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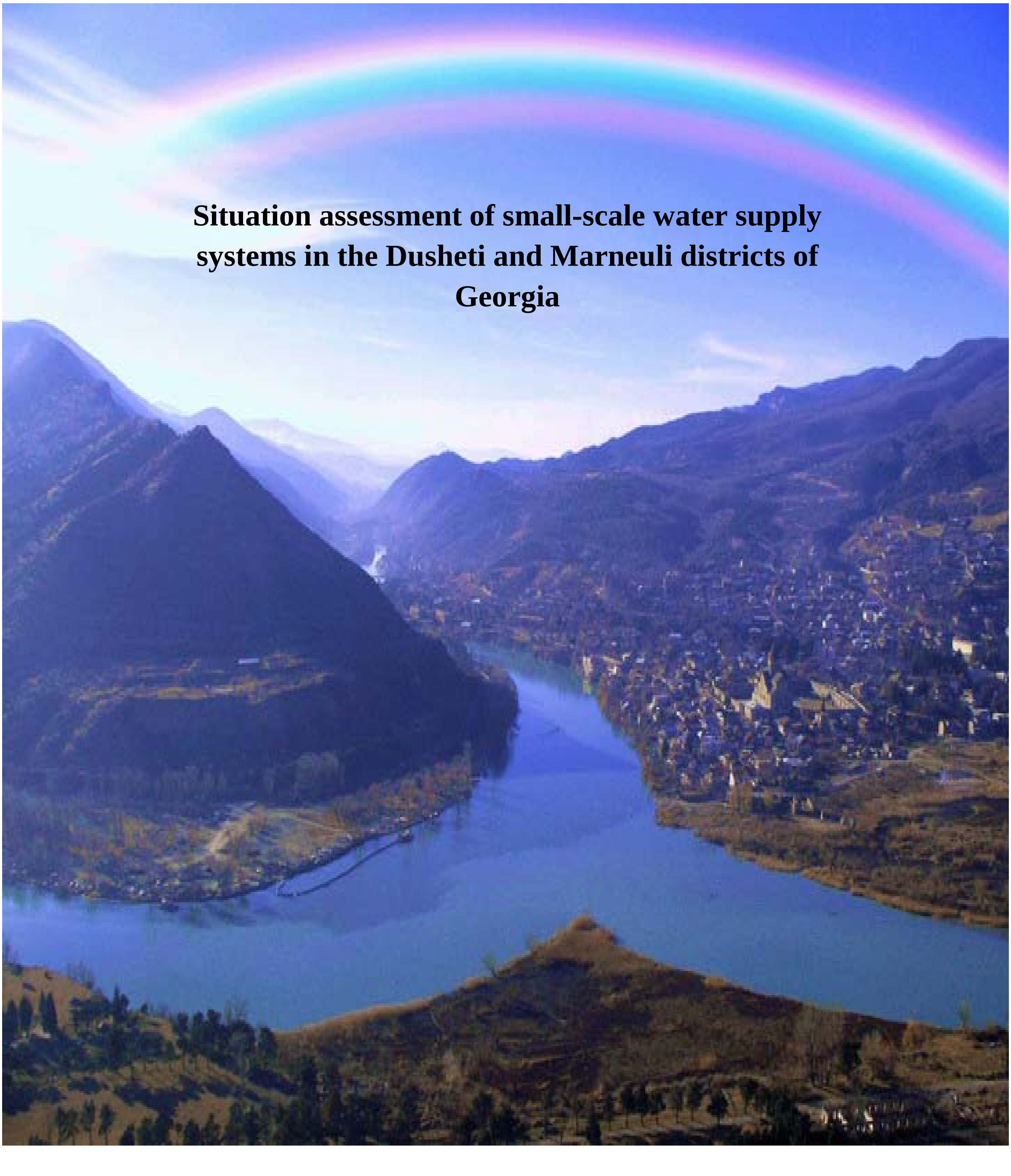
Situation assessment of small-scale water supply systems in the Dusheti and Marneuli districts of Georgia



Acknowledgements

In the framework of biennial collaboration agreement between the Ministry of Labor, Health and Social Affairs, Georgia, and WHO Regional Office for Europe, activities to introduce the Water Safety Plan (WSP) approach have been initiated in Georgia. This work has been expanded by the project "Support to the introduction of ecological management of water protection zones as a first step to the introduction of water safety plans in small scale water supply systems in Dusheti and Marneuli districts in Georgia".

Technical assistance to the project has been provided by the WHO Collaborating Centre for Research on Drinking Water Hygiene at the Federal Environment Agency, Germany, and WHO Regional Office for Europe and Country Office of Georgia. The project was funded by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety with means of the Advisory Assistance Programme for Environmental Protection in the Countries of Central and Eastern Europe, the Caucasus and Central Asia. The L. Sakvarelidze National Center for Disease Control & Public Health (NCDCPH), and the Georgian Environmental and Biological Monitoring Association (GEBMA) were responsible for overall implementation of the project.

The authors express their gratitude for the intellectual contribution, financial assistance and expert advice provided through all stages of preparing this project, to the following:

- World Health Organization Regional Office for Europe (WHO EURO)
- WHO Collaborating Center for Research on Drinking Water Hygiene (WHO CC) at the Federal Environment Agency (UBA) of Germany
- German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
- World Health Organization Country Office of Georgia (WHO CO)
- United Nations Economic Commission for Europe (UNECE)

The content of this publication lies within the responsibility of the authors.

The authors are grateful to Ralph Wollman, Katrin Leischner, Marco Keiner, Francesca Bernardini, Carola Bjorklund, Rusudan Klimiashvili, Nino Mamulashvili, Giorga Knechtlin, Andrea Rhein for their valuable assistance in this project.

The authors would like to thank Nata Avaliani, Giorgi Kandelaki, Maia Butsashvili and Paata Imnadze for their helpful comments and suggestions, and for their significant contribution to the full-value implementation of this project.

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Preface

Diarrhoeal disease is the second leading contributor to the global burden of disease for children under 5; each year diarrhoea claims the lives of 1.3 million children in this age group[1]. WHO estimates that around 9% of the total burden of disease worldwide could be prevented by improvements related to drinking-water, sanitation, hygiene and water resource management[2].

For this reason, the issue of provision of population with safe drinking-water remains the most important issue for the improvement of children's and adults' health and well-being in Georgia. In the framework of Millennium Development Goals (MDG), the world community undertook the obligation to halve the number of population having no access to safe drinking-water from 1990 to 2015.

In 1999, Georgia signed the UNECE Convention on Protection and Use of Transboundary Watercourses and International Lakes as well as the Protocol on Water and Health. One of the Protocol goals is the protection of human health from waterborne disease and ensuring well-being in the framework of sustainable development in all the relevant national, transboundary and international contexts. Subsequently, in 2008, at the meeting of the working group of the EU Water Initiative[3], the representatives of Georgia confirmed support of the Government to the national policy dialogue process on integrated management of water resources in the period of 2010-2012. Preparatory activities for national policy dialogue began in November 2010. In October 2011 the Memorandum of Understanding between Georgia and UNECE was signed, the main purpose of which is the facilitation of achievement of the MDG related to water and sanitation.

Georgia, as the signatory of the Millennium Declaration, undertook the obligation to achieve Millennium Development Goals, reflect them in national development strategies and perform periodic reporting on the status of implementation of goals.

46.9 % of population of Georgia live in rural areas and use water from small scale water supply systems. Thus, the assessment of drinking-water quality, risk factors for contamination, and situation of water-borne diseases are priority issues for the country.

In the scope of the pilot project "Support to the introduction of ecological management of water protection zones as a first step to the introduction of Water Safety Plans in small scale water supply systems in Dusheti and Marneuli districts in Georgia" a baseline assessment of drinking-water quality was carried out and sanitary risks for water contamination identified. Based on findings, recommendations for further action were developed.

Introduction of Water Safety Plans in small scale water supply systems is an approach to ensure provision of safe drinking-water to population, thereby prevent and reduce incidence of water-borne diseases in the country.

The Minister of Labor, Health and Social Affairs of Georgia

David Sergeenko

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[1] WHO (2011a). *Cause-specific mortality: regional estimates for 2008*. Geneva, World Health Organization (http://www.who.int/healthinfo/global_burden_disease/estimates_regional/en/index.html).

[2] Prüss-Ustün, A et al (2008). *Safer water, better health: costs, benefits and sustainability of interventions to protect and promote health*. Geneva, World Health Organization (http://www.who.int/quantifying_ehimpacts/publications/saferwater/en/index.html).

[3] The meeting of Working Group of EU Water Initiative was held on 4 December 4 2008 in Ashkhabad, Turkmenistan.

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List of abbreviations and acronyms

AHPFM	Ad-hoc Project Facilitation Mechanism
BMU	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, Germany
DALY	Disability adjusted life years
E. coli	*Escherichia coli*
F	Fluoride
Fe	Iron
GEBMA	Georgian Environmental and Biological Monitoring Association
GV	Guideline value
JMP	Joint Monitoring Program
NCDCPH	L. Sakvarelidze National Center for Disease Control & Public Health
NH_4^+	Ammonium
NO_3^-	Nitrate
pH	Potential hydrogen ion concentration
RADWQ	Rapid Assessment of Drinking-water Quality
SIS	Sanitary inspection score
TDS	Total dissolved solids
TTC	Thermotolerant coliforms
UBA	Federal Environment Agency, Germany
UNECE	United Nations Economic Commission for Europe
UNICEF	United Nations Children’s Fund
WHO	World Health Organization
WSP	Water Safety Plan

1. Project background and goal

Water is a natural resource essential for human life and health. The provision of safe, sufficient and affordable drinking-water is one of the prerequisites for the people's wellbeing and health, and for economic development of a country.

Small-scale water supplies are the backbone of water supply in rural areas in the entire pan-European region[4]. The provision of safe and acceptable drinking-water frequently represents a challenge to small scale water supplies, as these systems typically are less protected compared to bigger centralized systems. Consequently, the risk is higher for rise and spread of diarrhea and other water-borne disease, including non-contagious diseases. Thus, administration, management and efficient use of the existing resources in small scale water supplies require special political attention in any country.

Poor water quality continues to pose a major threat to human health. Diarrhoeal disease alone amounts to an estimated 4.1 % of the total global burden of disease, as expressed in disability-adjusted life years (DALY), and is responsible for the death of 1.8 million people every year (WHO, 2004). WHO estimates that 88 % of that burden is attributable to unsafe water supply, inadequate sanitation and poor hygiene practices and is mostly concentrated on children in developing countries. According to the data of the WHO, the burden from diarrheal disease for children under the age of 15 years is greater than the combined impact of HIV/AIDS, tuberculosis and malaria, and diarrhea is the most common cause of death among children under 5 years of age.

Since 2004, the WHO Guidelines for Drinking-water Quality have recommended that water suppliers develop and implement Water Safety Plans (WSPs) in order to systematically asses and manage risks to water supply. A WSP is a comprehensive risk assessment and risk management approach that encompasses all steps in water supply from catchment to consumer. WSP can be applied to all types of water supplies, including small scale water supplies.

Georgia is a signatory to the Protocol on Water and Health since 1999. The objective of the Protocol's Ad-hoc Project Facilitation Mechanism (AHPFM) is to help mainstream international support for national action in accordance with Article 14 of the Protocol and identify priority activities for non-infrastructure intervention, including (a) health-related aspects of integrated water resources management; (b) safe drinking-water supply and adequate sanitation; (c) reduction of childhood morbidity and mortality; (d) meeting the water needs of vulnerable groups; and (e) gender issues related to water and sanitation.

In order to support Georgia's efforts under the Protocol's work program in undertaking a baseline analysis of the water supply situation of small scale water supplies in rural areas, in line with the AHPFM recommendations and requirements, the project proposal from Georgia has been selected for funding in the framework of the Advisory Assistance Programme of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU).

[4] According to the definition of WHO, the European Region comprises the following 53 countries: Albania, Andorra,Armenia, Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Luxembourg, Malta, Monaco, Montenegro, Netherlands, Norway, Poland, Portugal, Republic of Moldova, Romania, Russian Federation, San Marino, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Tajikistan, the former Yugoslav Republic of Macedonia, Turkey, Turkmenistan, Ukraine, United Kingdom of Great Britain and Northern Ireland and Uzbekistan.

2. International strategies and policies on drinking-water and obligations of Georgia

2.1. The human right to water

The human right to water is recognized by a number of national and international programs. The most detailed and comprehensive definition of the right is provided in the 15th General Comment to the International Covenant On Economic, Social and Cultural Rights adopted in 1966 at the UN General Assembly, according to which "*each person is entitled to receiving sufficient, safe, physically accessible and affordable water for personal, as well as household use*"[5].

According to this Covenant, water, firstly, shall be considered as a social and cultural good and not as the source of economic benefit. The form of realization of the human right to water shall be sustainable and shall create the possibility of realization of the right of coming generations. Although, with consideration of circumstances existing in different situations, in order to fulfill the human right to water, the following factors need to be taken into account in all cases:

- Availability of sufficient quantity;
- Quality;
- Physical accessibility;
- Economic affordability;
- Acceptability.

In addition, the absence of discrimination and the availability of information are further important determinants for the right to water.

The sixty-fourth session of the United Nations General Assembly on 28 July 2010 adopted the resolution A/Res/64.292 recognizing access to clean water and sanitation a human right. The Assembly urged its member states as well as international organizations to allocate funding, resources and technology to improve access to affordable clean drinking-water and sanitation for everyone.

2.2. The Protocol on Water and Health

For the countries of European region the Protocol on Water and Health to the 1992 Convention on Protection and Use of Transboundary Watercourses and International Lakes provides a supranational legally-binding instrument aiming at sustainable water resource management and reduction of water-related diseases. The issues of sustainable use of water resources and health are interconnected in these agreements.

The main aim of the Protocol, in the framework of the concept of sustainable development, is to protect human health and well-being on an individual as well as a collective basis, including prevention, control and reduction of water-related diseases, in conformity with all relevant governmental transboundary and international requirements.

In accordance with the requirements of Article 6 of the Protocol, for the purpose of reduction and prevention of spreading of water-borne diseases, the signatories shall specify targets, target indicators, dates of their implementation and activities to be carried out. Specific tasks are to be developed for achievement of their aim and relevant indicators shall be selected for monitoring. One of the indicators for health-related progress is the share of population that has permanent access to safe drinking-water and improved sanitation facilities.

Georgia signed the Protocol on Water and Health in 1999, but has not yet ratified it. However, Georgia is a party to the Convention on Protection and Use of Transboundary Watercourses and International Lakes[6].

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[5] As of September 1, 2011 the Covenant is ratified by 160 countries. Georgia joined the Covenant in 1994. General comment No.15 to the UN International Covenant "On Economic, Social and Cultural Rights"1, adopted in 1966 at the UN General Assembly.

[6] UNECE Convention on Protection and Use of Transboundary Watercourses and International Lakes adopted in 1992.

Consequently, the Ministry of Labor, Health and Social Affairs actively cooperates with the Secretariat of the Convention as well as with the experts of the Protocol on Water and Health[7] in order to develop specific measures for prevention of water-related disease outbreak and strengthening surveillance in the country. In addition, in October 2011, a Memorandum of Understanding was signed between Georgia and UNECE, the main aim of which is the facilitation of achievement of Millennium Development Goals in water-related issues.

2.3. Other obligations

The Parma Declaration, adopted at the fifth Ministerial Conference on Environment and Health[8] 2010 in Parma, Italy, requires that measures taken for the purpose of protection of children's health shall be directed towards the improvement of living conditions and reduction of harmful environmental impact. In the first priority goal (RPG 1) of the Parma Declaration, the ministers of environment and health expressed their aspiration to ensure availability of safe drinking-water and adequate sanitation conditions for every child at home, pre-school institutions, schools, medical institutions and recreational water use sites by 2020.

Presently, Georgia is party to a number of multilateral and bilateral international agreements and each agreement imposes certain obligations to the country. Georgia, as the partner country to the European Neighborhood Policy, undertook the obligation to perform the harmonization of its legislation with the legislation of the European Union and introduce internationally recognized environmental approaches, regulations and recommendations, and to align water-related legislation with European water legislation. Full implementation of the EU-Georgian Action Plan will significantly contribute to the introduction of sustainable use and management of water resources, improvement of wastewater treatment, improvement of the quality and safety of drinking-water and recreational waters, protection of ecosystems, elimination of water deficit and ensuring of involvement of all stakeholders.

The government of Georgia has started the reform of water supply systems, in the framework of which stable provision of drinking-water for the population of Georgia is envisaged through large scale investments in coming years.

The reduction of water-borne diseases and safety of small scale water supply systems is recognized as a priority area in the Biennial Cooperation Agreement (BCA) signed between the Ministry of Labor, Health and Social Affairs of Georgia and the WHO Country Office of Georgia.

2.4. Progress towards reaching the MDG on drinking-water and sanitation

The WHO/UNICEF Joint Monitoring Programme for Water Supply and sanitation (JMP) reports globally the progress of achieving the Millennium Development Goals related to water supply and sanitation, and provides support to countries in improving their monitoring performance to enable better planning and management at the country level.

According to the latest global JMP report (2012), in Georgia 98 % of the total population use improved drinking-water sources and 95 % use improved sanitation facilities (see Tables 1 and 2). However, there is a substantial disparity between urban and rural areas for water piped into the households. This indicator is 92 % in urban area and 51 % in rural areas.

[7] Protocol on Eater and Health Problems to the UN ECE Convention on Protection and Use of Transboundary Watercourses and International Lakes was adopted on June 17 in London, which came into force on August 4, 2005.

[8] The fifth Ministerial Conference on Environment and Health, 2010, Parma, Italy. http://www.euro.who.int/__data/assets/pdf_file/0011/78608/E93618.pdf

Table 1. Use of improved drinking-water sources (percentage of population) (WHO and UNICEF 2012)

Year	**Urban***			**Rural***			**National***		
	Total improved	Piped on premises	Other improved	Total improved	Piped on premises	Other improved	Total improved	Piped on premises	Other improved
1990	94	81	13	66	19	47	81	53	28
2000	97	86	11	80	34	46	89	61	28
2010	100	92	8	96	51	45	98	73	25

* According to the JMP (WHO and UNICEF, 2012), "improved" drinking-water sources are defined as those that, by the nature of their construction, are protected from outside contamination, particularly faecal matter, and include the following supply technologies: household connection, public standpipe, borehole, protected dug well, protected spring, rainwater collection.

Table 2. Use of improved sanitation facilities (percentage of population) (WHO and UNICEF 2012)

Year	**Population (x 1,000)**	**Urban***	**Rural***	**National***
1990	5,460	97	95	96
2000	4,746	96	94	95
2010	4,352	96	93	95

* According to the JMP (WHO and UNICEF, 2012), "improved" sanitation facilities are defined as those that hygienically separate human excreta from human contact. The following technologies are included: flush toilet, piped sewer system, septic tank, flush/pour flush to pit latrine, ventilated improved pit latrine, pit latrine with slab and composting toilet.

3. Management of water resources, quality control and water related disease surveillance in Georgia

3.1. Legislative framework for drinking-water

Water policy in Georgia is determined by a number of legislative acts.

In 2005, the parliament of Georgia adopted the law on "Food Safety and Quality". The law is in full compliance with the Regulation EC 178/2002 of the European Parliament and Council "General Basis and Requirements of the Law on Food". In accordance with the Law, "*food (or food product) is any product intended for human nutrition, processed or unprocessed. Food also includes all kinds of beverages, chewing gum, all substances, including drinking-water, packaged water intended for use in food, which is purposefully added in the composition of food during its production or processing*". Thus, according to the law, drinking-water safety and quality regulation is in place within the framework of food (food product) regulation in Georgia.

The law on "Public Health" was adopted in Georgia in 2007. The article 12 describes the responsibilities of the Governmental Commission for Emergency Situation Management in the case of epidemic and pandemic events, particularly hazardous for human health. Organization of activities for restoring water quality in emergency situation is one of the obligations of this Commission in accordance with this article. The article 23 stipulates the following general provisions to ensure safety of water and protection of public health:

1. The Ministry of Labor, Health and Social Affairs of Georgia, in accordance with the recommendations of the World Health Organization, sets quality norms and technical regulations of drinking-water that is safe for human health;
2. The Ministry of Environment and Natural Resources provides:
   - development and implementation of uniform governmental policy in the sphere of water resources management using the principles of sustainable development and basin-based management;
   - protection of water bodies from negative impacts which could be harmful to health, worsen water supply conditions and cause its qualitative changes;
   - organization of the state system of water use permits;
   - planning and implementation of water use suspension, termination or prohibition measures in special cases.
3. Internal control of water quality and external laboratory audit shall be performed by accredited independent laboratories.

Revised norms of drinking-water quality and components of regulation of water supplies were approved on 16 August 2001 through the order #297 "Qualitative Norms of Environment" of the Minister of Labor, Health and Social Affairs of Georgia. A number of changes to the mentioned document were introduced in 2003, 2006, 2009 and in 2010.

Considering that the norms on drinking-water quality were extremely strict and difficult to meet as compared to the WHO guidelines and the European Union requirements, the same Ministry has developed and approved "Technical Regulations of Drinking Water" by the Order #349/N dated 17 December 2007. The requirements established by these regulations do not cover small scale water supply systems. Consequently, the assessment of individual wells in terms of drinking-water quality and other safety indicators is carried out in accordance with the sanitary norm "Hygienic Requirements towards the Quality of Water of Non-centralized Water Supply System" approved by the Order #297/N dated 16 August 2001.

It should be noted that the Governmental Commission for Facilitation of Partnership and Cooperation between Georgia and the EU was established in 2001, and in 2004 the National Program on harmonization of Georgian legislation with EU legislation was approved.

3.2. Management of water resources in Georgia

Presently the responsibilities related to water management in the country are divided among various governmental departments.

In 2006-2007 the number of systemic institutional, organizational and administrative changes was implemented in legislative and executive authorities, and the water-related competences are distributed among the following structures:

The *Ministry of Environment Protection of Georgia* is the main governmental department on national level in the field of water resources management and is responsible for the state management, protection of surface water and organization of water monitoring system.

The *Ministry of Labor, Health and Social Affairs of Georgia* is responsible for ensuring a safe environment for the protection of public health. For this, the ministry establishes qualitative norms, including those addressing drinking-water, surface water and underground water.

The *National Center for Disease Control and Public Health* (NCDCPH) was established in 2007, which, together with the Ministry of Labor, Health and Social Affairs, establishes above mentioned qualitative norms. The NCDCPH performs epidemic surveillance, control and monitoring of infectious and non-contagious diseases (including the diseases, caused by water), and develops and implements measures in the case of disease outbreaks.

The *Ministry of Regional Development and Infrastructure of Georgia* is responsible for development of drinking-water supply and sanitation systems in the regions and provision of water and sanitation facilities to the population.

The *Ministry of Agriculture of Georgia*, through the *National Food Agency (NFA)*, performs monitoring, surveillance and state control of drinking-water quality in compliance with the safety requirements established by the national legislation and standards.

The *Ministry of Energy and Natural Resources of Georgia* issues licenses for the use of natural resources, including underground water.

Local self-governance authorities are responsible for the management of water resources of local importance.

Water supplier operators perform internal laboratory control of quality of potable water, supplied to the population. The indicators of determination of drinking-water quality and the quantity of samples to be taken for analysis are identified by the authorized controlling governmental authority.

Presently the reform of institutional arrangements of executive authorities and governance systems is not yet completed. An example is the reorganization of the Ministry of Environment Protection and Natural Resources of Georgia in March 2011, on the basis of which part of the functions of the ministry was transferred to the Ministry of Energy of Georgia on 16 March 2011. The prerogative of surface water management remained with the Ministry of Environment Protection.

Coordination among various ministries and departments in the issues of water safety is fragmented. In order to control diseases caused by food, including water, the Governmental Resolution (2006) “On the Rules of Information Exchange and Implementation of Measures for Elimination of Disease Outbreak between National Food Agency of the Ministry of Agriculture of Georgia and National Center for Disease Control and Public Health of the Ministry of Labor, Health and Social Affairs” was adopted.

3.3. Laboratory capacity

One of the key preconditions of reduction or elimination of water-borne diseases is the ongoing assessment of the real situation which, among other measures, requires sustainable implementation of drinking-water quality monitoring. For this purpose existence of laboratories is necessary in the country, which shall identify the water quality indicators established by legislation.

According to the information provided by the *United National Accreditation Body* (Accreditation Center), presently throughout the country, there are 12 structural entities that have legal status and accredited for laboratory testing of drinking-water quality.

Each laboratory has undergone accreditation by the Accreditation Center, and the latter is the legal body appointed according to public law and subordinates to the *Ministry of Economy and Sustainable Development* of Georgia. The Accreditation Center operates in compliance with International Standards ISO/IEC 17 011. It is an affiliated member of the International Laboratory Accreditation Cooperation (ILAC) and signatory to the Agreement on Cooperation with European Accreditation Partnership.

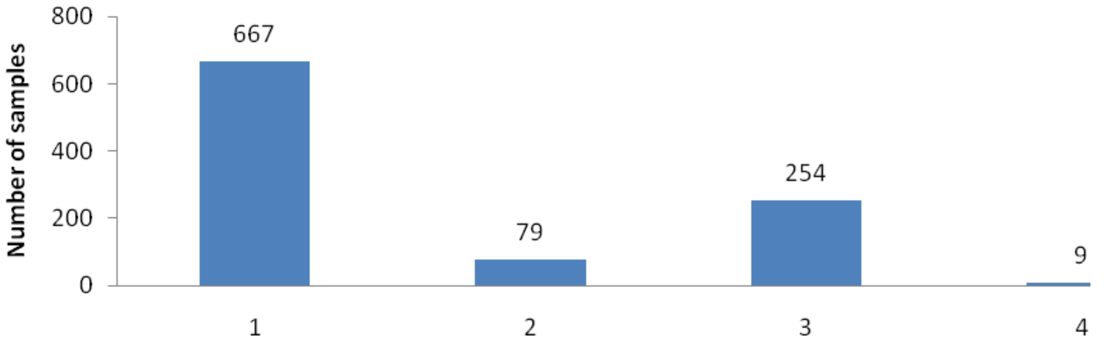
3.4. Water quality and monitoring

Underground waters with stable flow and good quality are mainly used for supply of water for Georgian population, although surface waters are also used.

During the past 10 years drinking-water quality was annually controlled in almost 50 cities and districts. The total number of samples taken annually varied between 40,000 and 68,000, including 20,500 – 29,000 samples for sanitary-chemical investigations, and over 18,000 – 23,800 samples for sanitary-bacteriological investigations. On average for the past 10 years, 16.7 % and 20.7 % of the total number of samples did not comply with normative requirements for chemical parameters and bacteriological parameters, respectively.

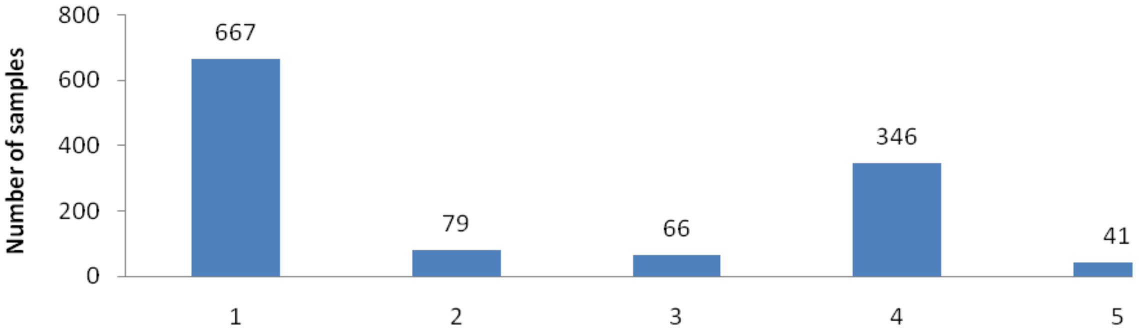
Presently the National Food Agency of the Ministry of Agriculture has developed annual plans of state control and state programs of monitoring of laboratory testing, in the framework of which state control and monitoring of drinking-water quality and safety is performed. Due to the lack of financial resources the number of analyses conducted in 2009 was much lower compared to the number of drinking-water quality analyses conducted in previous years. National compliance figures for 2009 for both chemical and microbiological parameters are shown in Figures 1 and 2, respectively.

Figure 1. The results of drinking-water laboratory analyses in Georgia for chemical parameters, 2009



1. The number of samples taken; 2. Samples taken from the source; 3. Total number of non-compliant samples by chemical parameters; 4. The number of non-compliant samples by chemical parameters taken from source

Figure 2. The results of drinking-water laboratory analyses in Georgia for bacteriological parameters, 2009



1. The number of samples taken; 2. Samples taken from the source; 3. The number of samples for bacteriological analyses from source; 4. Total number of non-compliant samples by bacteriological parameters; 5. The number of non-compliant samples by bacteriological parameters taken from source.

According to the information from the Ministry of Agriculture of Georgia, the state control on drinking-water quality has not been carried out in Dusheti and Marneuli districts in 2008 - 2010. The current results of the drinking-water quality testing are available from the National Food Agency. It should be noted that in all water supplies of Georgia, no testing has been conducted on drinking-water quality of springs and individual well waters used by rural population since 2001.

The Georgian United Water Supply Company (UWSC) operates water supplies in Dusheti and Marneuli, and as part of its responsibilities, UWSC performs quality control and monitoring of drinking-water in laboratories that exist in regions. The laboratories in Dusheti and Marneuli were granted by the International Red Cross Organization with laboratory equipment and reagents for bacteriological and chemical testing.

In Dusheti district approximately 20.0 % of small scale water supply systems are managed by UWSC, which has arranged a drinking-water quality control laboratory locally and performs drinking-water quality control according to the established rule. The municipality of Dusheti district does not have a drinking-water quality control laboratory for surveillance, consequently, control and monitoring of water quality of the remaining 80 % of small scale water supply systems in municipal use is not performed.

In Marneuli district approximately 30.0 % of small scale water supply systems are managed by UWSC, which performs drinking-water quality control according to the established rule. The service center of the company in Marneuli does not have a laboratory and the samples are transported to the Bolnisi regional laboratory located close to the city of Marneuli (approximately 40 km). If we consider the requirement that analyses of the water samples shall be performed not later than in 4-6 hours (especially microbiological testing), the service center in Marneuli has to arrange a laboratory locally. The municipality of Marneuli district does not have a drinking-water quality assessment laboratory either. Quality control of water of small scale water supply systems in municipal use is performed but an increase of the number of samples taken is required.

3.5. Water-related disease surveillance

The Protocol on Water and Health defines "*water-related disease to mean any significant adverse effects on human health, such as death, disability, illness or disorders, caused directly or indirectly by the condition, or changes in the quantity or quality, of any waters*". Water borne diseases are frequently caused by the ingestion of faecally contaminated water. Cholera and typhoid fever are classical examples of waterborne diseases, where low concentration of highly infectious pathogens is enough to cause severe diarrhea. Shigellosis, hepatitis A, amoebic dysentery and other gastrointestinal diseases can also be waterborne (Bradley, 1974).

In 2004, the surveillance information system in Georgia of reporting and notification of incidents and outbreaks of infectious diseases was improved. In particular, reporting to the upper level public health authorities has been performed by any available means of communication, urgently (notification card, telephone, fax, e-mail), within 24 hours from identification of the case. As a result, recording and registration of infectious diseases significantly increased, including those caused by water.

Analysis of health statistics data shows that between 2007 - 2010 incidence rates (per 100,000) of water related diseases like shigellosis, hepatitis A, amoebic dysentery and other gastrointestinal diseases decreased. The decrease might be due to underreporting, the lack of laboratory capacity and/or the lack of in-depth epidemiological surveillance of these diseases. A significant part of these reported diseases remains without laboratory investigation and is recorded as diarrheas of presumably infectious origin. Diagnosis of campylobacteriosis and cryptosporidiosis are not under surveillance in Georgia.

As for the diarrheas of presumably infectious origin, the incidence (per 100,000) in 2007 - 2009 is almost equal (2007: 263.6; 2008: 250.7; 2009: 226.3). On the other hand, in 2010 the number of incidences of diarrheas of presumably infectious origin has doubled compared to previous years (2010: 447.8). 65.0 - 70.0 % of cases proceeding with diarrhea, annually registered by Georgian surveillance system, are in child age, and the cause of hospitalization of children of age 0-3 years often are diseases proceeding with diarrhea (15.0-17.0 %).

With the support of WHO, from November 2006 to date, the sentinel surveillance, which includes children <5 years hospitalized with diarrhea, revealed that 35 % of diseases proceeding with diarrhea in this age group is caused by rotavirus. Based on the WHO recommendations, the Ministry of Labour, Health and Social Affairs of Georgia in 2012 decided to include vaccination against rotavirus infection in the national immunization programme. A cost efficiency assessment conducted by the Global Alliance Vaccines and Immunization (GAVI) showed that rotavirus vaccination will be highly remunerative and from the forecast viewpoint will significantly reduce diarrhea sickness and death rate among children in Georgia. The cost of treatment, disablement and/ or mortality during one year is 25 USD higher than the amount required for vaccination of one child with rotavirus vaccine.

On the basis of normative documents regulating epidemic surveillance in Georgia, investigation of single-time cases of water-borne diseases, with the exception of typhoid and paratyphoid, is not carried out. Reporting is carried out in routine manner once a month, in aggregated form. Complete study of pest holes and the relevant analysis is carried out only in the case of outbreaks. Consequently, in single cases of presumably water-related diseases, identified and registered by epidemic surveillance system, the factor of transfer of infection is not exactly specified. Therefore the role of unreliable drinking-water in spreading of these diseases cannot be excluded. In most cases, laboratory investigations of outbreaks are mainly conducted by the National Center of Disease Control and Public Health. This is due to the fact that material and technical capacity of bacteriological laboratories does not exist or is still weak in some districts and/or cities. Thus, this situation often significantly impedes the processes of laboratory diagnosis of cases.

During the project implementation, the data on water related diseases has been collected from the public health centers of the Dusheti and Marneuli districts. The number of incidences of water-related diseases is provided in Tables 3 and 4.

Table 3. Number of incidences of water-related diseases in Dusheti district

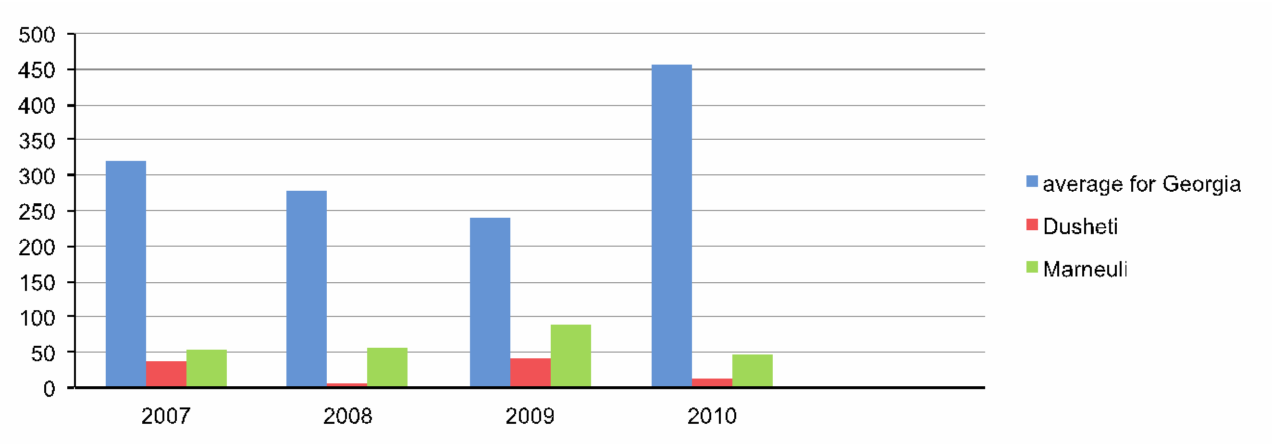
Diseases	2007	2008	2009	2010
Typhoid fever	0/0	0/0	0/0	0/0
Paratyphoid A and B	0/0	0/0	0/0	0/0
Other salmonellosis	326/0	160/0	166/0	77/0
Shigellosis	192/0	103/0	96/0	159/0
Diarrheas of presumably infectious origin	11,592/7	10,987/2	9,926/9	19,866/3
Viral hepatitis A and E	1,870/6	883/0	389/5	103/1
Giardiasis	15/0	4/0	4/0	7/0

Table 4. Number of incidences of water-borne diseases in Marneuli district

Diseases	2007	2008	2009	2010
Typhoid fever	0/0	0/0	0/0	0/0
Paratyphoid A and B	0/0	0/0	0/0	0/0
Other salmonellosis	326/1	160/0	166/0	77/0
Shigellosis	192/1	103/0	96/1	159/3
Diarrheas of presumably infectious origin	11,592/53	10,987/37	9,926/94	19,866/51
Viral hepatitis A and E	1,870/15	883/36	389/15	103/6
Giardiasis	15/0	4/0	4/1	7/0

Figure 3 indicates that for both districts, the cases of presumably water-related diseases during the period 2007 - 2010 occur only in single cases and the incidence of diarrheas of infectious origin is less, as compared with the average country incidence (Georgian Statistical Yearbook, 2011).

Figure 3. Cases of diseases proceeding with diarrhea



In the case of diseases proceeding with diarrhea, the population of Dusheti and Marneuli districts, ambulance as well as hospital patients, do not have access to laboratory testing. The bacteriological laboratories are not functional in public health care centers of these districts. In the case of outbreak of these diseases, investigation will be conducted only based on capacity of the NCDCPH.

Only for those patients living in these districts who undergo hospital treatment in referral hospitals of Tbilisi and Rustavi, there is a possibility for doing bacteriological analysis. The testing of out-patient patients is only possible in private bacteriological laboratories of Tbilisi, with consideration of financial affordability.

During the field visits, the cases of diarrheal diseases were discussed with the population in both districts. Mostly, the population practices self-treatment of diarrhea and approaches health care centers only in complicated conditions. This leads to underreporting of actual cases and reflection in the official statistical data accordingly. As for prevalence of non-communicable diseases caused by water, the situation requires conducting further detailed epidemiological surveys.

4. Methodology for field survey

4.1. Survey design

In accordance with the advice of WHO and the German Federal Environment Agency (UBA), the field survey method followed the recommendations provided by "Rapid Assessment of Drinking Water Quality" (RADWQ)[9]. The RADWQ method was established by WHO and UNICEF to gain a statistically representative "snapshot" of the quality of drinking-water from "improved" sources in a region or country. It is based on a combined assessment of sanitary inspection information and data on critical drinking-water quality parameters, employing one-time (non-routine) analysis.

RADWQ provide useful baseline information regarding water safety and ongoing risks to water supply. By using a variety of different techniques and by undertaking appropriate data analysis it is possible to indicate likely future water quality challenges. RADWQ is a method which is for adoption by any authority or institution that wants to prepare a snapshot of the quality of drinking water, e.g. as a first step towards strengthening drinking water quality regulations.

The survey design uses a cluster sampling approach for the selection of the water supplies to be included in the assessment. Cluster sampling means that the water supplies selected for inclusion in the assessment are located geographically close to one another (i.e. in "clusters"). The purpose of cluster sampling is to ensure that a representative sample of all water supply technology types in a country is obtained, whilst ensuring efficiency and reducing cost of the survey.

Some of the key benefits in implementing rapid assessments that have been reported include:

- Thorough compilation (from various institutions) and review of already existing data on drinking-water quality and water supply coverage in a country, as well as identification of data or information gaps, respectively;
- Creation of a national data base on drinking-water quality and sanitary conditions which provides good baseline information for establishing (or stepwise improvement of) routine water quality monitoring and surveillance programmes, and/or for targeting resources and efforts in surveillance and/or remediation programmes;
- Provision of capacity building and human resources development in water quality monitoring and assessment;
- Facilitation of networking between national, regional and local institutions that have a responsibility in drinking-water provision and management; and
- Mechanisms for raising public awareness on drinking-water quality and health issues in populations visited during the assessment.

In RADWQ, the survey design is followed by preparation and implementation of the field work where teams take water samples to be analyzed and conduct sanitary inspections, and subsequent data analysis. The roadmap to survey planning and implementation is presented in Figure 4.

In Georgia, according to the RADWQ methodology, an inter-sectoral working group[10] was established which included representatives from different ministries and departments. Each working group member has been assigned clear technical tasks. The working group included a programmer who was responsible for creation of a data base as well as data storage and analysis.

An overview of the stages of the survey design is presented in Figure 5.

[9] WHO, UNICEF (2012). Rapid Assessment of Drinking-water Quality. A Handbook for implementation, Geneva.

[10] The inter-sectoral group members are listed in the acknowledgement section.

Figure 4. Roadmap to survey planning and implementation of RADWQ

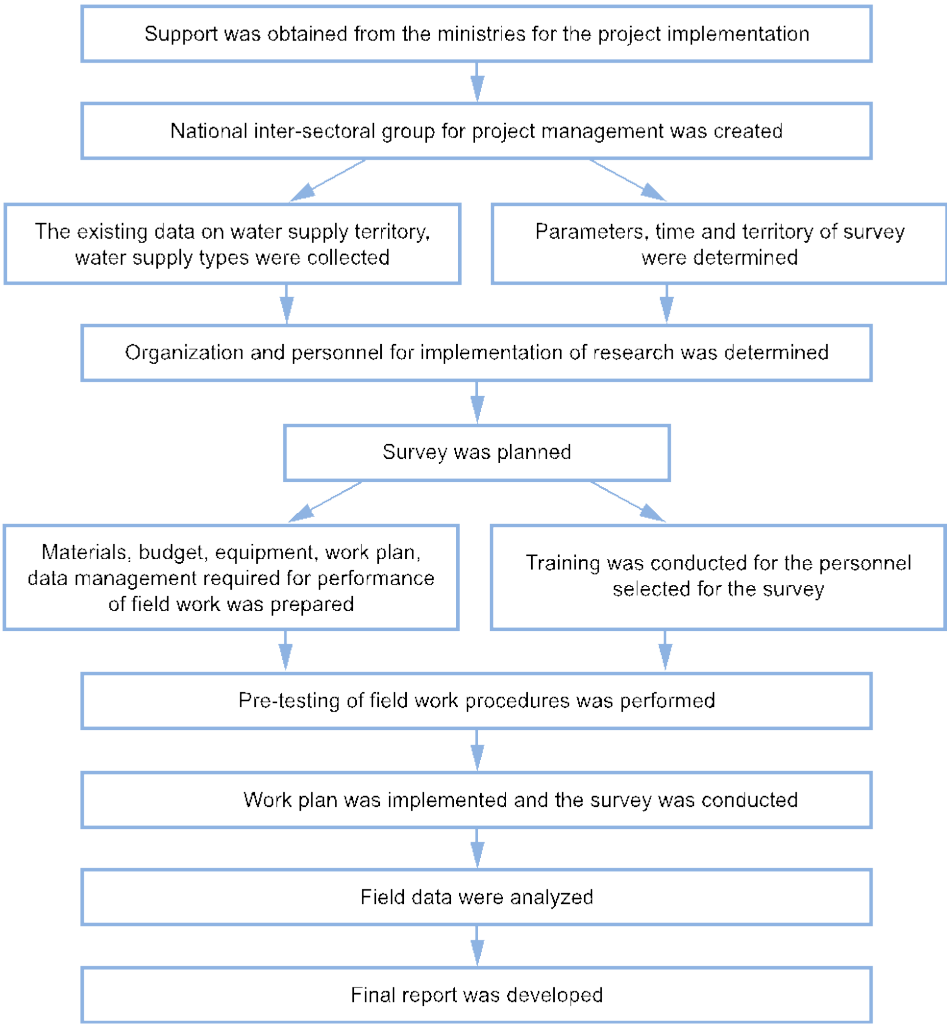
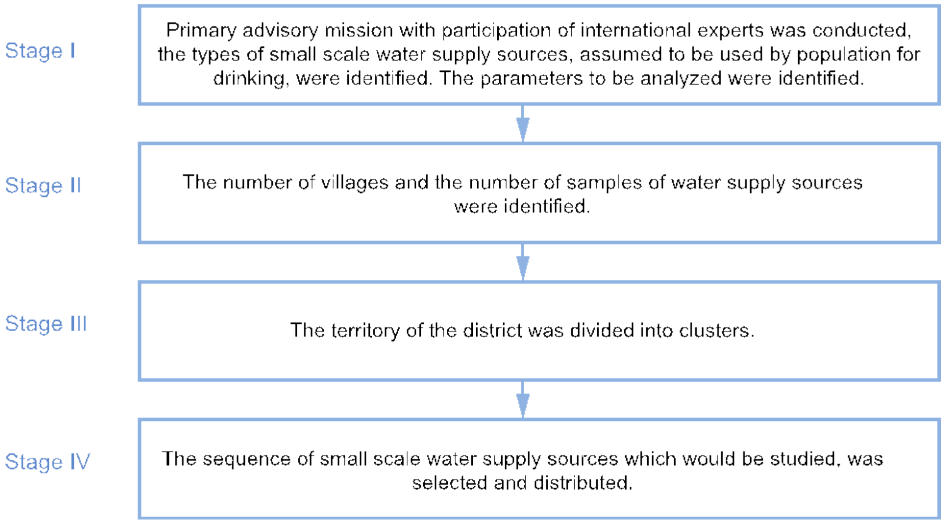


Figure 5. Overview of survey design process



Determination of sample size

The Dusheti district has a total of 33,800 inhabitants spread over 17 community councils covering 288 villages. The Marneuli district has a total of 126,300 inhabitants spread over 17 community councils covering 72 villages. The district of Dusheti is characterized by smaller villages primarily located in mountainous areas, whereas villages in Marneuli tend to be larger and primarily located in lowland areas.

Based on the funding and resources available, the total sample size for the assessment was determined to 260. Population-based proportional weighting was employed as the criterion for splitting the total sample size among the two study districts. Based on a total combined population of 160,100 inhabitants in both districts, the following numbers of samples were to be included in the assessment:

- Dusheti: 55 samples (i.e. 21 % of total sample size);
- Marneuli: 205 samples (i.e. 79 % of total sample size).

Since the scope of the study was a “rapid” situation assessment of water quality and sanitary risks of small-scale water supplies in the rural areas of Dusheti and Marneuli, water supplies in the centre towns of both districts were not included in the survey.

As a cutoff point, the project team decided to include villages with a population of at least 50 inhabitants into the assessment. However, as information on supplies prior to commencement of the field work was limited, this does not mean that all supplies included in the survey serve at least 50 people, as field work showed that there are several supplies present in some of the villages.

As the majority of the rural population in both districts employs household storage, in accordance with the RADWQ methodology, household samples were taken in 10 % of the total sample size in pre-selected settlements of both districts. As a result, the sample size was defined as follows:

- Dusheti: 50 samples from drinking-water supply sources plus 5 samples from household containers in villages where source sample are taken (see also Tables 5-7);
- Marneuli: 184 samples from drinking-water supply sources plus 21 samples from household containers in villages where source sample are taken (see also Tables 5-7).

Determination of drinking-water sources

A number of different supply technologies are prevailing in the villages of Dusheti and Marneuli districts, including gravity-fed or pressurized piped systems or point sources. There is no one “typical” supply situation in the villages. Water may be piped into home (with or without in-home storage reservoirs or tanks), piped to public taps (with or without central service reservoirs), collected by users from point sources and physically carried home or delivered by other transport means to home (e.g. animal transport). Villages often have several drinking water supply sources; some supplies may only be temporarily operated, others may provide water intermittently only. Also, local populations partly use two or more sources in parallel, i.e. one for drinking and one for other domestic purposes.

At the outset of the assessment neither an inventory of supplies nor detailed information on the number of supplies in the villages of both districts was available. Therefore, during the first phase of the field work, the project team carried out fact-finding missions by visiting the municipalities in Dusheti and Marneuli and interviewing local representatives regarding locations and types of supplies that are used by the population.

The local representatives advised that all types of drinking-water supplies that are used by the population for drinking shall be included in the assessment. Therefore, the study included “improved” and “not improved” sources (i.e. according to the JMP definitions given by WHO and UNICEF (2008)). The following types of small scale water supply systems are prevailing in the study districts and were therefore selected for the assessment:

- Borehole with mechanized pumping (i.e. in Dusheti, river bank filtrate was encountered to be the primary source water drawn off by boreholes with mechanized punmping)

- Spring
- Dug well (i.e. with hand pump or windlass)
- All above sources were either operated
- with a piped distribution system from abstraction point of source water until point of collection (i.e public tap) or consumption (i.e. household tap), with or without storage/service reservoirs, or
- as point sources with physical water collection by villagers.

For point sources, typically one sample was taken at source (including a corresponding sanitary inspection). For piped systems, typically one sample was taken at source plus (an) additional sample(s)/inspection(s) per storage/service reservoir (if employed) and/or one or more additional sample(s)/inspection(s) in the distribution system. In some circumstances, the first sample was not taken at source but at the storage/service reservoir (i.e. when sources were not accessible by the field teams). Details on locations and numbers of samples taken in the assessment are shown in Tables 5-7.

Determination of sampling points

At the outset of the study, an inventory of drinking-water supplies with detailed information on the percentage of the population using different types of supplies in the districts was not available. Therefore, the selection of individual supplies to be included in the assessment was not based on proportional weighting of populations using individual supply categories. The selection was rather ad-hoc and primarily based on expert judgment, i.e. on the interviews with representatives of the municipalities. They informed the project team on types and numbers of supplies in the villages and suggested supplies to be included in the assessment, with a focus on drinking-water supplies that had not been analyzed in recent years.

Based on the municipalities' suggestions and other criteria (e.g. geographic proximity and accessibility of supplies), the project team determined the concrete villages to be included in the assessment prior to field work. An exception was mountainous villages of the Dusheti district, where supplies were not always pre-selected but where local self-governance staff guided the field teams in identifying and reaching specific sampling sites. For the purpose of continuous implementation of field work, the study area was divided into 10 clusters (i.e. 5 in Dusheti and 5 in Marneuli), based on geographic proximity and accessibility of supplies, and the number of field teams available and travel time they required. There were two field teams in total, one working in each of the clusters.

An overview of the sampling design is given in Tables 5-7. In total, 126 water supplies were included in the assessment, serving about 60,000 persons in total, or 37.2 % of the total population of both districts. The number of persons served by individual supplies ranges from as few as 3 (private well) up to 8,500 (piped distribution). Whereas the majority of the supplies included in the assessment were dug wells (56.3 %), they served only 4.7 % of the population under study. On the contrary, boreholes only presented 20.6 % of the supplies included in the assessment but represented 65.5 % of the population under study.

Table 5. Summary of sampling design

District	Technologies covered in survey			Population covered in survey		Samples/inspections included in survey	
	Type	*No.*	*%*	*No.*	*%*	*Location*	*No.*
Dusheti	Borehole	10	32.3 %	6,600	78.4 %	Source	20
	Spring	16	51.6 %	1,773	21.0 %	Storage reservoir	15
	Dug well	4	12.9 %	42	0.5 %	Distribution system	15
	Unknown	1	3.2 %	10	0.1 %	Household container	5
	Total	**31**	**100 %**	**8,425**	**100 %**	**Total**	**55**
Marneuli	Borehole	16	16.8 %	32,400	63.4 %	Source	102
	Spring	7	7.4 %	9,064	17,8 %	Storage reservoir	18
	Dug well	67	70.5 %	2,728	5.3 %	Distribution system	64
	Unknown	5	5.3 %	6,900	13.5 %	Household container	21
	Total	**95**	**100 %**	**51,092**	**100 %**	**Total**	**205**
Total study area	Borehole	26	20.6 %	39,000	65.5 %	Source	122
	Spring	23	18.3 %	10,837	18.2 %	Storage reservoir	33
	Dug well	71	56.3 %	2,770	4.7 %	Distribution system	79
	Unknown	6	4.8 %	6,910	11.6 %	Household container	26
	Total	**126**	**100 %**	**59,517**	**100 %**	**Total**	**260**

Table 6. Sampling design for Dusheti district

Name of supply scheme	Population served	Technology type	Piped distribution	No. of samples taken	Sampling/inspection location
1	2,500	Borehole with mechanized pumping[1]	yes	2	2 storage reservoir
2	2,500	Borehole with mechanized pumping[1]	yes	5	2 storage reservoir 2 distribution system 1 household container
3	150	Spring	no	1	1 source
4	4	Spring	no	1	1 source
5	150	Spring	no	1	1 source
6	10	Dug well	no	1	1 source
7	250	Spring	no	1	1 source
8	150	Spring	no	2	1 source 1 household container
9	210	Spring	no	1	1 source
10	120	Spring	no	1	1 source
11	550	Borehole with mechanized pumping[1]	yes	5	2 storage reservoir 2 distribution system 1 household container
12	140	Spring	no	1	1 source
13	150	Spring	yes	2	1 source 1 household container

Name of supply scheme	Population served	Technology type	Piped distribution	No. of samples taken	Sampling/inspection location
14	125	Spring	yes	2	1 source 1 storage reservoir
15	90	Spring	no	1	1 source
16	92	Spring	no	1	1 source
17	300	Borehole with mechanized pumping[1]	yes	3	1 storage reservoir 2 distribution system
18	10	Unknown[2]	yes	2	1 storage reservoir 1 household container
19	240	Borehole with mechanized pumping[1]	yes	2	1 storage reservoir 1 distribution system
20	120	Borehole with mechanized pumping[1]	yes	2	1 storage reservoir 1 distribution system
21	240	Borehole with mechanized pumping[1]	yes	2	1 storage reservoir 1 distribution system
22	60	Borehole with mechanized pumping[1]	yes	2	1 storage reservoir 1 distribution system
23	40	Borehole with mechanized pumping[1]	yes	2	1 storage reservoir 1 distribution system
24	35	Spring	no	1	1 source
25	25	Spring	no	1	1 source
26	50	Borehole with mechanized pumping[1]	yes	5	1 storage reservoir 4 distribution system
27	12	Dug well	no	1	1 source
28	15	Dug well	no	1	1 source
29	5	Dug well	no	1	1 source
30	50	Spring	no	1	1 source
31	32	Spring	no	1	1 source

[1] River bank filtrate was encountered to be the source water (which was not initially considered in this assessment). In this supply, samples were taken at the distribution system and household level only.
[2] Information on source water was requested, but not available during the field visits.

Table 7 Sampling design for Marneuli district

Name of supply scheme	Population served	Technology type	Piped distribution	No. of samples taken	Sampling location
1	8,500	Borehole with mechanized pumping[3]	yes	40	20 source 15 distribution system 5 household container
2	1,693	Borehole with mechanized pumping[4]	yes	6	2 source 3 distribution system 1 household container
3	3,965	Borehole with mechanized pumping[5]	yes	13	3 source 2 storage reservoir 7 distribution system 1 household container
4	38	Dug well	no	1	1 source
5	45	Dug well	no	1	1 source
6	12	Dug well	no	1	1 source
7	100	Dug well	no	1	1 source
8	25	Dug well	no	1	1 source
9	8	Dug well	no	1	1 source
10	5	Dug well	no	1	1 source
11	6	Dug well	no	1	1 source
12	3	Dug well	no	1	1 source
13	8	Dug well	no	1	1 source
14	10	Dug well	no	1	1 source
15	12	Dug well	no	1	1 source
16	10	Dug well	no	1	1 source
17	8	Dug well	no	1	1 source
18	8	Dug well	no	1	1 source
19	10	Dug well	no	1	1 source
20	12	Dug well	no	1	1 source
21	10	Dug well	no	2	1 source 1 household container
22	9	Dug well	no	1	1 source
23	10	Dug well	no	1	1 source
24	1,600	Borehole with mechanized pumping[6]	yes	2	1 storage reservoir 1 household container
25	1,573	Dug well	no	1	1 source
26	20	Dug well	no	1	1 source
27	18	Borehole with mechanized pumping[6]	yes	2	1 storage reservoir 1 household container
28	20	Dug well	no	2	1 source 1 household container
29	10	Dug well	no	1	1 source

Name of supply scheme	Population served	Technology type	Piped distribution	No. of samples taken	Sampling location
30	12	Dug well	no	2	1 source 1 household container
31	10	Dug well	no	2	1 source 1 household container
32	1,500	Unknown[7]	yes	5	1 storage reservoir 3 distribution system 1 household container
33	9,000	Borehole with mechanized pumping	yes	8	1 source 6 distribution system 1 household container
34	14	Dug well	no	1	1 source
35	20	Dug well	no	1	1 source
36	10	Dug well	no	1	1 source
37	12	Dug well	no	1	1 source
38	570	Borehole with mechanized pumping[8]	yes	2	1 storage reservoir 1 distribution system
39	250	Borehole with mechanized pumping[6]	yes	1	1 distribution system
40	300[9]	Spring	no	1	1 source
41	300[9]	Borehole with mechanized pumping[6]	yes	2	1 distribution system 1 household container
42	12	Borehole with mechanized pumping	yes	4	1 source 2 distribution system 1 household container
43	1,970	Unknown[7]	yes	3	1 storage reservoir 1 distribution system 1 household container
44	1,920	Unknown[7]	yes	4	1 storage reservoir 2 distribution system 1 household container
45	860	Unknown[7]	yes	3	1 storage reservoir 1 distribution system 1 household container
46	2,000	Spring	yes	4	1 storage reservoir 3 distribution system
47	200	Dug well	no	1	1 source
48	15	Dug well	no	1	1 source
49	10	Dug well	no	1	1 source
50	4	Dug well	no	1	1 source
51	7	Dug well	no	1	1 source
52	8	Dug well	no	1	1 source
53	6	Dug well	no	1	1 source
54	4	Dug well	no	1	1 source
55	10	Dug well	no	1	1 source
56	412	Spring	no	1	1 source

Name of supply scheme	Population served	Technology type	Piped distribution	No. of samples taken	Sampling location
57	3,600	Borehole with mechanized pumping	yes	7	2 source 4 distribution system 1 household container
58	1,693	Borehole with mechanized pumping	yes	5	1 source 4 distribution system
59	18	Dug well	no	1	1 source
60	15	Dug well	no	1	1 source
61	10	Dug well	no	1	1 source
62	2,100	Borehole with mechanized pumping[8]	yes	4	1 storage reservoir 3 distribution system
63	3,800	Borehole with mechanized pumping[6]	yes	1	1 storage reservoir
64	12	Dug well	no	1	1 source
65	18	Dug well	no	1	1 source
66	11	Dug well	no	1	1 source
67	17	Dug well	no	1	1 source
68	20	Dug well	no	1	1 source
69	15	Dug well	no	1	1 source
70	22	Dug well	no	1	1 source
71	16	Dug well	no	1	1 source
72	20	Dug well	no	1	1 source
73	15	Dug well	no	1	1 source
74	18	Dug well	no	1	1 source
75	15	Dug well	no	1	1 source
76	10	Dug well	no	1	1 source
77	4,800	Spring[10]	yes	7	2 storage reservoir 5 distribution system
78	15	Dug well	no	1	1 source
79	12	Dug well	no	1	1 source
80	10	Dug well	no	1	1 source
81	15	Dug well	no	1	1 source
82	17	Dug well	no	1	1 source
83	12	Dug well	no	1	1 source
84	300	Spring	no	1	1 source
85	15	Dug well	no	1	1 source
86	12	Dug well	no	1	1 source
87	10	Dug well	no	1	1 source
88	15	Dug well	no	1	1 source
89	17	Dug well	no	1	1 source
90	12	Dug well	no	1	1 source

Name of supply scheme	Population served	Technology type	Piped distribution	No. of samples taken	Sampling location
91	3,190	Borehole with mechanized pumping	yes	3	1 source 1 storage reservoir 1 distribution system
92	1,100	Borehole (with mechanized pumping)[11]	yes	2	1 storage reservoir 1 distribution system
93	3,200	Spring[10]	yes	1	1 storage reservoir
94	650	Unknown[7]	yes	1	1 storage reservoir
95	50	Spring	no	1	1 source

[3] Water of 20 boreholes is stored in one reservoir, feeding the same distribution system.
[4] Water of 2 boreholes is stored in one reservoir, feeding the same distribution system.
[5] Water of 3 boreholes is stored in two reservoirs, feeding the same distribution system.
[6] No sample was taken at the source as this is located at a large distance from the village.
[7] Information on source water was requested, but not available during the field visits.
[8] No sampling was possible at the source which was equipped with an electric pump; first sample was taken at storage instead which is in close vicinity to the source.
[9] The total population of the village is 300. Two separate water supplies are present in the village. The whole population has access to the spring source, and is also connected to the piped distribution system.
[10] Source not accessible for sampling.
[11] Artesian groundwater with free outflow (without pump).

Parameter selection

The selection of parameters for inclusion in RADWQ in general is based on prioritizing those that are expected to have greatest impact on the health of all the population, especially the most vulnerable groups (e.g. children, the poor). In terms of priority the parameters to be included in water quality assessment and monitoring programmes can be summarized as follows:

1. Microbiological quality and those parameters related to microbiological quality (such as disinfectant residuals, potential hydrogen ion concentration (pH) and turbidity)
2. Chemical parameters of known health risk; and
3. Aesthetic parameters.

Table 8 shows the range of critical organoleptic/appearance, chemical and microbiological parameters which were selected for inclusion in the assessment. In accordance with the RADWQ methodology, also sanitary inspections were carried out at each water supply included in the assessment. For these selected parameters, Table 9 shows the national drinking-water quality standards by the Georgian Technical Regulation on Drinking Water Quality (2007) and WHO guideline values.

Table 8. Drinking-water quality parameters tested in the assessment

Microbiological parameters	Physico-chemical parameters	Organoleptic/appearance parameters
Total coliforms *E. coli* Faecal streptococci	Nitrate (NO_3^-) Ammonia (NH_4^+) Iron (Fe) Fluoride (F) Copper (Cu) pH Free chlorine residual	Turbidity Temperature Taste and odour Total dissolved solids (TDS)

Table 9. National drinking-water quality standard and WHO guideline values (GV)

	Parameter	National drinking-water standard	WHO GV	Remarks
Microbiological parameters				
1	Total coliforms	0 cfu/300 ml	-	Total coliforms are not of sanitary significance, i.e. they are not a reliable parameter for indicating faecal pollution and thus the potential presence of pathogens. However, presence of these organisms indicates inadequate treatment. Total coliforms are measured in 100 ml samples of water and should be absent immediately after treatment and disinfection.
2	*E. coli* (or thermotolerant coliforms as a surrogate)	0 cfu/300 ml	0 cfu/100 ml	Must not be detectable in any 100 ml or 300 ml sample, respectively. Although *E. coli* is a more precise indicator of feacal pollution, the count of thermotolerant coliform bacteria is an acceptable alternative. Presence of these organisms should lead to further action to investigate potential sources of contamination.
3	Faecal streptococci	0 cfu/250 ml	-	Faecal streptococci survive longer in water environments than *E. coli*, and they are more resistant to drying and to chlorination The detection should lead to taking further necessary action (further sampling; investigation of potential sources of contamination).
Physico-chemical parameters				
4	Nitrate (NO_3)	50 mg/l	50 mg/l (as NO3)	Nitrate is of concern because of its link to methaemoglobinaemia or 'blue-baby' syndrome, particularly relevant for infants aged <6 months.
5	Ammonia (NH_4)	2.0 mg/l	-	There is no WHO health-based guideline value for ammonia. Ammonia is mainly of importance to consumer acceptability; concentrations in excess of 1.5 mg/l may lead to odour problems. Ammonia in water is an indicator of possible bacterial, sewage and animal waste pollution.
6	Iron (Fe)	0.3 mg/l	-	There is no WHO health-based guideline value for iron but 0.3 mg/l for reasons of consumer acceptability. There is usually no noticeable taste at concentration below this level, although turbidity and colour may develop.
7	Fluoride (F)	0.7 mg/l	1.5 mg/l	Ingestion of excess fluoride is associated with dental and skeletal fluorosis. There are significant health effects of long-term exposure to fluoride in water. Volume of water consumed and intake from other sources (e.g. from food and air) should be considered when setting national standards for drinking-water.
8	Copper (Cu)	2.0 mg/l	2.0 mg/l	There are significant health effects of both short and long-term exposure to copper in drinking-water within piped systems, especially where copper piping is used and waters are acidic and/or aggressive.
9	pH	6-9	-	The GDWQ recommends that the optimum range is 6.5-8.5. For effective disinfection with chlorine, the pH should preferably be < 8.0. No WHO health-based guideline value for pH has been proposed.
10	Free chlorine	0.3-0.5 mg/l	-	WHO recommends a residual concentration of free chlorine of ≥ 0.5 mg/l after at least 30 min contact time at pH <8.0. A chlorine residual should be maintained throughout the distribution system and at the point of delivery; the minimum residual concentration should be 0.2 mg/l.

	Parameter	National drinking-water standard	WHO GV	Remarks
Organoleptic/appearance parameters				
11	Total dissolved solids (TDS)	1,000 mg/l	-	There is no WHO health-based guideline value for TDS but it is generally considered that drinking-water becomes significantly and increasingly unpalatable at levels greater than 1,000 mg/l. Although this parameter does not provide information about specific chemicals in water, it can act as a good indicator of water quality problems, particularly when it changes with time.
12	Taste and odour	intensity of no more than "score 2"	-	There are no WHO health-based guideline values for odor and taste but the water should not be objectionable.
13	Turbidity	< 3.5 NTU	-	There is no WHO health-based guideline value for turbidity but, because of its effects on the removal of microorganisms in treatment and disinfection, it is recommended that turbidity be kept as low as possible (<1 NTU for chlorinated supplies). Aesthetically, water with a turbidity <5 NTU is usually acceptable to consumers. Small water supplies where resources are limited and where there is limited or no treatment may not be able to achieve low levels of turbidity. In these cases, the aim should be to produce water that turbidity of at least less than 5 NTU.

As shown in Table 10, 14.5 % of the samples in Dusheti and 10.7 % of the samples in Marneuli were taken from chlorinated supplies. All samples from chlorinated supplies were analyzed for residual chlorine.

According to information on source water quality from previous surveys of the Georgian Ministry of Environment, no significant levels of iron, fluoride or copper were to be expected in source waters in Dusheti and Marneuli districts. Therefore, these parameters were not analyzed for all water supplies but only in a limited number of water samples taken in order to confirm this situation. The project team made a case by case decision on where to analyze for these parameters. In selecting the sites the following criteria were considered: Iron was primarily included where iron containing installations (i.e. tanks and/or pipes) were present; copper mainly in supplies located in agriculturally used areas where copper from pesticides could be expected.

Table 10. Drinking-water quality parameters and frequency of testing in Dusheti and Marneuli districts

Parameter	Proportion of water supplies tested	
	Dusheti	Marneuli
Total coliforms, *E. coli*, faecal streptococci Turbidity, pH, temperature, taste and odour, TDS Ammonia (NH_4), nitrate (NO_3)	100.0 %	100.0 %
Copper (Cu), fluoride (F), iron (Fe)	18.0 %	12.0 %
Free chlorine residual	14.5 %	10.7 %

4.2. Design of practical activities

For the purpose of continuous implementation of field work in the determined period of time of one month, a work plan was developed and two field groups, directed by a field work manager, were created. Each group consisted of 6 personnel with the relevant experience. They were responsible for taking of drinking-water samples and carrying out sanitary inspections.

The field work manager, whose activities were coordinated and overseen by the project coordinator, ensured implementation of the field work (i.e. provision of training and equipment, including purchase of the relevant materials, transport and logistics).

A unique code number was assigned to each drinking-water sample and sanitary inspection form and a database was created for analysis of information.

In order to prevent unexpected, improper meteorological conditions from affecting the progress of the assessment, the months of May-June was selected as appropriate period of field work. Field work began on 17 May and finished on 15 June 2011. The average air temperature during this period was 32-37 °C.

Drinking-water samples were taken according to the established national sanitary rules of water sampling[11], and transportation to laboratory was provided by vehicles. The time of sample delay was at maximum 3 hours. Samples for microbiological and chemical analysis were collected in separate vessels simultaneously. Residual free chlorine and water temperature were measured on-site. Assessment of microbiological, chemical and organoleptic parameters was performed in laboratory in conformity with international standards.

Analyses of drinking-water quality were conducted in the accredited laboratory of *G. Natadze Scientific-Research Institute of Sanitary, Hygiene and Medical Ecology*, which has many years of experience in the area of drinking-water research. The laboratory provided cold boxes (containers with ice) for storage and transportation of the samples. During transportation the samples were stored in a clean, cool and dark place in cold boxes and were protected from perishing and secondary contamination. The laboratory analyses were performed without delay after arrival in the lab. Test protocols on drinking-water quality and the results were presented in a timely manner.

NCDCPH vehicles were used for travel in districts. The drivers were ready and re-fuelling of vehicles was performed in a timely manner. There were no delays on the part of vehicles.

Sanitary inspection was carried out for each selected small scale water supply source and/or on all stages of supply (e.g. water abstraction, treatment, distribution, storage, household usage). In the process of sanitary inspection, through visual examination, potential risks and sources of contamination were identified and registered. The field teams used the sanitary inspection forms provided in the Annex. Training and pre-testing on the issues of sanitary inspection was conducted prior to the beginning of the field work. The training ensured preparedness of the personnel for field work and development of uniform understanding of the given risk-factors in sanitary inspection forms.

Before the beginning of the field work each group was provided with sampling equipment, materials required for making records, and sanitary inspection forms. At the end of each day the daily reporting form was filled out (see Annex). The sanitary inspection forms which had been filled out during that day were attached to the daily reporting form.

An Excel spreadsheet was used for data entry. A data manager with the relevant experience was responsible for the control of quality of data entry and analysis.

[11] Sanitary Rules of Water Sampling, 2002.

5. Results of field assessment

All results presented in the following sections 5.1-5.5 are based on results of water quality analyses and sanitary inspections conducted at source, storage/service reservoirs and in the distribution system (i.e. excluding the assessment at household level. Except for section 5.4, the following results' sections do not include any technology specific analyses. Section 5.6 summarizes the results at household level.

5.1. Microbiological parameters

There is a wide variety of microorganisms that may be found in water. These include some that are pathogenic and may cause a number of diseases. Sometimes also non-pathogenic microorganisms may lead to other problems in water supplies, in particular its organoleptic characteristics may which compromise the usability of the water. Although it is known that pathogens cause a number of water-borne diseases, the routine monitoring of pathogens is generally not undertaken. The reason is that detection of pathogenic microorganisms in water, due to their small number, is difficult.

As most water-borne pathogens get into water with faeces, it is usual practice to use faecal indicator organisms for the assessment of microbiological quality of drinking-water. Their use use plays an important role in public health protection, especially in low-income countries. Faecal indicator bacteria signal contamination of drinking-water and point to prevailing risks to water supply. Monitoring of indicator bacteria is an effective method for the assessment of the risk of significant epidemic outbreak.

The following microorganisms were analyzed in the assessment:

- Total coliform bacteria: Each sample was analyzed for total coliforms. Their presence may indicate water contamination. According to the WHO GDWQ, total coliform bacteria (excluding *E. coli*) occur in both sewage and natural waters. Some of these bacteria are excreted in the faeces of humans and animals, but many coliforms are heterotrophic and able to multiply in water and soil environments. Total coliforms can also survive and grow in water distribution systems, particularly in the presence of biofilms. Their presence always shows that system integrity is compromised (i.e. ingress, inefficient treatment etc.), and should always trigger investigation with respect to system shortcomings.
- *Escherichia coli (E. coli)*: Each sample was analyzed for *E. coli*. It is mainly derived from human and animal faeces. The presence of *E. coli* in drinking-water clearly signals that the water had been in contact with faeces and pathogens may be present, too. Presence of *E. coli* should therefore always trigger further investigation in terms of contamination pathways.
- Faecal streptococci (*Streptococcus faecalis*): Each sample was analyzed for faecal streptococci. They are generally more environmentally resistant than *E. coli*. They are introduced to water with human and animal faeces. The presence of faecal streptococci in drinking-water clearly signals that the water had been in contact with faeces and pathogens may be present, too. Presence of faecal streptococci should therefore always trigger further investigation in terms of contamination pathways.

Results for total coliforms

Every sample in the Dusheti and Marneuli districts was analyzed for total coliform bacteria. The results are shown in Table 11 and Figures 6 and 7. In the Dusheti 32.7 % and in Marneuli 27.2 % of the water samples tested were in compliance with the national drinking-water standard; or in other words, in both districts two third of the samples showed total coliform contamination.

Table 11. Compliance with the national standard for total coliforms

District	Number of samples	Compliance with national standard
Dusheti	50	32.7 %
Marneuli	184	27.2 %

Figure 6. Compliance with the national standard for total coliforms in Dusheti district

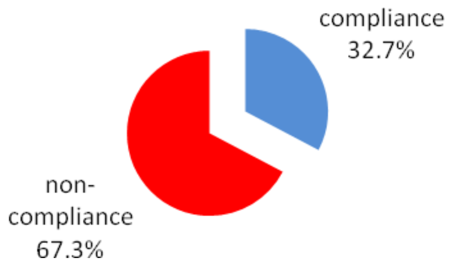


Figure 7. Compliance with the national standard for total coliforms in Marneuli district

Results for E. coli

E. coli was analyzed in all drinking-water samples taken in the Dusheti and Marneuli districts. The results are shown in Table 12 and Figures 8 and 9. In Dusheti 40.0 % and in Marneuli 31.5 % of water samples tested for *E. coli* were in compliance with the WHO guideline value (GV) and the national drinking-water standard. The distribution of *E. coli* contamination is shown in Figure 10; a significant number of samples shows very high E. coli counts in the range of 10 -100 colony forming units.

Table 12. Compliance with the national standard and WHO GV for E. coli

District	Number of samples	Compliance with WHO GV	Compliance with national standard
Dusheti	50	40.0 %	40.0 %
Marneuli	184	31.5 %	31.5 %

Figure 8. Compliance with the national standard and WHO GV for *E. coli* in Dusheti district

Figure 9. Compliance with the national standard and WHO GV for *E. coli* in Marneuli district

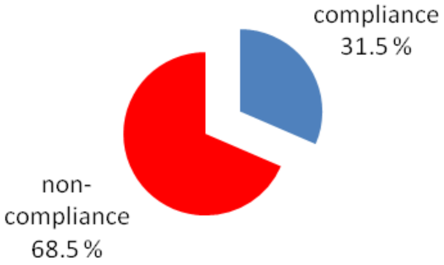
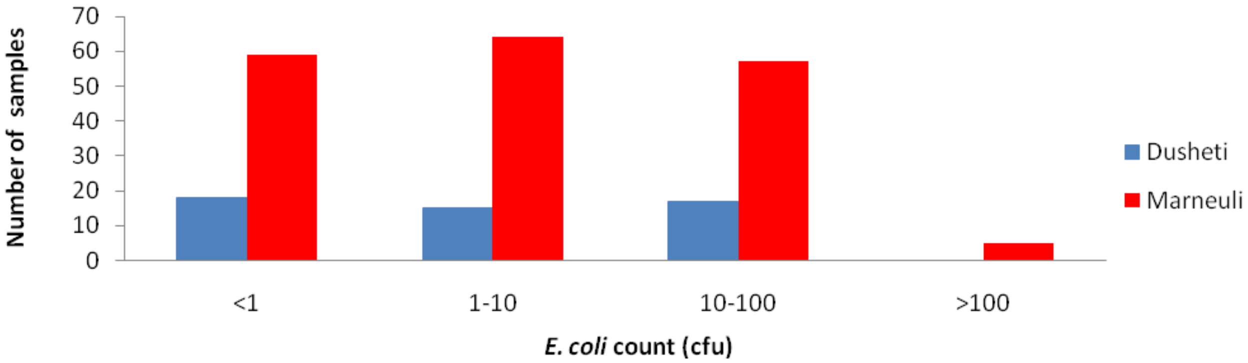


Figure 10. Distribution of *E. coli* counts



Results for faecal streptococci

Faecal streptococci were analyzed in all water samples taken in both districts. The results are shown in Table 13 and Figures 11 and 12. In Dusheti 66.0 % and in Marneuli 78.8 % of water samples tested were in compliance with the national drinking-water standard.

Table 13. Compliance with the national standard for faecal streptococci

District	Number of samples	Compliance with national standard
Dusheti	50	66.0
Marneuli	184	78.8

Figure 11. Compliance with the national standard for faecal streptococci in Dusheti district

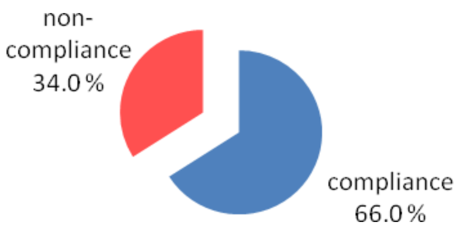
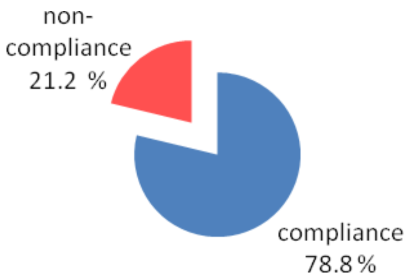


Figure 12. Compliance with the national standard for faecal streptococci in Marneuli district



5.2. Physico-chemical and organoleptic parameters

The physico-chemical parameters nitrate, ammonia, iron, chlorine residual, copper and fluoride were analyzed in drinking-water samples and results assessed within this project. In addition, the organoleptic parameters TDS, turbidity, temperature as well as taste and odour were subject of the assessment.

Results for nitrate

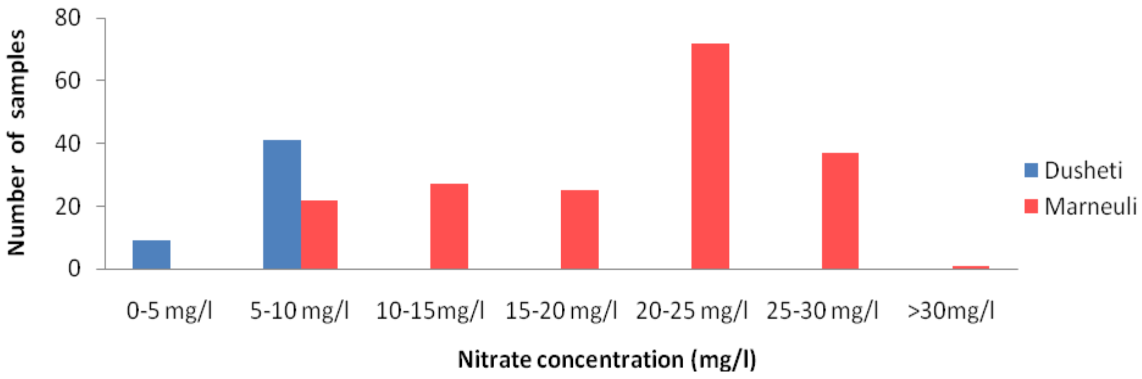
Nitrate is one of the most widely spread chemical contaminants and it is derived from human activities, in particular from the disposal of human and animal wastes and the use of inorganic fertilizers in agriculture. Nitrate is of concern because of its link to methaemoglobinaemia or 'blue-baby' syndrome.

Nitrate was analyzed in all samples taken in the Dusheti and Marneuli districts. The results are shown in Table 14 and Figure 13. All samples are compliant with both the national standard and WHO GV. Nitrate content in drinking-water is generally low; the vast majority of the samples showed concentration below 30.0 mg/l. The maximum concentration is recorded in Marneuli district, in a private well water in the village Dashtapa (30.1 mg/l).

Table 14. Compliance with the national standard and WHO GV for nitrate

District	Number of samples	Compliance with WHO GV	Compliance with national standard
Dusheti	50	100.0 %	100.0 %
Marneuli	184	100.0 %	100.0 %

Figure 13. Distribution of nitrate concentrations



Results for ammonia

The existence of ammonia in drinking-water does not have a direct impact on health. Ammonia in water is an indicator of possible pollution with wastewaters and animal faeces. Ammonia in the environment originates from metabolic, agricultural and industrial processes and from disinfection with chloramine. Natural concentrations in ground- and surface waters are usually below 0.2 mg/l, but anaerobic groundwaters may contain up to 3 mg/l.

Ammonium was analyzed in all drinking-water samples taken in Dusheti and Marneuli districts. The results are shown in Table 15. No ammonia was detected in any of the samples.

Table 15. Compliance with the national standard for ammonia

District	Number of samples	Compliance with national standard
Dusheti	50	100.0 %
Marneuli	184	100.0 %

Results for iron

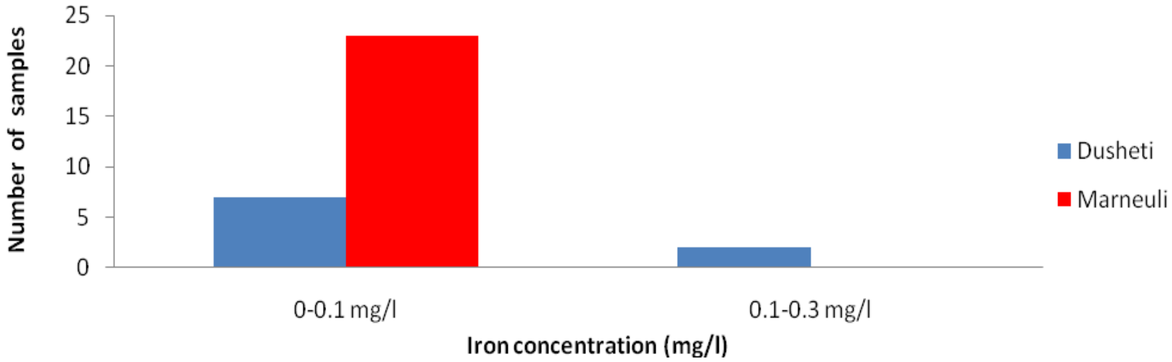
Iron may cause rejection of water for drinking purposes by consumers because of taste and color that develops when iron oxidizes into the ferric state. Iron causes coloring of clothes and sanitary ware. Iron contamination is a particular problem with groundwater supplies and is usually due to the oxidation of ferrous iron in the water itself, because of corrosion of galvanized iron riser pipes and, in some cases, from iron bacteria (Ferribacteriales).

Iron was analyzed in 13.7 % of drinking-water samples taken in Dusheti and Marneuli districts. The results are shown in Table 16 and Figure 14. All samples are compliant with the national standard. Iron content in drinking-water is generally low; the vast majority of the samples showed concentration below 0.1 mg/l. The maximum concentration detected was in a storage reservoir of the village Vardisubani in the Dusheti district where its value was 0.2 mg/l.

Table 16. Compliance with the national standard for iron

District	Number of samples	Compliance with national standard
Dusheti	9	100.0 %
Marneuli	23	100.0 %

Figure 14. Distribution of iron concentrations



Results for chlorine residual

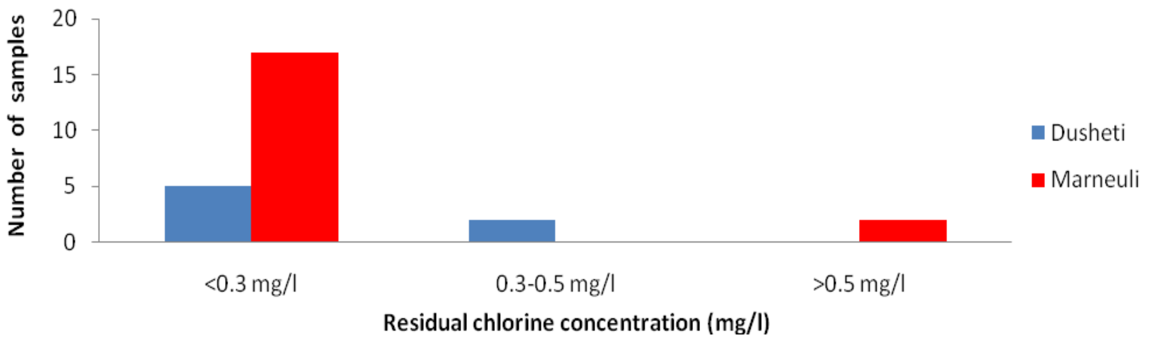
Disinfection of drinking-water with chlorine is economic and simple in terms of technological process and possibility of control over water disinfection process. The goal is to ensure microbiologically safe drinking-water in the distribution network and/or during storage after chlorination. Although chlorination may have an impact on the acceptability of water, it is required if raw water is microbially unsafe. The WHO recommends that for effective disinfection, there should be a residual concentration of free chlorine of ≥ 0.5mg/l after at least 30 min contact time at pH <8.0. A chlorine residual should be maintained throughout the distribution system and at the point of delivery, the minimum residual concentration of free chlorine should be 0.2 mg/l. The Georgian standard is a range 0.3-0.5 mg/l.

Of the samples taken from small scale water supplies in this assessment 14.0 % of the samples in the Dusheti district, and 9.8 % of the samples in the Marneuli district were taken from reportedly chlorinated supplies (excluding those samples taken at the household level). All of these samples were analyzed for residual chlorine. The results are shown in Table 17 and Figure 15. Only one quarter of the samples in Dusheti met the requirements of the national standard whereas none of the samples in Marneuli met the standard. It can therefore be concluded that chlorination practices of small scale drinking-water supplies investigated are inadequate, either because the technological process is insufficient, reagent concentration required for disinfection is determined incorrectly and/or the duration of its contact with water is insufficient. The identified amount of residual chlorine pointed to inefficiency of water treatment. As a result, drinking-water has been supplied to the population which is unreliable from the epidemic point of view. It is therefore important to increase the number of specialists working in water supply system and enhance their knowledge and skills.

Table 17. Compliance with the national standard for chlorine residuals

District	Number of samples	Compliance with national standard
Dusheti	7	22.2
Marneuli	18	0.0

Figure 15. Distribution of free residual chlorine concentrations



Results for copper

Copper is a necessary microelement for human metabolism. Its intake in big amounts and accumulation in various tissues causes the development of grave and irreversible damages. Copper affects acceptability of water as it imparts both taste and color at concentrations > 2.4 mg/l and causes staining of laundry and sanitary wares at concentrations > 1 mg/l. Although ingestion in food is also important, drinking-water can be a significant reservoir of copper. This is usually derived from pipes used in household plumbing systems and solders that contain copper. However, there are natural sources of copper in groundwater and some industrial discharges may also contain copper. Marneuli is rich with natural minerals: basalt, granite, gold, copper etc. Besides, this district is a significant center of production of agricultural products, where pesticides containing copper are used in agriculture. For this very reason we considered it appropriate to identify copper in drinking-water.

Copper was analyzed in 13.7 % of drinking-water samples taken in Dusheti and Marneuli districts. The results are shown in Table 18. All samples are compliant with both the national standard and WHO GV. Copper content in drinking-water is generally low. The maximum concentration of copper was detected in a drilled well of the village Kolagiri of Marneuli district, where its value is 0.17 mg/l.

Table 18. Compliance with the national standard and WHO GV for copper

District	Number of samples	Compliance with WHO GV	Compliance with national standard
Dusheti	9	100.0 %	100.0 %
Marneuli	23	100.0 %	100.0 %

Results for fluoride

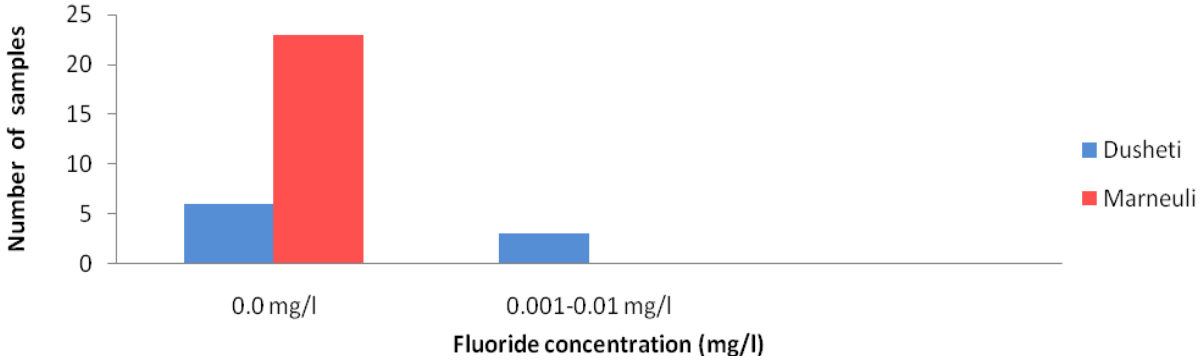
Fluoride is an essential element for humans, however, essentiality has not been demonstrated unequivocally. There is evidence of fluoride being a beneficial element with regard to the prevention of dental caries. In setting the national standards for fluoride or in evaluating possible health consequences of exposure to fluoride, it is essential to consider the average daily intake of water by the population of interest and the intake of fluoride from other sources (e.g. from food and air). Traces of fluoride are present in many waters, with higher concentration often associated with groundwaters. Various pathologies can develop in the organism as a result of consumption of drinking-water with low (< 0.5 mg/l) or high (> 1.5 mg/l) concentrations. Although fluoride may be released by industrial pollution, the majority of fluoride found in drinking-water supplies at levels of health concern is derived from natural sources.

Fluoride was analyzed in 13.7% of drinking-water samples taken in Dusheti and Marneuli districts. The results are shown in Table 19 and Figure 16. Only low levels of fluoride were detected in drinking-water in both districts; all samples complied with the WHO GV and the national standard for fluoride. In most samples, fluoride could not be detected; if it was detected, then as a trace in springs. The minimum values of fluoride for dental health were not considered in this assessment.

Table 19. Compliance with the national standard and WHO GV for fluoride

District	Number of samples	Compliance with WHO GV	Compliance with national standard
Dusheti	9	100.0 %	100.0 %
Marneuli	23	100.0 %	100.0 %

Figure 16. Distribution of fluoride concentrations



Results for total dissolved solids

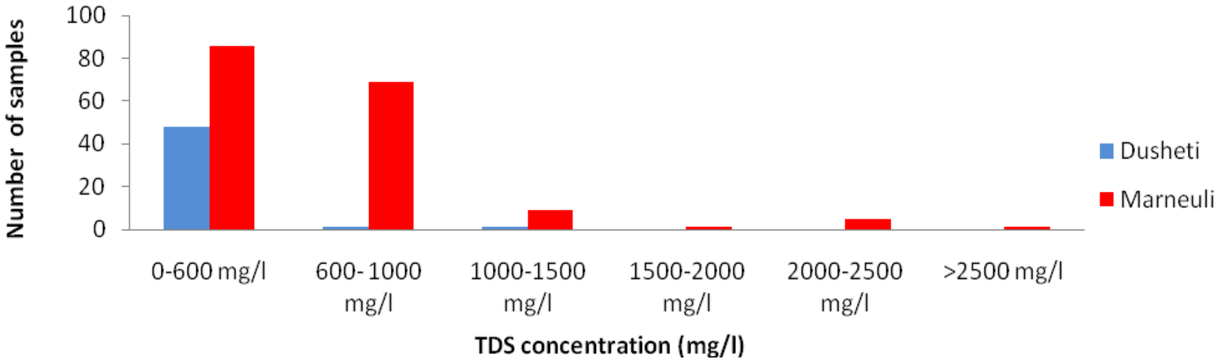
The hygienic norm of mineralization of drinking-water is less than 1,000 mg/l, as it is scientifically determined that consumption of drinking-water with high mineralization for a long period of time causes decrease of diuresis, swelling and retention of water in tissues in the organism. Therefore, it is not recommended to consume such water for drinking. Consumption of water with a total mineralization of < 100 mg/l is not recommended either as it causes developments of various pathologies.

Total dissolved solids were analyzed in all drinking-water samples taken in Dusheti and Marneuli districts. The results are shown in Table 20 and Figure 17. The majority of samples is compliant with the national standard. Some samples, however, are characterized by increased mineralization, particularly in samples taken from boreholes, dug wells and individual wells in the village of Tazakent of Marneuli district.

Table 20. Compliance with the national standard for total dissolved solids

District	Number of samples	Compliance with national standard
Dusheti	50	98.0 %
Marneuli	184	91.3 %

Figure 17. Distribution of total dissolved solid concentrations



Results for turbidity

High levels of turbidity can protect microorganisms from disinfection, stimulate bacteria growth and result in an increased chlorine demand. High turbidity levels are also of concern to consumer acceptability.

Turbidity was analyzed in all samples taken in the Dusheti and Marneuli districts. The results are shown in Table 21. All samples comply with the requirements of national standards.

Table 21. Compliance with the national standard for turbidity

District	Number of samples	Compliance with national standard
Dusheti	50	100.0
Marneuli	184	100.0

Results for odor, taste and temperature

Water temperature, odor and taste can lead to customer dissatisfaction and complaints and may also require additional treatment processes.

Temperature, odor and taste were tested in all samples of drinking-water taken in the Dusheti and Marneuli districts. No significant problems of aesthetic parameters were identified. Also, during the meetings with the local population, neither dissatisfaction nor complaints were expressed with regard to odor or taste.

5.3. Overall compliance

Table 22 provides a summary overview of compliance levels for all parameters included in the assessment for Dusheti and Marneuli districts. Whereas compliance with the national drinking-water standard is very high for the majority of physic-chemical and organoleptic parameters (except for residual chlorine levels in chlorinated supplies), compliance levels for microbiological parameters are generally poor. Overall compliance is defined as a sample being compliant with all parameters investigated; if only one parameter is not compliant with the national drinking-water standard, the sample is considered as not compliant. Overall compliance levels are comparable low, i.e. 26.0 % and 20.1 % in Dusheti and Marneuli, respectively.

These low compliance levels with the national standard is mainly due to limited resource protection and unsatisfactory conditions of the abstraction facilities and distribution networks of the small scale water supply systems in both districts. Also, in most small scale supplies, drinking-water is not disinfected (chlorinated), and in places where chlorination facilities are in place, the existing practices were found to be inadequate.

Table 22. Overview of overall compliance

Parameter	Compliance level	
	Dusheti	Marneuli
Microbiological parameters		
Total coliforms	32.7 %	27.2 %
E. coli	40.0 %	31.5 %
Faecal streptococci	66.0 %	78.8 %
Physico-chemical and organoleptic parameters		
Nitrates	100.0 %	100.0 %
Ammonia	100.0 %	100.0 %
Iron	100.0 %	100.0 %
Chlorine residuals	22.2 %	0.0 %
Copper	100.0 %	100.0 %
Fluoride	100.0 %	100.0 %
Total dissolved solids	98.0 %	91.3 %
Turbidity	100.0 %	100.0 %
Overall compliance		
All parameters	26.0 %	20.1 %

5.4. Sanitary risk factors

In accordance with the RADWQ methodology, each water sample was complemented by a sanitary inspection.

Sanitary inspection is the basic approach, consistently supported by WHO Guidelines for Drinking-water Quality (WHO 1997; 2004; 2011) and the US Environment Protection Agency (US EPA 1999). Sanitary inspection is a powerful fact-finding activity. It uses on-site observation to systematically identify, evaluate and record conditions, infrastructures and practices in relation to likely risks and possible pollution problems that may threaten drinking-water quality at the source, point of abstraction, treatment works, storage and distribution. As sanitary inspection aims at identifying risks – which is also a component of water safety plans – its use is particularly important for management and control of water sources locally.

Risk factors that can be identified by means of sanitary inspection can be grouped into three categories:

- Hazard factors are potential sources of faeces, which threaten water supplies, e.g. proximity of water sources to toilets, animal keeping, landfills and manure collection places.
- Pathway factors are unsatisfactory technical and hygienic condition due to which contaminants may get into water, including pipe damages, illegal connections, discontinuity, unprotected open reservoirs, wells without cover, faulty and eroded masonry and backfill area protecting springs, water extraction with violation of hygienic norms, incorrect storage of drinking-water.
- Indirect factors are disturbed sanitary protection zones or their absence, access of animals to water supply source or improper maintenance.

In many locations of both districts water treatment and disinfection facilities are not in place in small water supply systems. Also, routine monitoring of drinking-water quality in small scale water supply systems is not performed. Environmental protection measures are not widely applied. In particular, the existing practices of protecting sources for water supplies are inadequate and cannot ensure safeguarding the relevant quality of drinking-water. Therefore, sanitary inspection is particularly useful to identify prevailing risks and possible pollution problems.

In the assessment, standardized sanitary inspection forms (see Annex) were used. They contain a systematic checklist of 10 specific questions, which can be answered by the assessor using a mixture of visual observation and user interview on-site. For the purposes of the assessment, 6 different sanitary inspection forms were employed (see Annex and Tables 23-27).

The results of sanitary inspections in both districts and the frequency of individual risk factors identified during the inspections are provided in Tables 23-27. As shown in sections 5.1 and 5.3, microbial contamination is clearly present in many small water supply systems. Results of sanitary inspections point to relevant risk factors for microbial pollution, including unsatisfactory sanitary and technical conditions (i.e. pipe damages, unprotected and open reservoirs, wells without covers, faulty masonry of springs), absence of sanitary protection zones (i.e. allowing access of animals to water supply sources) and/or inadequate location for water extraction in relation to pollution sources in the vicinity of the abstraction point (i.e. toilets and solid wastes).

Table 23. Results of sanitary inspection for piped water distribution system

	Piped water distribution system	Frequency (%)	
		Dusheti	Marneuli
1	Do any taps or pipes leak at the sample site?	36.4	47.8
2	Does water collect around the sample site?	18.2	26.1
3	Is the area around the tap insanitary?	9.1	13.0
4	Is there a sewer or latrine within 30 m of any tap?	0.0	0.0
5	Has there been discontinuity in the last 10 days?	27.3	21.7
6	Is the supply main pipeline exposed in the sampling area?	0.0	17.4
7	Do users report any pipe breaks within the last week?	0.0	4.3
8	Is the supply tank cracked or leaking?	45.5	73.9
9	Are the vents on the tank damaged or open?	9.1	43.5
10	Is the inspection cover or concrete around the cover damaged or corroded?	0.0	87.0

Table 24. Results of sanitary inspection for household piped water

	Household piped water	Frequency (%)	
		Dusheti	Marneuli
1	Is the tap sited outside the house (e.g. in the yard)?	89.5	92.1
2	Is the water stored in a container inside the house?	0.0	4.8
3	Is the storage tank or any of the taps leaking or damaged?	21.1	27.0
4	Are any taps shared with other households?	52.6	57.1
5	Is the area around the tank or tap insanitary?	21.1	36.5
6	Are there any leaks in the household pipes?	5.3	11.1
7	Do animals have access to the area around the pipe?	57.9	85.7
8	Have users reported pipe breaks in the last week?	0.0	4.8
9	Has there been discontinuity in water supply in the last 10 days?	26.3	50.8

10	Is the water obtained from more than one source?	0.0	0.0

Table 25. Results of sanitary inspection for dug wells

	Dug wells	Frequency (%)	
		Dusheti	Marneuli
1	Is there a latrine within 10 m of the well?	0.0	12.7
2	Is the nearest latrine uphill of the well?	0.0	6.3
3	Is there any source of other pollution within 10 m of the well (e.g. animal breeding, cultivation, roads, industry etc.)?	0.0	85.7
4	Is the drainage absent or faulty allowing ponding within 3 m of the well?	0.0	20.6
5	Is the drainage channel absent or cracked, broken or in need of cleaning?	25.0	38.1
6	Is the cement or slab less than 2 m in diameter around the top of the well?	0.0	81.0
7	Does spilt water collect in the apron area?	0.0	38.1
8	Are there cracks in the cement floor or slab?	50.0	36.5
9	Is the handpump loose at the point of attachment, or for rope-washer pumps, is the pump cover missing?	0.0	11.1
10	Is the well-cover absent or insanitary?	0.0	15.9

Table 26. Results of sanitary inspection for springs

	Springs	Frequency (%)	
		Dusheti	Marneuli
1	Is the collection or spring box absent or faulty?	6.3	25.0
2	Is the masonry or backfill area protecting the spring faulty or eroded?	25.0	25.0
3	If there is a spring box, is there an unsanitary inspection cover or air vent?	12.5	0.0
4	Does spilt water flood the collection area (e.g. from overflow pipe)?	31.3	0.0
5	Is the fence absent or faulty?	93.8	75.0
6	Can animals have access within 10 m of the spring?	87.5	100.0
7	Is there a latrine uphill and/or within 30 m of the spring?	6.3	0.0
8	Does surface water collect uphill of the spring within 30 m?	0.0	0.0
9	Is the diversion ditch above the spring absent or non-functional?	0.0	25.0
10	Are there any other sources of pollution uphill of the spring (e.g. faeces or solid waste)?	25.0	0.0

Table 27. Results of sanitary inspection for boreholes with mechanized pumping

	Boreholes with mechanized pumping	Frequency (%)	
		Dusheti	Marneuli
1	Is there a latrine or sewer within 100 m of the pumping mechanism?	-	3.2
2	Is there a latrine within 10 m of the borehole?	-	3.2
3	Is there any source of other pollution within 50 m of the borehole (e.g. animal breeding, cultivation, roads, industry etc.)?	-	12.9
4	Is there an uncapped well within 100 m?	-	0.0
5	Is the drainage channel absent or cracked, broken or in need of cleaning?	-	9.7
6	Can animals come within 50 m of the borehole?	-	9.7
7	Is the base of the pumping mechanism permeable to water?	-	6.5
8	Is there any stagnant water within 2 m of the pumping mechanism?	-	3.2
9	Is the well seal insanitary?	-	12.9
10	Is the borehole cap cracked?	-	12.9

5.5. Comparative risk analysis

In line with WHO Guidelines for Drinking-water Quality (WHO 2011), all sampling locations were assessed for sanitary risks and assigned to risk categories, using a standard set of sanitary inspection questions based on the RADWQ guidelines (see section 5.4).

The use of sanitary inspection forms allows the calculation of individual risk scorings for drinking-water supply systems. The more risks are identified during an inspection, the higher priority should be given to improve the situation. In assessing comparative priorities for remedial intervention, in practice it has been proven useful to combine the results of *E. coli* counts with sanitary inspection scores. This concept is shown by Tables 28 and 29. Whereas microbial water quality analysis alone is representative of only one moment in time, inspection takes account of risk factors affecting the water supply. It is this combination of information that makes the combined risk analysis useful.

This comparative analysis is particularly useful when analysing and interpreting data of a larger number of water supplies in a district, region or the country. This analysis provides an effective mechanism to identify those supplies (in comparison to others) which require urgent remedial action. This allows targeted planning of resource effective intervention strategies.

A greater risk of contamination is likely to be associated with the occurrence of a greater degree of microbial contamination. Nevertheless, a high sanitary risk score associated with low level faecal contamination still requires urgent action, as does a low sanitary risk score associated with high-level faecal contamination. The priority rating of such systems is high.

As results of the comparative risk analysis are shown in Tables 28 and 29. Data show for both districts that most of the water supply locations included in the assessment can be classified as being either in the “low” or “intermediate” risk category (i.e. 76.0 % in Dusheti and 59.8 % in Marneuli). A significant portion of the studied samples is classified as “high” or “very high” (i.e. 24.0 % in Dusheti and 40.2 % in Marneuli). According to the data in Tables 28 and 29, risk levels in Marneuli seem to be higher than in Dusheti. Certain corrective measures are to be planned and priorities are to be determined with consideration of the specific risks identified during sanitary inspection and drinking-water quality data in each individual case. According to the identified priority level, particular attention should be paid to “very high” and “high” categories first of all.

Table 28. Comparative risk analysis matrix for Dusheti district

***E. coli* count (1/100 ml)**	**Sanitary inspection score (SIS)**			
	0-2	**3-5**	**6-8**	**9-10**
>100	0	0	0	0
11-100	8	3	0	0
1-10	10	9	0	0
<1	10	9	1	0

Risk level	**Low**	**Intermediate**	**High**	**Very high**
Priority action level	No action required	Low action priority	Higher action priority	Urgent action required
Proportion of samples	20.0 %	56.0 %	24.0 %	0.0 %

Table 29. Comparative risk analysis matrix for Marneuli district

***E. coli* count (1/100 ml)**	**Sanitary inspection score (SIS)**			
	0-2	**3-5**	**6-8**	**9-10**
>100	2	2	1	0
11-100	15	34	8	0
1-10	30	25	9	0
<1	23	32	3	0

Risk level	**Low**	**Intermediate**	**High**	**Very high**
Priority action level	No action required	Low action priority	Higher action priority	Urgent action required
Proportion of samples	12.5 %	47.3 %	37.5 %	2.7 %

5.6. Household water

Quality of water stored in households was also studied in both districts. Testing of household water was carried out only in the settlements where the source of water supply was studied. Compliance of drinking-water stored in household containers with WHO GV and national standards for *E. coli* is shown in Table 30. The results show that microbial compliance is poor, particularly in Marneuli where only 9.5 % of the samples complied with the standards.

Table 30. Compliance of drinking-water stored in household containers with WHO GV and national standard for *E. coli*

District	Number of samples	Compliance with WHO GV	Compliance with national standard
Dusheti	5	40.0 %	40.0 %
Marneuli	21	9.5 %	9.5 %

However, it should be noted that, during the field visits, field teams were informed by the population that consumers do not necessarily drink the water supplied by the "official" supplies which were subject to this assessment, but rather use alternative sources (e.g. private wells, springs). Therefore, as the water stored at the household level is not necessarily from the sources assessed, it was not possible to study the changes in water quality throughout the water supply chain through to the household level; no conclusion can be drawn regarding where contamination of the water actually occurs.

The results of sanitary inspection are shown in Table 31. A high number of risks to drinking-water safety were identified at the household level, particularly in Marneuli district. The most common risk factors encountered at household level included storage of other liquids or other materials in the containers, non-coverage of containers, keeping containers at ground level and discontinuity in water supply.

Table 31. Results of sanitary inspection for household containers

	Household containers	Frequency (%)	
		Dusheti	Marneuli
1	Is the water storage container used for storing any other liquid or material?	20.0	47.6
2	Is the water storage container kept at ground level?	0.0	42.9
3	Is the water storage container lid or cover absent or not in place?	0.0	76.2
4	Is the storage container cracked, leaking or insanitary?	0.0	9.5
5	Is the area around the storage container insanitary?	20.0	9.5
6	Do any animals have access to the area around the storage container?	0.0	19.0
7	Is the tap or utensil used to draw water from the container insanitary?	0.0	0.0
8	Is the water from the container also used for washing or bathing?	0.0	0.0
9	Has there been discontinuity in water supply in the last 10 days?	20.0	52.4
10	Is the water obtained from more than one source?	0.0	0.0

The results of comparative risk analysis are shown in Table 32. Data show that the majority (53.8 %) of the household water storages included in the assessment can be classified as being either in the "low" or "intermediate" risk category. Still, 46.2 % can be classified as being either in the "high" or "very high" risk category, requiring urgent attention. Therefore, for these supplies it is recommended to plan and implement educational programmes, trainings for the community, and permanent implementation of illustration and awareness raising campaigns.

Table 32. Comparative risk analysis matrix at household level

***E. coli* count (1/100 ml)**	**Sanitary inspection score (SIS)**			
	0-2	**3-5**	**6-8**	**9-10**
>100	0	2	0	0
11-100	4	6	0	0
1-10	4	6	0	0
<1	3	1	0	0

Risk level	**Low**	**Intermediate**	**High**	**Very high**
Priority action level	No action required	Low action priority	Higher action priority	Urgent action required
Proportion of samples	11.5 %	42.3 %	38.5 %	7.7 %

5.7. Working with local population

In the project, meetings were held in Dusheti and Marneuli district for the purpose of awareness raising and informing of the society about topics such as reduction of waterborne diseases and safety of small scale water supply systems, and the organization of sanitary protection zones. Participants were given booklets which were prepared in advance (i.e. the leaflets “How to avoid waterborne diseases”; “The procedures of washing hands”; and the sanitary rule “Hygienic requirements towards the quality of non-centralized water supply”).

Meetings carried out in the villages twice a day: in the morning and in the afternoon (i.e. in Dusheti district from 27 to 30 July 2011 and in Marneuli district from 31 July to 5 August 2011). The community was prior informed about the visit of the project team. Approximately 40 persons attended each meeting.

Presentations for the population were made on the following topics:

- “Approaches to Water Safety Plans” (N. Gabriadze)
- “Identification of hazards in the water supply” (M. Juruli)
- “How to avoid waterborne diseases” (M. Lashkarashvili)
- “Chemical and microbiological contamination of water” (I. Gvineria);
- “Sanitary inspection of small water supply systems” (A. Mindorashvili)

Detailed explanation was given to villagers, why it is important to develop the water safety plans in communities, how to identify risks on the route from catchment up to consumers, what are the main sources of contamination and how to avoid its harmful impact on health and environment. Community representatives discussed problems with great interest. The main questions raised by the people were as follow:

- Is it possible to use drinking-water from wells after flooding?
- Whom should we apply to when the tubes are damaged and water is leaking?
- Where can information on drinking-water quality be obtained?
- Where can we test drinking-water quality?

- Who should be responsible for waste disposal?

5.8. Working with local authorities

In the project, meetings with local authorities were held in the Dusheti and Marneuli districts, and information was delivered on the project tasks, progress and results. Water safety plan approaches were introduced.

Protocols of laboratory test results and the results of sanitary inspections were given to the heads of the municipalities ("Gamgebeli") of both Dusheti (Mr. Lasha Janashvili) and Marneuli (Mr. Zaza Dekanoidze) districts as well as to the representatives of local self-governance.

The results of the assessment and existing situation in small scale water supply systems were jointly discussed (see Figure 18). Local representatives were acquainted about microbial contamination of samples, violations of the rules of the process of water chlorination, as evidenced by the observed residual chlorine in the samples. Discussions also focused on laboratories, qualification of staff, risk factors for human health, and organization of sanitary protection zones. The pathways introducing contamination to small scale water supply systems, risks and hazardous events, water treatment and prevention of water-borne diseases, as well as waste management issues were discussed in detail. Recommendations were given for improvement of the situation at local level, which implies increasing the access to safe drinking-water for human health.

The heads of the municipalities have shown that in both districts, technical facilities and skills of workers engaged in the small water supply systems at the local balance needs to be improved. They do not know how to carry out proper cleaning, decontamination of water sources, waste disposal, quality control and monitoring and provision of technical services. Local authorities have promised to conduct more detailed monitoring of pollution sources and solve problems.

Figure 18. Meeting with the heads of district municipalities, representative of local authorities and the project team (left: Dusheti; right: Marneuli)

During the meetings, local authorities were also familiarized with the approaches of Water Safety Plans. It was explained in detail why is important to develop WSP in communities. This included presentation of the WSP modules, in particular:

Module 1 Establishment the WSP team

Module 2 Describe the water supply system

Module 3 Identify hazards and hazardous events and assess the risks

Module 4 Determine and validate control measures, reassess and prioritize the risks

Module 5 Develop, implement and maintain an improvement/upgrade plan

Module 6 Define monitoring of the control measures

Module 7 Verify the effectiveness of the WSP

Module 8 Prepare management procedures

Module 9 Develop supporting programs

Module 10 Plan and carry out periodic review of the WSP

Module 11 Revise the WSP following an incident

The WHO guidance manual on „Water Safety Plan Manual: Step-by-step risk management for drinking-water suppliers”, and the draft handbook on the “Rapid Assessment of Drinking water Quality” were translated into Georgian and provided to local authorities together with the booklet on “How to Avoid Water-borne Diseases”.

6. Conclusions and recommendations

The majority of residents of the two pilot districts use water from local small scale “village type” water supplies. Water is mostly distributed by gravity pipes. People also take water from individual wells and from natural springs. Sufficient water quantity is available in both Marneuli and Dusheti districts. Due to a lack of awareness on safe water and unsanitary conditions at the sources, abstraction facilities and distribution systems, drinking-water poses a risk to the health of the rural population.

The project has been a rich experience not only for the national experts, but also for the local authorities responsible for management and operation of small water supplies. In the project, local authorities and villagers have increased their knowledge about the prerequisites for providing safe and acceptable drinking-water, and about the actual quality of drinking-water they use. The local governments of both Marneuli and Dusheti districts decided to take further action towards creating an enabling environment to improve drinking-water quality. Namely, each district set up a working group to initiate improvements of the current water supply situation. Problems have been analyzed and possible solutions identified. Now it is very important that the residents remain motivated. On one hand, they can make efforts themselves for the protection of the water resources, and for the protection of their health. On the other hand they have to remind the authorities of their obligation.

The government of Georgia began an irreversible process of reformation of the water supply sector, in the framework of which sustainable provision of safe drinking-water to the population of Georgia is envisaged in coming years through large-scale investments. Introduction of Water Safety Plans in small scale water supply systems will facilitate reduction of drinking-water contamination and can contribute to improvement of drinking-water quality and of the epidemic situation. Essential part of the Water Safety Plan development is the assessment of risks to the drinking-water quality at each stage of water supply system, from water abstraction to consumer, with great involvement of all participants and stakeholders.

6.1. Basic conclusions

- A large proportion of sample staken in both districts showed microbial contamination. For total coliforms, 67.3 % and 72.8 % of the water samples were not compliant with the national standard at the time of sampling in Dusheti and Marneuli, respectively (excluding samples taken at household level). For *E. coli*, corresponding non-compliance levels amounted to 60.0 % and 68.5 %, respectively. These high contamination levels present a significant risk to public health as it indicates possible faecal pollution of the water consumed. This situation is mainly due to limited resource protection, and unsatisfactory sanitary and technical conditions of the abstraction facilities and distribution networks of the small scale water supply systems in both districts.
- Chemical contamination of the supplies in both districts is currently not of concern. The vast majority of the water samples tested for physico-chemical and organoleptic parameters were compliant with national standards and WHO GV. The survey showed, amongst others, that the water of both districts does not contain significant levels of fluoride. Minimum levels of fluoride for dental health were not considered in this assessment.
- In terms of overall compliance, only 26.0 % and 20.1 % of the water samples in Dusheti and Marneuli, respectively, were in compliance with the national drinking-water standard with respect to all parameters analyzed in this assessment. This is considered to be a significant level of non-compliance. This situation should trigger actions to improve the water supplies in order to enable them to provide safe water to the rural population.
- Sanitary inspections revealed a significant number of risk factors compromising the provision of safe drinking-water. They include, but are not limited to, non-existent sanitary protection zones; pit-latrines which are built, in violation of the sanitary rules, too close to wells; and compromised integrity of the abstraction facilities (e.g. non-existent coverage of wells, faulty spring masonries). Also, water abstraction and water storage practices in households were found to be inadequate.

- Based on a combined analysis of water quality and sanitary inspection findings, 40.2 % and 24.0 % of the investigated sites in Marneuli and Dusheti, respectively, can be categorized as at “high” or at “very high” risk, requiring “urgent” attention in terms of priority towards improvement. For household water storages, about 46.2 % can be categorized in these categories.
- In most small scale supplies, drinking-water is not disinfected (i.e. chlorinated), and in places where chlorination facilities are in place, the existing practices are inadequate.
- Routine ongoing drinking-water quality surveillance of the small scale water supplies, including sanitary inspection of the supplies and monitoring of drinking-water quality, is currently not carried out in both districts.
- Public awareness on water hygiene and risk-factors for water-related diseases is low.

6.2. Recommendations

National level

- The project team recommends to further develop the regulatory framework and set an effective mechanism for ensuring the protection of water sources, especially for small scale water supplies and to promote development and implementation of WSPs, a risk assessment and risk management approach, by the water suppliers through relevant legislation.
- Application of the WSP approach should be promoted, including training programmes for those involved in water supply, and existing materials on the application of WSP in small scale water supplies disseminated.
- Sanitary protection zones shall be organized, the distribution networks shall be restored, drinking-water shall be treated (e.g. chlorinated) with monitoring of the technological process, and disinfection of individual wells shall be ensured. Chlorination should be planned such that the contact time of water with chlorine shall be at minimum 1 hour, and concentration of residual chlorine at the beginning of the distribution shall be 0.3- 0.5 mg/l.
- Systematic and routine drinking-water quality surveillance (i.e. sanitary inspection and drinking-water quality monitoring) shall be established.
- The number of specialists working in water supply system should be increased and their knowledge and skills be enhanced.
- Communication with population shall be improved to raise their awareness (e.g. through TV programs, newspaper articles, publications, radio programs and targeted campaigns).
- The situation assessment, including the approach of sanitary inspections, made it possible to identify basic problems and risk of contamination of drinking-water in small scale water supplies. In the future, this methodology shall be used as a basis for the assessment of drinking-water quality throughout Georgia.

Local level

- The project team recommends that, in terms of concrete improvement interventions, pit-latrines shall be (re)constructed in accordance with the sanitary rules; sanitary protection zones shall be established, and where already in place, properly enforced; dug wells shall be properly covered; masonry of springs shall be protected (covered); and abstraction of drinking-water shall be improved in accordance with hygienic rules.
- Routine monitoring and inspection of drinking-water quality of small scale water supply systems shall be improved. Relevant control laboratories shall be established locally.
- It is recommended, to plan and implement educational programmes and trainings for the community. Targeted awareness raising campaigns and meetings with the local population shall be implemented

continuously, including programs in schools, in particular addressing general hygiene practices as well as safe transport, handling and storage of drinking-water in households.

7. Added value of the project for future goals

7.1. Applying the outcomes of the project for policy-making

The results of the assessment of water quality and sanitary conditions in small scale water supply systems in both districts, and the situation analysis of water related disease surveillance will bring the issue of capacity building for surveillance of water quality and prevention of water-related diseases in the priority agenda of the national and local government.

Georgia is signatory to the Protocol on Water and Health and recognizes the access to safe water and sanitation as a human right. The national monitoring programs currently do not cover drinking-water quality for small scale water supplies. The results of the project can be used for awareness raising at national level and advocacy for a better implementation of international agreements.

The project outcomes clearly indicated that regional and national authorities as well as international donors should give more attention on the situation in the rural areas of Georgia. Rural consumers will benefit from investments to improve the existing water sources, establishing water committees, education of stakeholders on financing, operation and maintenance of the local water sources.

7.2. Harmonization of drinking-water quality standards with international requirements

The project findings will serve as the evidence basis for creating an improved legislative/normative framework related to drinking-water quality. The existing hygienic norms and technical regulations need to be revised taking into consideration the WHO Guidelines for Drinking-water Quality (Fourth Edition, 2011) and relevant European Directives, with particular attention to water safety planning for centralized and small scale water supplies. In defining a revised framework, national circumstances such climatic-geographic, social-economic, health status and other conditions need to be considered. The project team will be able to apply the knowledge and experience gained throughout the project and contribute to the development of the regulatory and normative documents.

7.3. Involvement of women and strengthening their role in the water resources management process

Women and girls are frequently responsible for the use and storage of water at home (see Figure 19). In both districts, women have to carry water in big containers for long distances. According to the results of the investigation, an increase of the availability of sufficient amounts of safe drinking-water in particular for vulnerable groups of population of Dusheti and Marneuli districts is necessary.

Sanitary inspection in project districts revealed risk factors that cause secondary contamination of drinking-water at the household level. Women are mostly responsible for maintaining hygienic conditions at home. The community awareness raising activities conducted for local people, including women, therefore specifically focused prevention of water related diseases and particularly addressing the importance of improving water storage and handling at household level. Thus, the project will provide added value by empowering women and strengthening their role in the community in the implementation of WSPs and protection of health.

Figure 19. Woman taking water at the community water sources in Marneuli district (left: village Akhlo-Lalo; right: village Araflo)

7.4. Awareness raising and education

The survey results confirmed that political support from the relevant governmental structures is necessary for protection of sources in small scale water supply systems, water treatment and modernization of systems.

Among the activities that should be conducted to improve drinking-water quality and reduce existing risks is planning and implementation of educational activities. This includes activities targeting both community members and those (professionals) involved in operation and maintenance of small scale drinking-water supplies.

Such activities may include conducting targeted trainings for the local communities, distribution of relevant information materials and ongoing implementation of awareness raising campaigns on general hygiene, safe household handling and storage as well as household treatment options measures, for example.

In future, it will be particularly critical to identify the needs of educational activities for the technical staff of the water supply systems responsible for operation and maintenance on important topics such as maintenance and operation of drinking-water supplies, rapid testing and sanitary inspection methods and effective control measures for preventing of secondary contamination of drinking-water.

7.5. Planning of environment protection measures

The project results clearly indicate that the existing practice of protection of the water supply sources is improper for ensuring the drinking-water quality. In particular, the data of sanitary inspections indicate that contamination is closely related to presence of pit latrines without taking into consideration construction and hygienic requirements, i.e. in relation to safe distances to cattle-sheds and waste disposal facilities, for example. Revision of existing practices on waste management and on construction of pit latrines is required, as well as planning and implementation of educational activities on importance of environmental measures in the community.

7.6. Planning of engineering activities

The data of drinking-water quality analyses and sanitary inspections showed a clear need for well planned engineering activities to improve design, construction, basic operation and maintenance of water supply system, and practicing safe treatment and storage of household water.

In both districts, small scale water supply system facilities are not of the relevant quality and require significant improvement or replacement. Construction and/or extension of alternative water supply systems shall also be considered. Special attention shall be paid to the issue of disinfection/chlorination of water, which is either not carried out or carried out inadequately. Organization of water treatment, including continuous disinfection, and construction of the relevant infrastructure shall be planned. If water chlorination is envisaged, it shall be determined which specific reagent should be used (e.g. chlorine lime, other hypochlorites, liquid chlorine), and the relevant infrastructure shall be built. Use of chlorine lime is admissible for small water supply systems (with output < 3,000 m^3/day), and liquid chlorine is used for water supply systems of higher output.

7.7. National coordination among interested parties

The project has enhanced awareness on drinking-water quality issues and also initiated discussions on effective implementation of future surveillance and monitoring activities. In the project, cooperation became possible among the parties sharing responsibility in the drinking-water sector on the national and regional level, including the Ministry of Labor, Health and Social Affairs, the NCDCPH, the Ministry of Environment Protection and Agriculture, Environmental Inspection, United Water Supply Company, and the WHO Country Office.

In the project, a workshop on „Drinking-water safety in small scale water supplies and introduction to water safety plan approach" was held in Tbilisi on 30 November 2011. The representatives of the relevant ministries, the Parliament of Georgia, research institutes, universities, the United Water Supply Company, representatives of the local authorities of Dusheti and Marneuli districts, relevant NGOs, the experts of German Federal Environment Agency and other interested parties participated in the workshop. Mr. Otar Toidze (chairman of the Health and Social Affairs Committee of the Parliament of Georgia) expressed great interest in the WSP approach. Mr. Otar Toidze underlined the importance of their implementation in Georgia. The high level persons and participants welcomed the project and expressed their great interest to further scaling up and implementing WSPs in Georgia. Particular attention was given to the need for awareness raising activities for local authorities, stakeholders and the community. Mass media and various TV companies highlighted the workshop.

For the future it is necessary to develop a coordination mechanism among the relevant interested ministries and departments. This will ensure effective coordination and information exchange for the purpose of ensuring drinking-water quality, supply of a sufficient amount of drinking-water, and thus safeguarding human health. Also, implementation of control and monitoring, creation of a comprehensive database on drinking-water quality, and the assessment of the existing situation and development of further responses is required.

Annexes

Annex 1. Daily Reporting Form

Date	District/ cluster/village	Water supply technology code	Sample point	Time	Chlorine	SI score

Signature:

Annex 2. Sanitary inspection forms used during field work

1. Borehole with mechanized pumping
2. Piped water: distribution system
3. Household piped water
4. Household container
5. Dug well
6. Spring

1. RADWQ SANITARY INSPECTION FORM

BOREHOLE WITH MECHANIZED PUMPING

I. General information (a-c compulsory; d-f optional):

a. WSS No. ....
b. Village/Town: ....
c. Date of visit:...
d. Broad area/Region: ....
e. Zone: ....
f. People served: ....

II. Specific diagnostic information for assessment:

(Please indicate at which sites the risk was identified)

	Borehole with mechanized pumping	**Risk**
1	Is there a latrine or sewer within 100 m of the pumping mechanism?	Y/N
2	Is there a latrine within 10 m of the borehole?	Y/N
3	Is there any source of other pollution within 50 m of the borehole (e.g. animal breeding, cultivation, roads, industry etc.)?	Y/N
4	Is there an uncapped well within 100 m?	Y/N
5	Is the drainage channel absent or cracked, broken or in need of cleaning?	Y/N
6	Can animals come within 50 m of the borehole?	Y/N
7	Is the base of the pumping mechanism permeable to water?	Y/N
8	Is there any stagnant water within 2 m 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

III. Results and comments:

a. Risk score (tick appropriate box):

9-10 = Very high	6-8 = High	3-5 = Medium	0-2 = Low

b. The following important points of risk were noted:

- List nos. 1-10
- Additional comments (continue on back of form if necessary)

IV. Name and signature of assessors:

2. RADWQ SANITARY INSPECTION FORM

PIPED WATER: DISTRIBUTION SYSTEM

I. General information (a-c compulsory; d-e optional):

a. WSS No.: ....
b. Village/Town: ....
c. Date of visit:...
d. Broad area/Region: ....
e. Zone: ....

II. Specific diagnostic information for assessment:

(Please indicate at which sites the risk was identified)

	Piped water: distribution system	**Risk**
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 30 m 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 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**

Explanatory note:
Questions 1-7: Taps refers to inspection taps or public taps (where directly connected to distribution system).
Questions 8-10: A supply tank is either a clean water/storage tank at the water treatment works or in the distribution system.

III. Results and comments:

a. Risk score (tick appropriate box):

9-10 = Very high	6-8 = High	3-5 = Medium	0-2 = Low

b. The following important points of risk were noted:
- List nos. 1-10
- Additional comments (continue on back of form if necessary)

IV. Name and signature of assessors:

3. RADWQ SANITARY INSPECTION FORM

HOUSEHOLD PIPED WATER

I. General information (a-d compulsory; e-f optional):

a. WSS No.: ....
b. WSS No. of source related to household sample: ....
c. Village/Town: ....
d. Date of visit:..
e. Broad area/Region: ....
f. Zone: ....

II. Specific diagnostic information for assessment:

(Please indicate at which sites the risk was identified)

	Household piped water	Risk
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	Is the storage tank or any of the taps leaking or damaged?	Y/N
4	Are any taps shared with other households?	Y/N
5	Is the area around the tank or tap insanitary?	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 risks: /10

III. Results and comments:

a. Risk score (tick appropriate box):

9-10 = Very high	6-8 = High	3-5 = Medium	0-2 = Low

b. The following important points of risk were noted:

- List nos. 1-10
- Additional comments (continue on back of form if necessary)

c. Does the distribution system deliver water directly to a storage tank (usually on the roof)?

IV. Name and signature of assessors:

4. RADWQ SANITARY INSPECTION FORM

HOUSEHOLD CONTAINER

I. General information (a-d compulsory; e-f optional):

a. WSS No.: ....
b. WSS No. of source related to household sample: ....
c. Village/Town: ....
d. Date of visit:...
e. Broad area/Region: ....
f. Zone: ....

II. Specific diagnostic information for assessment:

(Please indicate at which sites the risk was identified)

	Household container	**Risk**
1	Is the water storage container used for storing any other liquid or material?	Y/N
2	Is the water storage container kept at ground level?	Y/N
3	Is the water storage container lid or cover absent or not in place?	Y/N
4	Is the storage container cracked, leaking or insanitary?	Y/N
5	Is the area around the storage container insanitary?	Y/N
6	Do any animals have access to the area around the storage container?	Y/N
7	Is the tap or utensil used to draw water from the container insanitary?	Y/N
8	Is the water from the container also used for washing or bathing?	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 risks: /10

III. Results and comments:

a. Risk score (tick appropriate box):

9-10 = Very high	6-8 = High	3-5 = Medium	0-2 = Low

b. The following important points of risk were noted:

- List nos. 1-10
- Additional comments (continue on back of form if necessary)

IV. Name and signature of assessors:

5. RADWQ SANITARY INSPECTION FORM

DUG WELL

I. General information (a-c compulsory; d-f optional):

a. WSS No.: ....
b. Village/Town: ....
c. Date of visit:..
d. Broad area/Region: ....
e. Zone: ....
f. People served: ....

II. Specific diagnostic information for assessment:

(Please indicate at which sites the risk was identified)

	Dug well	**Risk**
1	Is there a latrine within 10 m of the well?	Y/N
2	Is the nearest latrine uphill of the well?	Y/N
3	Is there any source of other pollution within 10 m of the well (e.g. animal breeding, cultivation, roads, industry etc.)?	Y/N
4	Is the drainage absent or faulty allowing ponding within 3 m of the well?	Y/N
5	Is the drainage channel absent or cracked, broken or in need of cleaning?	Y/N
6	Is the cement or slab less than 2 m in diameter around the top of the well?	Y/N
7	Does spilt water collect in the apron area?	Y/N
8	Are there cracks in the cement floor or slab?	Y/N
9	Is the hand pump loose at the point of attachment, or for rope-washer pumps, is the pump cover missing?	Y/N
10	Is the well-cover absent or insanitary?	Y/N
	Total score of risks:	**/10**

III. Results and comments:

a. Risk score (tick appropriate box):

9-10 = Very high	6-8 = High	3-5 = Medium	0-2 = Low

b. The following important points of risk were noted:
- List nos. 1-10
- Additional comments (continue on back of form if necessary)
-

c. Indicate if the dug well is not protected!

IV. Name and signature of assessors:

6. RADWQ SANITARY INSPECTION FORM

SPRING

I. General information (a-c compulsory; d-f optional):

a. WSS No.: ....
b. Village/Town: ....
c. Date of visit:...
d. Broad area/Region: ....
e. Zone: ....
f. People served: ....

II. Specific diagnostic information for assessment:

(Please indicate at which sites the risk was identified)

	Spring	**Risk**
1	Is the collection or spring box absent or faulty?	Y/N
2	Is the masonry or backfill area protecting the spring faulty or eroded	Y/N
3	If there is a spring box, is there an unsanitary inspection cover or air vent?	Y/N
4	Does spilt water flood the collection area (e.g. from overflow pipe)?	Y/N
5	Is the fence absent or faulty?	Y/N
6	Can animals have access within 10 m of the spring?	Y/N
7	Is there a latrine uphill and/or within 30 m of the spring?	Y/N
8	Does surface water collect uphill of the spring within 30 m?	Y/N
9	Is the diversion ditch above the spring absent or non-functional?	Y/N
10	Are there any other sources of pollution uphill of the spring (e.g. faeces, or solid waste)?	Y/N
	Total score of risks:	**/10**

III. Results and comments:

a. Risk score (tick appropriate box):

9-10 = Very high	6-8 = High	3-5 = Medium	0-2 = Low

b. The following important points of risk were noted:
- List nos. 1-10
- Additional comments (continue on back of form if necessary)

c. Indicate if the spring is not protected!

IV. Name and signature of assessors:

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