most of the respondents ended up spending about the same time a day on walking to the water sources and back. However, this came at the price of some choosing to collect less water.

7. Water quality

This chapter presents the results and analysis of the findings specific to water quality. Further this chapter also contains perceptions and thoughts about water quality, water quality and health related findings and findings about education on water quality and health. This chapter ends with some conclusions that have been drawn from these findings.

7.1 Introduction

Water samples were taken from ten sources both improved and unimproved sources.[159] In Chitu, well W1 and W3 - 5 were measured.[160] M1, B1 and B2 in the rural areas were also studied.[161] Three household taps H1 - 3 were also measured, (see table 7.1). These samples were all measured during dry season. The wet season normally occurs between June and August/ September. All the sources were tested for the physical parameter of electrical conductivity, temperature and pH. They were also tested for the chemical parameter of iron.

7.2. Physical and chemical parameters

Regarding pH, the WHO recommends that drinking water is in the range of 6.5 – 8.5.[162] Two improved water sources, i.e. M1 and B1, did not meet this standard set by the WHO. The unimproved water source B2 did not meet these standards either. However they were all close with a pH of 6.3 or 6.4. For the two wells with water pH lower than seven there is a chance the water is corrosive and there is an enhanced risk of metals dissolving in the water.[163] For all the sample sites 7 of 10 meet the target and had a pH of seven.

The electrical conductivity for all the studied water sources was 100% compliant with the standards for drinking water with a µS/cm in the range of 0 - 800. The best and lowest values were found in the M1, B1 and B2 since the values are all below 400 µS/cm. Interesting to note is that B2 is the unimproved water source. This indicates that the water quality of these water sources is good and most likely not contaminated. High values of electrical conductivity

[159] Other unimproved water sources were dry.
[160] Well C2 were always broken or closed
[161] Well O1 were dry during the whole study period
[162] http://www.who.
[163] Ibid.

could indicate that the water is contaminated. Low values also give the water a better taste than high values does.[164]

From the total water samples analyzed for iron, 8 of 10 sources complied with the standards for drinking water and only two water sources did not meet the set standards. The two sources that did not meet the standard is M1 with a value of 0.45 mg/l and a household tap H2 with the highest value of 1.1 mg/l. Noteworthy is also that all three household pipes have a higher value than the public taps in Chitu. This could indicate that there is a corrosion of the household pipes.[165] Due to corrosion in the M1 and H2 the taste or color might be affected. In relation to M1 no difference in the color could be noted however H2 had an affected water color.[166]

Since the temperature in all the water sources were above 20 degrees Celsius, there could be an increase of microbiological and decomposition of material in the sources.[167]

Even though two water sources, i.e. M1 and B1, did not meet the recommended guidelines regarding its pH and two sources did not meet the recommended targets regarding iron, the drinking water in the study area was still good for drinking at that given moment. Since the pH only differed a little bit and this small amount of iron does not affect human health negatively, in my opinion the drinking does not provide any significant health risks when consumed.

[164] Tadesse, et al. (2010)
[165] Ibid.
[166] Some respondents said they felt the water tasted bad sometimes at M1. H2 did not think it tasted bad.
[167] Strömner, Lisa (2011)

Table 7.1 Physical and chemical water quality results

Measured parameters	Chitu W 1	Chitu W3	Chitu W4	Chitu W5	Chitu H1	Chitu H2	Chitu H3	Meti M1	Berta B1	Berta Ditch B2	WHO Guidelines
pH	7,4	7,2	7,1	7,4	7,1	7,1	7,2	6,4	6,3	6,3	6-5-8.5
Ec (µS/cm)	350	370	330	330	350	340	320	280	180	190	0 -800
Temperature	23,8 º	24, 9º	25,5º	24,1º	26,0º	26,0º	22,5º	22,6º	25,3º	23,8º	-
Iron (mg/l)	0,21	0,25	0,24	0,25	0,29	1,1	0,27	0,47	0,25	0,25	0.3

7.3 The interviewees and their perceptions related to water quality

7.3.1 Socio-economic characteristics of the respondents about water quality

Most of the respondents were not formally educated. However a majority of respondents below 30 years old had some form of education. More respondents in the urban area than in the rural areas had finished primary education. About 9 out of 21 in the urban area and 3 out of 14 in the rural area hand finished primary education. Primary education is from grades 1 to 8 in Ethiopia.

Seven household members were most common for respondents in the rural areas while in the urban area five or less household members were most common. In the urban it was more common to find female headed households (6 out of 21) than in the rural areas where only 1 out of 14 households were female headed.

A majority of the respondents in the rural areas owned some land. In the urban area i.e. Chitu most respondents did not own any land. In rural areas a clear majority of the households accessed money from cultivating and selling crops. Selling fuel wood and making alcohol was the second and third most common ways to access income. In the urban area however the most common way to access income was from being a daily worker, i.e. work with whatever you can find for the day that provides money. Cultivating crop and selling alcohol came as number two and three of the most common ways of making money in the urban area. The diversity of respondents might increase the likelihood of the study capturing the perceptions of the water collectors in the studied area.

7.3.2 Perceptions and thoughts about water quality

Water Office

According to the Water Office in Chitu the water quality varies over the year and especially during the rain season the water quality becomes worse. However the Water Office states that the quality is still good and there are no water quality problems in the whole Wenchi area. The main water source in Chitu is treated with chlorine and is disinfected. The main water source is the one that supplies water to all the water sources in Chitu. Nothing else is done in order to increase the water quality. The Water Office has a test kit with which they can test the level of chlorine in the water by themselves. The major indicators they look at when determining the water quality besides the test kit is by estimating the color of the water. The clearer the water is the better water quality. However the Water Office is also responsible for

cleaning all the water sources in Chitu about every two years and the Water Office also tries to fix any leakage or problem as soon as possible according to Water Office personnel.[168]

The whole study area

A majority of the respondents in the studied area perceived clean water or water quality to be aesthetic factors such as clear color and good taste. After color and taste clean water or water quality was perceived to be water from a water source that is provided by the government or tap water. This water is regarded as being safe. Other perceptions from the respondents about what clean water or water quality is to them are e.g. if you do not get sick from the water, if it is treated regularly, no smell or odor, free from dust or that the water source is protected. Some of the thoughts by the respondents about what water quality means to them are;

"Clean water comes from the tap which is supplied by the government. I believe the government would not give us bad water".

(Female/16 years /4 household members (HM)/goes to school)

"Quality is water which is clean when you see it. It has a good color and it has a good taste and it comes from a tap".

(Female/ 30 years/ 8 HM/ selling Talat (i.e. alcohol), working in the fields, washing clothes etc)

"Clean and quality water means that you feel good and healthy when you drink it".

(Female/ 20 years/ 3 HM / sells alcohol and collects branches)

All of the respondents believed that clean water is important for health because you do not get diseases from clean water. Some people added that clean water is important in order to prevent diarrhoea diseases. One female aged 29 with five household members who earned her income from collecting tree branches said that *"in every part of your life clean things are good and clean water is good for our health".*

Urban area

When the respondents were asked if they believed that the source/ sources they collected their drinking water from were safe, all respondents in Chitu answered yes with various reasons. Examples of given reasons why they believed the water to be safe were, because it is tap, the

[168] Interview Water Office Chitu – 2012-03-09

government provides it or they have not been sick from this water. When asked what they think about the water´s smell, taste and color from their water source again all of the respondents in Chitu described all three indicators as being good.

"The water is good but not as good as bottle water".
(Female/ 25 years/ 3HM/ sells alcohol)

Rural areas
Also all the respondents around the B1 believed that their water source was safe. All respondents who use the well O1 when it is not dry also believed this water is safe. However just above half of the respondents that used the M1 did not think their water was safe for various reasons. These reasons included, e.g. that animals could come close or that there is no maintenance of this well.

Only one respondent felt that the Berta well had a bad color and a bad smell. However in Meti the respondents were more skeptical and only half of the respondents felt that the smell, taste and color were good. Some added it was good except in the summer time.

"The water is not good enough in Meti, the taste varies in this well and so does the river water".
(Female/29 years/ 5 HM/ Wife of a government employee)

What these findings show is that the water source in Meti is the one that the respondents felt was the most unsafe water source regarding its water quality. This relates to the fact that, again in Meti most people when using their smell, taste and eyes to determine the water, did not feel that the drinking water met their standards.

The whole study area
As described above all of the respondents make an assessment of the water quality status in one way or the other before they collect the drinking water. Some collectors use only one indicator to determine the water quality status but most respondents use more than one indicator. The indicators they use to determine if the water is good or bad in order of commonness are;

1. Looking for a clear color of the water (more than half of the respondents)

2. Looking for dirt settling on the bottom of the bucket or glass (just below half)
3. Taste (about one third)
4. No specific reason given other than looking at it (less than one third)
5. If they know it is treated water then they believe it is good (less than one third)
6. No smell or odor from the water (about one fourth)
7. It is supplied by the government and therefore it is good; no other assessment needed (less than one fourth).

"I always look at the color and when you look at the water you can see if there is any settling. If there is any settling in the water it means the water is bad and we don't drink it without boiling it first".
(Female/ 50 years/ 7 HM/ sells baskets and cultivates crop)

"*We have a clean glass cup and we pour the water in it so that we can see if it is bad or not. I look if there is something in the water."*
(Female/ 20 years/ 3 HM/ sells alcohol and collects branches)

What this shows is that the respondents estimate the water quality and if the water is safe for drinking mainly by looking, tasting and smelling the water. Almost half of the respondents were clear about what they were looking for when using their eyes to estimate if the water is safe. They used a clear glass or bucket and looked for dirt settling on the bottom. It is plausible that the respondents that use more than one indicator have a higher success rate to determine if the drinking water could cause any health problems.

A majority of the respondents pointed out that they think the water quality varies during the year and that the water quality becomes much worse during the rainy season. Some respondents added that it is the flood which causes the water to be dirty and smelly. All respondents, but one who had just moved to this area, thought that the water quality was bad in the rainy season in Chitu. Two respondents did not think the water quality varied or changed in the Meti well due to the seasons but most people did. These findings show that the respondents feel that the drinking water quality changes during the year due to the rainy season and that during the rainy season the drinking water may provide a health risk when consumed.

I also wanted to find out if they thought other factors than rain and flood could affect the water quality in any way, not only for their water source or sources, but for water in general. As noted above most people recognized the rain and floods as affecting the water quality badly. But regarding water more generally the answers varied some. The number one cause except nature in creating water quality problems in general are by the respondents said to be animals e.g. by animal defecation. Regarding if humans can affect the water quality, equally as many respondents did not believe humans could affect the water quality in any way as those who did believe humans could affect the water quality.

Figure 7.1 Meti well, students washing clothes next to the water source

(Photographed by the author, Mete walga kebele, March 2012)

Three people also believed that the government affects the water quality negatively when they do not protect the existing water in the country.

The reasons given for how humans can affect the water quality is in order of importance; 1) by using the rivers as a toilet i.e. defecation; 2) washing clothes in the rivers; 3) bathing in the rivers; 4) washing other things in the water and 5) by throwing rotten food in the river.

"When the water is not protected by the government and it is misused it can affect the quality".

(Female/ 26 years/ 4 HM/ sells fuel wood)

"Animals and people can affect the water quality e.g. when we wash our clothes".
(Female/ unknown age/ 5 HM/ cultivates crops and sells alcohol)

"I don´t think humans cause the problems; it is the nature or animals that does".
(Female/ 33 years/ 6 HM/ husband is a daily worker)

7.4 Water quality and health related issues

7.4.1 Diseases

Contaminated water could cause water related diseases e.g. diarrhoea or cholera. Regarding water borne diseases diarrhoea was the sixth most common disease in Wechi last year. There is no cholera in the whole Wenchi area today but there has been. Three years ago there was an outbreak of cholera. Further a health worker pointed out that people often get sick during the rainy season from water borne diseases. Internal parasites are today the second most common health problem. Regarding the whole Wechi area only Chitu and Darian have clean water. A lot of people use water from the rivers.

Only one of the respondents had had a child who had been sick from what they believed was caused by the water during the last month. The respondent´s child had diarrhoea. It must be noted here though that diarrhoea is not only caused by bad water quality but can also be linked to bad hygiene and sanitation.

Looking at a whole year a minority of all the adult respondents in Chitu had had diarrhoea. However more respondents said that one or many of their children had been sick from diarrhoea in that same time period. About one third of the respondents also said that they had been sick from diarrhoea a few years ago. In Meti one fourth of the respondents said that they had had diarrhoea within the last year and more than half of the respondents said that one or many of their children had been sick from diarrhoea the last year. Only one of the respondents using the Berta well had been sick in diarrhoea the last 12 months. A majority of the respondents said that they had been sick during the rainy season. None of the respondents mentioned any other water related diseases than diarrhoea during the interviews.

"In the rainy season I can feel some side effects in my stomach (…) in the winter (i.e. rainy season) the children get diarrhea".
(Female/ 33 years/ 6 HM/ husband is a daily worker)

The overall findings show that in relation to diseases most respondents have been sick from the Meti well and further it is the children who are affected the most by the bad water quality. Although diarrhoea can be caused by other factors, it is plausible that during the rainy season the water quality in all the examined water sources provides a significant health risk, especially for children. An interesting finding is also that the respondents in Chitu believed they were healthier now than a few years ago.

7.4.2 Health education in relation to water quality

According to Mr Manaye Syum Tariku at the Ministry of Health, Ethiopia has a national health extension package. This package has 17 focal points and one of them is the water supply safety measures extension package. This was created in 2004 and each kebele decides who to teach, but it should be taught at a household level. The aim is for every kebele to educate 500 households and the Ministry estimates that every household has five household members. This package educates about use, storage, treatment, clean water etc. The Ministry also plans for every kebele in the country to have a test kit for testing water quality. The government is in the process of buying such water quality test kits.[169]

According to the vice of head at the Woreda Health Office, some of the population in the Wenchi area has been educated about health risks associated with water quality and how to prevent water related diseases. It is the health center and the school together with a non-governmental organization (NGO) called World Vision of Ethiopia that provide such education. The Chitu health center has educated 3 223 people with the help of World Vision Ethiopia. The health center in Chitu provides health service to approximately 25 000 people.[170]

Approximately one third of the respondents (all women) said that they had been educated about clean water/ water quality and health. All of these respondents that had been taught said that they in turn have shared their acquired knowledge with their husbands and children.

[169] Interview Mr Manaye Syum Tariku at the Ministry of health – 2012-02-28
[170] Interview Health Office in Chitu – 12-03-21

Some respondents even said that they taught their whole family, i.e. mother, father, siblings, cousins etc. One respondent also answered that she had told everyone what she knew. All the respondents who had been trained also said that it had only been them (women) who had been taught. When asked about who provided the education three providers were mentioned: the government, the health center and the World Vision of Ethiopia.

Amongst the respondents the interest to learn about water quality and health was strong and even those who had some training wanted to know more. When the respondents were asked if they would like some education about water quality and health, all of the respondents answered affirmatively. Even each and every one of those who already had some training would like to learn more. One collector said;

"Yes I would like that, then I can tell my children and they can tell their children, and we can get healthier".
(Female/ 25 years/ 4 HM/ cultivates crops and sells fuel wood)

7.4.3 Treating, transporting and storing the water

The health center also provides people with "aqua tabs", "wohaga" or "kula afar" which are tablets, powder or liquid to treat the water before drinking it. The health center provides it to people for free and according to the vice head, people can just come and obtain it from the health center. Furthermore there is no limit on how many water treatment tablets, powder packages etc an individual or household can get. However the health center only has a certain amount and when it is gone there are no more until the World Vision provides a new shipping. The health center often has a shortage of the "Aqua tabs" or "wohaga". It is the World vision of Ethiopia that provides all the water treatment medicine for this region. In 2011, ten thousand bottles were provided over the whole region. The powder packages are new for this year. It is also possible for the inhabitants to buy the "Aqua tabs" or "wohaga" from the pharmacy[171] and it costs about 3 ETB.[172] However a majority of the respondents cannot afford to buy this since it is expensive.

For the whole area and amongst all the respondents, one third answered that they never treat the water in any way e.g. not using water cleaning tablets, liquid or boiling the water. A

[171] Interview woreda health office Chitu – 2012-03-21
[172] 1 ETB = 0,39 SEK 2012-06-18

minority answered that they used to treat the water but they have not gotten any tablets, liquid etc from the government in a very long time. All of these respondents could not afford buying the water treatment medicine themselves and more than half did not know why they no longer get the treatment medicine. Approximately half of the respondents answered that they treat the water in one way or the other, however most people only treated the water during the rainy season. A majority of the respondents who answered that they treat the water said that they boil the water. However the boiling was often a substitute when they did not have any water treatment medicine. Some also said that they boil only in the rainy season or when they can see that the water is bad. Others added that river water always needs to be boiled but that the well water never did or only during rain. The water treatment liquid and the water treatment tablets were equally common; no one had yet used the powder form that was provided this year to the health center.

"If we use water that is not collected from the river, then we don´t treat it. But if we use river water we treat it with the tablets that clean the water. These tablets have been provided by the government. We only get 10 tablets every rainy season".
(Female/ 50 years/ 7 HM/ selling crop and baskets)

All respondents covered their jerry cans or buckets during transport. Some also said that they wash the lid and the bucket every time at the water source before they refill it. Only four respondents said that they store the left over water for drinking the next day. However all of the respondents with tap water to their yard said that they store the water.

7.5 Conclusions

The water quality results represent a snapshot of the quality of drinking water in the studied area. The findings can only reflect the state of the water at the moment when tests were done and it is plausible that the state of the drinking water changes during the year due to rain seasons. Based on the water quality measurements none of the drinking water sources had any water quality problems at that given time and they did not provide any significant health risks when water was consumed.

However, based on the findings it is possible that during the rainy season the water quality becomes worse and that especially for children the drinking water from all water sources may provide a significant health risk if not treated. The most common water related disease during

the rainy season is diarrhoea. The water source in Meti was the water source from which most people had become ill. Furthermore the respondents in Chitu believed that they had become healthier during the last years. This could indicate that the water quality is better now than before. On the other hand the wells in Chitu were built in 2006 and maybe the construction of these wells is a cause for the better health amongst these respondents. The water in the wells constructed in 2006 in Chitu are treated with chlorine.

A majority of the respondents using the Meti water source felt that the source was not safe. Most respondents use more than one indicator to estimate if the drinking water quality is good or bad and it is plausible that people that use more than one indicator have a higher success rate in determining if the water quality is good or bad.

About 3 223 people in the Wenchi area have had health education related to water quality and this knowledge is always transferred within the family. This shows that the health extension package launched by the government is being implemented in this area.

Almost half of the respondents did not think that humans could affect the water quality in general in any way and that only animals were the problem. If people are not taught about the linkage between contamination, water quality and health it is possible that water contamination problems in the area never decline. If people are not aware of problems with e.g. defecation near the water source they will not see any reason to avoid such practices.

In relation to my research question about water quality I conclude that during the dry season there are no significant health risks when consuming the water from the studied water sources. The water quality was good at the time of the study. However there seem to be water quality problems during the rainy season and the drinking water can then be a health risk, especially for children.

8. Water safety

This chapter presents the sanitary risk factors at all the studied water sources, a total of 10 sites. First an introduction of the state of all the water sources is presented. This is followed by a more thorough description of water sources and the respondents' perceptions about these sources. At the end the conclusions are presented with the most common risk factors.

8.1 Introduction

A sanitary risk inspection has been made at all the located improved water sources except one.[173] Three household taps have also been inspected. The inspection is a visual assessment of the environmental surroundings. It is based on ten questions and every answer that complies gets one point. This can then be compared to the points developed by the RADWQ for different sanitary risks, (see appendix 1). The overall results of all examined water sources are presented in the table 8.1 below.

Table 8.1 Total sanitary risks

Improved water source	Total score of risk (%)
W1 Piped water witch supply tank	10% very low risk
W3 Piped water witch supply tank	30% low risk
W4 Piped water witch supply tank	30% low risk
W5 Piped water witch supply tank	30% low risk
H1 Household piped water	40% low risk
H2 Household piped water	20% very low risk
H3 Household piped water	40% low risk
O1 Deep borehole with mechanized pump	60% medium risk
M1 Deep borehole with mechanized pump	60% medium risk
B1 Deep borehole with hand pump	50% low risk

The different water sources will now be presented categorized by water source type i.e. piped water with supply tank; distribution system; deep borehole with mechanized pumping; deep borehole with hand pump and household piped water.

[173] W2 was broken and closed during the whole field work period

8.2 Piped water with supply tanks

Four sites in Chitu with the RADWQ definition piped water with supply tank: distribution system was inspected. All four sites are located in Chitu and they are all connected to one source as described in chapter six. See table 8.2 for the risk inspection results.

Table 8.2 Sanitary risk inspection at piped water

	PIPED WATER WITH SUPPLY TANKS: DISTRIBUTION SYSTEM:	Risk frequency (%)
1	Do any taps or pipes leak at the sample site?	100%
2	Does water collect around the sample site?	25%
3	Is the area around the tap insanitary?	0%
4	Is there a sewer or latrine within 30m of any tap?	75%
5	Has there been discontinuity in the last 10 days?	0%
6	Is the supply main pipeline exposed in the sampling area?	0%
7	Do users report any pipe breaks within the last?	0%
8	Is the supply tank cracked or leaking?	25%
9	Are the vents and covers on the tank damaged or open?	25%
10	Is the inspection cover or concrete around the cover damaged or corroded?	50%

As can be seen above in this table, the greatest risk relates to leakage and the second biggest risk is that there are latrines or sewers near the water source. Well number 1 also had taps that were rusty at the supply tank and one of the taps did not work. It had been broken for years. Well number 3 had only three working taps out of a total of six and two were leaking. The tank system at this source also leaked. Well number 4 had the largest leakage in the tank system and it had been like that for over a year. The Water Office had told the people that they need to buy a new tank two months ago, something they said they cannot afford. The last inspected well number 5 started leaking six months ago and five out of six taps worked.

A majority of the respondents that use the water sources in Chitu said that they are happy with the way the water sources are currently maintained. Only respondents using well number 2 said that they were not happy. A majority of those respondents said that they are not happy since the well is often broken.[174]

Figure 8.1 Well nr 4 leaking

(Photographed by the author, Chitu, March 2012)

Most people knew that the water sources were maintained and that it is the government who is responsible for this. Some respondents knew more specifically that it is the Water Office that has the responsibility. None of the respondents in Chitu that use one of these sources, except well number 2, had any improvements that they could think of regarding the maintenance, cleanliness or anything that could be improved. Regarding well number 2 a majority answered that they would like the repairmen of the wells to be faster than at present. Well number 2 is constantly breaking down. One respondent using well number 2 answered:

"*No I´m not happy, it is broken and they don´t fix it. We can´t get water close to our home and there is often a problem with this well*".

(Female / 20 years/ 3 HM/ making alcohol)

8.3 Deep boreholes with mechanized pumping

There were two deep boreholes with mechanized pumping in the study area. These were the wells M1 and O1. O1 was at the time dry but a risk inspection could still be carried out. For a better description of the risk inspection see table 8.3 below.

[174] This is the well that never got examined since it was always closed or broken when visited.

Table 8.3 Sanitary risk inspection at mechanized borehole

	DEEP BOREHOLE WITH MECHANISED PUMPING:	Risk frequency (%)
1	Is there a latrine or sewer within 100m of the pumping mechanism?	50%
2	Is there a latrine within 10m of the borehole?	0%
3	Is there any source of other pollution within 50m (e.g. animal breeding, cultivation, roads, industry etc)?	100%
4	Is there an uncapped well within 100m?	0%
5	Is the drainage channel cracked, broken or needing cleaning?	100%
6	Can animals come within 50m of the borehole?	100%
7	Is the base of the pumping mechanism permeable to water?	100%
8	Does water form pools within 2m of the pumping mechanism?	100%
9	Is the well seal insanitary?	50%
10	Is the borehole cap cracked?	0%

Regarding these two water sources five risk areas are in a high risk for contributing to -if not causing- water quality problems now or in the future. The five areas with the greatest risks for these water sources are: that there is pollution near the sources; there is some sort of drainage problem; animals can come close to the sources; the base for the pumping is permeable to water and there are pools forming around the pumping mechanisms. As can be seen on the photo below from the Meti well, the fence around the water source is poorly made and this results in animals drinking there. Further, cattle were often brought there from surrounding areas to drink. The fence only consisted of a few scattered wooden poles. A concern related to pollution risks is that approximately three meters from the pumping mechanism there is a washing stand. People in this area go here to wash clothes and the used water goes back into the ground. In relation to the other water source outside of Chitu (O1), again animals could drink from the source and there was no fence.

Figure 8.2 Showing animals drinking from The Meti water source

(Photographed by the author, Meti, March 2012)

Respondents that use these two water sources knew that the wells are not maintained at the moment and that no one are responsible for this. Regarding the Meti well some respondents answered that there had been a man who lived in the area before who used to maintain the well. But since he moved away three years ago, no one is maintaining the well any longer. A majority of the respondents using these wells were not happy about the water sources´ present condition and lack of maintenance. People often had ideas of improvements that they thought were needed and most people thought that a fence or a proper fence was needed. Related to the Meti source more than half thought that it would be better to keep the washing area separated from the well. Other improvements related to both water sources were that the water needed to be treated and that the area surrounding the water source needed to be cleaned regularly. As one respondent that uses the Meti well said:

"*It is better to build a fence around it and keep the washing area separated from the well".*

(Female/ 29 years/ 5 HM/ owes land and husband government employee)

8.4 Borehole with handpump

In the study area there was also one borehole with a handpump. This is the one referred to as Berta well or B1. The results of the sanitary risk inspection are presented in table 8.4 below.

8.4 Sanitary risk inspection at handpumped borehole

	BOREHOLE WITH HANDPUMP:	**Risk frequency (%)**
1	Is there a latrine within 10m of the borehole?	0%
2	Is there a latrine uphill of the borehole?	0%
3	Are there any other sources of pollution within 10m of borehole? (e.g. animal breeding, cultivation, roads, industry etc)	100%
4	Is the drainage faulty allowing ponding within 2m of the borehole?	100%
5	Is the drainage channel cracked, broken or need cleaning?	100%
6	Can animals come within 10m of the borehole?	100%
7	Is the apron less than 2m in diameter?	0%
8	Does spilt water collect in the apron area?	100%
9	Is the apron or pump cover cracked or damaged?	0%
10	Is the hand pump loose at the point of attachment? or (for rope-washer pump is the pump cover missing)	0%

Regarding this water source there are some risk areas that could be a sanitary risk i.e. pollution near the source; bad drainage; animals can come close; collection of spilt water and cracks.

Figure 8.3 Berta well

(Photographed by the author, near Chitu, March 2012)

Respondents using this well were overall unhappy about how the well was maintained. It is the community around this water source who are responsible for cleaning, maintaining and treating it. However this water source is not treated or cleaned regularly according to the

respondents. Improvements that people thought were needed all related to the treatment of the water and the cleaning of the well and disinfecting it.

8.5 Household piped water

Three household piped water sites were also inspected in Chitu. The results are presented in table 8.5 below.

Table 8.5 Sanitary risk inspection at households

	HOUSEHOLD PIPED WATER:	Risk frequency (%)
1	Is the tap sited outside the house (e.g. in the yard)?	100%
2	Is the water stored in a container inside the house?	100%
3	Are any taps leaking or damaged?	33%
4	Are any taps shared with other households?	33%
5	Is the area around the tap unsanitary?	66%
6	Are there any leaks in the household pipes?	33%
7	Do animals have access to the area around the pipe?	33%
8	Have users reported pipe breaks in the last week?	0%
9	Has there been discontinuity in water supply in the last 10 days?	0%
10	Is the water obtained from more than one source?	0%

Related to pipe water to the house all of the respondents had their tap located outside the house in their yard. Water taps outside increases the possibilities for contamination problems e.g. animals licking the tap. Another possible risk relates to the storage and the fact that all of the respondents stored water in the house. By storing the drinking water the chances for it to be contaminated increase due to the lack of cleaning or disinfection of the storage unit. Some of the households also kept farm animals in their yard.

Again all the respondents with household taps were happy about the way the original source is maintained. All respondents knew that the government or Water Office is responsible for this. None of the respondents had cleaned or disinfected their own yard tap nor had anyone else done it. They did not have any improvements that they could think of and seemed satisfied with the existing conditions.

Figure 8.4 Leaking yard tap in Chitu
(Photographed by the author, Chitu, March 2012)

8.6 Conclusions

All the piped water with supply tanks in Chitu has a low or very low sanitary risk. It is only the water sources outside Chitu (O1) and the water source in Meti (M1) that have a medium sanitary risk. The biggest problem with all the water sources in Chitu was leaking taps. The sanitary risk inspection also complies with the answers from the respondents and them being happy about how their water sources are maintained and treated.

Regarding the deep boreholes with mechanized pump there are several risks, e.g. possible pollution and that animals can come within 50 m of the borehole. Both these water sources have in common that no one is responsible for their maintenance. All respondents had ideas of improvements for their water source but nothing seems to be done by the people themselves.

Regarding the borehole with handpump there are also some risks, presenting a medium sanitary risk. For example, animals but also faulty drainage may cause future quality problems. At this source the community maintained the well and all the respondents were happy about this.

The results also showed that the water sources that were maintained by the Water Office had a lower sanitary risk score. Based on the findings the conclusion is that it is important that

either some government organs or the community is responsible for maintenance of the water sources.

In relation to the research question the conclusion is that it is the water sources Meti (M1), the source outside Chitu (O1) and the Berta well (B1) that have the greatest sanitary risks. They all had problems that may cause water quality problems in the future if not treated. The most common sanitary risks for the different sources are presented in table 8.6.

Table 8.6 Most common sanitary risk factors

Sanitary risk questions	Risk frequency (%)
PIPED WATER WITH SUPPLY TANKS: DISTRIBUTION SYSTEM: 4 sites	
1. Do any taps or pipes leak at the sample site?	100%
4. Is there a sewer or latrine within 30m of any tap?	75%
10. Is the inspection cover or concrete around the cover damaged or corroded?	50%
DEEP BOREHOLE WITH MECHANIZED PUMPING: 2 sites	
3. Is there any source of other pollution within 50m (e.g. animal breeding, cultivation, roads, industry etc)?	100%
5. Is the drainage channel cracked, broken or needing cleaning?	100%
6. Can animals come within 50m of the borehole?	100%
7. Is the base of the pumping mechanism permeable to water?	100%
8. Does water form pools within 2m of the pumping mechanism?	100%
BOREHOLE WITH HAND PUMP: 1 site	
3. Are there any other sources of pollution within 10m of borehole? (e.g. animal breeding, cultivation, roads, industry etc)	100%
4. Is the drainage faulty allowing ponding within 2m of the borehole?	100%
5. Is the drainage channel cracked, broken or need cleaning?	100%
6. Can animals come within 10m of the borehole?	100%
8. Does spilt water collect in the apron area?	100%
HOUSEHOLD PIPED WATER: 3 sites	
1. Is the tap sited outside the house (e.g. in the yard)?	100%
2. Is the water stored in a container inside the house?	100%
5. Is the area around the tap unsanitary?	66%

9. Final Conclusions

The purpose of this study is to explore the status of water security of the households in Chitu and its surrounding area and Meti in Mete Walga Kebele. A comprehensive analysis of the water access, water quality and water safety in the study area was undertaken. From these finding some conclusions were drawn about the access, quality and safety. This chapter will develop some of these conclusions and especially draw final conclusions about the water security in the area. However conclusions about the definitions of the MDG goal of access to sustainable safe drinking water can also be drawn. These conclusions will now be presented and discussed in relation to published literature.

9.1 Summary of the conclusions

What access do households have to water used for domestic purposes?

According to Howard and Bartram in Chitu the respondents using W1-5 had a service level of basic access to water. Further, about 200 households in Chitu that had a yard tap had an intermediate access. Also the respondents using M1 had a service level of basic access to water with regards to the walking time for collecting water. A majority of the respondents did not spend more than 30 minutes in total walking time round trip collecting one jerry can of water. According to Howard and Bartram however with regards to the quantities of water collected their service level would be no access to water. In Chitu the respondents had five wells to choose from, still I find it plausible that the respondents in Chitu are more time constrained than the respondents using the other water sources, i.e. M1, B1 & O1. They are believed to be more time constrained due to e.g. queuing by the well in Chitu or the well being opened earlier or later than it should.

What is the quality of the drinking water?

None of the drinking water sources studied had any water quality problems and they did not pose any significant health risks for humans when consuming the water. However it is possible that the drinking water becomes worse during rainy season since diarrhoea was common especially amongst children during that time. Most people said that they or their children had become ill from the Meti water source.

What are the sanitary risk factors at the drinking water sources?

The water sources that had the highest risk scores are Meti well (M1), the source outside Chitu (O1) and the Berta well (B1). The most common sanitary risk factors at the different water sources studied are presented in the table 8.6.

9.2 Access to water

According to Howard and Bartram's service level matrix and in regard to the respondents' time spent on walking to the water source, the study area has a service level of basic access. Most of the respondents have access to improved water sources (JMP definition). Compared to the rating in the 2002 water supply and sanitation inputs for Ethiopia's PRSP, the study area is doing on average much better in relation to people's access to drinking water than the overall country did in 2002. It is possible that the overall ratings for Ethiopia have gone up as well since then.

If the water quantities accessible per person a day are included in the service level matrix only Chitu would have a basic access. Most respondents using the Meti well would be classified according to the service level matrix as having no access. This is because most of the respondents' households had an accessibility of less than 5 liters of water per capita a day. In Chitu the average amount of water was 10 – 15 liters per capita a day.

In the urban setting the population's access to improved water sources would be about 100% according to Howard and Bartram service level matrix and distance to the source. In the rural setting this level would be much higher than the 2002 rating of 18%. However the rural areas do not have the same accessibility as the urban area, i.e. W1-5, in relation to the population's access to water with regard to the distance. In relation to the Ethiopian water access goal for 2012/13 that 97% of the populations in urban areas should have potable water services within 0.5 km radius is met in the study area. Also the rural goal of 86% within 1.5 km radius is met. However the Ethiopian governments criteria for building new wells of people in rural areas being able to obtain 50 liters of water per capita a day, is far away from the reality in the study area. The criteria of people accessing 20 liters per capita a day in urban areas is almost met by the respondents in Chitu.

According to the 2006 Human Development Report, having basic access to water should have positive effects in the communities in terms of e.g. lower child mortality and reduced poverty.

However if this is the case in the study area this study cannot answer. Further, there are also problems in Chitu with e.g. power cuts, opening and closing at set times, queuing at the taps and few hours a day that the wells are open. The most common water supply source in the study area was deep-drilled wells.

9.3 Water quality

Tadesse et al. argue that pH values under 8 means that there is an effective chlorine treatment of the water. Since all the water sources in the study had values below 8, the treatment with chlorine done by the Water Office is probably effective in disinfecting the water in Chitu. It is plausible that this is interlinked with the respondents´ thoughts that they are healthier now than they were a few years ago. The wells in Chitu were constructed in 2006 and before that they had to use the well outside Chitu. Further Tadesse et al. and the WHO state that high values of electrical conductivity could indicate that the water is contaminated. Since none of the examined water sources had high values of electrical conductivity it indicates that there was no major contamination in the drinking water at that given time. I have argued based on previous knowledge and the findings that the measurement data have shown that there was no water quality problems at the time of this study that were of any significant health risks for humans when water was consumed. The previous study from RADWQ in 2004 – 2005 found an water quality accordance of approximately 78% with the WHO guidelines. This study has about 70% accordance with the guidelines. The RADWQ also found an electrical conductivity accordance of about 95% and in these findings the numbers were 100%. However the RADWQ tested for more physical and chemical parameters than I did. This means that there is a validity bias in this comparison with the RADWQ tests. What the results could indicate in a humble way is that the water quality status in the studied area has not changed much in the last seven to eight years and that the water quality is still overall good.

On the other hand based on further findings in relation to the water quality it is plausible that during the rainy season the water quality becomes worse. During the rainy season and especially for children there could be health risks involved in consuming the water if it is not treated. According to the WHO, drinking water is safe when there is no health risks involved when consumed. Since respondents have pointed out that diarrhoea is common during the rainy season I argue that the water sources in the area could pose a health risk and especially the water source M1. It is possible that other water sources in the Oromia region also could have drinking water that poses a health risk during the rainy season. These findings indicate

that improved water sources can have water quality problems that could be a threat to human health when the water is consumed. However the unimproved source B2 (that is a ditch) had overall good ratings and compliance with the WHO drinking water standards. This could indicate that just because a source is classified as unimproved does not always mean that the water quality is bad.

In relation to water quality it has been shown that many respondents in the studied area believe that only animals can affect the quality of the water and not humans. According to the Ministry of Health, waste from animals is a common contaminant but so are human excreta and liquid waste.

9.4 Water safety

The results of the sanitary risk factor inspection were not unexpected and they confirm some of the previous knowledge from the RADWQ study done in 2004 and 2005 in Ethiopia. The RADWQ found three areas that were of higher sanitary risks regarding deep boreholes with mechanized pumping. The finding complies with two of their results with a high risk, i.e. animals can come within 50 meters of the borehole and other possible pollution sources. Furthermore the base was being permeable to water and water was forming pools around the pumping mechanisms. This was a problem for the two deep boreholes with mechanized pumps.

Regarding boreholes with hand pump the findings are again compliant with the RADWQ findings of the three most common risk areas. However other forms of pollution and spilt water collecting in the apron area were also a high risk at the studied water source.

In relation to the household water again the results were similar to that of the RADWQ research. The two largest problems regarding household piped water were that the taps were located outside and that water was being stored in containers inside. On the other hand I also found that the area around the tap being unsanitary was a bigger problem than animals having access to the pipe in the studied area and this is a difference from the RADWQ.

The least compliant results compared to the RADWQ were regarding piped water with supply tanks: distribution systems. The previous research had found that water collecting around the site, insanitary surroundings and a sewer or latrine near the sources were major risks. In the

studied area the biggest problems were leaking taps or pipes followed by sewers or latrines near the site and damaged or corroded cover. Only one of these findings complied with the RADWQ. Since the RADWQ was a large-scale study in the whole country, I believe there is some omitted variable bias in the comparison with their findings. If I had examined more wells there is a chance the findings would have been different.

The findings show that the sanitary risk for the water sources not located in Chitu is likely to be greater over time due to infrastructure deterioration and absence of proper maintenance. These three wells also had the highest risk score at this moment. The result has shown that it is not only important to build water sources; it is equally important with regard to water safety to leave the responsibility for the wells with someone who is well suited for the task.

9.5 Water security

According to Howard and Bartram's service level matrix, the study area with regard to the walking time has a basic access to water and with regard to quantities of water collected only the respondents in Chitu have a basic access. The respondents using M1 have no access to water according to the service level matrix. However reasonable access to water is described by the UNICEF and WHO as being at least 20 liters of water per person a day. Most respondents in the study area do not have access to 20 liters of water per capita a day. This means that most respondents do not have reasonable access to water according to the UNICEF and WHO. In relation to the service level matrix, with the water quantities included, and the UNICEF and WHO definition it becomes noticeable that there is a problem in the study area regarding the number of liters of water per capita a day. If access to water is understood as having a improved water source within 30 minutes round trip there is no problem.

If the accessibility is interlinked with sanitary risk factors then it is clear that it is the rural areas, i.e. M1, B1 and O1, that are lagging behind Chitu. It is possible that the rural water supply has low levels of sustainability. This conclusion is based on no or limited maintenance, limited or no knowledge of how to maintain the water sources and insufficient government support. In Chitu as well as in the rural areas there is a problem with the lack of affordability by the communities to buy spare or new parts when needed. The water sources W1-5 that were maintained by the government had much lower sanitary risk scores.

Finally if these findings are linked with the water quality results it is the rural areas that have the greatest health risks for the population during the rainy season. At the time of the study all the water sources had however overall good water quality. Seen to all three factors i.e. access, safety and quality and the water security in the study area Chitu would have partial household water security. Chitu have low sanitary risk scores, at the time good water quality and the population all had access to the source within 1 km radius. Even though they did not fetch the 20 liters of water a day per capita the respondents´ were close with an average of 10-15 liters a day per person. The rural areas would have no household water security. The quality was at the time good however the largest health risks when consuming the water during the rainy season are found there. The highest sanitary risk scores for the water infrastructure and the lowest numbers of liters of water per capita a day were also found there. Further, as was mentioned before maybe one of the reasons why people in the rural areas collect more rain water could be that the rural water sources have a higher sanitary risk scores, have more problems during the rainy season and people often collect less quantities of water from the sources. These factors are superior to the fact that the population in rural areas has a water source within a 30 minutes round trip. This is why I find that they have no household water security.

9.6 The MDG goal of water

Through the findings I have presented that the people in the studied area at that given time had no household water security or only partial household security. The MDG goal of sustainable access to safe drinking water by the JMPs definition is access to improved water sources. Since people in the studied area have basic access to improved water sources using Howard and Bartram´s definition they meet the MDG target for water, both in the urban and rural setting.

However I have shown throughout this study that other factors are also of importance with regard to water access. The MDG target and the definition (JMP, WHO and UNICEF) ascribed to it regarding water access exclude important factors at this moment. If sustainable safe drinking water access is researched as described in the goal itself I argue it includes more factors than just the literal access part to water. I believe that there is a need for improvements of the definition regarding how to research this. As other scholars e.g. Howard and Bartram I think the access part also needs to include the quantities of water needed. How you define

peoples´ access could be different depending on if only distance is studied, or if quantities are included as well, which has also been shown in this study. However since it has been developed by others e.g. Howard and Bartram I will not further discuss this here.

Through this study it is clear that the sanitary risks of the infrastructure and the water quality are equally important as distance and quantities. This is especially true if the drinking water accessibility should be sustainable and safe in the long run. The results suggest that during the rainy season the water sources used are not "safe" water quality-wise. Furthermore the wells that are not maintained are likely to have even higher risk scores in the future and this might lead to contamination and water quality problems, i.e. they are not sustainable. In relation to the definition sustainable access to safe drinking water I am not sure whether the water access is sustainable especially in the rural areas.

Based on the findings I argue that the definition of measuring the progress towards the MDG related to water should be redefined and possibly be based on water security, i.e. water quantities, distance to the water source, water safety and water quality instead. The access is important, both the distance and the quantities. However equally important are the water quality and the sanitary status of the water source, especially if we want it to be a sustainable water source. By changing the definition the awareness of drinking water access in countries would be shown in another light. Not only would it be important for people to have access to drinking water but it would be equally important that this water does not pose a significant health risk if consumed. If e.g. a water source is believed not to be safe for human consumption it is possible that people walk much further to another water source that is believed to be better. This could then change their access to drinking water. Further the water infrastructure would also have to be highlighted for the sustainability of this water accessibility. It is plausible that if the definition was changed governments as well as the donor community could work more effectively in securing sustainable water access for people. The JMPs rapid assessment of drinking water quality method and implementation might be a first step towards a broader definition on how to study access to safe sustainable water.

By changing the definition I believe the progress towards the MDGs related to water access in Ethiopia but also in the world would be lower. By not including, e.g. water quantities the

progress towards the MDG is better then what the reality for peoples´ access to water might be. It is possible that as in the study area, improved water sources can have water quality problems and that high sanitary risks may cause future water quality problems. If there is a water quality problem only during rainy seasons in other areas as well or if there is a problem all year around I can only speculate about. However what has been shown is that just because a source is improved it does not mean that the water source never poses a health risk for humans. Reversely, it has also been shown that just because a water source is classified as unimproved it does not mean that it always poses a threat to humans when the water is consumed.

9.7 Recommendations

There are several things that need to be done in the study area in order to improve the populations´ sustainable safe water access. I will be focusing on some improvements that can be done even with small measures. However there are some improvements that would require more effort and funds in example well O1 could be drilled deeper in an attempt to avoid dry out, or if this is not possible another water source (as close as possible to O1) could be drilled.

Water access

There is a need for an installation of more taps at the water sources in Chitu. Installing more taps could lead to reduced queuing time for the water collectors. Longer opening hours at the water sources would also improve the water access. It is also believed that opening well number 1 at least two times a day would have positive effect on the collector's time spent on queuing at other water sources in Chitu. This might also improve the number of liters obtained for the people using this well. Regarding all the personnel responsible for the wells opening and closing hours I think it would benefit the community if they were told about the importance of their responsibilities', as well as keeping the scheduled opening hours.

Water quality

It is important that awareness-raising in the communities about the human affects on water quality is brought up. There needs to be a clear link between water quality, water contamination and health in order for the people to be able to decide to make smaller changes in their lives that will have positive affects regarding these matters. When the Health Office informs people about water quality and health this issue could be brought up as well.

However it is important that this link is clear not only on the local level but also on the governmental level.

Water Safety

Improvements regarding the borehole with a handpump could be e.g. a better drainage channel and animals could be kept at a further distance from the water access in order to reduce possible water quality problems in the future. With regards to the households taps a measure that could be taken to minimize possible contamination and quality problems would be to make a small fence around the yard tap. This would at least prevent the animals from drinking, licking the tap and defecating near it.

Further I think it would benefit the communities in the studied area if the Ethiopian government or surrounding community could be responsible for the water sources, since the water sources that are maintained have lower risk scores. In a long term perspective, after a well is built, it is important to leave the responsibility with the government or community. If no one feels responsible for the well the infrastructure will deteriorate faster as it becomes older than a well that is maintained. However the community or the government needs to have the capacity and resources to take care of the water source. Investments in capacity building might have to be done. The water offices would need to have more staff and more people with the right technical qualifications. Since the Ethiopian government has regional, woreda and kebele water offices it is plausible that they could take over the responsibility for all the improved water sources in the studied area. Again in a long term perspective and in relation to the MDGs this could help in making sure that Ethiopia reaches their goal of access to safe drinking water but also that this access is sustainable.

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Appendix 1 Sanitary risk inspection

Site name/ nr_____ date/time_____

PIPED WATER WITH SUPPLY TANKS: DISTRIBUTION SYSTEM
1. Do any taps or pipes leak at the sample site? Y/N
2. Does water collect around the sample site? Y/N
3. Is the area around the tap insanitary? Y/N
4. Is there a sewer or latrine within 30m of any tap Y/N
5. Has there been discontinuity in the last 10 days? Y/N
6. Is the supply main pipeline exposed in the sampling area?? Y/N
7. Do users report any pipe breaks within the last week Y/N
8. Is the supply tank cracked or leaking? Y/N
9. Are the vents and covers on the tank damaged or open? Y/N
10. Is the inspection cover or concrete around the cover damaged or corroded"? Y/N
Total Score of Risks ……../10

DEEP BOREHOLE WITH MECHANISED PUMPING
1. Is there a latrine or sewer within 100m of the pumping mechanism? Y/N
2. Is there a latrine within 10m of the borehole? Y/N
3. Is there any source of other pollution within 50m (e.g. animal breeding, cultivation, roads, industry etc)? Y/N
4. Is there an uncapped well within 100m? Y/N
5. Is the drainage channel cracked, broken or needing cleaning? Y/N
6. Can animals come within 50m of the borehole? Y/N
7. Is the base of the pumping mechanism permeable to water? Y/N
8. Does water form pools within 2m of the pumping mechanism? Y/N
9. Is the well seal insanitary? Y/N
10. Is the borehole cap cracked? Y/N
Total Score of Risks ……./10

BOREHOLE WITH HANDPUMP
1. Is there a latrine within 10m of the borehole? Y/N
2. Is there a latrine uphill of the borehole? Y/N
3. Are there any other sources of pollution within 10m of borehole? Y/N
(e.g. animal breeding, cultivation, roads, industry etc)
4. Is the drainage faulty allowing ponding within 2m of the borehole? Y/N
5. Is the drainage channel cracked, broken or need cleaning? Y/N
6. Can animals come within 10m of the borehole? Y/N
7. Is the apron less than 2m in diameter? Y/N
8. Does spilt water collect in the apron area? Y/N
9. Is the apron or pump cover cracked or damaged? Y/N
10. Is the hand pump loose at the point of attachment? Y/N
or (for rope-washer pump is the pump cover missing)
Total Score of Risks ……../10

HOUSEHOLD PIPED WATER
1 Is the tap sited outside the house (e.g. in the yard)? Y/N
2 Is the water stored in a container inside the house? Y/N
3 Are any taps leaking or damaged? Y/N
4 Are any taps shared with other households? Y/N
5 Is the area around the tap unsanitary? Y/N
6 Are there any leaks in the household pipes? Y/N
7 Do animals have access to the area around the pipe? Y/N
8 Have users reported pipe breaks in the last week? Y/N
9 Has there been discontinuity in water supply in the last 10 days? Y/N
10 Is the water obtained from more than one source? Y/N
Total score of risk ……../10

Appendix 2 JMP: s definition of an improved and unimproved water source

According to the Joint Monitoring program (JMP) *"an improved drinking-water source is defined as one that, by nature of its construction or through active intervention, is protected from outside contamination, in particular from contamination with faecal matter"*[175]. In order to be able to compare data between different countries the JMP uses a classification of "unimproved" and "improved" drinking sources.

Improved drinking water sources are as follows;

- *Piped water to plot/yard*. This is also called a yard connection and it is defined as a piped water connection to a plot outside the house or to a tap placed in the yard.
- *Piped water into dwelling.* This is also called a household connection and it refers to water service pipe connected with in house pluming. It can be connected to one or more taps in the house.
- *Standpipe or public tap.* This is defined as a public water point where people can collect water. These can also have one or more taps and standpipes are also called public fountains. A public standpipe is often made of concrete, brickwork or masonry.
- *Borehole or tubewell.* The tubewell or borehole has been created in the purpose of reaching the ground water supplies and is has been drilled, bored or driven. They are installed with a pump in order for people to reach the water. This pump can be powered by diesel, electricity, humans, the wind, animals or solar power. They are often protected by a platform that is surrounding the borehole or tubewell. This platform prevents infiltration of run-off water at the well head as well as it leads spilled water away from the well. The tubewell or boreholes are often constructed with pipes or casing. This protects the well from caving in and protects the water source from run-off water.
- *Protected dug well.* This is a dug well that is protected from run-off water. This is done by a casing or a lining that is raised above ground level. It also has a platform that diverts spilled water away from the well as well. Furthermore the protected dug well needs to be covered. This needs to be done in order to protect the dug well from animals and so that bird dropping cannot fall into the well.
- *Protected spring.* A "spring box" is often made of concrete, masonry or bricks and it protects this water source. It protects it from animals, bird droppings and run-off

[175] http://www.wssinfo.org/definitions-methods/introduction/ (downloaded 2012-01-19)

water. The “spring box” is “*built around the spring so that water fl ows directly out of the box into a pipe or cistern, without being exposed to outside pollution*“[176].

- *Rainwater.* Rainwater can be stored in tanks, cisterns or containers until it needs to be used and it refers to the rain that is harvested or collected from the surface. It can be harvested by ground catchment or by roof catchment.[177]

Unimproved water sources are as folows;

- *Unprotected spring.* Unprotecetd spings often do not have a ”spring box” and it is not protected from animals, run-off or bird dropping.
- *Unprotected dug well.* The JMP have made two conditions wich helps diffine a unprotecetd dug well. Only one of these two conditions needs to be true in order for it to be a defined a unprotected dug well. These conditions are as follows; the well is not protected from animals and bird dropping, the dug well is not protected from run-off water.
- *Surface water.* Surface water is defined as water that is located above ground. It can include streams, ponds, rivers, lakes, canals, irrigation channels and dams.
- *Tanker-truck.* Water is brought in by truck to the commounity and it is then beeing sold.
- *Cart with small drum/tank.* This definition refers to water beeing sold by a provider who tarnsport it to the community.
- *Bottled water.* Botteled water can be considered to be an improved water source but only if the household uses another improved water source for there personal hygene and cooking.[178]

[176] http://www.wssinfo.org/definitions-methods/introduction/ (downloaded 2012-03-19)
[177] Ibid.
[178] Ibid.

Appendix 3 Interview guide / Access to water

Name:

Sex:

Age:

Members of household:

1) Do you live nearby this well?
2) A) Do you often fetch your water at this well?
   B) Where else do you fetch water?
3) Who in your household fetches the water every day?
4) What do you use the water for?
5) How many liters of water do you fetch every day?
6) How many liters of water do you use in household every day?
7) Do you think you get enough water for your household?
8) Is there a price, if so how much and do you think it´s fair?
9) Does this well have any opening hours, if so what are they?
10) What do you think of your water access?
11) Does the water access vary from time to time?
12) What do you think about the water quality?
13) Do you think that you get enough water for you and your household's needs?
14) Can you think of any improvements that you think needs to be done about the water access or the water quality?
15) Do you have any other comment?

Appendix 4 Interview guide Quality, Safety and further access questions

Background variables

- Name:
- Gender:
- Age:
- Have you had any school education and how long in that case:
- Number of people in the household:
- Who are those people:
- How long have you been living here in this house:
- Where did you live before:
- Daily activities:

General points

- What responsibility do the children have?
- Does your family own any land?
- How do you access income or money in your household?

Water quality

1. What does water quality mean to you?
2. Tell me what you think when you hear safe or clean water and if you think the source or sources you use are safe?
3. How do you know if the water is good or bad?
4. On a scale from 0 to 10 how good would you say the water is? 10 being as good as bottle water.
5. Do you think the water quality varies depending on the season?
6. How would you describe the drinking water from that source you use regarding its color, smell and taste?
7. If more than one source is used – why do you fetch water for drinking from different sources?
8. Would you describe the water from that other source the same regarding its color, taste and smell?
9. How is the water quality at the other used sources?
10. What do you think is/ could be a cause for water quality problem at this source?
11. What do you think is the cause for water quality problems in the whole Ethiopia? (water in general)

Further related questions

12. Have you or any one from your household been sick from drinking water fetched in the used water source? (water related illnesses) If yes, how many times last year/ this year? During the last month? What illness was it?
13. Have you had diarrhea this last month/ year?
14. Have any in your family had diarrhea the last month/ year?
15. Have you heard of any person in this village/ area that has gotten sick from that water source?
16. Do you treat the water at home in any way before you use it?
17. Do you boil the drinking water?
18. Have you participated in any educational and awareness activities about water supply/ quality? When?
19. Who provided that education?

20. Who participated in your household?
21. Have you taught anyone about clean water and what you learnt?
22. If not, would you like to learn more about water quality and health?

Water safety

1. How would you describe the surroundings area regarding the water source where you collect your drinking water? (sanitary status)
2. Do you know how the water source is maintained?
3. Do you know how often is it cleaned or disinfected?
4. Who is maintaining the water source?
5. Are you satisfied with the way the water source is currently maintained?
6. If not then why and what do you think needs to be improved?

Deeper understanding of water access

- What water source or sources do you fetch the household's drinking water from? And how many liters a day do you use?
- What do you think about collecting rain water?
- Do you collect rain water? Why/ why not?
- How do you collect the rain water? How do you store it?
- What do you use the rain water for?
- Do you know of anyone collecting rain water and for what purpose?

- Have you been involved in the decision making about the locations of the wells, the price, and opening hours?
- Would you like to be more involved in the decision making regarding the wells/ water?

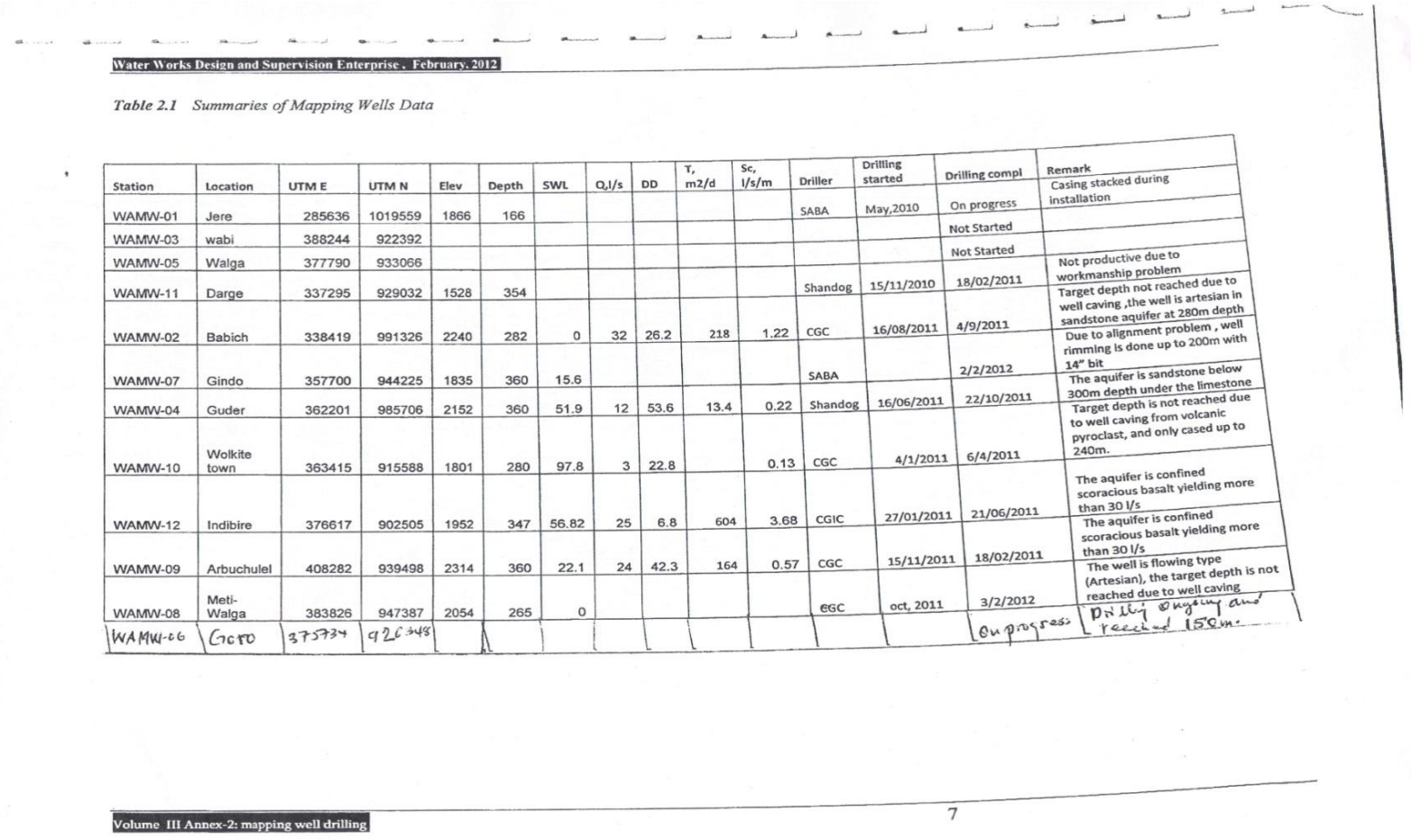
- Is there anything else related to my questions that you think I should know?

- Is there anything else you like to add or explain further?

Appendix 5 Water sources

Name of the water source	Code of the water source	Water source type defined by The JMP	Location N	Location E	Source of protection	cleanliness	Year constr.
Chitu Well	W1	Public tap / piped water with supply tanks: distribution system	08,53352º	037,98158º	Fence/metal	Partially clean	2006
Chitu Well	W2	Public tap/ Piped water with supply tanks: distribution system	08,60989º	037,92266º	Fence/ metal	Partly Clean	2006
Chitu Well	W3	Public tap / Piped water with supply tanks: distribution system	08,60777º	037,92483º	Fence/metal	Very clean	2006
Chitu well	W4	Public tap / Piped water with supply tanks: distribution system	08, 60794º	037,92663º	Fence/metal	Partially clean	2006
Chitu well	W5	Public tap / Piped water with supply tanks: distribution system	08, 60795º	037,92662º	Fence /metal	Partially clean	2006
Chitu Household tap	H1	Household taped Water in the yard	08,60056 º	037,92923º	None	Partially clean	2007
Chitu Household tap	H2	Household taped Water in the yard	08, 60692º	037,92446º	None	Clean	2007
Chitu Household tap	H3	Household taped Water in the yard	08, 60784º	037,92620º	None	Partially clean	2006
Meti Well	M1	Deep borehole with Mechanized pumping	08, 58094º	037,94193º	Wood sticks	Not clean at all	Before 1988
Outside Chitu	O1	Deep borehole with mechanized pump	08, 60777º	037,92434º	Fence/ wood	Not clean at all	Before 1990

Appendix 6 Coordinates for new wells by the water works design and supervision enterprise



Water Works Design and Supervision Enterprise , February, 2012

Table 2.1 Summaries of Mapping Wells Data

Station	Location	UTM E	UTM N	Elev	Depth	SWL	Q,l/s	DD	T, m2/d	Sc, l/s/m	Driller	Drilling started	Drilling compl	Remark
WAMW-01	Jere	285636	1019559	1866	166						SABA	May,2010	On progress	Casing stacked during installation
WAMW-03	wabi	388244	922392										Not Started	
WAMW-05	Walga	377790	933066										Not Started	
WAMW-11	Darge	337295	929032	1528	354						Shandog	15/11/2010	18/02/2011	Not productive due to workmanship problem
WAMW-02	Babich	338419	991326	2240	282	0	32	26.2	218	1.22	CGC	16/08/2011	4/9/2011	Target depth not reached due to well caving ,the well is artesian in sandstone aquifer at 280m depth
WAMW-07	Gindo	357700	944225	1835	360	15.6					SABA		2/2/2012	Due to alignment problem , well rimming is done up to 200m with 14" bit
WAMW-04	Guder	362201	985706	2152	360	51.9	12	53.6	13.4	0.22	Shandog	16/06/2011	22/10/2011	The aquifer is sandstone below 300m depth under the limestone
WAMW-10	Wolkite town	363415	915588	1801	280	97.8	3	22.8		0.13	CGC	4/1/2011	6/4/2011	Target depth is not reached due to well caving from volcanic pyroclast, and only cased up to 240m.
WAMW-12	Indibire	376617	902505	1952	347	56.82	25	6.8	604	3.68	CGIC	27/01/2011	21/06/2011	The aquifer is confined scoracious basalt yielding more than 30 l/s
WAMW-09	Arbuchulel	408282	939498	2314	360	22.1	24	42.3	164	0.57	CGC	15/11/2011	18/02/2011	The aquifer is confined scoracious basalt yielding more than 30 l/s
WAMW-08	Meti-Walga	383826	947387	2054	265	0					CGC	oct, 2011	3/2/2012	The well is flowing type (Artesian), the target depth is not reached due to well caving
WAMW-06	Goro	375734	926348										On progress	Drilling ongoing and reached 150m.

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Source: Obtain by the author from the water works design and supervision enterprise 2012-03-23