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Small-scale water supplies in the pan-European region

Background · Challenges · Improvements

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Acknowledgements

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Contents

Introduction

Public water tap, Rudaki district, RSS region, Tajikistan
© UNICEF, Dushanbe (Tajikistan)/ Nargis Artushevskaya

Small-scale water supplies are the backbone of water supply in rural areas in the entire pan-European region.[1]

Safe and acceptable water for human consumption that is available in sufficient quantity, physically accessible and affordable is a crucial prerequisite for human well-being. Access to safe water is not only fundamental to good health but also to satisfactory livelihoods, dignity and prospects for economic growth and education. The lack of access to sufficient amounts of safe water leads to human suffering and to loss of human potential, which is ethically indefensible as well as economically wasteful.[2]

1 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 United Nations Development Programme. *Summary human development report 2006. Beyond scarcity: power, poverty and the global water crisis*. New York, UNDP, 2006 (http://hdr.undp.org/en/media/HDR06-complete.pdf, accessed 7 July 2010).

Worldwide, diarrhoeal disease is the second leading contributor to global disease burden. The burden from diarrhoeal disease is largely preventable, as almost 90% of it can be attributed to unsafe water, inadequate sanitation and insufficient hygiene. For children under the age of 15 years, the burden of diarrhoeal disease is greater than the combined impact of HIV/AIDS, tuberculosis (TB) and malaria, and diarrhoea is the second most common cause of death among children under 5 years of age. For all age groups, approximately 207 million incidents and 39 000 deaths in the European Region are attributed to diarrhoea every year. The burden of disease caused by diarrhoea in Europe amounts to approximately 1.4 million disability-adjusted life years (DALYs) per year. WHO estimates that improvements in access to safe water and adequate sanitation can reduce the number of children who die each year on a global scale by 2.2 million.[3,4,5]

Recently, the Fifth Ministerial Conference on Environment and Health (Parma, Italy, March 2010) called for action on protecting children's health from poor environmental and living conditions, especially lack of water and sanitation, in the European Region. By means of the Parma Declaration on Environment and Health, the ministers of health and environment in the European Region commit to providing each child with access to safe water and sanitation in homes, childcare centres, preschools, schools, health-care institutions and public recreational water settings by 2020, and to revitalize hygiene practices.[6]

The provision of safe and acceptable drinking water of sufficient quantity frequently represents a challenge to small-scale water supplies. Experience has shown that they are more vulnerable to breakdown and contamination than larger utilities, and that they require particular political attention due to their administrative, managerial or resourcing specifics. Many of today's national and international policy frameworks already recognize that further attention to this topic is needed.

One of the policy frameworks addressing small-scale water supplies is the Protocol on Water and Health to the 1992 Convention on the Protection and Use of Transboundary

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3 WHO. *Global burden of disease: 2004 update*. Geneva, World Health Organization, 2008a (http://www.who.int/healthinfo/global_burden_disease/GBD_report_2004update_full.pdf, 6 July 2010).

4 WHO. *UN-water global annual assessment of sanitation and drinking-water (GLAAS) 2010: targeting resources for better results*. Geneva, World Health Organization 2008b (http://www.unwater.org/downloads/UN-Water_GLAAS_2010_Report.pdf, accessed 6 July 2010).

5 UNICEF, WHO. *Diarrhoea: why children are still dying and what can be done*, New York/Geneva, United Nations Children's Fund, World Health Organization, 2009 (http://whqlibdoc.who.int/publications/2009/9789241598415_eng.pdf, accessed 6 July 2010).

6 WHO Regional Office for Europe. *Parma Declaration on Environment and Health*, Copenhagen, WHO Regional Office for Europe, 2010.

Public well for families living in apartments, Ukraine 2007 © WECF, Munich (Germany)/ Margriet Samwel

Watercourses and International Lakes (London, 17 June 1999) — the first legally binding, multilateral agreement in the European Region linking sustainable water management and health protection. One of the Protocol's aims is to prevent, control and reduce water-related diseases through adequate supply of safe drinking water and the sustainable management of water resources. Given the significance of small-scale water supplies in the rural and peri-urban areas in the entire European Region, they were addressed as a thematic area of the Programme of Work for 2007–2009.

In 2008 the German Federal Environment Agency (FEA), WHO Collaborating Centre for Research on Drinking Water Hygiene (Germany) hosted a workshop on "Water Safety in Small-Scale Water Supplies in the European Region: Common Challenges and Needs" (Bad Elster, 26–27 November 2008).[7] A broad range of experts from 19 countries from within the European Region — including drinking-water regulators, researchers, health surveillance professionals and fieldworkers from nongovernmental organizations (NGOs) — shared their experiences and evidence related to challenges commonly encountered in small-scale water supplies, along with options for effective management approaches.

7 Further information on the outcomes and conclusions of the workshop can be found in: UNECE, WHO Regional Office for Europe. *Report on the Workshop on Water Safety in Small-Scale Water Supplies in the European Region*. Geneva, United Nations Economic Commission for Europe, WHO Regional Office for Europe, 2009 (http://www.unece.org/env/water/meetings/wgwh/Secondmeeting_2009/ece_mp_wh_wg_1_2009_9.pdf, accessed 13 August 2010).

Participants identified that small-scale water supplies require more focused attention and recommended that this should become a specific activity under the future Protocol work programme, and that awareness-raising material should be generated. This view has repeatedly been confirmed by the Parties to the Protocol.

According to the provisions of its article 6, the Protocol requires Parties to set targets and target dates for preventing, controlling and reducing water-related disease. Such targets may include, but are not limited to, various initiatives improving the situation of small-scale water supplies.

This document is intended for supporting decision makers, such as policymakers or regulators in the drinking-water sector, to appreciate better and address the particularities and characteristics of small-scale water supplies. It provides a range of background information, case studies and lessons learned, and gives ideas for addressing issues relating to small-scale water supplies in national programmes. Additionally, information on further reading as well as current international networking activities with respect to small-scale water supplies is provided.

What are small-scale water supplies?

The definition of a small-scale water supply can vary widely within and between countries. Frequently, small-scale water supplies are defined on the basis of legislatively specified criteria, such as population size, quantity of water provided, number of service connections or the type of supply technology used.

No matter what criteria or terms are used to describe small-scale water supplies, typically it is not the size in itself that sets them apart from larger supplies, but rather their administrative, managerial and operational characteristics, conditions and challenges. For the purpose of this report, the term "small-scale water supplies" is used throughout. Unless otherwise specified, this term does not refer to a particular number of people served or an amount of water supplied.

Small-scale water supplies can be categorized by two criteria: the group of people responsible for their administration, management and operation; and the group of users they supply. Small-scale water supplies comprise the types of supplies listed here.

- **Private or individual wells**: point sources, such as boreholes, dug wells, springs or rainwater collection, potentially piped into the dwelling or yard, which typically serve a single family or a small number of households (for example, farms, hamlets), and which are operated by the users themselves.
- **Community-managed supplies**: systems administered and managed via self-responsibility by the community members (for example, cooperatives) who are also the users of the water. Community-managed water supplies range from point sources (such as dug wells, boreholes or springs) from which community members collect water and carry it home, to more sophisticated systems which may involve treatment, storage and piped distribution into dwellings or yards.
- **Public supplies**: systems administered and managed by a distinct public entity (such as a municipality or water board association) responsible for the provision of drinking water to the public in a spatially limited area (for example, a small municipality or town).

Small-scale water supplies are vital to supplying water to significant parts of the population in all countries of the European Region. This applies to both permanent residents and transient users (such as tourists, guests). Small-scale water supplies usually prevail in rural areas, including individual farms or settlements, hamlets, villages and small towns, or on small islands. Typically, they can also be found in vacation or leisure homes, trailer parks or camping grounds. Displaced, mobile, migrant and temporary populations — including occupiers of temporary homes, pilgrims, nomads, seasonal workers or participants of large festivals or fairs — may place additional stress on the management and operation of small-scale water supplies. Water supplies serving peri-urban areas (that is, the communities surrounding major towns and cities) are often beyond the reach of municipal services and organized in the same way, and can therefore — in a number of circumstances — also be considered as small-scale water supplies.

Well house of a rural, public water supply, Lithuania © UBA, Dessau-Roßlau (Germany)/ Oliver Schmoll

Why are small-scale water supplies important?

The United Nations Millennium Development Goal (MDG) target 7c calls on countries to halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation. The Joint Monitoring Programme (JMP) for Water Supply and Sanitation of WHO and the United Nation Children's Fund (UNICEF) is mandated to monitor progress towards that MDG. As the indicator for drinking water, the JMP uses the proportion of the population making use of an "improved" drinking-water source in urban and rural areas. "Improved" drinking-water sources (see Table 1) are those that, by the nature of their construction, adequately protect the source from outside contamination, in particular regarding faecal matter. Therefore, they are more likely to provide safe drinking-water than sources characterized as "unimproved". Current JMP data suggest that, on a global scale, the access to safe drinking water targeted for 2015 is expected to be met or even exceeded at the current rate of progress.[8]

Spring water, town of Viterbo, Italy
© National Institute of Health, Rome (Italy)/ Emanuele Ferretti, Massimo Ottaviani

Properly maintained well head, source supplying small village in Southern Moravia, Czech Republic
© National Institute of Public Health, Prague (Czech Republic)/ Frantisek Kozisek

8 WHO and UNICEF. *Progress on sanitation and drinking water: 2010 update*. Geneva, New York, World Health Organization, United Nations Children's Fund, 2010 (http://www.unicef.org/media/files/JMP-2010Final.pdf, accessed 7 July 2010).

Waiting at the public tap for filling bucket with drinking water, Romania 2008
© WECF, Munich (Germany)/ Margriet Samwel

Table 1. JMP classification for "improved" and "unimproved" drinking-water sources

'Improved' drinking-water sources	'Unimproved' drinking-water sources
Piped water into dwelling, plot or yard	Unprotected dug well
Public tap or standpipe	Unprotected spring
Tubewell or borehole	Cart with small tank or drum
Protected dug well	Tanker truck
Protected spring	Surface water (river, dam, lake, pond, stream, canal, irrigation channel)
Rainwater collection	Bottled water[9]

Source: WHO/UNICEF, 2010.[10]

On a global scale, 884 million people or 13% of the world's population had no access to improved water supply in 2008. Disparities between urban and rural areas are significant: 84% of the population without access to improved sources live in rural areas.[11]

In the pan-European region (see Map 1), approximately 30% of the total population live in rural areas (see Map 2 and Table 2), in which small-scale water supplies predominantly prevail. Access to improved drinking-water sources in countries of this region varies between 70% and 100% of the total population, and in rural areas

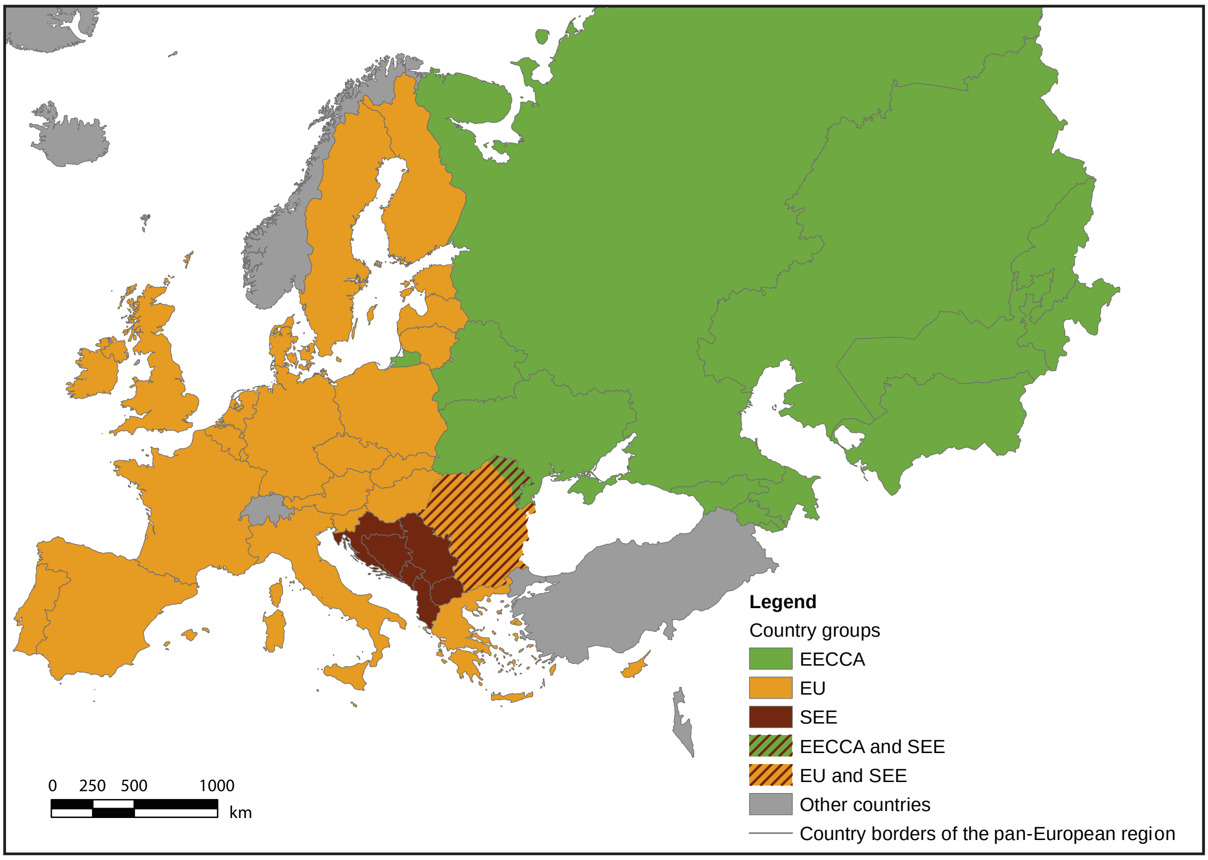
9 Under JMP definition, bottled water is considered to be improved only when the household uses drinking-water from an improved source for cooking and personal hygiene; where this information is not available, bottled water is classified on a case-by-case basis.

10 WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation [web site]. Geneva, New York, World Health Organization/United Nations Children's Fund, 2010 (http://www.wssinfo.org/definitions/infrastructure.html, accessed 6 September 2010).

11 See footnote 8.

between 61% and 100% (see Map 3 and Table 2). Of the population in urban areas, 1% are without access to improved drinking-water sources; however, in rural areas, this is the case for 6% of the population, or approximately 14 million people.[12] More details for Eastern European, Caucasus and Central Asian (EECCA) countries, for South-Eastern Europe (SEE) countries and European Union (EU) member States are given in Table 2.

Map 1. Country groups in the pan-European region[13]
Sources: EUROPA, 2010;[14] WHO Regional Office for Europe, 2008;[15] OECD, 2010.[16]
Cartography and design: Institute for Hygiene and Public Health, University of Bonn, Germany, 2010.



12 See footnote 8.

13 *EU countries*: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom; *Eastern European, Caucasus and Central Asia countries*: Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Republic of Moldova, Russian Federation, Tajikistan, Turkmenistan, Ukraine and Uzbekistan; *SEE countries (according to the definition of the WHO SEE Health Network)*: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Montenegro, Republic of Moldova, Romania, Serbia and the former Yugoslav Republic of Macedonia; *Other countries*: Andorra, Iceland, Israel, Monaco, Norway, San Marino, Switzerland and Turkey.

14 EUROPA. Gateway to the European Union [web site]. Luxembourg, EUROPA, 2010 (http://europa.eu/about-eu/27-member-countries/index_en.htm, accessed 7 September 2010).

15 WHO Regional Office for Europe. South-Eastern Europe Health Network (SEEHN). *Memorandum of Understanding*. Copenhagen, WHO Regional Office for Europe, 2008 (http://www.euro.who.int/__data/assets/pdf_file/0006/108663/SEE_MoU.pdf, accessed 7 September 2010).

16 OECD. 12 Eastern European, Caucasus and Central Asian countries [web site]. Paris, Organization for Economic Cooperation and Development, 2010 (http://www.oecd.org/document/29/0,3343,en_2649_33722239_35976157_1_1_1_1,00.html (accessed 7 September 2010).

Map 2. Proportion of rural population in countries of the pan-European region in 2008
Cartography and design: Institute for Hygiene and Public Health,
University of Bonn, Germany, 2010.
Source: WHO and UNICEF, 2010.[17]

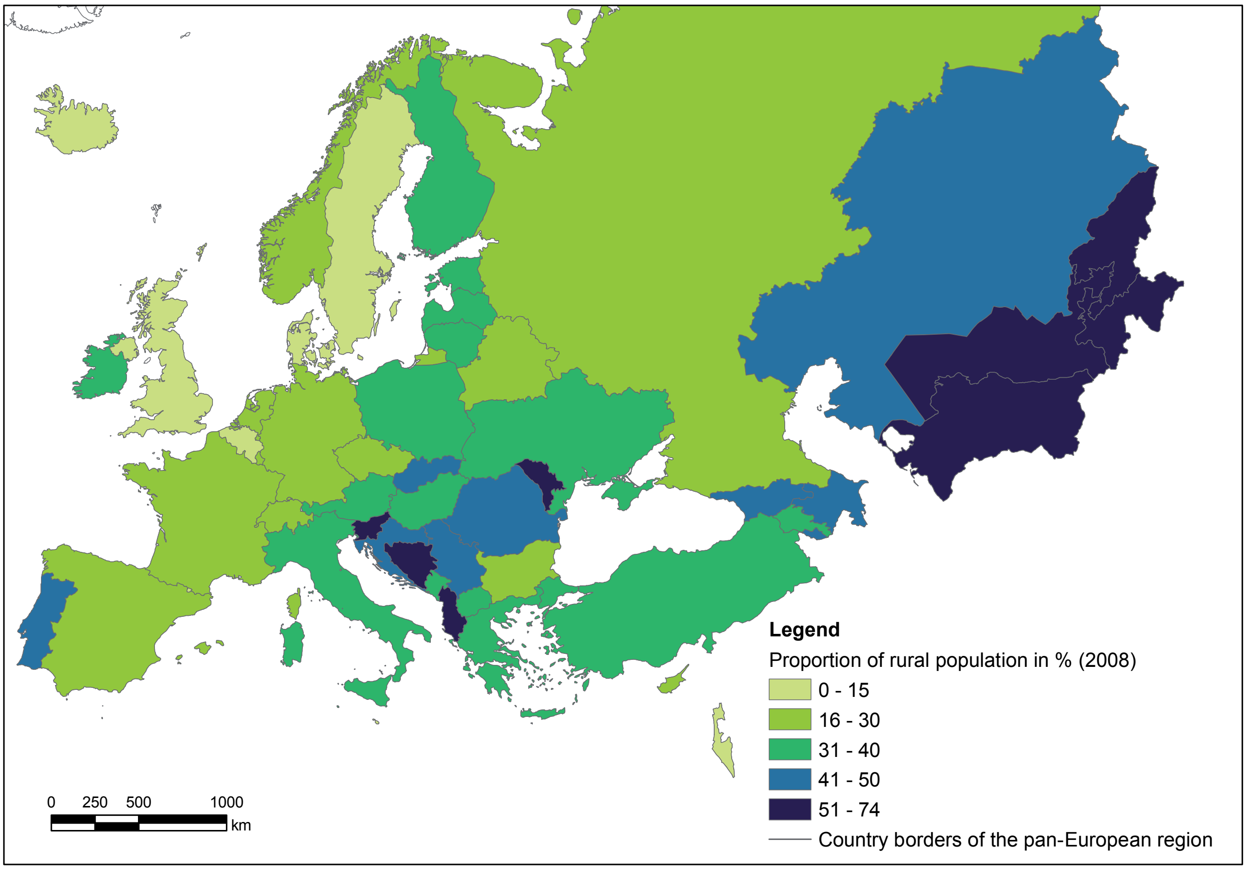


Table 2. Access to improved drinking-water sources in rural areas in the pan-European region[18]

Area	Total population	Proportion of rural population (%)	Access to improved sources Rural population (%)	Total population (%)
pan-European region	889 165 000	30	94	98
EU	494 769 000	26	100	100
EECCA	276 819 000	36	87	94
SEE	56 428 000	45	96	98
Other countries	93 736 000	28	97	99

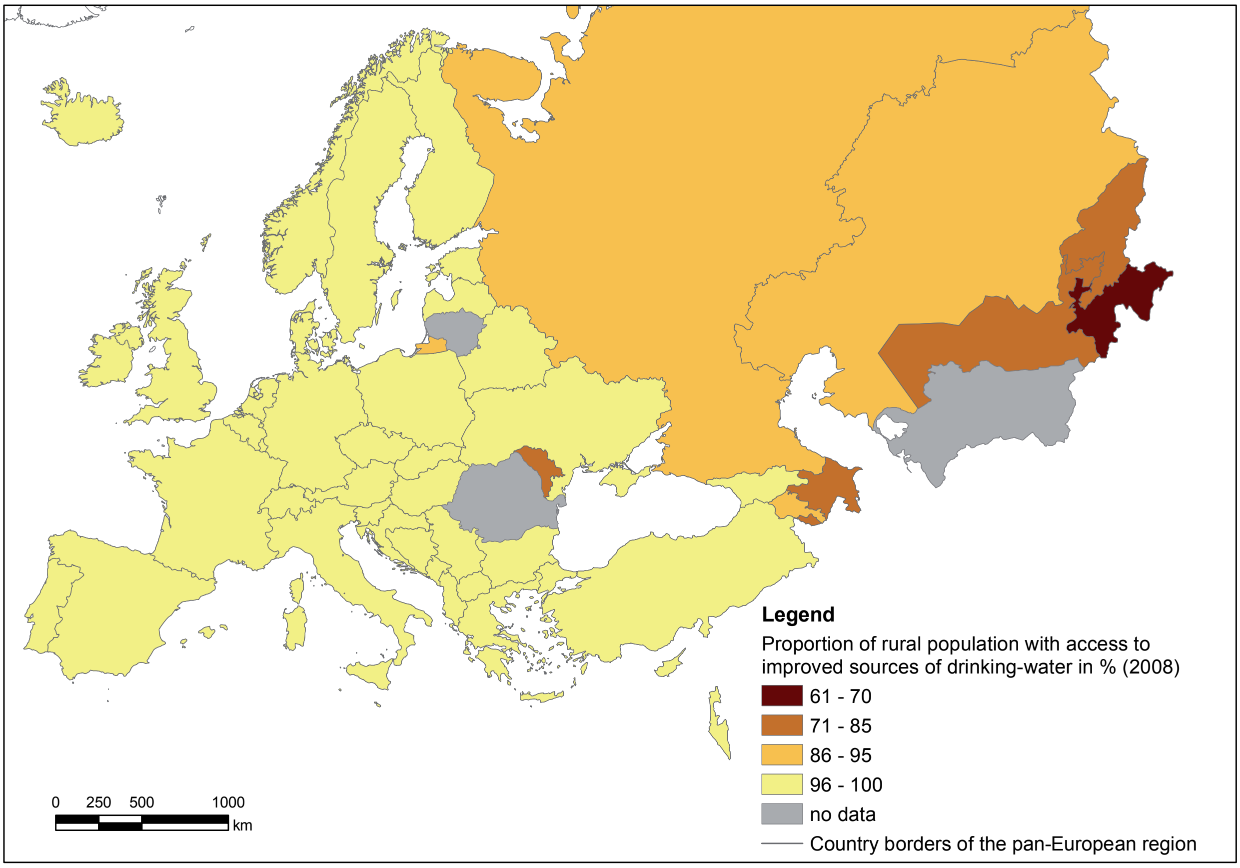
Source: Authors' calculations based on WHO and UNICEF, 2010.[19]

17 See footnote 8.

18 Data on access to improved sources do not include data for Lithuania, Romania, San Marino and Turkmenistan as available data sets are incomplete.

19 See footnote 8.

Map 3. Proportion of rural population with access to improved sources of drinking water in countries of the pan-European region in 2008
Cartography and design: Institute for Hygiene and Public Health, University of Bonn, Germany, 2010.
Source: WHO and UNICEF, 2010.[20]



Detailed and systematic information on how many small-scale water supplies exist and where they prevail in different countries of the pan-European region is not readily available. However, it is very clear: *they are many* — and this is borne out by the exemplary data gathered in the list that follows.[21]

20 See footnote 8.

21 Unless otherwise indicated, all country-specific data are based on personal communication at the workshop held on 26–27 November 2008, Bad Elster, Germany, and personal communication with workshop participants in 2010.

- Hulsmann estimates that 1 in 10 citizens of the **EU** receives drinking water from small or very small systems, including private wells.[22]
- In **Armenia**, water supply is achieved through approximately 880 centralized public water supplies, largely managed by five organized utilities. Additionally, in 578 rural communities (out of 915), the supply is operated by the community or municipality itself.
- In **Belarus**, approximately 52% of the rural population received drinking water from small centralized public water supplies in 2008.
- In the **Czech Republic**, 7.6% of the population (or approximately 780 000 people) are supplied with water from individual sources (that is, domestic wells for permanent households). In addition, several million people use water from domestic wells during weekends or holidays (for example, cottages, weekend houses, recreational facilities). According to the last official estimation in 1989, there were approximately 750 000 private wells in the Czech Republic. For public supplies, in 2007, 93% of the 4065 water supply zones each served fewer than 5000 people, with 29% serving fewer than 100 individuals and 51% serving between 101 and 1000 people.
- In **Estonia**, 16% of the total population rely on private water supplies (boreholes and wells) and 59% of the rural population are connected to centralized public water supplies. Out of the 1235 centralized drinking-water supplies in Estonia, 107 supply between 100 and 1000 m^3 per day, serving approximately 12% of the total population; and 1106 supply less than 100 m^3 per day, also serving approximately 12% of the total population.
- Approximately 1000 of the 1450 waterworks in **Finland** are classified as small-scale waterworks in rural areas, serving 50 to 500 inhabitants. These are mostly community managed (usually cooperatives); however, some small waterworks are managed by the municipality. Approximately 10% of the population make use of private boreholes or dug wells. In addition, private wells are the main source of drinking-water supply for rural holiday homes.

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22 Hulsmann A. *Small systems large problems: A European inventory of small water systems and associated problems*. Nieuwegein, Web-based European Knowledge Network on Water (WEKNOW), 2005.

- In **Germany**, approximately 20% of the population (or approximately 16 million people) receive water from more than 3300 small public supplies serving fewer than 5000 people, and approximately 700 000 use water from some 185 000 private or hamlet wells. In the federal states (Länder) of Bavaria and Baden-Württemberg, for example, more than one third of the population are served by small public supplies.
- In **Hungary**, approximately 75% of about 1650 water supply systems registered with the water authorities supply fewer than 5000 inhabitants. Approximately 0.8% of the total population are served by systems supplying fewer than 500 people, and approximately 15% by systems supplying fewer than 5000 people. Out of the total of 317 water supply companies, there are 192 that only operate one single water supply system, 119 of which supply fewer than 5000 people.
- In **Italy**, out of the approximately 11 500 drinking-water supplies, more than 7100 served between 3 and 275 m^3 per day, and approximately 2800 served between 276 and 1370 m^3 per day in 1999. Most of those small public supplies use spring or well water as their water supply sources.
- Approximately 25% of the total population of 3.4 million people in **Lithuania** is supplied with water from individual (dug) wells, mostly serving one family each. Out of the 1918 centralized public drinking-water supplies in Lithuania, 6% serve between 100 and 1000 m^3 per day and 91% serve less than 100 m^3 per day.
- In **Scotland**, a population of around 144 000 people (that is, excluding thousands of occasional users such as holiday-makers) or 3% of the total population are served by approximately 17 500 private water supplies.
- More than 90% of the approximately 2600 drinking-water suppliers in **Switzerland** are small suppliers, serving fewer than 5000 inhabitants. The tendency is that the number of combined supply networks of water suppliers is growing from year to year, while the number of small-scale supplies serving a single commune is decreasing.
- In **the former Yugoslav Republic of Macedonia** approximately 140 000 people (or approximately 15% of the rural population or 6.4% of the total population, respectively) use water from individual sources (for example, springs, wells and so on).

What are the challenges?

Small-scale water supplies have a number of similar characteristics and face a number of similar challenges related to their regulatory environment; administration; management; operation; and available technical, personnel and financial resources; they include — but are not limited to — the aspects listed in the following subsections. It should be noted, however, that not every characteristic described below is necessarily relevant to all small-scale water supplies, nor are the challenges limited to small-scale water supplies alone. The challenges listed here rather reflect experiences shared and reported by countries of the pan-European region within the Protocol context.

Regulations

- Small-scale water supplies are often not regulated or regulated differently compared to larger supplies. The supranational legislation of the EU is an example of this: according to the provisions of the Drinking Water Directive (DWD), member States may exempt supplies serving less than 10 m^3 a day or serving fewer than 50 individuals from the minimum requirements of the DWD, unless the water is supplied as part of a commercial or public activity.[23]
  In cases in which regulatory requirements for small-scale water supplies exist, they are often not feasible, or enforcement mechanisms tend to be weak or ineffective, among other reasons, due to their large numbers and the geographical spread of small-scale water supplies.
- Regulations often base required drinking-water quality monitoring frequencies on the size of the population served. Minimum monitoring requirements for small-scale water supplies are comparatively rare and typically range between 1 and 4 analyses per year; some jurisdictions even exclude private wells from any monitoring requirements. In combination with non-existent or less-stringent reporting requirements, in many countries, systematic evidence on the status of drinking-water quality in small-scale water supplies is not readily available.

23 European Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption. Available online in several languages at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31998L0083:en:NOT, accessed 7 July 2010.

Attention and sense of responsibility

- Experience has shown that small-scale water supplies typically receive less political attention. Managers and operators of small community-managed supplies or of small public supplies are rarely organized in professional networks or in lobby groups that could function as a mouthpiece for their interests. Therefore, financial and political support — both locally and nationally — are harder to leverage, resulting in limited and inconsistent resourcing.
- There is frequently a low level of awareness and knowledge of potential risks from water to health among rural populations — as if to say: "My grandpa already drank our local groundwater and never got sick".
- The inaccurate perception of the importance of water supply for public health protection may lead to a lack of a sense of responsibility among local decision makers, resulting in comparatively little political priority and thus underresourcing of water supply.

Staff and management

- Small-scale water supplies frequently lack personnel with specialized knowledge. Often non-water professionals or undertrained individuals operate the supply. In community-managed or public supplies, staff regularly carry out many tasks within the community or municipality in addition to water supply. Due to the larger geographical spread covered by small-scale water supplies, and sometimes their remoteness and isolation, operators do not have easy access to information, expert assistance and technical support; there is also a low level of networking in scientific and professional communities.
- Frequently, there is a lack of awareness, knowledge and application of internationally or nationally recognized good managerial and operational practices, including those recommended by the WHO Guidelines for Drinking-water Quality[24,25] or relevant international standards. Integrated risk-assessment

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24 WHO. *Guidelines for drinking-water quality, volume 1: recommendations*, third edition, Geneva, World Health Organization, 2004 (http://www.who.int/water_sanitation_health/dwq/gdwq3rev/en, accessed 6 July 2010).

25 WHO. *Guidelines for drinking-water quality, volume 3: surveillance and control of community supplies, second edition*. Geneva, World Health Organization, 1997 (http://www.who.int/water_sanitation_health/dwq/gdwqvol32ed.pdf, accessed 3 September 2010).

Water reservoir tower supplying small village in Southern Moravia, Czech Republic
© National Institute of Public Health, Prague (Czech Republic)/ Frantisek Kozisek

and risk-management approaches, such as the WHO-recommended Water Safety Plan (WSP) approach, are not extensively applied.

Water resources and treatment

- Small-scale water supplies are often vulnerable to contamination. In many rural contexts, there is often a lack of integrated approaches regarding water source protection; sanitary protection of drinking-water sources is frequently inadequate; protection zones are often not established; and sometimes owners and users do not know where the water supplied is coming from. Experience has shown that adequate disposal of waste and excreta, wastewater drainage, placement of septic systems, controlling animal access to water supplies and market hygiene in rural communities often pose challenges in rural communities, along with little understanding in the general public of the importance of water resource protection. Especially in rural agricultural areas, common pollution risks include livestock, wildlife, poor manure management and inadequate local sanitation practices, which frequently result in poor microbial drinking-water quality (see also Box 2 regarding campylobacteriosis) and elevated nitrate levels.

- The use of water-treatment technologies is generally limited and not necessarily consistent with source water quality. In many rural settings, groundwater is used for drinking purposes without disinfection, regardless of its contamination level. Heavy rainfalls and thaw also exert significant strain on small-scale treatment systems. Small-scale water supplies are less resilient to quality and quantity (for example, water scarcity) issues, induced by the possible impacts of climate change.
- Small-scale water supplies are often more vulnerable to breakdown. Maintenance of infrastructures is frequently limited due to lack of knowledge and understanding, or lack of adequate resourcing (for example, financial and personnel, spare parts or building materials). As a consequence, aged supply infrastructures — even of "improved" sources — are often disrupted or not in working condition. This, combined with the lack of electricity, can limit operations, affect water quality and quantity, and frequently lead to intermittent supply with negative impacts on personal, domestic and food hygiene conditions. Users may also turn to other, potentially "unimproved" and therefore unsafe sources as alternative sources of water supply.
- Small-scale water supplies have relatively greater capital costs for technical installations, and per-unit costs of materials and construction are also generally greater. There is often a lack of financial mechanisms to cover the local costs for monitoring, maintenance and operation.

Borehole with agricultural activity right up to borehole. Scotland.
© Drinking Water Quality Regulator for Scotland, Edinborough (Scotland)

Damaged water supply system in Farhor district, Khatlon region, Tajikistan
© UNICEF, Dushanbe (Tajikistan)/ Nargis Artushevskaya

Borehole with no protection from livestock. Scotland.
© Drinking Water Quality Regulator for Scotland, Edinborough (Scotland)

What is the evidence?

In many countries of the pan-European region, systematic evidence on the status of drinking-water quality in small-scale water supplies is not readily available. Personnel, financial or technical capacities, as well as outreach of local, regional or national agencies mandated with drinking-water quality are often weak in rural areas. Experience has shown that systematic and ongoing routine drinking-water quality surveillance of small-scale water supplies — including drinking-water quality monitoring and sanitary inspection — is frequently inadequate or non-existent. In rural areas, independent surveillance of drinking-water quality and sanitary risks is frequently rather random and ad hoc, for example in response to disease outbreaks or incidents.

Nationally available drinking-water quality data are often biased towards water supply in urban areas and rarely represent the situation in rural areas. Furthermore, data are commonly scattered among different local, regional and national institutions, difficult to access and thus not ready for analysis. In consequence, readily available hard data relating to drinking-water quality in small-scale water supplies in the pan-European region are scarce, and the respective evidence therefore often remains informal and anecdotal. An overview of examples of drinking-water quality data for a limited number of countries in the pan-European region is shown in Box 1.

The information provided in Box 1 shows that compliance with microbial indicators (for example, *Escherichia coli*, thermotolerant coliforms) remains a challenge in many small-scale water supplies, more than in centralized supplies, resulting in water of a quality that is potentially not safe for consumption and liable to affect public health. However, data on the occurrence of waterborne pathogens which may be of relevance in rural areas (for example, pathogenic *Escherichia coli*, *Campylobacter jejuni*, *Salmonella typhi*, *Cryptosporidium parvum*, *Giardia intestinalis*) are only sparsely available due to the lack of specialized analytical techniques in many local laboratories. In addition to microbial pollution, chemical contamination with naturally occurring arsenic, fluoride, uranium, sulphate, iron, manganese or toxins from algal blooms — as well as nitrate or pesticides in agricultural areas — remain a considerable local or regional concern.

Box 1. Exemplary drinking-water quality data for small-scale water supplies in the pan-European region[26]

Belarus

Non-compliance with the sanitary requirements for drinking water from small centralized public water supplies to rural populations is at approximately 14.5% for microbial indicator parameters and 30.1% for chemical indicator parameters; non-compliance with nitrates and nitrites is highest, at 28.6%. Waterborne outbreaks have not been reported since 2003.

Croatia

In Croatia there are 443 small water supply systems (serving approximately 50 to 3000 people), which are not subject to regular water quality testing by the Public Health Institute. According to data collected in 2008 during a study by the Croatian Public Health Institute on the status of small-scale water supply systems, approximately 7% of the Croatian population are supplied by such systems. According to this study, approximately 70% of this 7% of the population receive water which is not in compliance with the respective standards. Approximately 14% of the population are supplied with water from private wells; however, no quality data are available for these supplies.

Czech Republic

According to a study carried out by the National Institute of Public Health in 1999, reviewing water quality data from approximately 1700 small public groundwater well supplies and 3300 private wells from the period 1991–1998, there was a non-compliance rate with health-related parameters of approximately 70%. A total of 9 out of 27 waterborne outbreaks reported in 1995–2005 were caused by private (domestic) wells and another 10 by small commercial wells.

England and Wales

An analysis of data collected from 150 local authorities in England covering approximately 35 000 microbial water quality results for approximately 11 200 private water supply sites for the time period 1996–2003 showed that *Escherichia coli* (*E. coli*) was detected in 19% of samples, with at least one positive sample being detected at 32% of water supply sites (compared to 0.1% of samples from mains water supplies). While only approximately 0.5% of the total population rely on private supplies, 36% of all detected drinking-water outbreaks were associated with such supplies.[27,28]

Estonia

In 96 small centralized water supplies, the major drinking-water quality problems include excess concentrations of naturally occurring fluoride of higher than 1.5 mg/l. The degree of contamination varies regionally and depends on the used groundwater level. Temporary deviations from required microbiological parameters were noted in 0.05% of the waterworks under surveillance in 2009. Mostly, these deviations from requirements occur when there are technical problems relating to the water supply.

Due to technical improvements (such as well, pipeline and treatment plant repair and water treatment methods) and increased monitoring, there have been no outbreaks associated with drinking-water since 1996.

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26 Unless otherwise indicated, all country-specific data in Box 1 are based on personal communications at the workshop held on 26–27 November 2008 in Bad Elster, Germany, along with personal communications with workshop participants in 2010.

27 Hunter, P. R. et al., An assessment of the costs and benefits of interventions aimed at improving rural community water supplies in developed countries. *Science of the Total Environment*, 2009, 407:3681–3685.

28 Richardson, H. Y. et al., Microbiological surveillance of private water supplies in England — the impact of environmental and climate factors on water quality. *Water Research*, 2009, 43(8):2159–2168.

Box 1. Continued.

Finland

In a pilot study which investigated 245 small-scale water supplies serving less than 500 individuals in rural areas, the most frequent drinking-water quality problems identified include acidity (33% of the samples); iron and manganese (26%); coliforms (18%); turbidity and colour (9%); *E. coli* (7%); and fluoride (4%). Another study from the year 2008 came up with the general finding that the quality of drinking water produced by small water supplies (N=740) is worse than the quality of water from large water supplies (N=170). The compliance percentages were, however, higher than detected in the pilot study mentioned above. In the category of smallest water supplies, producing 10 to 100 m^3 of water per day, 97% of the results complied with the quality requirements for total coliforms; the corresponding percentage was 99.4% in the category of the largest water supplies, producing over 1000 m^3 of water per day.[29]

Germany

In the federal state (*Land*) of Baden-Württemberg, as an example, 523 samples from approximately 13 500 private wells were analysed in 2007; non-compliance rates for *E. coli* and total coliforms were at 18% and 43%, respectively. Non-compliance rates for small public water supplies serving fewer than 5000 people were at 2% and 5% for *E. coli* and total coliforms, respectively.

A recent review of water quality data for small public supplies in Germany for 2007–2008[30] revealed that non-compliances for *E. coli*, enterococci, colony count, nitrate, ammonium, iron, manganese, pH and turbidity were particularly frequent. The review also showed that, in comparison to larger supplies, non-compliance was more frequent with decreasing size of supplies. Whereas 95.6% of the drinking-water supply zones serving more than 1000 m^3 per day complied with the parametric values of the EU DWD in 2007,[31] this was the case for 93.2% of the supply zones serving between 400 and 1000 m^3 per day, for 92.4% of the supply zones serving between 100 and 400 m^3 per day, and for 89.7% of the supply zones serving between 10 and 100 m^3 per day.

Lithuania

No routine monitoring for private wells is required; for most of the shallow dug wells, monitoring is carried out on an ad hoc basis. Contamination with nitrate (46%) and microbial indicators (28%) are the most common. Maximum nitrate levels found were 620 mg/l (median: 43 mg/l), and a few cases of infant metheamoglobinaemia (blue baby syndrome) are reported every year (for example, three cases in 2007). In small public drinking-water supplies, excess concentrations of naturally occurring fluoride are a major quality concern. Out of all cases of non-compliance detected, 95% occur in small public water supplies serving less than 100 m^3 per day.

29 Zacheus O. Talousveden, laadussa eniten ongelmia pienillä laitoksilla [Quality problems in drinking water from small water supplies]. *Vesitalous*, 2009, 3:6–9 (in Finnish).

30 FEA and Ministry of Health. *Berichterstattung über kleine Wasserversorgungsgebiete nach Richtlinie 98/83/EG über die Qualität von Wasser für den menschlichen Gebrauch. Zusammenfassung der Länderberichte über kleine Wasserversorgungsgebiete*. German Federal Environment Agency and Ministry of Health, 2010.

31 FEA and Ministry of Health. *Bericht des Bundesministeriums für Gesundheit und des Umweltbundesamtes an die Verbraucherinnen und Verbraucher über die Qualität von Wasser für den menschlichen Gebrauch (Trinkwasser) in Deutschland: Berichtszeitraum: 1. Januar 2005 bis 31. Dezember 2007*. Bonn/Dessau, Federal Environment Agency and Ministry of Health, 2008 (http://www.umweltdaten.de/publikationen/fpdf-l/3616.pdf, accessed 24 August 2010).

Box 1. Continued.

Scotland

Out of 1750 samples taken from private water supplies in Scotland between 1992 and 1998, 41% failed compliance for total coliforms, 30% failed for *E. coli* and 15% failed for nitrate. The combined failure rate was 48%. After the introduction of new regulations for private water supplies, data from 2008 show that 23% of the 2650 samples taken from private supplies did not comply with *E. coli* standards. Non-compliance rates in 2009 were 21% for *E. coli*, 19% for colour, 31% for pH, 10% for iron, 10% for manganese and 7% for lead. Between 1 January 2006 and 15 October 2008 there were 48 confirmed clinical cases of *E. coli* O157 infection, in which *E. coli*. O157 contamination of a private water supply was either confirmed or suspected.

The former Yugoslav Republic of Macedonia

In 2007, 33% of the rural population used centralized piped water supply systems with a bacteriological failure rate of approximately 2%. Local piped water supply systems were used by 54% of the rural population (bacteriological failure rate: 23%). Local (non-piped) water sources were used by 13% (bacteriological failure rate: 30%).

The challenges reported — in combination with water-quality data indicating a comparatively high degree of non-compliance with microbial indicators — give rise to the question to what extent small-scale water supplies are actually more prone to cause outbreaks of waterborne disease (such as acute diarrhoeal illness, typhoid, cholera, bacillary dysentery, campylobacteriosis, *E. coli* infections and viral hepatitis A and E), compared to supplies of a larger scale.

Systematic, easily accessible evidence relating to waterborne disease outbreaks in small communities in the pan-European region is currently not readily available. However, anecdotal evidence suggests that outbreaks of waterborne diseases in small rural communities are largely underreported. Experience has shown that disease surveillance is primarily ad hoc, driven in response to incidents rather than systematically, and that effective surveillance systems are often lacking in rural areas. Even where monitoring and surveillance are adequate, a complicating factor that presents a challenge is that single outbreaks typically have relatively low numbers of cases, which are difficult to capture and to associate with a common source of exposure. For example, an outbreak that causes 10% of the population served to become ill is easier to detect if the population served is 5000 (where 500 people would be affected), than if the population served is 50 (where only 5 people would become ill). Sporadic disease is likely to be much more common than outbreaks, and small outbreaks are more likely not to be attributed

Water quality monitoring, village health clinic, Rudaki district, Tajikistan
© UNICEF, Dushanbe (Tajikistan)/ Nargis Artushevskaya

Indicating the nitrate concentration in water by means of a nitrate quick test, Romania 2009
© WECF, Munich (Germany)/ Margriet Samwel

Public well with indication 'water is not suitable for drinking', Romania 2008
© WECF, Munich (Germany)/ Margriet Samwel

to water.[32] As a result, waterborne disease outbreaks in small-scale supplies are underreported and often remain undetected. In addition, most of the diseases transmitted by ingestion of contaminated water are transmitted in higher frequencies from other sources, such as food and person-to-person contact, making it difficult to identify the extent of the contribution of water. Furthermore, diseases may be transmitted through bathing waters, which can be contaminated with pathogenic microorganisms.

Waterborne disease caused by zoonotic organisms —such as *Campylobacter*, *Cryptosporidium*, *giardia* or pathogenic *E. coli* — has been associated with contaminated drinking water obtained from rural catchments. Excreted material (for example from

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32 See footnote 27.

livestock, wildlife) and other waste products are the predominant sources of waterborne zoonotic pathogens. Unprotected small-scale water supplies in rural areas may be a particular concern.[33] Box 2 presents the outcomes of a literature review on campylobacteriosis in rural areas of the pan-European region in which small-scale water supplies prevail.

Box 2. Summary of results of a literature review on campylobacteriosis in rural areas[34]

The Italian National Institute of Health is conducting a literature review on campylobacteriosis in order to examine whether this disease has a particularly high incidence in rural areas in comparison with urban areas and to highlight the reasons why.

Campylobacteriosis is a zoonotic disease. Hence, it is expected that human exposure and incidence of campylobacteriosis in rural areas is comparatively high. From the analysis of national cases recorded over an 11-year period in Denmark, researchers found that individuals, particularly children, living in areas of the country with a low population density had an increased risk of sporadic campylobacteriosis. This study also made it possible to identify the important role of water as a vehicle for transmission of the disease.[35] Similar conclusions were drawn in Norway, Sweden and the United Kingdom.[36,37,38] All studies underline the role of ruminants as a cause of environmental contamination through their faeces (via soil, water). The United Kingdom study also pointed out the importance of exposures due to recreational and occupational activities in rural areas, and it identified *Campylobacter jejuni* as the prevalent species in rural areas, occurring in 11% of faecal samples from non-avian wildlife; in 36% of cattle faeces samples; and in 15% of water samples.[39]

In 2007, in 25 EU member States, as well as Iceland, Liechtenstein and Norway, 203,709 confirmed cases of campylobacteriosis were recorded. Campylobacteriosis was the most frequently reported gastro-enteric pathogen, with an incidence of almost 46.7 cases per 100 000. Much lower incidences were reported in the same geographic area for other food-borne and waterborne diseases, such as brucellosis (0.1), leptospirosis (0.2), VTEC/STEC (0.6), cryptosporidiosis (2.4) and hepatitis A (2.8). Similar high values were observed for salmonellosis (34.3) and giardiasis (61.7). The incidence of campylobacteriosis was much higher in summer months, male gender, infants and young people, as well as travelling people.[40]

33 Cotruvo, J. A., et al., eds. *Waterborne zoonoses: identification, causes, and control*. London, World Health Organization and IWA Publishing, 2004.

34 Box compiled by Enzo Funari.

35 Ethelberg, S., et al. Spatial distribution and registry-based case-control analysis of campylobacter infections in Denmark, 1991–2001. *Am J Epidemiol*, 2005, 162(10):1008–1015.

36 Nygård, K., et al. Association between environmental risk factors and campylobacter infections in Sweden. *Epidemiology and Infection*, 2004, 132(2):317–325.

37 Kapperud, Gl, et al. Risk factors for sporadic campylobacter infections: results of a case-control study in southeastern Norway. *J Clin Microbiol*, 1992, 30(12):3117–3121.

38 Brown, P. E., et al. Frequency and spatial distribution of environmental campylobacter spp. *Appl Environ Microbiol*, 2004, 70(11):6501–6511.

39 Idem.

40 European Centre for Disease Prevention and Control., *Annual epidemiological report on communicable diseases in Europe 2009 (revised edition)*, Stockholm, European Centre for Disease Prevention and Control. 2010 (http://www.ecdc.europa.eu/en/publications/Publications/0910_SUR_Annual_Epidemiological_Report_on_Communicable_Diseases_in_Europe.pdf, accessed 11 August 2010).

Box 2. Continued.

The Italian National Institute of Health is conducting a literature review on campylobacteriosis in order to examine whether this disease has a particularly high incidence in rural areas in comparison with urban areas and to highlight the reasons why.

In north-east Scotland, children showed a higher incidence of campylobacteriosis in rural than in urban areas. The main sources of infection were direct contact with farm animals and indirect contact with animal faeces (through contaminated soil, waters, food). No significant difference was observed in the incidence of the disease in the adult population living in rural or urban areas. The main disease transmission for the adult population was through the food-borne route.[41]

The analysis of available data and information on campylobacteriosis in rural areas versus urban areas allows the conclusions listed here to be drawn.

- Children are the more affected age group (pattern of exposure) with respect to campylobacteriosis associated with *C. jejuni*, whereas people over 65 years and women are the groups more affected by *C. Coli*.
- Several wild and reared animals are reservoirs of pathogenic *Campylobacter* spp.
- Rural areas are subject to pathogenic *Campylobacter* spp. transmission because of diffuse animal faecal contamination of soil and water.
- Campylobacteriosis can be transmitted by consumption of faecal contaminated drinking-water and food (for example, meat, milk and uncooked vegetables), as well as direct contact with farm animals and contaminated soil.
- Flies can play an important role in campylobacteriosis and in its seasonality in rural areas.
- Cross-contamination can play a significant role, especially because the infective dose of pathogenic *Campylobacter* spp. is relatively low.

The recommendations listed here are given to mitigate the risk of campylobacteriosis outbreaks in rural areas. The key actors should:

- Undertake preventive measures, including avoiding contamination of water sources with animal and human waste (for example, preventing direct access of animals to water sources); adequate treatment and protection of water during distribution and storage (for example, treated and disinfected water should be protected from bird faeces).
- Ensure adequate management of manure to prevent or mitigate soil and water contamination, including safe application and disposal practices.
- Control and monitor the quality of waters for drinking-water abstraction or for recreational use; as *Campylobacter* spp. is not particularly resistant to disinfection, *E. coli* (or thermotolerant coliforms) is an appropriate indicator for *Campylobacter* spp. presence in drinking-water (WHO, 2004);[42] household water treatment should be promoted for those who are exposed to contaminated water.
- Organize and carry out educational campaigns in order to raise the awareness of environmental sources of *Campylobacter* organisms and the resulting risk of infection among young children (for example, from ingesting contaminated drinking water); public health authorities should target their advice accordingly.

The fragility of rural areas with respect to campylobacteriosis should be similar for other zoonotic diseases, such as those caused by *Cryptosporidium* and *Giardia* spp., pathogenic *E. Coli*, and so on.

41 Strachan, N. J., et al., Attribution of campylobacter infections in northeast Scotland to specific sources by use of multilocus sequence typing. *J Infect Dis*, 2009, 199(8):1205–1208.

42 See footnote 24.

What are the cost and benefits of interventions?

The economic benefits from investing in small-scale water supplies and from developing appropriate policies, programmes and regulations are significant.

The prevention of waterborne illness and death results in the avoidance of associated health costs, as well as increased potential for education and business development, and an increase in the long-term sustainability of small communities. If the proportion of people who do not have access to improved water sources and improved sanitation facilities by 2015 is not halved, this would lead to estimated health care costs (worldwide) of US$ 7 billion for health agencies, US$ 340 million for individuals and US $ 63 billion in terms of time lost to the economy and education, every year.[43]

Private water supply, Perth and Kinross, Scotland
© Perth and Kinross Council, Perth (Scotland)

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43 Hutton G, Haller L. *Evaluation of the costs and benefits of water and sanitation improvements at the global level*. Geneva, World Health Organization, 2004 (http://www.who.int/water_sanitation_health/wsh0404.pdf, accessed 9 August 2010).

By improving access to safe drinking water and adequate sanitation, in addition to health benefits through the prevention of diarrhoeal and other waterborne diseases, significant economic benefits may be gained. These include:

- Health care savings by health agencies and individuals;
- Productive days gained per year (for those aged 15–59 years);
- Increased school attendance;
- Time savings (working days gained) resulting from more convenient access to services;
- Value of deaths averted (based on future earnings).[44]

While the median reported Government spending on sanitation and drinking water on a global scale is 0.48% (for drinking water: 0.04–2.80%) of the gross domestic product (GDP), investments result in large economic returns of approximately 2–7% of the GDP.[45]

According to WHO, 62% of sanitation and drinking-water aid is targeted towards large systems (for drinking water these include treatment, drinking-water conveyance and distribution), whereas approximately 16% of the aid is targeted at basic systems (low-cost technologies, such as – for drinking water – hand pumps, spring catchments, gravity-fed systems, rainwater collection, storage tanks, and small distribution systems).[46]

For small-scale water supplies in rural communities, Hunter and colleagues[47] estimated cost-benefit ratios based on costs of improvement interventions in small-scale water supplies aiming at reducing acute diarrhoeal illness and the value of preventable disease measured by direct and indirect costs of illness prevented by these interventions. Globally, an investment of US$ 1 results in a mean return of US$ 2.8 for developed countries. For the pan-European region, the return varies between US$ 2.5 and US$ 21.3. This clearly demonstrates that the financial benefits outweigh the investments in improvements.

Box 3 provides details of a region-specific study, particularly analysing cost benefits of a grant scheme introduced for financing upgrades of private water supplies in Scotland.

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44 Hutton G, Haller L. *Evaluation of the costs and benefits of water and sanitation improvements at the global level*. Geneva, World Health Organization, 2004 (http://www.who.int/water_sanitation_health/wsh0404.pdf, accessed 9 August 2010).

45 See footnote 4.

46 See footnote 4.

47 See footnote 27.

Box 3. Case study of cost-benefit analysis of private water supplies in Scotland[48]

The Scottish Private Water Supplies (Scotland) Grant Regulations of 2006 introduced a grant scheme to provide financial assistance to users of private water supplies to upgrade their supplies and further safeguard public health. Based on a cost–benefit analysis which had been conducted prior to the introduction of the regulations in order to predict their impact, an update in 2010 reviewed and improved the assessment, based on the experience gathered.

For the assessment, an area with 1414 registered private water supplies and a population of approximately 107 000 — mainly living in rural communities — was studied. The assessment considered costs for upgrade and maintenance of the supplies, as well as staff and administration for the local authority. Considered benefits included the avoided cost of illness from drinking contaminated water from private water supplies, analysing the total number of supplies already advanced to date, and projecting the number of supplies which would be advanced over an extended period. Over a projected 15-year period from 2005, the cost–benefit analysis identified a benefits-to-costs ratio of 1.3. In different scenarios assessed in a sensitivity analysis, the ratio varied between 0.4 and 4.7, showing that the results are highly dependent on the reporting rate and duration of illness. In cases in which the reporting rate and duration of illness are seen to increase, the cost–benefit analysis ratio will increase as well.

Wooden cover of well before refurbishment
© Landratsamt, Breisgau-Hochschwarzwald, Freiburg (Germany)/ Michael Gassner

Well after refurbishment
© Landratsamt, Breisgau-Hochschwarzwald, Freiburg (Germany)/ Michael Gassner

48 Scottish Government and Drinking Water Quality Regulator. *Cost benefit analysis of the private water supplies (Scotland) regulations 2006, detailed case study, final report*. Edinburgh, Scottish Government and Drinking Water Quality Regulator, 2010.

How can Water Safety Plans support improvement?

The third edition of the WHO Guidelines for Drinking-water Quality recommends the WSP approach as the most effective means of consistently ensuring the safety of a drinking-water supply.[49] Based on the principles of hazard analysis and critical control points (HACCP), which is well known and has been established by the food industry since the 1960s, the WSP approach focuses on prevention and takes an integrated system approach, aiming to minimize risks in the water supply chain from catchment to consumer. As shown in Figure 1, a WSP comprises a series of universal principles framed in a straightforward structure. At the core, a WSP requires a risk assessment encompassing all steps in the water supply chain, followed by implementation and monitoring of risk-management control measures. Simply put, a WSP may be characterized as the continuous investigation of and response to the following questions:

- What are the risks to my supply system?
- How do I fix them?
- How do I know that they are fixed?

Well supplying summer youth camp, with improperly sealed cover, Western Bohemia, Czech Republic.

49 See footnote 24.

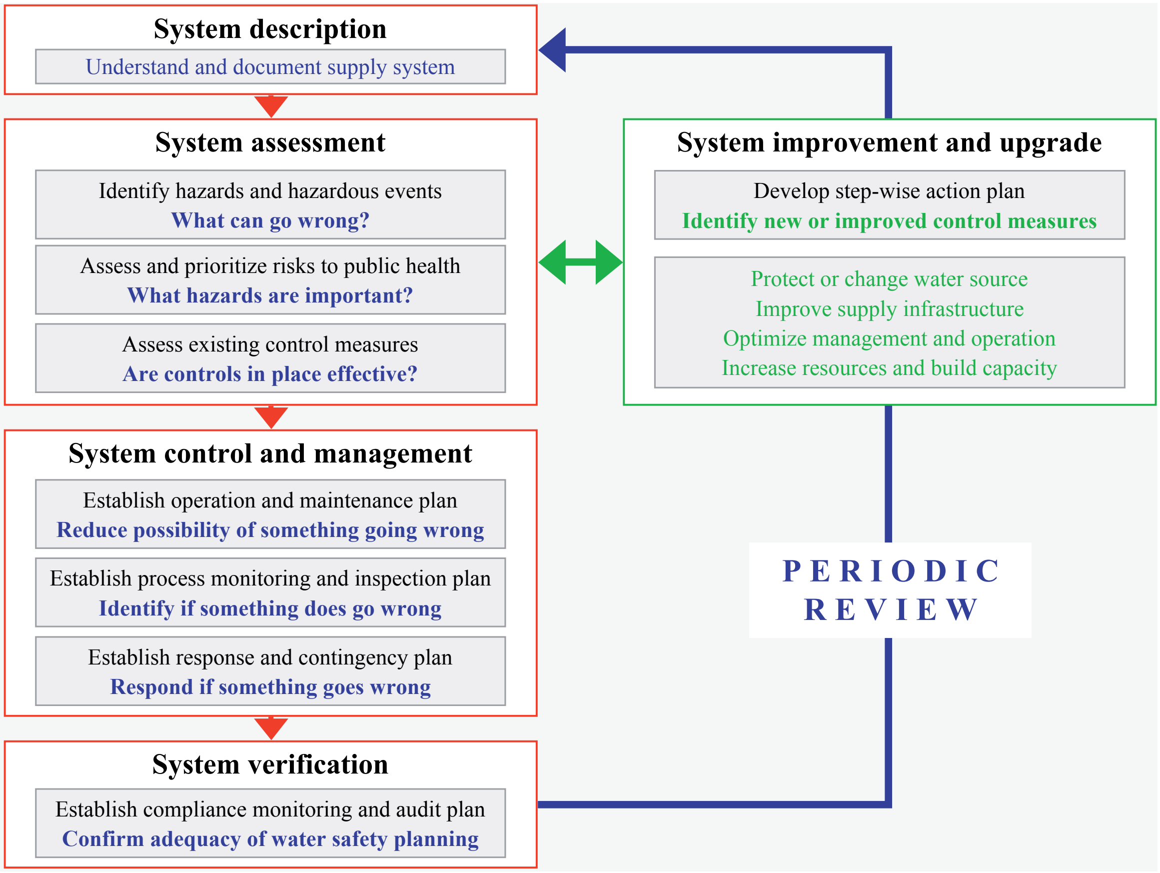

Figure 1. Conceptional summary of WSP steps
Source: Authors' own compilation, based on Bartram et al., 2009.[50]

WSPs should be implemented within a public health context, responding to clear health-based targets and quality checked through independent surveillance. Detailed and practice-oriented step-by-step guidance on WSP implementation is provided by the WHO Water Safety Plan Manual, which is currently available in English, Spanish and Chinese.[51] A complementary manual, specifically suited to the particular needs of small-scale water supplies, is currently being developed by WHO.

WSPs are applicable to all water supplies, irrespective of their size, system layout or organizational set-up. WSP-type approaches have been successfully implemented in private or individual well settings and small community-managed and public supplies. Experience indicates a range of benefits related to WSP implementation (see also Box 4). For example, a WSP can:

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50 Bartram J et al. *Water safety plan manual: step-by-step risk management for drinking-water suppliers.* Geneva, World Health Organization, 2009 (http://www.who.int/water_sanitation_health/publication_9789241562638/en/index.html, accessed 6 July 2010).

51 Idem.

- Lead to more reliable operation and water delivery;
- Lead to immediate drinking-water quality and compliance improvements;
- Support proactive supply management and operation, with a focus on prevention;
- Provide opportunities for operators to take a fresh look at their supply system and to develop a better understanding of it;
- Direct attention and action towards the greatest risks to a water supply and to public health;
- Lead to step-wise improvement and upgrade planning over time;
- Support basic assessment of needs and substantiate requests for resources to implement supply improvements;
- Stimulate multi-stakeholder cooperation and communication.

Box 4. Examples of application of WSP in small-scale water supplies

Germany

Four neighbouring small-scale water supplies conducted a WSP pilot project as a joint exercise. Project participants concluded that the WSP approach is an excellent tool which is feasible and straightforward to use in small public supplies, as their system design is typically less complex and responsibility patterns are less diverse. A range of immediate improvements could be achieved in the course of the project. Participating water suppliers found that WSPs help operators to avoid becoming blind to system shortcomings; to identify key risks and prevent accidents or severe system failures; and to increase the organizational reliability of supply management through more consistent documentation of due diligence, also resulting in increased legal security against allegations of managerial negligence. The partnership approach chosen by the four supplies was assessed to be beneficial in terms of mutual support and knowledge sharing.[52]

Iceland

Reports of waterborne disease since 1995 have all been related to small waterworks in fishing towns or in recreational areas. In Iceland, drinking water is classified as a foodstuff, and water suppliers are required to comply with food hygiene regulations and to prepare safety plans on the basis of hazard analysis and critical control points (HACCP) principles since 1995. The implementation of full HACCP systems was found to be too complex and time consuming for smaller waterworks with limited resources. Therefore, to aid the implementation of a preventive WSP-type approach in smaller communities, a simple five-step guidance tool was developed by Samorka (the Association of Icelandic Waterworks) in cooperation with four small waterworks in 2004. All water supplies serving between 500 and 5000 individuals are legally required to implement the five-step model, while supplies serving 100 to 500 inhabitants — as well as suppliers serving food processors — need to implement a sanitary checklist.

52 Friedmann, R. Water Safety Plan für die Trinkwasserversorgung: auf sicheren Füßen stehen: WSP – ein ausgezeichnetes Instrument für kleine Unternehmen. *ZfK Technik*, 2008, October: 23.

Box 4. Continued.

Iceland

An analysis of regular surveillance results in 2004 showed that in south Iceland, which is a farming area with a population of approximately 20 000, 100% compliance with regulatory requirements for drinking-water quality was achieved in the three towns in which the WSP had been implemented, whereas the overall compliance in this area was 85%, and non-compliance occurred predominantly in small waterworks.

According to a current assessment of the experience with HACCP in Iceland, which also takes into account the experience of small-scale water supplies, the main benefits reported include improved and systemized managerial and operational procedures; an increase in traceability; more reliable provision of safe drinking water; financial gains; better services and feedback mechanisms on complaints; and better knowledge of the water supply system among operators. Important elements of success that have been revealed are intensive training, a participatory approach of stakeholders in the implementation process and simple guidelines.[53,54]

Romania

The NGO Women in Europe for a Common Future (WECF) reported on the application of WSP in eight rural Romanian schools. In a participatory approach, teachers and pupils investigated the risks to and quality of their local drinking water and developed plans of action to be taken to improve drinking-water quality and to minimize health risks. Schools and other stakeholders involved in WSP development appreciated the practical activities and flexibility of the programme. They found that the WSP approach in schools had a positive effect on awareness-raising and capacity-building for drinking-water quality and related diseases. The need to implement local drinking-water safety strategies was identified to community members, in terms of cooperation of civil society with local authorities and mobilization of the community (including the youth) to take action towards drinking-water quality improvements. The community-based WSP approach was also found to forward local water source protection efforts, adequate management of the water supply system, access to information and ownership of the community for their water supply system. The project clearly showed that WSP programmes can serve as a bridge between local communities and regional and national authorities, and that they can contribute to setting objectives for rural areas.[55]

53 Gunnarsdóttir, M. J. Gissurarson, L. R., HACCP and water safety plans in Icelandic water supply: preliminary evaluation of experience. *Journal of Water and Health*, 2008, 6(3):377–382.

54 Gunnarsdóttir, M. J. Gardarsson, S., *Study of water safety plans at sixteen Icelandic waterworks.* In: Danva. Proceedings of the 7th Nordic drinking-water conference 7-9 June 2010, Copenhagen.

55 Samwel, M., Jorritsma, F., Radu O., *Lessons from water safety plans for small-scale water supply systems as developed by schools in Romania.* Utrecht/Annemasse/Munich, Women for a Common Future in Europe, 2010 (http://www.wecf.eu/download/2010/03/wsp_romania.pdf, accessed 6 July 2010.

The WHO Guidelines provide the international point of reference for the majority of national and supranational drinking-water frameworks. So far, there has been significant international momentum and increasing policy recognition of the WSP approach in response to the Guidelines. Some countries — such as Wales and England in the United Kingdom, as well as Hungary — have revised their drinking-water regulations to require water suppliers to implement WSPs; in Switzerland, Iceland, Sweden and the former Yugoslav Republic of Macedonia, drinking water is classified as a foodstuff, and water suppliers are required to comply with food hygiene regulations and to prepare safety plans on the basis of HACCP principles; and the European Commission is considering including WSP requirements in the forthcoming revision of the EU Drinking Water Directive. Moreover, in a range of countries, including the Czech Republic, Austria, Finland, Germany and Kyrgyzstan, WSP pilot projects — including for small-scale water supplies — have been implemented.

Also, a road map directed towards Governments and regulators, providing guidance on how to introduce and scale up the implementation of WSP, has been made available by WHO. The road map describes key steps that could be taken at country level in revising or developing new drinking-water quality policies, programmes and regulations in order to encourage or require WSP implementation by water suppliers as a means to improve public health.[56]

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56 De France, J., et al. *Think big, start small, scale up: a road map to support country-level implementation of water safety plans*. Geneva, World Health Organization, 2010 (http://www.who.int/water_sanitation_health/WHS_WWD2010_roadmap_2010_10_en.pdf, accessed 6 July 2010).

How can an enabling environment be created?

To achieve short- and long-term improvements to the situation surrounding small-scale water supplies, a suite of nationally and locally adapted measures and programmes at different levels is required, collectively creating an enabling environment.

Individual elements of such an environment may include, but are not limited to, the following objectives:

- Establishment of appropriate (or amendment of existing) national or regional drinking-water quality policies, programmes and regulations, giving due recognition and priority to the particularities and needs of small-scale water supplies.
- Establishment of financial support programmes targeting drinking-water supply in rural areas, including improvement of access to financial markets in order to better capacitate small-scale water suppliers to make investments.
- Promotion and rollout of specialized awareness-raising programmes for decision makers at national, regional and local levels, involved in regulation, surveillance and management of drinking-water quality, aiding an increased understanding of the:
  - Important link between water quality and public health;
  - Particularities, challenges and special needs of small-scale water supplies;
  - Advantages of investing in improvements in small-scale water supplies, including expected cost benefits from preventing illness and associated benefits in education and business development, as well as those for long-term sustainability of small communities;
  - Need for and added value of WSP implementation as a proactive and preventative approach in identifying and controlling potential risks to drinking-water supplies;
  - Benefits of the implementation of preventive water-protection measures;
  - Viable options for incentivizing and supporting improvements in small-scale water supplies;
  - Need to take into account the health risks for children from unsafe drinking water.

Very well maintained public well in village in Western Bohemia, Czech Republic
© National Institute of Public Health, Prague (Czech Republic)/ Frantisek Kozisek

Teachers participating in a workshop on developing Water Safety Plans for small scale water supply systems, Romania 2008
© WECF, Munich (Germany)/ Margriet Samwel

- Establishment of vital support structures to capacitate, train and aid operators of small-scale water supplies. Individual measures may include, for example:
  - Promotion and support of WSP through respective model or pilot projects in small-scale water supplies;
  - Development, promotion and rollout of ongoing capacity-building and education programmes for operators of small-scale water supplies, with particular focus on practical aspects in WSP implementation and specialized technical, operational and managerial information in relation to good practices in resource protection, sustainable water resource management, treatment, distribution and plumbing;
  - Provision of plainly worded and easy-to-understand guidance and resource materials in local languages that enhance access to technical knowledge; this includes guidance on WSP implementation, technology-specific model WSPs adapted to the national particularities of small-scale water supplies, as well as standards for sanitary protection zones, disinfection and treatment practices adapted to the specific requirements of small-scale water supplies;
  - Establishment of national or regional institutions functioning as resource centres which provide access to expertise and professional support for operators or owners of small-scale water supplies, including access to WSP advisory services by trained facilitators;
  - Establishment and promotion of partnership or twinning programmes that foster cooperation and expert knowledge transfer (for example, between a larger supply, managed by a utility, and a small-scale water supply);
  - Networking programmes that facilitate sharing of experience and information among operators of small-scale water supplies;
  - Specialized outreach programmes for operators in remote areas.
- Strengthening of local surveillance and information systems, by establishing:
  - Procedures for drinking-water quality surveillance of small-scale water supplies, including water quality monitoring and sanitary inspection (for example, on the basis of the recommendations of the WHO Guidelines for Drinking-water Quality);[57]
  - Basic sampling procedures and laboratory methods for routine sampling and analysis of critical microbial and chemical drinking-water quality parameters;

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57 See footnote 25.

- Adequate disease outbreak detection and response mechanisms, including early warning systems and reporting;
- Communication mechanisms providing comprehensible information on water and health issues and prevention of disease outbreaks for local authorities and consumers;
- Increased cooperation between different local stakeholders to be able to detect outbreaks (for example, between local health inspectors and health services in hospitals).

- Outreach and communication campaigns to increase understanding of sustainable water resource management and water and health issues in rural populations (for example, through local and national media); to increase understanding of personal, domestic and community hygiene as an important barrier to many infectious diseases and to encourage improved hygiene practices (for example, promoting the importance of hand washing); as well as to raise awareness among general practitioners and health system staff (for example, in hospitals and nursing homes).
- Outreach and communication campaigns, particularly aiming at parents, to protect young children from the effects of contaminated small-scale water supplies.
- Cooperation arrangements, for example with:
  - Funding (or donor) agencies which can support long-term investment and improvement programmes;
  - International or local NGOs which can play an important catalytic role in implementing programmes to raise awareness, and to provide safe drinking water and adequate sanitation to small communities in rural areas.

Networking and resource materials

WHO is hosting the International Network for Small Community Water Supply Management (SCWSM).[58] The Network aims to promote the achievement of substantive and sustainable improvement to the safety of small-scale water supplies through the shared objectives of:

- Developing internationally recognized policy and technical guidance, including guidance for WSP implementation in small-scale water supplies;
- Developing and facilitating access to effective tools aiding WSP implementation;
- Facilitating access to lessons learned from good practices and case studies demonstrating improvements;
- Building the evidence base to facilitate advocacy for political support;
- Promoting innovative research and sharing research outcomes;
- Designing technical cooperation and capacity-building activities.

The SCWSM Network is open to anyone working in the field of small-scale water supplies. Members typically represent Governments, universities and NGOs; there are over 150 members and 40 countries currently represented in the Network. Members work together through face-to-face meetings and a virtual Web-based forum.

Both the virtual forum and a dedicated WHO web site[59] publish information and documents providing access to examples of national, regional and international resource materials, including:

- A WSP manual for small-scale water supplies (in development);
- A collection of approximately 500 examples of training tools;
- A collection of over 30 examples of risk communication tools;
- A collection of approximately 50 examples of risk-assessment tools;
- Guidance on communicating with respect to safe drinking water;
- Guidance on how to conduct cost–benefit analyses for water supply improvements;
- Promotional fact sheets to increase awareness of the challenges faced by small-scale water supplies.

58 SCWSM Network information is available online at: http://www.who.int/water_sanitation_health/dwq/scwsm_network/en/index.html (accessed 6 September 2010); e-mail contact: scwsm@who.int. Further information on small-scale water supplies can also be found at the following WHO web site: http://www.who.int/water_sanitation_health/dwq/smallcommunity/en/index.html (accessed 6 September 2010).

59 Idem.

While the SCWSM Network provides a broad range of resource materials from various world regions, a non-comprehensive selection of example materials from the pan-European region is given in the following subsections. The materials may provide a point of entry for further reading or a point of departure and inspiration for the development of own country-specific materials in local languages.

Example resource materials for small public supplies

- In **Finland**, the Finnish Environment Institute published a guide entitled Operation and maintenance of small waterworks. The focus of this guide is on water supplies using shallow groundwater sources. The purpose is to provide operators with background information and advice regarding water quality; sources and prevention of water pollution; waterworks technologies and maintenance; distribution; and routine operational monitoring, technology and emergency situations at small waterworks, including practical checklists for assessing the vulnerability of small waterworks and for planning operation and maintenance as well as model contingency plans. The guide serves as a handbook for waterworks operators to prepare for an official examination to prove their required minimum qualification. The publication is available in Finnish, Swedish and English.[60]
- In **Iceland**, Samorka — the Association of Icelandic Waterworks — published a guide entitled Water quality safety plan for small communities. The purpose of the guide is to aid the implementation of a preventive WSP-type approach in small waterworks, called "Mini-HACCP". It describes a five-step implementation process, covering system description and assessment, staff and training aspects, various sanitary procedures, quality-control requirements and measures in cases of deviations and emergencies, including a range of templates supporting HACCP implementation. The publication is available in Icelandic and English.[61]
- In **Switzerland**, the Swiss Gas and Water Industry Association published Recommendations for a simple quality assurance system for water supplies

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60 Isomäki, E., et al. *Operation and maintenance of small waterworks*. Helsinki, Finnish Environment Institute SYKE, 2008 (http://www.ymparisto.fi/download.asp?contentid=118520&lan=en, accessed 6 July 2010).

61 Samorka (ed.), *Water quality safety plan for small communities*. Reykjavík, SAMORKA, 2009 (http://www.samorka.is/doc/1659?download=false, accessed 6 July 2010). A draft version of the document is also available in English but not accessible online.

Spring source in forest, small public water supply, Lower Saxony, Germany
© UBA, Dessau-Roßlau (Germany)/ Oliver Schmoll

Spring source with roots
© Landratsamt, Breisgau-Hochschwarzwald, Freiburg (Germany)/ Michael Gassner

(WQS). The publication primarily focuses on step-by-step guidance for operators of small waterworks for practical implementation of a HACCP-based quality-assurance system which complies with the legal requirements in Switzerland. The guide is organized around nine implementation steps, covering supply description, hazard analysis, measures for controlling hazards, instructions for maintenance, monitoring and inspections, record-keeping and periodical evaluations. The guide is enriched by a suite of practical checklists, template forms and case examples. The publication is available in English, French and German.[62]

Example resource materials for private supplies and individual wells

- The **Scottish** Government published the Private water supplies: technical manual in 2006. The manual provides a substantive reference document which is intended to assist professionals regulating, surveying and maintaining private water supplies. It extensively covers background information on properties and contaminants of water; source selection; protection and monitoring; risk assessment for private water supplies (including case studies); water treatment

62 Swiss Gas and Water Industry Association (ed.) *Regulation W 1002 e: Recommendations for a simple quality assurance system for water supplies (WQS)*. Zurich, Swiss Gas and Water Industry Association, 2003.

processes; legislative background; sampling, storage and transportation of water samples; and response to waterborne hazards for private water supplies. The Scottish Government also published the Public toolkit, addressing owners and users of private wells, which includes plainly worded background to the legal situation and monitoring requirements, as well as a questionnaire for a user (self-)risk assessment of their own water supply. Both publications are available in English; section 4 of the technical manual, on risk assessment, is also available in Russian.[63]

- In **Austria**, several guidance documents are available. These include, for example, an information brochure published by the federal state (Land) of Kärnten, which addresses owners of private wells and provides guidance on the fulfilment of the owner's legal obligations, common causes for well water contamination and common structural deficiencies of wells, as well as options for their operation and maintenance.[64] The federal state of Salzburg has published a report on their drinking-water campaign, conducted in 1997, which investigated the status of private wells through a systematic evaluation of drinking-water quality data and inspection information. The document gives recommendations on data to be collected on site; explanations regarding individual drinking-water quality parameters; interpretation of analytical results; an overview of the most important risk factors affecting well water quality; as well as recommendations for measures to address these risks.[65] Another comprehensive guidance document was published by the Austrian Agency for Health and Food Safety and the Austrian Ministry of Health, Family and Youth,[66] providing information on different types of wells; construction of private wells; repair, control and maintenance of existing facilities; drinking-water analysis;

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63 Scottish Executive (ed.). *Private water supplies: technical manual*. Edinburgh, Scottish Executive, 2006 (www.privatewatersupplies.gov.uk/private_water/files/Full Doc.pdf, accessed 6 July 2010). The Russian translation is available on CD; it has been distributed to WHO country offices and can be obtained from WHO Regional Office for Europe. At the web site www.privatewatersupplies.gov.uk, further documents can be accessed, such as a sampling manual, forms and survey templates, information on risk assessment, and the "*Public toolkit*".

64 Amt der Kärntner Landesregierung (ed.) *Betrieb und Wartung von privaten Hausbrunnen und Quellen, Klagenfurt*. Klagenfurt am Wörthersee, Amt der Kärntner Landesregierung 2005 (http://www.ktn.gv.at/12320_DE, accessed 6 July 2010).

65 Wendtner W, König K, König C. *Zusammenfassender Bericht über die Aktion Sauberes Trinkwasser: Alles klar*. Salzburg, Land Salzburg, 2001 (http://www.salzburg.gv.at/pdf-60-info-tw-broschuere-abt16.pdf, accessed 6 July 2010).

66 AGES, Bundesministerium für Gesundheit, Familie und Jugend (eds.). *Trinkwasser aus Hausbrunnen und Quellfassungen: Ein Ratgeber für private Betreiber*, Vienna, Österreichische Agentur für Gesundheit und Ernährungssicherheit GmbH, Bundesministerium für Gesundheit, Familie und Jugend, 2008 (http://www.bmgfj.gv.at/cms/site/attachments/7/1/1/CH0619/CMS1206020050749/trinkwasser_aus_hausbrunnen_und_quellfassungen.pdf, accessed 6 July 2010).

Steel inspection cover for a modern household well, Norfolk, England
© University of East Anglia, Norwich (United Kingdom)/ Helen Risebro

and the legislative framework. All materials are available in German.

- In **Germany**, a joint task force of the federal states (Länder) and the FEA has developed a guidance document specifically aiming at the information needs of local health authorities involved in the surveillance of individual (private) wells. The document provides information on the legal basis and respective responsibilities in the surveillance of wells, as well as on the particularities of drinking-water supply from more than one source (that is, private and public); recommendations on monitoring parameters and frequencies; and guidance on possible remedial measures in source protection, as well as on rehabilitation of supply infrastructures and treatment options. It also includes templates for on-site inspections or specimen letters for registration of wells.[67] The document is available in German. Furthermore, some administrative districts have published similar guidance documents, particularly for operators of private wells and authorities involved in surveillance.[68]

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67 Bund-Länder-Arbeitsgruppe "Kleinanlagen" (ed.). *Empfehlungen zur Überwachung von Kleinanlagen der Trinkwasserversorgung: Leitfaden für Gesundheitsämter*. Bad Elster, Bund-Länder-Arbeitsgruppe "Kleinanlagen", 2003 (http://www.frankfurt.de/sixcms/media.php/738/uba__berwachung_von_kleinanlagen.pdf, accessed 6 July 2010).

68 Example materials from the administrative districts include:
- Der Kreisausschuss des Main-Taunus-Kreises -- Gesundheitsamt (ed.). *Kleinanlagen in der Trinkwasserversorgung: Anforderungen gemäß Trinkwasserverordnung 2001*. Hofheim am Taunus, Der Kreisausschuss des Main-Taunus-Kreises -- Gesundheitsamt, 2006 (http://www.mtk.org/cps/rde/xbcr/mtk_internet/Ortsfeste_Trinkwasseranlagen.pdf, accessed 6 July 2010).
- Bayerisches Landesamt für Gesundheit und Lebensmittelsicherheit (ed.). *Überwachung von Kleinanlagen: Vollzug durch die Staatlichen und Städtischen Gesundheitsämter*. Erlangen/Oberschleißheim/Würzburg, Bayerisches Landesamt für Gesundheit und Lebensmittelsicherheit, 2009 (http://www.lgl.bayern.de/gesundheit/hygiene/doc/empfeh-

- The NGO **Women in Europe for a Common Future (WECF)** published a manual for teachers and pupils on developing WSPs for school water supplies fed by boreholes, dug wells and springs. It provides plainly worded information on the development and implementation of a WSP, including guidance on programme organization, system and stakeholder analyses, hazard identification and risk assessment, and system improvements. It also provides a range of technical background information for teachers regarding hydrogeology, different types of water supplies and water quality and options for source protection, as well as useful questionnaires and templates that aid WSP development in schools.
  The document is available in Romanian, Russian and English.[69]

lungen_anlagen_wasserversorgung.pdf, accessed 6 July 2010).

69 Möller, D., Samwel, M., *Developing water safety plans involving schools: introducing "water safety plans" for small-scale water supply systems: manual for teachers and pupils*, Utrecht/Annemasse/Munich, Women in Europe for a Common Future 2009 (http://www.wecf.eu/english/publications/2008/wspmanuals-revised.php, accessed 6 July 2010).

Small-scale water supplies are the backbone of water supply in rural areas in the entire pan-European region.

Safe and acceptable water for human consumption that is available in sufficient quantity, physically accessible and affordable is a crucial prerequisite for human well-being. Access to safe water is not only fundamental to good health but also to satisfactory livelihoods, dignity and prospects for economic growth and education.

The provision of safe and acceptable drinking water of sufficient quantity frequently represents a challenge to small-scale water supplies. Experience has shown that it is typically their administrative, managerial and operational characteristics and resourcing specifics which set them apart from larger supplies. They are more vulnerable to breakdown and contamination than larger utilities. Many of today's national and international policy frameworks already recognize that further attention to this topic is needed.

This document is intended for supporting decision-makers, such as policy-makers or regulators in the drinking-water sector, to appreciate better and address the particularities and characteristics of small-scale water supplies. It provides a range of background information, case studies and lessons learned, and gives ideas for addressing issues relating to small-scale water supplies in national programmes. Additionally, information on further reading as well as current international networking activities with respect to small-scale water supplies is provided.

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