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Small-scale water supplies and sanitation

INFORMAL DOCUMENT

Final draft
"Taking policy action to improve small-scale water supply and sanitation systems: tools and good practices from the WHO European Region"

The programme of work for 2014-2016 stipulates the development of a policy guidance document on small-scale water supplies and sanitation in English and Russian.

The lead Parties and organization of programme area 3, with the support of an expert group on small-scale systems established under the Protocol's auspices, led the development of the guidance document entitles "Taking policy action to improve small-scale water supply and sanitation systems: tools and good practices from the WHO European Region".

A draft for review was presented to the seventh meeting of the Working Group on Water and Health. The document was also subject to a comprehensive peer review process. Comments from peer review and from members of the Working Group were addressed in the finalization process.

The Working Group will be invited to endorse the submission of the document as publication for adoption by the Meeting of the Parties at its fourth session.

Taking policy action to improve small-scale water supply and sanitation systems

Tools and good practices from the WHO European Region

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Foreword

Access to safe and sustainable drinking-water and sanitation services is paramount for living a healthy and dignified life. In the WHO European Region it is nonetheless a reality that those living in rural areas who rely on small-scale water supply and sanitation systems often receive lower levels of service and are thereby more vulnerable to environmental health risks. Those served by small-scale systems have the right to the same level of health protection as others. Taking action at the policy level contributes to achieving the human right to water and sanitation.

Goals 3 and 6 of the 2030 Agenda for Sustainable Development call for combating waterborne diseases and for ensuring universal and equitable access to safe drinking-water and adequate and equitable sanitation for all by 2030. Universal access for all cannot be achieved without paying due attention to the particularities and challenges that may impair the provision of safe and sustainable services by small-scale water supply and sanitation systems.

Improving the situation of small-scale systems in rural areas and small towns is reported to be challenging in all countries across the Region, irrespective of their level of socioeconomic development. To tackle these hurdles the Parties to the Protocol on Water and Health to the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes – which is jointly serviced by the United Nations Economic Commission for Europe and WHO Regional Office for Europe – have chosen small-scale water supply and sanitation systems as a priority area for action in the Protocol's programmes of work since 2007.

The Protocol is a product of the European Environment and Health Process and presents the primary European policy instrument in the water, sanitation and health domain. Its provisions and principles fully align with the goals of the 2030 Agenda pertinent to water, sanitation and health. It provides a platform for partnership and cooperation across government sectors – including health, water, environment and education – and a legally binding instrument that allows Parties to identify national targets and take action according to their prevailing conditions, needs and priorities. The Protocol's planning and accountability approach offers a practical framework for Parties to translate and operationalize the ambitions of the Agenda 2030 in the national context. It thus presents a unique tool for defining and committing to policy interventions addressing small-scale water supply and sanitation systems.

The tools and good practices presented in this document, together with a variety of case studies, illustrate how countries in the Region have taken the initiative to improve the situation of small-scale systems. They are intended to inspire policy-makers and serve as a starting-point for action.

In the spirit of the European health policy framework, Health 2020, ensuring that all people have access to safe and sustainable water and sanitation services forms the basis for reducing health inequalities, creating resilient communities and protecting and promoting equitable health and well-being throughout the Region.

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An international group of experts, policy-makers and practitioners contributed through provision of insights, text and peer review. While key contributors are specifically noted below, the quality of the document as a whole is due in large part to reviews and feedback provided by many individuals. It was also reviewed and endorsed by the Working Group on Water and Health under the Protocol on Water and Health.

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Abbreviations

ATOs	minimum catchment areas (ambiti territoriali ottimali)
BDZ	Demonstration Centre for Decentralized Wastewater Treatment (Bildungs- und Demonstrationszentrum für dezentrale Abwasserbehandlung)
DVGW	German Technical and Scientific Association for Gas and Water (Deutscher Verein des Gas- und Wasserfaches)
DWA	German Association for Water, Wastewater and Waste (Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall)
EC	European Commission
E. coli	*Escherichia coli*
EPA	Environmental Protection Agency (Ireland)
ERSAR	Portuguese Water and Waste Services Regulation Authority (Entidade Reguladora dos Serviços de Águas e Resíduos)
EU	European Union
GWS	group water schemes
JMP	WHO/UNICEF Joint Monitoring Programme (for Water Supply and Sanitation)
NGO	nongovernmental organization
NIP	national inspection plan for domestic wastewater treatment systems
OECD	Organisation for Economic Co-operation and Development
PE	population equivalent
RWSN	Rural Water Supply Network
SPANC	public service for onsite sanitation (service public d'assainissement non collectif)
SSP	sanitation safety plan
SVGW	Swiss Gas and Water Industry Association (Schweizerischer Verein des Gas- und Wasserfaches)
TajWSS	Tajikistan Water Supply and Sanitation (Network)
UNICEF	United Nations Children's Fund
WECF	Women in Europe for a Common Future
WSP	water safety plan
ZWAV	Vogtland Association for Water and Wastewater Management (Zweckverband Wasser und Abwasser Vogtland)

Executive summary

Access to adequate water and sanitation services is essential for good individual and population health. People served by small-scale systems in rural areas and small towns have the right to the same level of health protection as others. Goals 3 and 6 of the 2030 Agenda for Sustainable Development call for combating of waterborne diseases and for ensuring universal and equitable access to both safe drinking-water and adequate sanitation for all by 2030. To achieve universal access, due attention needs to be paid to the particularities and challenges that may impair the provision of safe and sustainable services by small-scale water supply and sanitation systems.

Small-scale systems, which include individual systems and small centralized systems, are often operated by untrained or undertrained individuals who lack specialized knowledge and have limited awareness of the health aspects related to water and sanitation services. Owing to the broad geographical spread and sometimes the remoteness of small-scale systems, independent surveillance by mandated authorities is frequently lacking and operators experience a lack of access to professional networking, information, expert assistance and technical support. Appropriate use of treatment technologies is generally limited; where it is in place it does not necessarily reflect local conditions and needs. Small-scale water supplies may also be more severely affected by the anticipated effects of climate change in terms of handling extreme variations in quantity and quality. As a consequence of all these factors, small-scale systems are more vulnerable to inadequate management and breakdown. If they are dysfunctional, this can lead to unsafe services or insufficient quantities of drinking-water, which may lead to health consequences – primarily diarrhoeal illness, as a result of exposure to faecal pathogens.

The Protocol on Water and Health to the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes is a legally binding instrument that is distinctive to the European Region. With its strong integrated and intersectoral approach and its focus on prevention, reduction and control of water-related disease through the whole water-cycle, the Protocol's provisions and principles fully align with Goals 3 and 6 of the 2030 Agenda and other goals pertinent to water, sanitation and health. Increasing policy attention and action to improve the situation of small-scale water and sanitation systems has been a priority area under the Protocol programmes of work since 2007. This document illustrates a range of recognized tools that are available to policy-makers at the national level to improve the situation of small-scale systems in a sustainable manner. It includes 42 case studies from 18 countries across the WHO European Region that illustrate how these tools can be applied in practice.

Taking such action at the policy level contributes to building healthy and resilient communities, reduces the burden of water-, sanitation- and hygiene-related disease, reduces inequities between rural and urban areas, promotes human rights and gender equality and improves environmental protection. The evidence is clear that the financial benefits outweigh the investments in improvements to water and sanitation systems. It has been estimated for the WHO European Region that an investment of US$ 1 in small-scale water supplies results in a mean return ranging from US$ 2 in higher-income countries to US$ 21 in lower-income countries. For the Caucasus and central Asia, for example, every US$ spent on improving sanitation brings an average economic return of US$ 4.8 in the form of time savings, lower health costs and improved productivity.

It is the responsibility of national and subnational decision-makers to prepare and implement long-term strategies to improve the situation of small-scale water supply and sanitation systems. Both establishing a firm rationale for improvement and defining explicit policies with clear goals and short-, mid- and long-term targets are essential to secure the commitment of stakeholders at all levels and to mobilize and allocate necessary resources. To identify the need to adopt or amend policies and to set national targets for improvement, it is important to determine and appreciate the status quo of small-scale systems. Such baseline analysis establishes a clear overview of those areas

particularly in need of policy attention, and informs and supports mobilization of adequate resources for change.

The Protocol on Water and Health is an effective instrument to address small-scale water supply and sanitation systems at the policy level. Articles 6 and 7 of the Protocol require countries that have ratified it to establish and publish targets for achieving a high level of protection of human health and sustainable management of water resources, reflecting countries' needs, priorities and available resources, and to undertake periodic review and assessment of the progress reached. Thus, the Protocol offers a strong tool in translating the aspirations of the 2030 Agenda – specifically Goals 3 and 6 – into national targets and operationalizing their implementation. A number of countries have set and implemented targets related to small-scale water supply and sanitation systems under the provisions of the Protocol.

Several tools are available to create an enabling environment for short-, mid- and long-term improvements and thereby incrementally to achieve access to safe and sustainable water supply and sanitation services in rural areas and small towns. Such tools include legislation and regulations, technical standards, surveillance, financing, training and qualification programmes, awareness-raising and cooperative partnership arrangements.

Laws and regulations are powerful instruments for translating the aims and visions of an agreed policy for small-scale drinking-water and sanitation systems into action. They provide a "regulatory push" to ensure that improvements to small-scale systems happen. These instruments usually specify drinking-water quality standards and wastewater discharge requirements, including interventions in response to noncompliance with limit values. They may also include other provisions – for example, relating to water and sanitation management and surveillance. It is important that legislation and regulations reflect the situation and particular needs of small-scale systems. A gradual approach is preferable for implementation of new requirements – this will encourage long-term improvement and increase compliance.

Adhering to technical standards helps operators of small-scale systems with due diligence in providing safe services that are protective of human health and the environment. It can also help to facilitate approval of systems by appropriate authorities and institutes, where required. Uptake of relevant standards in small-scale systems requires proactive support by:

- encouraging national standardization organizations to create standards specifically for small-scale systems;
- making them available in local languages and free of charge or at a reasonable price that operators in low-resource settings can afford;
- raising awareness about the existence of relevant standards among operators and local water and health officers;
- providing assistance to facilitate understanding of relevant standards.

Maintaining vigilant surveillance systems that include aspects of water quality is a prerequisite for ensuring the same level of health protection for all people in a country. Policy-makers should make provision for surveillance by public health authorities in legislation and regulations, taking into account the particularities of small-scale systems. These instruments need to establish the mandate and responsibilities of surveillance agencies; describe specific activities and frequencies; and define the type of drinking-water and sanitation systems that are subject to surveillance. Surveillance agencies should have the power to compel action to respond to and rectify water quality incidents causing outbreaks of waterborne disease or other threats to public health. In the context of small-scale systems, surveillance agencies often need to take on a supporting role to achieve improvements, rather than relying too greatly on threatening consequences of noncompliance. To

address the challenges related to the often large number and wide geographical spread of locations of small-scale systems, their surveillance may be supported by regular self-checks by operators. Communication solutions and field testing kits may be applied to overcome the challenges related to system remoteness. Risk-based approaches such as water safety plans and sanitary inspections can inform surveillance agencies' priorities and schedules of activities.

Making provision for the sustainable financing of small-scale water supply and sanitation systems is the basis for maintaining good services in the long term, ensuring affordable services for all; it thereby represents a way to create equitable access. Sustainable financing is particularly important for small-scale systems as they typically have higher investment and maintenance costs per person served. To ensure sustainable financing for small-scale systems, it is helpful to consider the different types of cost that occur throughout the lifecycle of the service and to create a larger level of scale to reduce operational costs and ensure affordable services. Policy-makers should make provision for securing sustainable financing by using taxes, tariffs and transfers, as well as considering subsidies and solidarity mechanisms to account for affordability of services.

Knowledgeable personnel who understand good practices in management, financing, operation and maintenance are an important prerequisite for ensuring safe water supply and sanitation services. To empower operators to do their jobs and to update their knowledge it is crucial to offer training and qualification programmes, including vocational and on-the-job peer-to-peer training arrangements. A good way to ensure that staff have sufficient knowledge is to put in place legislation and regulations that require minimum levels of education and qualification and/or competency testing of staff, reflecting the size and complexity of the systems. This may cover both aspects of initial levels of education and requirements for regular training and further qualifications. Provision of training accessible in rural locations and encouraging networking among operators further improves their knowledge.

Raising awareness is vital to inform local decision-makers and the general public about drinking-water and sanitation safety as key factors for public health protection, and consequently for economic development and sustainable livelihoods. It is imperative that all parties understand the importance of small-scale systems for rural communities, including the challenges they experience, the solutions available and the health and economic benefits of improving the situation. Cross-sectoral approaches are critical in the context of small-scale systems, particularly to explain the link between drinking-water and sanitation. Advocacy efforts need to address those who can have an impact on small-scale systems but do not work on water and sanitation directly.

It is beneficial for small-scale systems to join forces with neighbouring municipalities and communities or with bigger utilities by forming cooperative partnership arrangements. In such arrangements, capacities and efficiency increase as a result of extended human, technical and financial resources. Cooperative arrangements can lead to the pooling of knowledge and experience of staff, and thereby to higher levels of professionalism and better conditions for improved management and operation. Other advantages include the joint implementation of technical innovations and rationalization in the procurement of equipment and spare parts. Costs can be shared, with increased flexibility in applying funds if several municipalities contribute and agree jointly on priorities for their use. Further, overall operational costs may be reduced through sharing facilities and equipment. Policy-makers can promote and initiate cooperative arrangements, such as by forming associations and facilitating networking platforms to enable sharing of knowledge and experiences and to provide a good opportunity for peer-to-peer support.

Effective protection of water resources, proper sanitation planning and the adoption of water and sanitation safety plan approaches are essential concepts in securing safe drinking-water and sanitation services that are protective of health and the environment in rural areas. The various tools

discussed in this document support the creation of an enabling environment for promoting and implementing these concepts and good practices to improve the situation of small-scale water supplies and sanitation systems.

A well protected source of drinking-water is vital for supplying safe drinking-water. Effective protection of water resources is the first step in the multibarrier approach, which aims to have several controls in place along the supply chain from catchment to consumer. This step is particularly relevant for increasing the safety of small-scale systems, where treatment is often lacking or limited in scope and availability.

Sanitation planning means making informed choices about sanitation solutions that are appropriate and affordable in the local context and fit for avoiding or reducing health risks through exposure to wastewater and excreta. Sanitation planning should take into account the full sanitation service delivery chain and consider that the most cost-effective and appropriate technologies to achieve the defined service levels and the appropriate scale of operation may be different for small-scale systems.

The water safety plan approach is recommended by the WHO guidelines for drinking-water quality as the most effective means of ensuring the safety of water supplies, addressing the entire supply chain from catchment to the point of consumption. The introduction of this approach for small-scale water supplies is associated with improved water quality and reliability, and eventually with reduced risks to health. For small-scale water supply systems it is indispensable to address sanitation and hygiene aspects in the development and implementation of water safety plans. Similarly, sanitation safety plans are based on preventive risk assessment and management principles. They apply the approach from the point of sanitation waste generation to the waste's release to the environment through final use and/or disposal. Sanitation safety plans complement water safety plans by closing the loop from sanitation waste generation to the consumption of drinking-water, leading to holistic risk assessment and management.

1. About this document

1.1. Background

The challenges small-scale drinking-water supply and sanitation systems face are a recognized concern across the entire WHO European Region.[1] Such systems are typically prevalent in rural areas, small towns and periurban areas, where they are often the most suitable option for economic, technical or hygiene reasons. In 2015 about 264 million people (29% of the Region's population) live in rural areas *(1)*. Approximately 207 million people (23% of the Region's population) receive water from supplies serving fewer than 5000 people. Of these, 63 million (7% of the Region's population) are served by very small non-piped water supplies (i.e. individual wells and similar) *(2)*. Most of these people also use sanitation systems of a similar scale or do not have access to adequate sanitation. In central and eastern Europe, for example, 40% of the population is not connected to wastewater collection and treatment systems *(3)*.

Small-scale systems often face a variety of managerial, operational, technical, staffing and resourcing challenges. Irrespective of the level of socioeconomic development of individual countries, these challenges are very similar throughout the Region. They may hinder the provision of safe and sustainable drinking-water and sanitation services, and can result in adverse health outcomes and environmental damage. Increasing access to safe drinking-water and sanitation will improve community health and well-being and subsequently enhance sustainable livelihoods, poverty reduction and economic development *(4)*.

Strong links exist between the provision of safe drinking-water and safe sanitation practices, particularly in rural areas, where facilities are typically located very close to each other. Poorly regulated, designed, sited and managed onsite sanitation (such as pit latrines or leaking and overflowing septic tanks contaminating water resources) can have a severe impact on drinking-water quality and thereby on public health. It is important to take a holistic approach, addressing drinking-water, sanitation and hygiene aspects together. Fostering close communication and collaboration among relevant stakeholders – particularly those responsible for water and those responsible for sanitation – is also critical.

Recognition of the need for more national and international policy attention to address the challenges related to small-scale systems is growing. The 1999 Protocol on Water and Health to the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes *(5)* (hereafter "the Protocol") has included this subject as one of the priority areas in its programmes of work since 2007. In 2011, the publication *Small-scale water supplies in the pan-European region (4)* was released under the Protocol as a first step to support better understanding of the current state of small-scale water supplies and the challenges they face.

1.2. Aim and scope

This publication responds to the need expressed by the Parties to the Protocol to address small-scale water supply and sanitation systems in the WHO European Region. It primarily aims to support effective policy action and promote good practices for creating an enabling environment towards

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

improving the situation of small-scale systems. It addresses both small-scale centralized systems and individual onsite systems for water supply and sanitation.

Policy-makers can choose from a wide range of regulatory, planning, financial and educational instruments to improve the situation of small-scale water supply and sanitation systems. This document illustrates a range of such instruments applicable at both the national and subnational levels. This overview is supported by a number of good practice case studies from across the Region and information from a survey on small-scale water supplies conducted under the Protocol *(2)*. The aim is for the examples described to inspire decision-makers and practitioners to consider improvement actions that they can adapt for their own circumstances, even if only elements of the tools can be implemented.

1.3. Target audience

The primary target audience of this document is policy-makers who develop water supply and sanitation policies at the national or subnational – for example, regional or state – levels. These may be found in different sectors, such as health, water management, environment, agriculture, rural development and finance, and may be responsible for one or more of the following:

- establishing and reviewing the effectiveness of policies, legislation, regulations and standards for drinking-water, sanitation and hygiene;
- mainstreaming health aspects into the policies of different sectors;
- allocating financial resources to enable the implementation of policies and programmes;
- providing guidance and capacity-building to local entities (such as local governments).

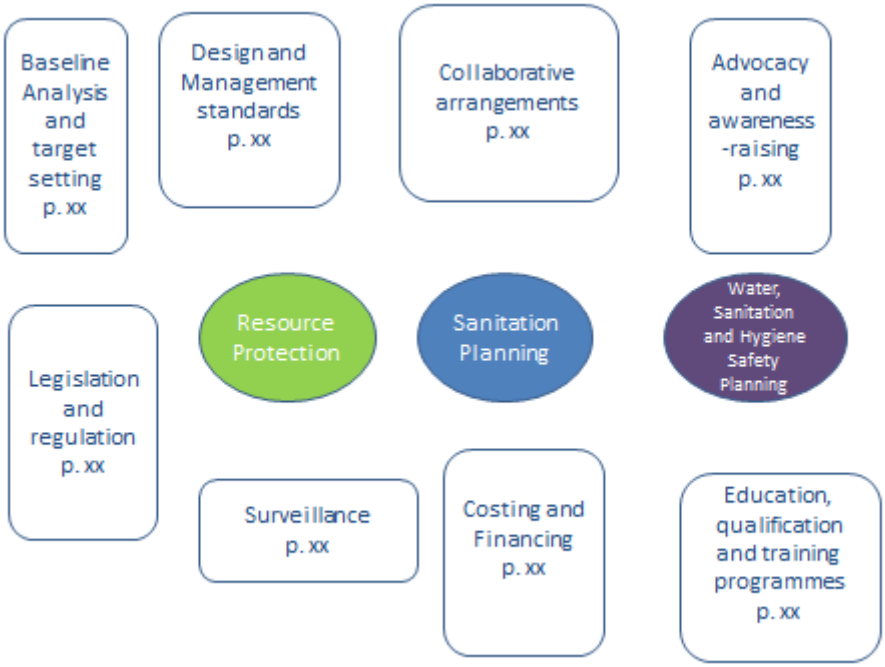
Other stakeholders such as aid and funding agencies, local governments and nongovernmental organizations (NGOs) may also find the information relevant for their programmes and projects.

1.4. Structure

Chapters 2 and 3 of this document help the reader to understand the problem from a broader perspective: they highlight the concerns surrounding small-scale systems and the benefits that result from addressing them.

Chapters 4 and 5 form the core of this publication. Chapter 4 outlines a range of policy instruments representing a “toolbox” of options from which policy-makers can choose. Chapter 5 provides examples of good practices chosen to illustrate how these tools can be applied to improving the situation of small-scale water supply and sanitation systems. Fig. 1 provides an overview of the topics covered by Chapters 4 and 5.

Fig. 1. Overview of Chapters 4 and 5



2. Concerns related to small-scale water supply and sanitation systems

2.1. Definitions of "small-scale" systems

Small-scale water supply systems comprise private or individual facilities typically supplying one or a small number of premises for domestic and/or commercial use, community-managed supplies and publicly managed supplies, typically supplying hamlets, villages, small towns and periurban areas. These may be piped or non-piped, and may or may not include centralized treatment, storage and distribution.

A similar situation exists for small-scale sanitation systems. The Protocol defines sanitation as the collection, transport, treatment and disposal or reuse of human excreta or domestic wastewater, whether through collective systems or by installations serving a single household or undertaking *(5)*. Small-scale sanitation technologies range from simple onsite systems such as pit latrines, to flush or pour flush, to septic tanks or collective sewerage systems with or without wastewater treatment. These systems can be operated by organized utilities; however, many onsite systems are managed by communities or individuals.

There is no universal definition of a "small-scale" system: descriptions differ between countries within the WHO European Region. Legislation typically defines small-scale water supplies based on criteria such as the number of people served, the type of management, the quantity of water provided and whether the supply is piped or non-piped, centralized or decentralized, rural or urban *(2)*. Similarly, small-scale sanitation systems may be classified by the quantity of wastewater treated, the number of service connections or the type of technology used. For the purposes of this document, a general distinction for both drinking-water supply and sanitation systems is made between small-scale centralized systems and individual onsite systems, bearing in mind that this may not always exactly reflect the prevailing definitions of all countries in the Region.

Small-scale systems are typically more prevalent in rural areas, which, in many cases, do not have the same level of access to improved water and sanitation services as urban areas *(6)* (see Box 1).

The problem, however, is not the size itself – it is the characteristics and challenges of their use that set small-scale systems apart.

Box 1. Rural–urban disparities in access to "improved" sanitation facilities and drinking-water sources in the WHO European Region

The WHO/United Nations Children's Fund (UNICEF) Joint Monitoring Programme (JMP) for Water Supply and Sanitation *(1)* defines access to "improved" sanitation as access to a facility that hygienically separates human excreta from human contact. The definition of an "improved" drinking-water source is one that, by the nature of its construction, is adequately protected from outside contamination – particularly faecal matter. The categories "improved sanitation" and "improved source of drinking-water" describe specific system technologies that are generally fit to deliver safe services. It should be noted, however, that the current JMP does not collect data on whether these systems do indeed deliver safe services (such as information on their condition or the quality of drinking-water they supply) but only on whether they are in place.

In the WHO European Region in the past 15 years, 60 million people have gained access to improved drinking-water sources and sanitation facilities. The JMP data for 2015, however, illustrate that this progress masks significant rural–urban disparities for the population and between countries and subregions *(1)*.

- Unimproved sanitation is used by 11% of the rural population compared to 5% of the urban population.
- While 4% of the rural population rely on unimproved drinking-water sources, this is only the case for 0.6% of the urban population. In addition, 18% of rural dwellers lack access to piped drinking-water on their premises as opposed to only 2% of town and city residents.
- In the Caucasus and central Asia 62% of the rural population live in homes without access to piped water on the premises, whereas only 9% of the urban population are similarly disadvantaged.

2.2. Challenges of small-scale systems

Small-scale water supply and sanitation systems have a number of similar characteristics and face a range of comparable challenges. It should be noted, however, that not every characteristic described in this section is necessarily relevant to all small-scale systems; nor are the challenges limited to small-scale water supply and sanitation systems alone. The most important aspects influencing small-scale systems include the following.

- A lack of awareness of the relevance of small-scale drinking-water supply and sanitation systems, combined with limited knowledge about their prevalence and conditions and the resulting effects on public health protection, may lead to a lack of a sense of responsibility among the relevant decision-makers. As a result, small-scale systems often receive limited policy attention and institutional support, resulting in underresourcing and little action on improvement.
- Less policy attention is often given to sanitation. Access to adequate sanitation in rural areas frequently lags behind the provision of drinking-water, as shown in Box 1. In general, expenditure on sanitation is less than for drinking-water provision. Globally, expenditure on rural sanitation is estimated to be less than 10% of total water, sanitation and hygiene finance. These low expenditure levels may partly be routed in the low-cost approaches in rural areas; nevertheless, funding requirements remain high *(7)*.
- Small-scale systems are not always sufficiently regulated – for example, with respect to surveillance requirements *(2)*. In settings where regulation is in place, drinking-water and

sanitation are frequently regulated separately, or interministerial coordination may be insufficient. This hinders the uptake of integrated approaches to water and sanitation, which would be particularly beneficial for small-scale systems in rural areas.

- Limited interinstitutional collaboration between public authorities at different levels of government (local, subnational and national) may prevent the particularities of small-scale systems – which are typically best known at the local level – from being taken into account sufficiently at the national and subnational levels (for example, in regulations).
- Ensuring ongoing independent surveillance is a common challenge. In around 11% of countries in the WHO European Region only regular self-checking of water quality is required – no independent surveillance by mandated authorities is undertaken. In another 5% of countries neither independent surveillance nor self-checking is required *(2)*. Even where independent surveillance is required, the sheer number of systems and their geographical spread and remoteness make implementation a challenge.
- Small-scale systems are often operated by untrained or undertrained individuals who lack specialized knowledge and have limited awareness of the health aspects related to water and sanitation services. Of the respondents to the Protocol survey, 48% stated that no minimum qualification requirements for operators of small-scale public water supplies are in place in their country or territory *(2)*. In some settings operators take care of water and sanitation systems as only one aspect of their many duties; in others no person or institution at all is formally responsible for system operation and management. This, in combination with inappropriate financing, may compromise systems' sustainability (see Box 2).
- Small-scale systems typically have relatively larger per-unit costs for technical installations, materials and construction because of the smaller number of people served *(8)*. In addition, the ability to pay for the services is frequently lower among the rural population than in urban areas *(9, 10)*. As a result, small-scale systems often face a lack of sustainable financial resources to maintain, repair or upgrade system infrastructure.
- Owing to the broad geographical spread and sometimes the remoteness and isolation of small-scale systems, operators frequently lack access to professional networking, information, expert assistance and technical support, and may not know about the existing assistance and support mechanisms available in the Region. Requirements or standards for good operation and maintenance practices are frequently not readily available to operators of small-scale systems.
- Small-scale systems are often located in rural areas where drinking-water sources and sanitation facilities, as well as local animal husbandry activities, are located in close proximity. Inadequate sanitation and farming practices may be a source of faecal contamination of drinking-water sources and thereby pose a risk to public health.
- Appropriate use of treatment technologies is generally limited; where it is in place it does not necessarily reflect local conditions and needs. Participatory planning and knowledge of alternative cost-efficient sanitation and wastewater treatment systems are often lacking.
- Small-scale wastewater treatment plants may struggle to meet effluent standards too stringent for them to comply with, taking into account available resources. Overly ambitious standards may therefore prevent implementation of cost-effective local sanitation solutions.
- Small-scale water supplies may be more affected by the anticipated effects of climate change. As climate patterns change, stress on water sources needed for different purposes (such as drinking-water provision and irrigated agriculture) may increase *(11)*; small-scale systems that rely on a single water source are likely to be affected in particular *(12)*. If drinking-water treatment is in place at all, it is typically not designed to handle extreme variations in quantity and quality *(13)*. An increase in extreme weather events, such as heavy rainfall and flooding, may affect decentralized sanitation systems and lead to contamination of the environment and drinking-water supplies in their vicinity.

Box 2. Sustainability of sanitation and drinking-water services

A particular challenge for small-scale sanitation and water supply systems is their sustainability. Abrams et al. describe sustainability as "whether or not something continues to work over time" *(14)*. Applied to water supplies, this definition becomes whether water continues to flow over time and whether that water meets the agreed standards or level of service. For sanitation, it refers to whether the benefits of access to sanitation (such as adequate separation of human waste and contact, and including convenience and privacy) are maintained over time.

What is crucial here is that the definition refers to the sustainability of the service, not of the system. A system may eventually come to the end of its expected life, but the service should continue – the system will need to be replaced or extended. It is therefore essential that policy-makers contribute to an enabling environment embracing the idea of sustainable support.

2.3. Health consequences of dysfunctional water supply and sanitation services

As a result of the challenges outlined in section 2.2, small-scale systems are more vulnerable to breakdown and poor management. If they are dysfunctional, this in turn can lead to unsafe services or insufficient quantities of drinking-water.

Insufficient or inappropriate sanitation and excreta management may lead to the presence of faecal pathogens – and in some circumstances harmful chemicals – in the environment, including the contamination of local drinking-water sources, as well as the direct contact of humans with excreta. These issues are enhanced in cases where knowledge of the relationship between drinking-water, sanitation and hygiene is limited, and where hygiene behaviour is inappropriate or compromised (for example, due to lack of soap and/or facilities for washing hands after use of sanitation facilities).

Higher exposures to faecal pathogens of human and animal origin, insufficient amounts of drinking-water, unsafe drinking-water and inadequate hygiene behaviours increase the risk of water-, sanitation- and hygiene-related diseases – primarily diarrhoeal illness and soil-transmitted helminth infections – and thereby pose a threat to public health. In low- and middle-income countries in the WHO European Region approximately 10 deaths per day are attributable to inadequate water, sanitation and hand hygiene *(15)*.

In many countries regular water quality surveillance and the reporting of data on small-scale water supplies to the national level are inadequate or nonexistent. Similarly, many countries do not have readily available data on the prevalence and conditions of sanitation facilities, particularly in rural areas. Nevertheless, the information currently available indicates a clear relationship between the size of the supply and drinking-water quality: in smaller supplies the risk of noncompliance with limit values is higher. This is illustrated by the examples in Box 3 and the results of a survey organized by the European Commission (EC). For the period 2008–2010, European Union (EU) countries reported that compliance with microbiological water quality parameters laid down in Council Directive 98/83/EC on the quality of water intended for human consumption *(16)* (known as the "Drinking Water Directive") was significantly lower for small-scale supplies (serving 50–5000 people) than large systems *(17)*. While 23 EU countries achieved average compliance rates of over 99% for large systems, only four countries achieved this level for small-scale systems.

Box 3. Drinking-water quality data for small-scale water supplies from Georgia and the United Kingdom

- A rapid assessment of drinking-water quality and prevailing sanitary risk in two pilot districts of rural Georgia (Dusheti and Marneuli) in 2011 indicated significant microbiological contamination of drinking-water. Compliance with the national standards for faecal indicator bacteria, such as *Escherichia coli* (*E. coli*), was evident in less than 40% of the samples. Overall compliance for one or more microbiological and physicochemical parameters investigated during the assessment was even lower, occurring in less than 25% of the samples *(18)*.
- Regulatory data from Scotland for 2011 indicate a clear gradient in compliance with microbiological standards from small to large supplies: supplies serving fewer than 50 people showed comparatively low average compliance rates at 58% for coliform bacteria and 78% for *E. coli*. In contrast, for supplies serving between 501 and 5000 inhabitants, the compliance rates for these two parameters were 98% and 99% respectively *(2)*.
- A study from England analysed about 35 000 samples from more than 11 000 private drinking-water supplies for microbial parameters; *E. coli* was detected in 19% of the samples *(19)*. Contamination appeared to be more prevalent between June and December, and samples from springs and surface water were more likely to be contaminated than groundwater sources. Failure to meet the EU standard for *E. coli* in drinking-water was furthermore linearly associated with the density of sheep in the area and rainfall on the previous day. Further evidence from England indicates *(20)* that samples from larger supplies were less frequently contaminated.

Systematic evidence on the degree of disease attributable to small-scale water supply and sanitation systems is not readily available. Limited data, however, suggest that small-scale water supply and sanitation systems pose a risk to the health of users, while the incidence of drinking-water, sanitation and hygiene-related disease in rural communities is assumed to be largely underreported. For example, a study evaluating waterborne outbreaks in Nordic countries (Denmark, Finland, Norway and Sweden) in 1998–2012 concluded that 35% of the notified outbreaks were linked to single-household water supplies *(21)*. In England and Wales 36% of the outbreaks of infectious disease in 1970–2000 were associated with private drinking-water supplies that serve approximately 0.5% of the population *(22)*. Another study from England showed that contaminated private water supplies pose a substantial risk of infectious intestinal disease, particularly to children under the age of 10 years *(23)*. Data from Ireland indicate that patients infected by verocytotoxigenic *E. coli* – an *E.coli* strain that produces a powerful toxin and can cause severe illness – are 3–4 times more likely to have consumed water from untreated private wells *(24)*. Research from the United States of America suggests that an increased risk of *Cryptosporidium* infection is associated with the presence of onsite wastewater systems and private wells *(25)*. The density of septic systems – particularly so-called holding tanks, for which improper discharge of wastewater by homeowners has been reported to be common – was identified as a risk factor for diarrhoea *(26)*. The use of private wells is associated with *Salmonella* infections, and the use of residential septic systems is a risk for both *Salmonella* and *E. coli* infections *(27)*.

A clear example of health risk relating to unsafe sanitation is the infection caused by soil-transmitted helminths (commonly called “intestinal worms”). Intestinal worm infections in children result in adverse health outcomes such as malnutrition and stunted growth, as well as impaired cognitive abilities, leading to lower school performance *(28)*. Soil-transmitted helminths continue to be a significant health burden because of poor human excreta disposal practices *(29)*. WHO estimates that in the WHO European Region more than 4 million children are in need of deworming *(30)*.

The effects of unsafe and unreliable water and sanitation services also go beyond direct health impacts, affecting social, economic and environmental factors and exacerbating existing discriminatory patterns. Extensive collection times for fetching drinking-water from distant sources reduce the time available for learning or generating family income. Limited availability of water may hinder market gardening and animal husbandry, and thus income generation. Further, the health care costs incurred for treating children suffering from drinking-water, sanitation and hygiene-related diseases may put undue demands on family earnings.

3. Benefits of improving small-scale water supply and sanitation systems

3.1. Building healthy and resilient communities

Whether people are healthy or not is determined by their physical environment and circumstances, among other factors. The provision of adequate sanitation and safe drinking-water in sufficient quantities for hydration, food preparation and good personal and domestic hygiene is a key determinant of health and well-being. Good individual, family and community health enhances opportunities for sustainable livelihoods, reduction of poverty and economic development. Safe sanitation, including adequate wastewater treatment and safe disposal of excreta and wastewater, contributes to a clean and healthy environment. If safely managed, reuse of wastewater in horticulture and agriculture may empower small food producers and may contribute to food and nutrition security in rural communities, especially in water-scarce areas where alternative supplies and fertilizers are not readily available.

3.2. Improving the human rights situation

Access to safe drinking-water and sanitation is recognized as a human right by United Nations General Assembly Resolution 64/292 *(31)* and Human Rights Council Resolution 18/1 *(32)*. The progressive realization of this right requires (among other things) that all people should have equitable access to safe, acceptable, physically accessible and affordable water and sanitation services, including isolated rural populations as well as poor, vulnerable and marginalized community members. Policy attention to improving small-scale water supply and sanitation services contributes to a reduction in rural–urban disparities and other inequities, thereby fostering the progressive realization of the human right to water and sanitation.

3.3. Increasing gender equality

Women are the prime users of “domestic water” and have a key role in hygiene activities, such as promoting handwashing behaviours in the household and food production. In certain rural areas of the WHO European Region women and girls are also responsible for faeces disposal and fetching water when piped water in the household is unavailable *(33, 34)*. Girls may encounter poor hygiene conditions and a lack of adequate infrastructure for proper disposal of sanitary towels in schools *(35–39)*. Thus, women and girls benefit from improvements and more convenient access to sanitation facilities. Women’s involvement in water and sanitation decision-making may improve governance and promote women’s empowerment through effective participation, while addressing their specific needs. It may also allow for gender mainstreaming in water, sanitation and hygiene policies *(33)*.

3.4. Achieving economic benefits

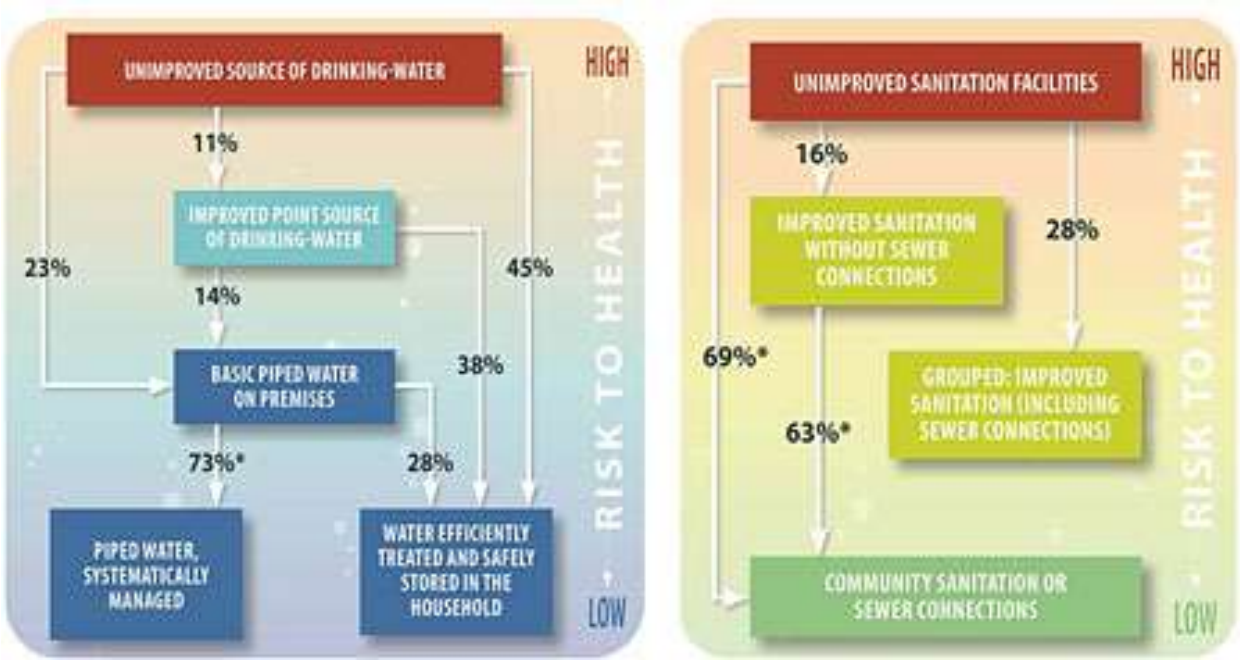
The evidence is clear that the financial benefits outweigh the investments in improvements to water and sanitation systems. It has been estimated for the WHO European Region that an investment of US$ 1 results in a mean return ranging from US$ 2 in higher-income countries to US$ 21 in lower-

income countries. ("Investment" encompasses cost-of-improvement interventions in small-scale water supplies aimed at reducing acute diarrhoeal illness and "return" includes the value of preventable disease measured by direct and indirect costs of illness prevented by these interventions *(40)*). For the Caucasus and central Asia, for example, every US$ spent on improving sanitation brings an average economic return of US$ 4.8 in the form of time savings, lower health costs and improved productivity *(41)*.

3.5. Reducing the burden of diarrhoeal disease

Diarrhoeal disease can be prevented effectively through the safe management of drinking-water and sanitation services. For example, a study from Iceland showed that the population receiving drinking-water from supplies applying the WHO-recommended water safety plan (WSP) approach – a proactive risk assessment and risk management method (see section 5.2 on sanitation planning) – was 14% less likely to develop clinical cases of diarrhoea *(42)*. In a global assessment, WHO researchers estimated that a transition from improved sanitation facilities without sewer connections to community sanitation or sewer connections could account for a significant reduction in diarrhoeal disease risk in low- and middle-income countries *(43)*. Large reductions in the risk of diarrhoeal disease are possible when water supply systems are improved – for example, by a transition from access to basic piped water on premises to services systematically managed by WSP-type approaches (see Fig. 2).

Fig. 2. Diarrhoeal disease risk reductions associated with transitions in sanitation and drinking-water



Note: estimates of risk reductions associated with transitions to higher levels of service are based on limited evidence and should therefore be considered preliminary.
Source: WHO *(43)*.

4. Policy tools to create an enabling environment

It is the responsibility of national and subnational decision-makers to set the stage for and implement long-term strategies to improve the situation of small-scale water supply and sanitation systems. Establishing a firm rationale for improvement and defining explicit policies with clear goals and short-, mid- and long-term targets are essential to secure the commitment of stakeholders at all levels and to mobilize and allocate necessary resources. In order to develop effective policies

on small-scale water supply and sanitation systems, the following aspects are paramount for policy-makers:

- to have a clear understanding of the prevailing situation and the political will to improve it;
- to allocate adequate resources for change;
- to address water supply and sanitation using an integrated and coherent approach;
- to consult with water, health, environment and other relevant authorities at all levels to understand the perspectives of those who will be affected by the policies or who can contribute to the policy-making process and implementation;
- to embed local and subnational perspectives and initiatives in the overall policy-making process;
- to allow in policy formulation for a step-by-step improvement approach that reflects prevailing conditions, priorities and available resources – this allows immediate small improvements as well as larger solutions in the future, thereby facilitating the establishment of both short-term and long-term targets.

Several tools are available to policy-makers to create an enabling environment for achieving short-, mid- and long-term improvements and thereby incrementally reaching the goal of providing safe and sustainable water supply and sanitation services in rural areas and small towns. The following sections outline a number of options and highlight how they can be tailored to the particularities of small-scale systems. These approaches need to be adapted to prevailing national conditions and do not necessarily need to be followed in the order of appearance in the following sections.

4.1. Baseline analysis and target-setting

To ascertain the need to adopt or amend existing policies and to set national targets towards improving the situation for small-scale water supply and sanitation, it is important to determine and appreciate the status quo. Such baseline analysis will establish a clear overview of those areas particularly in need of policy attention and those already working well.

The Protocol *(5)* is an effective instrument to address small-scale water supply and sanitation systems at the policy level. Articles 6 and 7 of the Protocol require countries that have ratified it to establish and publish targets for achieving a high level of protection of human health and sustainable management of water resources, reflecting countries' needs, priorities and available resources, as well as to undertake periodic review and assessment of the progress reached. Detailed information on the target-setting process is given in the publication *Guidelines on the setting of targets, evaluation of progress and reporting (44)*. While this approach was developed under the Protocol, countries that are not (yet) Parties to the Protocol may take a similar approach, and some have already done so, applying these principles in a step-by-step manner. The main steps are:

- identifying key stakeholders and establishing a steering committee;
- performing a baseline analysis;
- identifying and prioritizing problems;
- reaching agreement on draft targets and a programme of measures and indicators to assess progress towards achieving them;
- undertaking broad consultation on the proposed targets with all stakeholders, including public participation;
- reaching a final agreement on the targets and communicating them to all stakeholders;
- implementing the targets and monitoring their achievement;
- reviewing and assessing progress and reporting.

The Protocol's planning and accountability approach offers a practical framework for Parties to translate the aspirations of 2030 Agenda for Sustainable Development into specific national targets and action. The target-setting framework under the Protocol can therefore be a tool to operationalize

the implementation of Goal 6 and the other goals pertinent to water, sanitation and health, and to foster their achievement in the European region.

4.1.1. Getting started: forming a steering committee and stakeholder mapping

Setting national policy targets requires cooperation across sectors. The target-setting process provides opportunities to create a platform that brings together different stakeholders and promotes partner alignment. Countries that have already set targets under the Protocol have reported positive results when a steering committee has provided clear leadership in the target-setting process. An existing national group or body in the water, sanitation and health sector can also be tasked with guiding the target-setting process (see Case study 1 from Tajikistan). While the steering committee would typically have a small number of members, a wide range of stakeholder groups should be considered for consultation throughout baseline analysis and target-setting, including but not limited to:

- regulators with the authority to develop regulations and legislation;
- authorities at different levels (local, subnational and national), including those responsible for implementation, enforcement and surveillance of instruments;
- authorities from different sectors, including public health, water resource management, environment, water supply, sanitation, rural development, finance, education and agriculture;
- water supply and sanitation service providers and their professional associations;
- standard-setting bodies;
- scientists to substantiate the policy measures;
- civil society through, for example, consumer associations and NGOs involved in the water and sanitation sector, including those representing sections of the population such as girls and women and marginalized groups.

It is important to engage all main stakeholders early in the process and to define their roles and responsibilities to ensure their long-term commitment in target-setting and implementation.

Case study 1. The Tajikistan Water Supply and Sanitation (TajWSS) Network

The TajWSS Network was established in 2009 and is intended as a national multistakeholder network of actors from government; international institutions and donors; science institutions and academia; and public, private and other not-for-profit organizations in the water and sanitation sector in Tajikistan, who gather on a quarterly basis to advance the national drinking-water and sanitation agenda *(45)*. The Network was launched with financial support of the Swiss Agency for Development and Cooperation and implemented by Oxfam, in cooperation with the United Nations Development Programme and the Ministry of Energy and Water Resources of Tajikistan. Local-level networks are also in place; these coordinate subsector activities and act as a link between the local and national actors.

Since its establishment the Network has become a platform for many interested organizations to discuss gaps hindering water and sanitation policies; share practices, tools and methodologies across institutions and partners; and take stock of both what exists and what works well and lessons learnt from failures. For example, in 2010 the Network contributed to the passing of a national law on drinking-water *(46)* and played a crucial role in stakeholder consultations to develop draft national targets under the Protocol in 2013. Further major contributions made to national policy, regulations and bylaws concerned, for example, the development of a national methodology to calculate water tariffs, the taxation system, ownership of water supply systems and construction permits.

The Network has supported the establishment of local water user associations to manage small-scale systems in pilot villages and conducted training sessions on their management, accounting, operation and maintenance, as well as on gender equality, water treatment and sanitation.

4.1.2. Baseline analysis: determining and understanding the status quo

A multidisciplinary team should gather and review information relevant to understand the current situation of small-scale water supply and sanitation systems, including but not limited to:

- existing national policies and strategies, as well as legislation, regulations, standards and guidelines, including information on how far they address small-scale systems and how they are enforced (see section 4.2 on legislation and regulations and section 4.3 on technical standards and guidance);
- requirements for self-checking by operators or communities and independent surveillance by authorities of small-scale systems (see section 4.4 on surveillance);
- numbers and prevailing technologies of small-scale systems, their geographical distribution and the populations served;
- responsibilities for management, operation, maintenance, financing and surveillance of small-scale systems;
- formalized/institutionalized linkages between water and sanitation sectors in practice (see section 4.8 on cooperative arrangements and networking);
- data on accessibility, continuity, affordability and sustainability of services;
- data on drinking-water quality and sanitary status of water supply systems, including the main related challenges and possible changes over time;
- data on quality of wastewater discharges, including the main related challenges and possible changes over time;
- epidemiological data and health indicators related to small-scale water supplies, sanitation and hygiene;
- information on the management of excreta, wastewater and sludge from pit latrines and septic tanks, the extent of the reuse of wastewater, the quality of reused wastewater, reuse practices and similar;

- qualifications and experience of staff operating small-scale water supply and sanitation systems;
- programmes and initiatives already in place to improve small-scale systems;
- existing awareness-raising, training and education programmes (see section 4.7 on advocacy and awareness-raising and section 4.6 on education, qualification and training);
- existing or emerging and future challenges expected – for example, concerning climate change, population development, population distribution, land use and human activities.

It is not unusual for information on small-scale systems to be limited at the outset. The survey on small-scale water supplies conducted under the Protocol *(2)* revealed, for example, that only 18% of national authorities had information readily available at the national level on drinking-water quality for individual or non-piped supplies. In many cases, data will not be available for the entire country but may result from projects and studies targeted at a limited area or a limited number of system categories. In such situations, systematic data collection, including building an inventory of small-scale systems (see volume 3 of the WHO guidelines for drinking-water quality *(47)* for more details), becomes an important first step in baseline analysis (see Case study 2 from Ireland).

Case study 2. Inventory and baseline information in Ireland

In Ireland legislation *(48)* requires that supervisory authorities maintain a register of all supplies in their area of responsibility and make this information available to the national authority *(49)*. This includes information on the name and address of supplier, volume of water supplied, type of water treatment in place, source of the water supply and supply zone code allocated under the national monitoring programme.

Community-run "group water schemes" (GWS) currently supply water to around 70 000 households in Ireland (over 4% of the population). Monitoring of these supplies began in the 1990s and successive reports by the Environmental Protection Agency (EPA) highlighted the poor quality of drinking-water in privately sourced GWS. The EC began infringement proceedings against Ireland in 2002, citing poor quality in 453 schemes.

The first report issued under the 1998 EU Drinking Water Directive *(16)* covering the year 2004, which clearly separated out private GWS from other private supplies, found that over 40% of private GWS were contaminated with *E. coli* at least once during the year. To address the quality issues, the National Federation of Group Water Schemes *(50)* was established in 1997 as the representative and negotiating organization for community-owned rural water services in Ireland. The Federation assists its members to achieve the required drinking-water quality standards through representation, negotiation, support, awareness-raising and training, and coordinates action to improve GWS. Since 2004, the number of schemes contaminated with *E. coli* has dropped from 282 to 32 in 2013. This shows the added value of performing a baseline analysis from which to build further improvement action.

Data gathered under existing international monitoring mechanisms on water, sanitation and hygiene (such as the United Nations Water Global Analysis and Assessment of Sanitation and Drinking-Water *(7)* and the WHO/UNICEF JMP *(1)*) can also be used to establish the baseline situation. Information from scientific studies and NGO reports can also be considered.

As illustrated by Case study 3 from Georgia, undertaking a one-off targeted rapid assessment exercise helps countries to gain a statistically representative snapshot of the water quality and sanitary conditions of water supplies (more information on this methodology is available from the WHO publication *Rapid assessment of drinking-water quality (51)*).

Case study 3. Assessing small-scale water supply systems in Georgia

In Georgia 48% of the population lives in rural areas, where small-scale water supply systems are frequently in use. Anecdotal evidence suggests that the situation concerning waterborne diseases is usually worse in rural areas; in recent years, however, surveillance and thus available data have been limited. The management of small-scale water supply systems was identified as an issue of national importance. The Georgian authorities initiated a project to assess the drinking-water quality and sanitary risks in such supplies in two pilot districts to improve the evidence base regarding the current situation *(18)*.

A core project team was established comprising members from the health, water, environment and agriculture sectors. Field teams visited the drinking-water supplies and took samples, which were analysed for a limited number of core microbial and chemical parameters at water sources, storage and distribution locations and households. To identify prevailing sanitary risk factors, field teams also conducted standardized sanitary inspections of the supplies and their surroundings and interviewed supply operators. These activities were supported by outreach programmes for the local population, training of local authorities and dissemination of awareness-raising materials, including leaflets on handwashing procedures and how to avoid waterborne diseases.

On average, 70% of the analysed samples showed microbial contamination. Sanitary inspections revealed a significant number of risk factors compromising the provision of safe drinking-water. These included nonexistent sanitary protection zones, pit latrines built too close to wells – in violation of the sanitary rules – and compromised integrity of the abstraction facilities (such as missing covering of wells and faulty spring masonry). Water abstraction and water storage practices in households were found to be inadequate and water disinfection was mostly either not in place or not operational.

Based on the main issues identified, recommendations for further action were developed to improve drinking-water safety. The baseline analysis also informed the national process of target-setting under the Protocol. Recommendations included further development of the regulatory framework and mechanisms to water safety plans the protection of supplies, implementation of WSPs, strengthening of the surveillance system, adherence to sanitary rules for construction of decentralized sanitation facilities, recommendations for technical improvements and increased awareness-raising activities for the population.

Once sufficient evidence is acquired it is vital to analyse and assess the information systematically in support of rational policy-making and strategic planning, and to draw conclusions about priority improvement needs and actions. Questions to be considered in this process by the steering committee include the following.

- What are the health risks, environmental impacts, economic consequences, inequities and other consequences arising from the current situation of small-scale systems?
- What are the underlying causes?
- What are the main issues to be addressed?
- What approaches and instruments can be applied to promote safe and sustainable access to water supply and sanitation services from small-scale systems?
- Based on previous experiences, what approaches or instruments were found to be successful, which were unsuccessful, and why was this so?

4.1.3. Setting targets and planning action

The targets identified and chosen for improving small-scale systems may consider one or more of the tools and good practices presented in this document (see sections 4.2–4.8 and Chapter 5) and specifically address:

- updating legislation, regulations, technical standards and guidance to reflect the particularities of small-scale systems;
- increasing access to improved drinking-water supply and sanitation systems in rural areas;
- conducting awareness-raising and education campaigns for communities and local decision-makers;
- adapting surveillance programmes to include remote areas;
- introducing financial instruments to support improvements in small-scale systems;
- establishing water protection zones in rural areas;
- promoting approaches for safe and sustainable management of small-scale systems.

Policies and approaches applied in other countries can inspire policy development. To this end, intercountry collaboration under the Protocol and within international networks (see Box 4) may serve as a platform for such information exchange.

Box 4. International networking

- The Rural Water Supply Network (RWSN), hosted by the Swiss Resource Centre and Consultancies for Development Foundation, has more than 2500 members participating either as organizations or individually from about 100 countries *(52)*. RWSN is managed in English, French and Spanish. It is subdivided into the following working groups: accelerating self-supply; sustainable groundwater development; equity and inclusion; and management and support. The Network also has sections to cater for people seeking assistance with implementation, funding and investment, policy, knowledge and networking, and training.
- The WHO-hosted International Small Community Water Supply Network was established in 2005 *(53)*. In order to assist countries in the operation and management of small-scale supplies, particularly in rural and remote areas, the Network provides a platform to identify common management and technical issues regarding small community water supplies. It also aims to develop workable solutions in a geographical, socioeconomic and cultural context. The Network has grown to include around 125 members from approximately 35 countries. It has held several international meetings, giving participants the opportunity to share information on subnational, national and international approaches, good practices and challenges. Between meetings, a virtual forum gives all Network members the chance to raise issues for discussion and to participate in ongoing activities.
- The International Network of Drinking-water Regulators, also hosted by WHO and established in 2008, is an international forum that aims to address and share information on regulatory issues related to drinking-water *(54)*. It also promotes good regulatory practice on a variety of water quality and water management issues and continuous improvements of regulatory frameworks, covering issues related to regulating small-scale water supplies.

In setting and prioritizing targets, as well as in planning concrete actions for implementation, the availability of institutional, human and financial resources needs to be taken into account to align what ideally should be done with what realistically can be done. An approach that has proved successful for setting targets is to strive for incremental improvement rather than risk discouragement by starting the process with unrealistically high and barely achievable targets.

Timelines agreed in the target-setting process should include regular reviews of achievements and the effectiveness of measures, as well as adaptation of the targets, if required. Timelines for a concrete action plan need to take into account the geographical spread and number of locations for which improvement is sought, and thus include a step-by-step approach. For example, training initiatives for operators will not typically take place at the same time across the country but will be rolled out over time, and interim targets can be set with modest objectives on the way to full compliance.

Part of an agreement on targets is also the identification of reliable quantitative and/or qualitative indicators to measure progress. Assigning responsibilities may include review and encouragement of possible partnerships in implementation – for example, by partnering with associations, NGOs and aid agencies.

4.1.4. Examples of target-setting under the Protocol

To prevent, control and reduce water-related disease, Article 6 of the Protocol *(5)* stipulates a number of thematic areas for target-setting, of which the following are relevant for small-scale systems:

- improving drinking-water quality of small-scale water supplies (paragraph 2(a));
- reducing the scale of water-related diseases in rural areas (paragraph 2(b));
- improving access to drinking-water and sanitation services in rural areas (paragraphs 2(c) and 2(d));
- improving the performance levels of small-scale water supply and sanitation systems (paragraph 2(e));
- increasing the application of recognized good practices in small-scale systems (paragraph 2(f));
- reducing the occurrence of untreated wastewater and improving the quality of discharges from small-scale sanitation systems (paragraphs 2(g) and 2(h));
- improving protection of resources used for drinking-water supplies (paragraphs 2(j) and 2(m)).

In accordance with these provisions, a number of countries have set and implemented targets related to small-scale water supply and sanitation systems *(55)*. A selection of specific examples is shown in Box 5.

Box 5. Examples of targets on small-scale systems set under the Protocol

Czech Republic ***(56)***

- For water mains serving fewer than 5000 inhabitants the number of instances of noncompliance should be reduced to 1% for indicators with high health relevance.
- Inhabitants of outlying areas and small municipalities should be able to connect to the public mains. Local authorities planning to extend the water network into the periphery of the municipality should be supported through financial assistance from the state.
- High-quality and adequate wastewater treatment should be ensured in small agglomerations with fewer than 2000 inhabitants where public sewers exist, as per Council Directive 91/271/EEC *(57)*.

Hungary ***(58)***

- The aim for the end of 2015 was to supply 96% of the population with public drinking-water that complies with the relevant chemical limit values. Significant improvements should be made in the reduction of arsenic and nitrite concentrations in drinking-water.
- The aim for the end of 2010 was to have sanitation and advanced sewage treatment in place for settlements with population equivalents (PEs) of more than 15 000. As a next step, the aim for the end of 2015 was to establish 100% access to sanitation and biological sewage treatment in smaller settlements with PEs between 2000 and 15 000.
- No untreated sewage should be discharged from settlements with more than 2000 PEs after 2015.

Kyrgyzstan ***(59)***

- In rural settlements compliance of drinking-water quality with microbiological and chemical standards should be ensured in over 90% of annual samples by 2017 and in over 95% by 2020.

Norway ***(60)***

- The supervisory authority should maintain an up-to-date overview of the drinking-water quality for all water supply systems supplying more than 50 people.
- All water and sewerage works that serve 50 or more people/PEs should have a satisfactory internal control system, including a risk and vulnerability analysis that covers the effects of climate change.
- Systems serving more than 50 PEs should be assessed for inclusion in an operational assistance scheme.
- In rural areas connection to public sewerage systems should be considered, as well as cross-subsidization of costly connections to the collective water supply.

Ukraine ***(61)***

- The proportion of annual samples showing noncompliance of drinking-water quality with chemical parameters is targeted at 15% for 2015 and 7.5% for 2020 in rural areas, and at 7% for 2015 and 3% for 2020 in urban areas.

4.2. Legislation and regulations

Laws and regulations are powerful instruments for translating the aims and visions of an agreed policy for small-scale drinking-water and sanitation systems into action, contributing to achieving the goals set. They can provide a “regulatory push” to ensure that improvements to small-scale systems happen, which can stimulate change and help to mobilize resources. These instruments usually specify drinking-water quality standards and wastewater discharge requirements, including interventions in response to noncompliance with standards. They may, however, also include other

provisions relating to water and sanitation management and surveillance. They form the backbone of all policy instruments highlighted in this section and can expand upon, among others, the policy elements related to good practice highlighted in Chapter 5.

Laws and regulations are typically made at the national or subnational level. Nevertheless, the impetus to create legislation can be inspired by "bottom-up" initiatives, where experiences at the local level show or confirm the benefits of feasible approaches that justify and trigger adoption in national legislation and regulations. Laws emanate from the legislative branch of the government (such as the parliament), and introducing or modifying legislation can be a complex and lengthy process. To ensure flexibility, therefore, further details of legislative provisions could be specified in supporting documents, which can typically be adapted more quickly and easily to allow for the incorporation of technical, scientific and other developments available to the executive branch. These include regulations, bylaws, sanitary norms, technical standards, technological cards, guidelines and codes of good practice. Regulation appears where laws delegate the power to make rules to the executive branch (such as the relevant ministry). This delegated legislation has the same legal force as a law.

At a supranational level, international human rights law demands that states work towards achieving universal access to water, sanitation and the highest attainable standard of health for everyone, guided by human rights principles and the standards of the above human rights *(31, 32)*. These human rights mean that the level of health protection set out in legal and regulatory provisions on the quality of drinking-water, for example, should ideally be the same for the entire population of the country, regardless of whether it is supplied from a large or small or from a centralized or decentralized system.

Requirements for drinking-water quality, safe management principles or environmental protection from wastewater discharges are universal, regardless of a system's size. While the level of protection should not be compromised, however, the way this can be reached in practice may differ in the context of large or small systems. For example, requirements regarding effluents may depend not only on the receiving water body and on parameter concentrations but also on the amount of treated wastewater discharged, which is typically lower for small-scale systems.

4.2.1. Considering small-scale systems in legislation and regulations

It is important that legislation and regulations reflect the situation and particular needs of small-scale systems. Options for taking these into account include the following.

- Separate legislation and regulations for small-scale systems could be issued; alternatively, legislation and regulations that address both large and small systems might include specific provisions for small-scale systems (see Case study 4 from Finland and Case study 5 from Germany).
- A gradual approach is preferable for implementation of new requirements – this will encourage long-term improvement and increase compliance. It is likely that it will not be possible to meet all requirements at once, particularly in resource-limited settings.
- Regulators may formulate specific monitoring and surveillance requirements for small-scale systems that reflect the realities of financial, technical and institutional capacities. Risk-based surveillance approaches allow greater flexibility, taking into consideration local specifics while maintaining the same level of health protection (see section 4.4 on surveillance).
- Bylaws, documents, sanitary norms, technical standards, technological cards, guidelines and codes supporting legislation need to be flexible enough to accommodate new developments (such as newly emerging technologies that may be particularly suitable for small-scale systems).
- The regulatory authority responsible may find it beneficial to approach enforcement differently for large and small systems. Legislation and regulations should be flexible enough to

accommodate approaches to enforcement that will allow local authorities to build trust by taking an advisory role or applying incentive mechanisms (see section 4.2.3).

Case study 4. Regulation, institutional framework and financing of small-scale sanitation systems in Finland

About 1 million people in Finland are not connected to communal sewerage systems because settlements are widely dispersed. The Environmental Protection Act *(62)* concerns all buildings with wastewater effluent in areas with no communal sewerage network connection. The legislation obliges homeowners and occupants to install or renew existing wastewater treatment systems that can fulfil the load reduction criteria under normal circumstances and to keep records about their systems. Inhabitants can apply for relief from the liability for five years for socioeconomic reasons, however.

Homeowners and occupants have to bear the costs of changes to the system but can apply for financial aid. Tax deductions can be granted for work done at homes and holiday residences, and allowances for renovations can be granted from general government funds. The Finnish Ministry of the Environment can also, based on the Act on Support for Water Supply *(63)*, subsidize the total costs of the wastewater treatment system by up to 30% (in special cases by up to 50%).

In making or revising legislation and regulations suitable for small-scale systems it is beneficial to consider the following aspects.

- Good understanding of the reasoning behind changes to legislation and regulations will increase compliance and acceptance among relevant stakeholders (including local authorities, surveillance agencies, professional associations, operators and the public). This can be achieved by consulting and communicating with them throughout the development or revision process.
- Regulatory power to improve the situation for small-scale systems may not always lie within the obvious policy sectors (such as water or health). Other sectors that have an impact and regulatory power in addressing small-scale systems (such as agriculture and rural development) should be involved wherever possible.
- Establishing an organized and ongoing communication and coordination process between relevant institutions and sectors sharing responsibility for addressing small-scale systems helps to overcome inconsistencies in existing legislation from different sectors. If an interagency coordination mechanism already exists, it is advisable to build on this (see Case study 5 from Germany for an example of including private wells in national legislation). The communication process should also include a feedback loop, especially since implementation of regulations for small-scale systems is frequently the task of regional and local authorities; this could provide important information for future reviews of legislation and regulations.
- In preparing decisions on legislation and regulations, it is beneficial to map and take into account the status and number of small-scale systems and their geographical spread, as well as the institutional capacity to support implementation of legislation and regulations (see section 4.4 on surveillance).
- Setting out clear definitions and categories of different types and sizes of system in legislation aids understanding and implementation.
- Policy-makers need to take into account the financial impacts of new legislation or regulations and who will bear these, and make provisions to ensure that the financial impacts can be covered.

Case study 5. Private wells in Germany

Under the German Drinking-water Ordinance *(64)* the requirements for drinking-water quality must be met by all supplies, regardless of their size or organizational and ownership structures. The minimum requirements stipulated by the Ordinance therefore apply to private wells, including the fact that they are subject to surveillance by the authorities. The same limit values apply for private wells, all supplies have to be notified to the respective authority, they are subject to regular self-checking and independent surveillance and operators have to notify the local health authority in case of noncompliance.

The Ordinance differentiates requirements for the following aspects according to the size of the supply and whether it is only for personal consumption.

- Water testing and inspection are required less frequently for private wells.
- The scope of parameters subject to testing is limited in private wells that only supply one family.
- The measures required in response to noncompliance with limit values are different.
- Provision of information to consumers on drinking-water quality and development of a plan describing measures in case of water supply disruption are required for private wells supplying more than one premises.

Private well owners need to analyse their drinking-water at least annually for microbial parameters and to notify the local health authority in cases of noncompliance.

Germany has a joint interinstitutional working group on private wells, comprising representatives of the 16 federal states and federal authorities, including the health and water resource protection sectors. It is mandated to review current evidence on private wells and to provide advice to the local health authorities responsible for surveillance. The working group has developed an advice booklet *(65)* addressing private well owners and informing them – in easy-to-understand language – of their statutory obligations, highlighting the benefits of regular self-checking and surveillance by the authorities. The booklet provides information on common hazards in the vicinity and potential structural damage and highlights options for repair, control and monitoring. It aims to improve communication between owners of private wells and the authorities. The working group has also developed a brochure for local health authorities with recommendations on the surveillance of private wells.

4.2.2. Using existing legislation or international guidelines as a starting-point

Most countries already have legislation and regulations or sanitary norms on sanitation and drinking-water quality in place, which means that revising them to include requirements to address small-scale systems is not a process that will start from scratch. Legislation from other countries can also serve as a model.

For EU Member States and accession countries European legislation is a starting-point for action at the national level. The Drinking Water Directive *(16)* lays down minimum requirements on water quality and obligations for remedial action, monitoring and reporting. The Directive distinguishes requirements for monitoring frequency for different sizes of water supply, depending on the volume of water supplied and the number of people served (see Box 6).

The Directive is binding law for EU countries but allows exemption from the minimum monitoring requirements of individual supplies that provide less than 10 m^3 of water per day or serve fewer than 50 people. Nevertheless, several EU countries (including Germany and Portugal) have decided not to exempt such supplies and the requirements of the Directive for small-scale systems thus apply in these countries. It should be noted that while the Directive allows small-scale systems to be

exempted from monitoring, this does not entail exemption from the duty to take action when a potential danger to human health is apparent *(49)*.

Box 6. Categories used in Council Directive 98/83/EC on the quality of water intended for human consumption (Drinking Water Directive)

The Directive *(16)* establishes different drinking-water supply categories and stipulates monitoring frequencies that increase with the volume of water being supplied. For example, the minimum annual frequency of sampling and analysis for compliance monitoring of *E. coli* is as follows:

- for systems supplying ≤100 m^3/day: >0 samples;
- for systems supplying >100 m^3/day to ≤1000 m^3/day: four samples;
- for systems supplying >1000 m^3/day: four samples plus three additional samples for each 1000 m^3/d and part thereof of the total volume.

Council Directive 91/271/EEC on urban wastewater treatment *(57)* makes provision for agglomerations with PEs of 2000 and over. This Directive is complemented by a guide on extensive wastewater treatment processes adapted to small and medium-sized communities with PEs of 500–5000 *(66)*. Several EU countries (including Finland and the Netherlands) have also put in place regulations to cover wastewater from small communities and settlements with remote houses (see Boxes 7 and 8 for examples of legal and regulatory requirements for small-scale systems).

WHO guidelines provide a scientific point of departure for developing national legislation and regulations defining the minimum requirements for protecting public health. These include guidelines for the safe use of wastewater, excreta and greywater in agriculture *(67)* and for drinking-water quality *(68)*. Volume 3 of the latter *(47)*, which is currently under revision, specifically addresses small-scale systems. This volume deals with the planning and implementation of surveillance, undertaking surveys and sanitary inspections, water sampling and data analysis (see section 4.4 on surveillance). Furthermore, it sets out different types of technology, hygiene education and legislative, regulatory, policy and basic management aspects.

Box 7. Examples of legal and regulatory requirements for small-scale water supplies

- In Denmark the requirement for water quality is universal but different regulations are in place for mandatory monitoring, depending on the size of the supply. The legal instrument regulating the catchments of water supplies also applies to small-scale water supplies serving fewer than 10 households *(69)*.
- Regulations in England specify that the local authority must conduct regular risk assessments for and monitor small-scale ("private") supplies *(70)*, whereas for large ("public") supplies the responsibility lies with the utilities *(71)*.
- Finland has issued separate legislation for regulating small-scale supplies with its Decree for supplies serving <50 consumers or providing water <10 m^3/day – including private household wells – where, according to the legislation, local health authorities must ensure that owners are adequately informed about the water quality in their regions *(72)*.

Box 8. Examples of legal and regulatory requirements for small-scale sanitation systems

- According to Finnish law, there must be an appropriate toilet on the property or in the immediate proximity of each dwelling *(73)*. The law also states that "a toilet has to be placed, constructed and kept in order in such a way that it does not harm the health of those visiting it or staying in its vicinity" (see Case study 4 from Finland).
- In the Netherlands Article 10.33 of the Environmental Management Act of the Ministry of Infrastructure and the Environment *(74)* stipulates that even though municipalities are responsible for the collection and transportation of municipal wastewater, separate onsite sanitation systems are not prohibited, as long as they do not damage the environment.
- Many EU countries have lower requirements for small wastewater treatment plants than for larger plants. For example, in Latvia the required treatment efficiency for plants with 500–2000 PEs is 50–70% for biological oxygen demand, while it is 70–90% for plants with more than 2000 PEs. For small wastewater treatment plants the legislation specifies "appropriate treatment", which is defined on a case-by-case basis depending on the receiving water body, and subject to approval by the regional environmental protection authority *(75)*.

4.2.3. Incentive-based regulation

Where enforcement capacity is limited and technological innovation or the use of locally appropriate solutions to achieve a particular policy goal are encouraged, incentive-based regulation can be considered for small public systems. Such instruments have a long tradition in environmental policy-making. Examples include introducing taxes for polluting activities, subsidies for activities preventing pollution (see section 5.3 on water and sanitation safety planning) and combined approaches *(76, 77)*.

In the context of small-scale systems, for instance, it is conceivable to lower taxes for wastewater treatment plants according to the level of effluent quality achieved. In a similar vein, donor agencies have been exploring results-based financing mechanisms, including for solutions for small-scale sanitation systems. The publication *Identifying the potential for results-based financing for sanitation (78)* provides examples of these efforts.

4.3. Technical standards and guidance

In order for small-scale systems to provide safe services that are protective of human health it is advisable that they adhere to technical standards and/or other technical guidance (see Box 9). This helps operators with due diligence and can also help to facilitate systems approval by appropriate authorities and institutes, where required.

Technical standards and guidance may specify requirements for the protection of drinking-water sources. These may include the design, construction, operation and management of water abstraction infrastructures, water treatment systems and processes and water distribution and storage systems, as well as requirements for monitoring, laboratory accreditation, training and qualification of operators (see section 4.6 on education, qualification and training). For sanitation they may cover provisions for collective and onsite sanitation systems, addressing technical and managerial aspects of wastewater collection and transport, treatment – including requirements for the quality of discharged wastewater – the location of systems and sites for discharge.

Box 9. Definitions of technical standards and guidance for small-scale systems

- Technical standards (also sometimes referred to as technological cards, technical guidelines, management standards or codes of good practice) comprise of a set of rules that set definitions, specifications and requirements for technologies, products, processes, services and proper management. Such standards may be initiated by industry or legislators and are typically elaborated, approved and updated by national or international standardization organizations, from which they can be purchased. Products, processes and services are typically standardized on a voluntary basis; however, laws, regulations and sanitary norms may refer to them and require compliance with them. Technical standards are subject to continuous revision; interested parties are involved in their development.
- Guidance documents are sets of instructions, recommendations or technical information prepared by expert groups, technical and scientific associations or government bodies. In contrast to standards, guidance documents are frequently made available free of charge. They can be adopted as legal requirements or used as recommendations as appropriate, depending on the legal context. Typically, guidance documents are more flexible in terms of continuous update according to changes in science and technology and may therefore change faster than regulations and standards. Guidance documents are also typically broader than standards and can refer to a wider range of options and possibilities. Technologies and management approaches that are not (yet) standardized may be described in guidance documents. For example, compact sanitation systems tend to be standardized, while natural treatment systems are commonly covered by guidance documents.

Standards, guidelines and similar technical and management rules can be of a statutory or nonstatutory nature. Legislation can make reference to and adopt a list of standards to be applied, such as different treatment technologies. Not all technical standards cited in legislation may be suitable in the context of small-scale systems, however, and therefore legislation may stipulate specific technology, operation and management requirements that allow environmental and health protection targets to be met. Case study 6 from Germany provides an example of legislation referring to standards and guidance documents, showing how technical and scientific associations select those most relevant to small-scale systems and make them affordable.

Case study 6. Technical standards and guidance documents for small-scale water supply and sanitation systems in Germany

The German Drinking-Water Ordinance of 21 May 2001 *(64)* requires that facilities for the treatment and distribution of drinking-water are planned, constructed and operated at minimum in compliance with generally recognized codes of practice. One of the main tasks of the German Technical and Scientific Association for Gas and Water (DVGW) is the development of technical rules and standards that represent these codes of practice. The development process is founded on broad participation of experts and practitioners in their respective fields – it thus reflects the latest available technical knowledge and principles applied in the field.

Complying with the requirements stipulated by the technical rules and standards means that operators can be confident that they are also complying with legal standards; it also supports due diligence in the operation of drinking-water supplies. Areas covered by these standards and rules include, for example, the management of resources used for drinking-water abstraction; drinking-water installations in buildings; design and operation of abstraction, treatment and distribution systems; and organization and management of drinking-water supplies. Many operators of small-scale supplies, however, regard this set of nearly 300 technical rules as too expensive and complex to implement. Application of the full set is not widespread and operators of small-scale systems often follow only a limited number of the standards and rules.

In response, DVGW facilitated application in small-scale supplies by selecting the 45 standards and rules most applicable to small-scale systems. The selection includes technical rules on the most commonly prevailing supply technologies in small public supplies, organization and management of drinking-water supplies, planning for emergencies in public water supplies and relevant legislation. DVGW offers this selection for small-scale systems at a significantly reduced price. The online version also provides links to scientific publications and circulars, as well as information on dates of relevant training courses.

Further guidance for operators of small individual supplies is provided by the German Institute for Standardization. The standard DIN 2001 specifically addresses requirements for drinking-water, planning, construction, operation and maintenance for individual wells and nonstationary plants *(79)*. In conjunction, the German Environment Agency published a guidance document targeting private well owners (see Case study 5 from Germany), which provides advice and guidance to owners of individual wells and springs on their duties and responsibilities, legal requirements, sanitary inspection and options for remedial actions *(65)*.

The German Association for Water, Wastewater and Waste (DWA) plays a similar role in the field of sanitation and wastewater management. It publishes uniform technical guidelines for water management, land development, soil conservation, wastewater and waste technology. These are prepared by committees of experts in related fields working on a voluntary basis and are subject to a formal public procedure of acceptance. The documents contain information and guidance on planning, construction, operation, maintenance and inspection of sanitation facilities and on services and products, among others. Although DWA technical guidelines are not legally binding, they are commonly referred to by relevant authorities when, for example, giving a permit or approval for wastewater treatment plants. DWA has prepared several guidelines for small-scale wastewater treatment systems, some of which are also available in English *(80–82)*.

Experience has shown that the proper application of available standards and guidance documents in small-scale water supply and sanitation systems is a challenge for a variety of reasons. Operators are frequently simply not aware of their existence or cannot readily select the standards pertinent to their specific contexts; another potential obstacle is that the documents often need to be purchased.

Limits in the skills and knowledge of operators may also hinder implementation of the requirements contained in the standards and guidance documents. Operators may need support – such as hands-on advice – when applying good practices and improving the system and its operation.

Policy-makers and other stakeholders can help to overcome these challenges for small-scale systems by:

- adapting international standards to the national context and making them available in national or local languages;
- developing specific guidance documents for small-scale system operators and/or encouraging national standardization organizations to create standards specifically for small-scale systems;
- providing and advocating packages of standards for small-scale systems, which select those most relevant from the wide range of available documents;
- making relevant documents available free of charge or at a reasonable price that operators in low-resource settings can afford;
- raising awareness about the existence of relevant standards among small-scale system operators and local water and health officers;
- helping operators to access standards (for example, through Internet platforms, by distributing hard copies to operators in the field or by making them available through local water and health offices);
- providing assistance or guidance – for example, through training courses – to facilitate understanding of relevant standards, which are often written in technical language that may be difficult for operators of small-scale systems to comprehend fully.

In the development of national technical and management standards for small-scale water supply and sanitation systems, the system specifics and local characteristics need to be considered. To support effective use of slow sand filtration, ultraviolet disinfection and chlorination, for example, standard-setting bodies should take into account the typical personnel, economic and organizational realities of small-scale system operators in the national context when providing technical and operational requirements and recommendations.

Requirements for the construction, operation and maintenance of onsite water supply or sanitation systems can also be addressed by standards. These systems may be the responsibility of the site owner, a service provider – such as a public wastewater association, responsible for running collective as well as onsite systems – or a special service institution (see section 4.8 on cooperative arrangements and networking).

If legislation requires compliance with a certain standard, it should clearly state whether it is applicable to all or just selected types of system. Different standards may be required, taking into account how different sizes of system in different locations can reach the same level of health protection. The WHO guidelines for drinking-water quality *(68)*, for example, encourage national regulatory agencies to formulate health-based targets in terms of specific technology targets for small-scale water supply systems. Legislation may thus cite standards addressing specific and approved treatment processes or requirements for the protection of wellheads. References to standards make it easier to keep such targets up to date with prevailing scientific knowledge and technology.

Standards are available at national, multinational (such as the European Committee for Standardization) and international (such as the International Organization for Standardization) levels. Developers of national standards for small-scale systems can use those from other countries or at a multinational level as models, particularly if they refer to a similar setting (see examples from the European context of standards and guidance specifically addressing small-scale systems in Boxes 10 and 11).

Box 10. Examples of technical standards and guidance for small-scale sanitation systems

- At the EU level standards specifically addressing small-scale wastewater systems include one on small wastewater treatment systems for up to 50 PEs – Parts 1–7 (EN 12566) *(83)*.
- Austrian guidance documents address constructed wetlands soil filter application, dimensioning, construction and operation *(84)*.
- Denmark has guidance for the implementation of both vertical flow *(85)* and horizontal flow *(86)* reed bed treatment plants for PEs of up to 30.
- The German DWA has prepared technical guidelines for the design, construction and operation of reed beds for municipal wastewater for PEs of up to 1000 (see Case study 6 from Germany).
- In Ireland, EPA's *Code of practice: wastewater treatment systems serving single houses (87)* sets out the requirements for new onsite wastewater treatment systems serving fewer than 10 PEs and includes a methodology to allow site conditions to be assessed and an appropriate treatment system to be selected, installed and maintained. The Code is referred to in the Irish Building Regulations technical guidance documents *(88)*. It establishes an overall framework of best practice in relation to the development of wastewater treatment and disposal systems in unsewered rural areas, for protection of the environment and specifically for water quality.
- An example of an international guidance document is the *Compendium of sanitation systems and technologies*, which provides an overview of different sanitation system technologies and configurations for a variety of contexts: it can be used as a planning tool and in decision-making. Technology information sheets describe advantages, disadvantages, applications and the appropriateness of different sanitation technologies, including for small-scale systems *(89)*.

Box 11. Examples of technical standards and guidance documents for small-scale water supplies

- The Austrian Association for Gas and Water published guidance for implementation of a simple WSP in 2008 *(90)*. The guidance document includes step-by-step working instructions, illustrative examples and templates to support operators of small-scale systems in developing WSPs. Similarly, the Swiss Gas and Water Industry Association (SVGW) published Regulation W 1002, which offers recommendations for a simple quality assurance system for water supplies *(91)*.
- Belarus's Aqua-Bel Association has produced technical recommendations on water supplies and sanitation in cottages and on facilities and equipment for decentralized drinking-water supplies used in populated areas *(92).*
- Finnish authorities and research institutes have produced several guides applicable to small-scale water supplies, covering emergency planning, crisis communication, the operation and maintenance of small waterworks, back-up distribution during delivery breaks, wells, well-water analyses, materials used in drinking-water mains and good practices for sewage water treatment (see, for example, *Operation and maintenance of small waterworks (93)*).
- In Ireland the Department of the Environment, Community and Local Government produced guidance documents on the preparation of rural water strategic plans and on treatment for GWS in 1998 *(94)*. The National Federation of Group Water Schemes (the representative body for small community-run private schemes) also publishes information booklets and training for the efficient operation of small-scale water supplies *(50).* EPA has published a series of advice notes on drinking-water with the involvement of the Federation, which explain how investigations should be carried out when failures are detected (such as *E. coli*, nitrate, lead and similar), operational best practice (for example, for cleaning of reservoirs and chemical dosing) and source protection. These are drafted and circulated to the relevant stakeholders including water supplies (public and private), health authorities, regulatory bodies and representatives from the private sector (such as consultants) for agreement prior to publication. They are then published on the EPA website and can be used as a guide for best practice *(95)*.
- The Regulatory Authority for Water and Waste Services in Portugal has published technical guides and recommendations on its website, including Recommendation 03/2008 on the control of drinking-water quality in individual supplies *(96).*
- The Republic of Moldova has produced sanitary norms for non-piped water supply quality, protection and maintenance Nr. 06.6.3.18-96 *(97)*.
- In 2003 the Russian Federation adopted a regulation setting hygiene specifications for decentralized water supplies *(98).* This sets specifications for choosing the location, construction, maintenance and operation of water intake structures for decentralized water supplies; for construction of dug wells, tube wells and spring interception systems; and for water quality and procedures for water quality monitoring in decentralized supplies.
- The Scottish Executive has produced a technical manual for private water supplies in the United Kingdom to assist professionals regulating and maintaining private water supplies by providing an accessible reference document *(99)*. It covers, among others, the legislative background, risk assessment principles, source selection, protection and monitoring, water treatment processes, sampling, storage and transportation of water samples, as well as waterborne hazard responses.

4.4. Surveillance

Independent surveillance is the external and periodic review of all aspects of water quality and public health safety. It is an investigative activity undertaken to identify and evaluate potential health risks associated with drinking-water and sanitation systems, including waterborne illness

events *(68)*. Surveillance promotes incremental improvement and provides an opportunity to gather data about the status of small-scale water supply and sanitation systems.

National or subnational policy-makers should make provision for surveillance in legislation and regulations, taking into account the particularities of small-scale systems (see section 4.2 on legislation and regulations). These instruments need to establish the mandate and responsibilities of surveillance agencies; describe specific surveillance activities and frequencies; and define the type of drinking-water and sanitation systems that are subject to surveillance. They should also specify requirements for monitoring and other obligations of operators. Surveillance agencies should have the power to compel action to respond to and rectify water quality incidents causing outbreaks of waterborne disease or other threats to public health. Whereas legislation and regulations provide a framework that enables and requires surveillance agencies to perform an independent oversight role, actual surveillance activities take place at the local level. In many countries these are undertaken by health (or public health), environmental health or environmental protection authorities.

In the context of small-scale water supply and sanitation systems, independent surveillance typically encompasses the following activities:

- monitoring of drinking-water quality;
- monitoring of treated wastewater for discharge or reuse, focusing on relevant health-related parameters;
- onsite risk assessment and sanitary inspections of drinking-water supplies' infrastructure and surroundings;
- onsite inspections of wastewater treatment plants, public latrines or toilets (for example, in schools);
- monitoring of other service level indicators, such as water quantity supplied and accessibility, coverage, affordability and continuity of sanitation and water systems;
- checking routine monitoring carried out by operators and the results;
- data collection on safe operation and operational capacity;
- auditing of WSPs where these are in place;
- participation in investigating, responding to and reporting on outbreaks of waterborne disease.

Detailed information on the surveillance and control of community supplies can be found in volume 3 of the WHO guidelines for drinking-water quality *(47)*, including both regulatory and practical aspects.

Onsite inspections and risk assessments are crucial elements of the surveillance of small-scale systems. They can be performed regularly at low cost, even in the absence of capacities to undertake water quality analyses. They establish information about the possible sources of both immediate and ongoing contamination, provide a longer-term perspective on causes of contamination (as an "early warning" function) and enhance knowledge of system conditions. Case study 7 from Ireland provides an example of how national authorities have facilitated risk-based surveillance of domestic wastewater treatment plants conducted at the local level.

Case study 7. Risk-based inspection of domestic wastewater treatment systems in Ireland

In Ireland the overall risk to the environment on a national scale from domestic wastewater treatment systems is relatively low in comparison to agricultural activities and urban wastewater discharges. EPA has, however, identified areas of the country where the potential risk from wastewater treatment systems at a local level may be significant.

According to the Central Statistics Office, onsite domestic wastewater treatment systems collect, treat and discharge wastewater from almost 500 000 households in Ireland *(100)*. A national inspection plan for domestic wastewater treatment systems (NIP) was issued by EPA in 2013. This uses a two-strand approach of education and awareness strategies linked with a risk-based inspection process.

To inform the NIP, EPA developed risk assessment methodology using data on density of systems, attenuation and infiltration to establish zones of risk across the entire country. The categories are low, moderate, high and very high. This is used in conjunction with the location of sensitive receptors, such as drinking-water zones of contribution areas, to allocate inspections based on risk and sensitivity.

The NIP is delivered by local authorities and the number of inspections for each county is allocated on a risk basis. Engagement activities began in early 2013 and the first inspections were carried out in August 2013. The inspections have allowed, for the first time, the systematic collection of data on the nature and condition of domestic wastewater treatment systems in Ireland.

In the context of small-scale systems, surveillance agencies often need to take on a supporting role to achieve improvements, rather than relying on threatening consequences of noncompliance. Onsite surveillance activities provide opportunities to facilitate the provision of technical advice to those who operate the systems, as well as building relationships and trust between operators and surveillance authorities. While operators need to understand that they must eventually comply with statutory requirements, it is important to allow time and give support to solve the problems identified. Creating an atmosphere of cooperation also facilitates access to information for the surveillance authority. It is therefore beneficial if regulations on surveillance accommodate such cooperative approaches for small-scale systems.

Unresolved ownership of small-scale systems can represent an obstacle to surveillance; in these cases there is no legal entity to which the surveillance agency can prescribe remedial and corrective measures or penalties. In order to overcome this barrier it is beneficial to clarify such responsibilities through regulation (see section 4.2 on legislation and regulations).

The surveillance system needs to ensure that data and information obtained through surveillance at the local level are systematically collated and analysed to inform policy-making relevant to small-scale systems and identify preventive interventions to protect public health and improve sustainability of services. This is also stipulated in the EC's Framework for Action for the management of small drinking-water supplies, which recommends national reporting of results of compliance monitoring on all supplies, including small ones *(49)*. Surveillance and notification systems for waterborne disease outbreaks provide important complementary sources of information for assessing the situation of small-scale systems. As demonstrated by Case study 8 from Finland, these can provide valuable data on the causes of outbreaks and can thereby steer legislation, training and education.

Case study 8. Notification system for waterborne outbreaks in Finland

Finland introduced a compulsory notification system for waterborne disease outbreaks in 1997. This was established to complement the Finnish water quality surveillance system and general public health surveillance. Health care practitioners notify municipal authorities about cases of possible waterborne disease. If outbreaks are suspected in at least two different households, municipal authorities are obliged to inform national authorities through an electronic notification system; this must be done as soon as possible, even before confirmative water quality analyses. They are also obliged to inform consumers and to give any necessary instructions and restrictions regarding the use of water. The national authorities can provide support remotely or, in the case of large outbreaks, on site. The electronic notification system allows all relevant authorities across different levels of government to access information and track the status of the outbreak investigation and its management.

After the outbreak a report must be created on its extent, the number of exposed and ill people, the patients' symptoms, the causative agent(s) and the management and remedial actions taken. This is done by a nominated expert group – a statutory presence in every municipality, which consists of experts in food- and waterborne outbreaks; it includes representatives of health care, municipal health protection, veterinary and drinking-water services.

Data collected through the notification system have informed statistics and the management of subsequent waterborne disease outbreaks. They show that in Finland such outbreaks mostly occur in populations served by small-scale water supplies. The system has also contributed to more accurate estimates of the number of outbreaks. Reduced reporting limits introduced with the notification system allow for the identification of even the smallest waterborne disease outbreaks. One remaining limitation is underreporting: Finnish authorities estimate that only 1–2% of people suffering from self-limiting diarrhoea seek formal health care – the starting-point of the notification system.

Other advantages include a better information base on the causes of outbreaks, which has increased public knowledge and has been used to steer legislation, training and education. Municipal health protection authorities and employees in water treatment plants are more conscious and prepared than previously to start preventive and remedial actions to ensure the quality of drinking-water. Increased public awareness and media interest even in small-scale outbreaks has improved authorities' preparedness to gain information and respond to questions and comments raised by consumers.

Where capacities and resources allow, surveillance approaches may also include additional aspects, such as monitoring and auditing of indicators of financial management of small-scale public systems (for example, unaccounted-for water, tariff levels and financial balance sheets). These aspects are not usually addressed by public health surveillance agencies, as regulation functions are often split, with separate entities responsible for economic, quality of service and environmental regulation. For public health surveillance authorities it may therefore be beneficial to establish or strengthen cooperation and exchange of information with agencies working in the area of financial surveillance.

A dual approach, differentiating the roles and responsibilities of service providers from those of an authority responsible for independent surveillance protective of public health has proven to be effective *(68)*. Surveillance does not remove or replace the responsibility of the operators to ensure the quality and safety of the service. Case study 9 from France provides an example of how a legal requirement for a WSP approach, including requirements for regular quality control by operators, complements independent surveillance.

Case study 9. The dual approach – water quality surveillance by authorities and operator self-checking for WSP monitoring in France

Compliance sampling and analysis requirements for surveillance are defined by the French water authorities according to the EU Drinking Water Directive *(16)*. Regional health agencies organize sampling and analysis at the local level, to be carried out by independent laboratories after a formal tendering process.

In addition to this independent sampling, operators are obliged to create a WSP that outlines suitable monitoring for routine operations. The monitoring activities must provide relevant information to ensure that hazards do not enter the system and must comprise the following, according to the French public health code *(101)*:

- regular verification that measures to protect the resource and supply are in place and effective, and that works are operating according to specifications;
- a sampling and analysis programme at critical points identified by the risk analysis, as defined by the water supplier (operational monitoring); and
- a file containing all the instructions and records (the "sanitary file").

For treatment plants and distribution systems regular checking must cover, among other things, availability of treatment chemicals and regular checking of sensors. Sampling and analyses (onsite measures with quick field tests or laboratory analyses) must be proportionate to the risks identified; sampling frequency is defined according to the resources and performance of the installations.

In this dual approach to water surveillance by authorities and operators, record-keeping in the "sanitary file" is essential to ensure traceability of operations and surveillance; the approach also ensures a greater frequency of monitoring or more control points on specific parameters. If the water authorities observe noncompliance in their sampling they can check the "sanitary file", and an operator discovering noncompliance during self-checking is obliged to alert the authorities. This set-up enables health services to verify that the WSP is effective.

Regular surveillance comprising auditing aspects of safety and/or verification testing can be supported through regular self-checking by operators to ensure that their systems are capable of routinely delivering safe services and through reporting of related outcomes. Case study 10 from Germany provides an example of how independent surveillance of small-scale sanitation systems by the relevant authorities can be supported by checks conducted by certified experts.

Case study 10. Surveillance of small-scale onsite wastewater treatment plants in Bavaria, Germany

In the Federal State of Bavaria around 380 000 inhabitants are served by 84 000 small-scale onsite wastewater treatment plants or septic tanks for which the owners are accountable *(102)*. The requirements for effluent standards are set according to both the size of system (in line with the Waste Water Ordinance *(103)*) and the receiving water body into which the effluent is discharged. Most of the treatment plants (82%) need to meet the standard for biochemical or chemical oxygen demand removal only; 11% need to meet the standard for nitrification and 7% the standard for nitrogen removal. Additional requirements on reducing microbial contamination concern 6% of the plants and on phosphorus removal concern 1% of the plants.

Bavaria initiated an incentive programme for 2003–2014 to upgrade small-scale wastewater systems, which provides €2000 on average per small-scale wastewater treatment plant. The programme had spent a total of €187 million by the end of 2014. By 2015, 92% of the small-scale wastewater systems in Bavaria had been upgraded *(104)*.

Technical systems for onsite wastewater treatment require approval from the German Institute for Structural Engineering. Based on this approval, maintenance routines have to be carried out two or three times annually, according to the type of technology. Regular surveillance by the regional water authorities, as for urban wastewater treatment plants, is not feasible for small rural systems, but effluent standards are expected to be met if the construction, operation and maintenance are performed according to the approved specifications. Based on the Bavarian Water Act *(105)*, the owner has to prove that the treatment plant fulfils the effluent standard every second or fourth year by assigning a certified expert to assess the system. As part of this assessment, an onsite inspection is conducted to check performance and the operational diary is reviewed to assess self-checking and maintenance, including analysis results. Of the plants inspected, 77% did not exhibit any substantial defects and only 7% showed major defects *(104)*.

The Federal State of Bavaria created a free Internet platform for surveillance and approval data from onsite wastewater treatment plants *(106)*. Although its use is voluntary, data from more than 50 000 wastewater treatment plants have been recorded to date. Evaluation of the data shows extensive compliance with both the Waste Water Ordinance effluent standards and the German Institute for Structural Engineering approval criteria: 94% of the plants meet the required chemical oxygen demand standard, 83% the nitrification standard, 77% the nitrogen removal standard and 80% the phosphorus removal standard. If the results do not meet the legal requirements immediate action needs to be taken by the operator and, in the case of significant deficiencies, a follow-up check needs to be conducted by a certified expert within two months.

Conducting drinking-water and wastewater quality tests, onsite visits for sanitary inspections and information collection may be a resource-intensive task in terms of staffing, travel time and costs, sampling devices, consumables and transport, as well as laboratory capacities, especially in contexts where a surveillance agency oversees many small-scale systems in large or remote areas. In order to overcome these costly and logistic difficulties, and acknowledging that visiting (including follow-up), inspecting and testing of all systems – even at minimum frequencies – is not always feasible, several options are available to facilitate the surveillance of small-scale systems. If national policy-makers choose to make use of these options, it is important that their application is supported by legislation and regulations and by resources so that local authorities are able to apply them in practice.

Activities conducted by operators of small-scale systems may support independent surveillance in a number of ways.

- Sanitary inspections do not have to be conducted by the surveillance agency alone; they can be carried out by operators of public and individual small-scale systems or, in the case of community-managed supplies, by community members who can then submit the results to the surveillance authority.
- Self-testing by operators may complement water quality testing by surveillance authorities. This requires the establishment of a mechanism for collecting and ideally reporting of these data, as well as the facility to contact the regulatory agency in case the operators or users are concerned about the results. Prerequisites for such self-testing include trained operators and availability of (field) testing equipment, as well as a continual supply of necessary consumables.
- In the context of small-scale public systems, self-reporting on many of the other parameters characterizing the level of service is also a relevant and feasible option. Operators are already required to collect some of these data – for example, they may need to measure how much water is produced, sold and lost or how much wastewater is being treated. The aggregate numbers can be reported to the relevant authorities, such as regulators. The same applies to financial data. It is important, however, that authorities provide feedback on the information received and suggest measures to improve performance in order to achieve the spirit of cooperation outlined above.
- In order to increase the commitment required to support independent surveillance and improvements, communication to enhance understanding of surveillance results and required follow-up actions – through either verbal explanations or easy-to-understand written guidance – is a helpful approach. This could be combined with awareness-raising activities (see section 4.7 on advocacy and awareness-raising).

Analytical and communication solutions can also be used to overcome the challenges related to system remoteness.

- Sufficiently equipped laboratories may not be available in rural areas to allow for complex analyses of a wide range of parameters, and the time taken to transport samples from remote supplies may be too long to allow timely analysis of, for example, microbial parameters. Mobile laboratories and/or field testing kits can be used by authorities conducting surveillance. By analysing water quality on site, the burden of transporting samples – as well as the administrative effort of reporting results back to the system managers – is reduced. Results can be shown and communicated directly to the operators and users, fostering their understanding of the relationship between water, sanitation and health. It is important to maintain the supply of testing chemicals and other consumables to surveillance authorities in order to ensure sustainable use of field testing equipment. The selection of parameters to be monitored and the type of monitoring (whether via central/regional laboratories, mobile laboratories or field kits) will depend on the financial and human resources available, as well as the remoteness of the systems to be monitored. If field testing kits are employed for routine surveillance monitoring purposes, it is important that national or subnational agencies obtain evidence that the results compare with lab-based standard methods.
- Communication technology can help to facilitate surveillance activities for small-scale systems, such as the use of Internet-based data collection and exchange, mobile phone technology, exchange of digital photos to report on risks discovered or improvements made and the option of phone consultations with surveillance authorities. Such technologies can reduce the administrative and financial burden for authorities and support continual surveillance.

Furthermore, risk-based approaches may be applied to support prioritization of surveillance activities in small-scale systems.

- Risk-based approaches such as WSPs and sanitary inspections can support the prioritization of surveillance efforts, particularly in low-resource settings (see Case study 11 from Scotland). The outcomes of a risk assessment, if made available with previous surveillance results, can inform surveillance agencies' priorities and schedules when making choices about:

- supplies that have been reported to show significant risks and therefore require urgent attention;
- the spatial coverage of surveillance activities, including, for example, incremental inclusion of remote supplies in surveillance programmes;
- the frequency of visits for inspection and water quality testing, which might decrease with previous satisfactory surveillance results;
- the set of parameters to be included in water quality testing, which may be of a limited number at first but might be expanded should local risk assessments point to specific contaminants, if resources allow.

- If risk-based approaches are not applied or if legislation does not support such an approach, system sizes can be used as a first indicator to help prioritize surveillance activities: sampling and inspection frequency can be staggered according to the population sizes served. This should not, however, lead to a lack of surveillance of the smallest systems in the long term, and surveillance should aim at a representative picture of the prevailing technologies and conditions across the country.

Case study 11. A risk-based surveillance approach in Scotland

Sampling and analysis requirements for small-scale water supply and sanitation systems in Scotland are specifically set out in national legislation. Scotland is obliged to comply with the requirements of the EU Drinking Water Directive *(16)* for supplies that produce 10 m^3 or more a day, supply 50 or more people or supply a commercial or public activity. The Private Water Supplies (Scotland) Regulations 2006 *(107)* set out requirements for sampling in small-scale water supply systems providing less than 10 m^3 a day or supplying fewer than 50 people.

A risk-based approach for many parameters is allowed for in the regulations, so that a large number of parameters can be eliminated either through risk assessment – by demonstrating that the parameter is not relevant in the local setting – or if they have not been detected over a period of time. This significantly reduces the cost to the owners and users of supplies, who generally bear the costs for sampling and analysis. Samples are taken by local authority environmental health teams and must by law be analysed at an accredited laboratory.

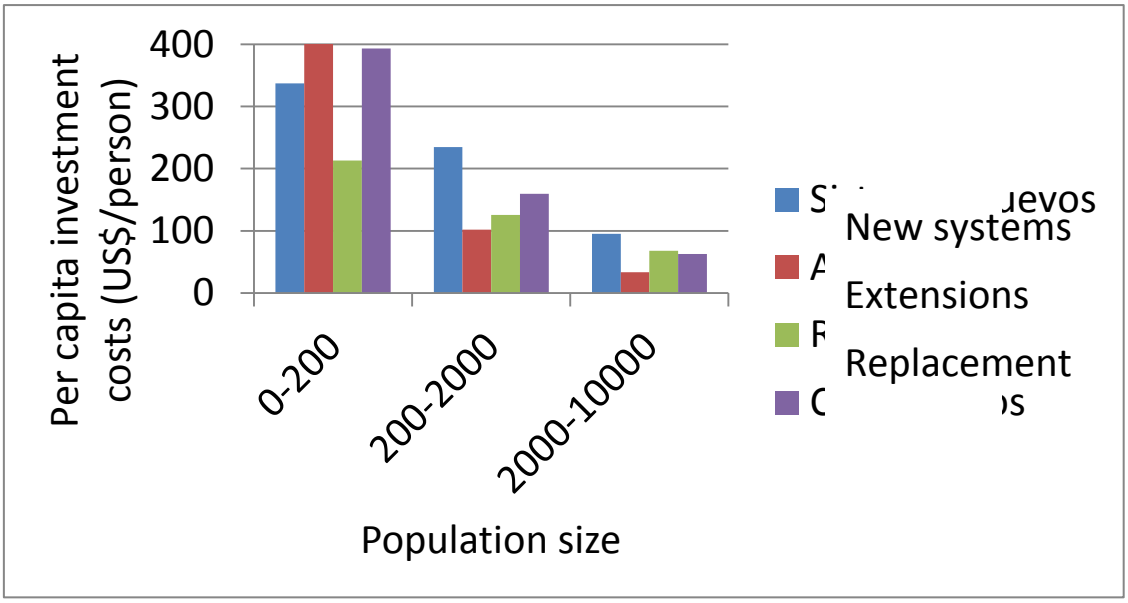
Testing results are reported by the local authority to the owners and users of supplies and the authority is under a duty to investigate failures of water quality standards and to give health-based advice on the supply. Formal notices of improvement can be issued. Analysis results are reported by local authorities to the Drinking Water Quality Regulator for Scotland under a statutory requirement; they are published in the Regulator's annual report.

As with legislation and regulation, surveillance activities relate to many other aspects of good practice discussed in this document. For example, if surveillance covers small-scale water supply and sanitation systems, the results may be used as indicators to document progress towards achieving targets (see section 4.1 on baseline analysis and target-setting). Surveillance results may also inform water safety planning processes by identifying areas of concern that need increased attention. At the same time, information resulting from the WSP process can also feed into a surveillance system (see section 5.2 on sanitation planning). Surveillance that covers small-scale systems, including those in remote areas, also requires financial means, which need to be mobilized (see section 4.5 on costing and financing).

4.5. Costing and financing

Making provision for the sustainable financing of small-scale water supply and sanitation systems is the basis for maintaining good services in the long term, ensuring affordable services for all, and thereby represents a way to create equitable access. Sustainable financing is particularly important for small-scale systems as they typically have higher investment and maintenance costs per person (see Fig. 3 for an example from Honduras).

Fig. 3. Per person investment costs for small-scale water systems serving populations of various sizes



Source: Smits et al. *(8)*.

4.5.1 Costs and sources of financing

The provision of water and sanitation systems incurs different types of cost throughout the life-cycle of the services. Capital costs include pre-construction feasibility costs, infrastructure construction and one-off training for operators. Recurring costs include minor maintenance, major maintenance, institutional support to keep the systems running and payment of any loans taken. All these need to be covered and may require different sources of financing. Table 1 provides an overview of types of cost and common sources of financing for small-scale water and sanitation services.

To finance sustainable, reliable and safe services it is vital that approximate costs are known and planned for from the start. In reality, cost data for small-scale systems are often lacking or incomplete, and it is crucial to carry out assessments regarding all relevant cost categories to ensure that systems keep working over time. Reference costs may be known, particularly for the initial capital expenditure, but much less insight often exists into the other cost categories. National policy-makers can commission dedicated studies in order to obtain this information. To give grounded financial data, the different costs could be tracked regularly, based, for example, on a sample of representative types of systems.

Once the approximate costs are known, it is important to identify, in broad terms, the sources of financing. The Organisation for Economic Co-operation and Development (OECD) divides these into three large groups: taxes (internal public finance), tariffs (user fees and initial contributions) and transfers (external development aid) *(108)*. Other sources often mentioned – such as micro-credit and other repayable finance – eventually fall into one of these three groups. Credit, for example, needs to be paid back by users and would thus come under “tariffs”.

A challenge in getting financing to cover the costs incurred is that the financial revenue accrues to a different group of stakeholders from the group that actually pays. For instance, users pay tariffs to a utility and these do not necessarily cover major maintenance, which is the responsibility of the municipality. Furthermore, time is an important factor: revenues might only be generated long after investments are made (for instance, when decreasing non-revenue water increases the amount of billable water volume). For further guidance on costing and financing for water and sanitation services see, for example, Fonseca et al. *(109)*, Winpenny *(110)* and Pinkham et al. *(111)*.

Table 1. Cost components and common sources of financing for small-scale drinking-water and sanitation systems

Cost category	Description	Common sources of financing
Capital or one-off costs		
Capital expenditure – hardware and software	This includes expenditure on fixed assets such as concrete structures, pumps, pipes and toilets –for both initial construction and system extension – and the accompanying "software" such as capacity-building or sanitation promotion. System upgrade is also considered capital expenditure. These costs occur at the level of the local service provider.	• Capital costs for private water supplies from individual wells or springs are by definition almost entirely self-financed, either as upfront payments from users or in-kind contributions (such as labour). • For onsite sanitation, policies differ greatly: some countries provide full subsidies (public financing through taxation); in others it is the financial responsibility of the individual household. • General taxes are widely used in the WHO European Region to finance the initial infrastructure development. • Transfers may be used, including grants and soft loans for infrastructure development from one country to another.
Recurring costs		

Operating and minor maintenance expenditure	This includes expenditure on labour/staff, fuel, energy and materials needed for operation, safe management and routine maintenance to keep systems running. These costs occur at the level of the local service provider.	• This is mainly funded through tariffs, complemented by:
		  ○ cross-subsidies from larger systems;
		  ○ subsidies from general taxes.

Capital maintenance expenditure	This includes renewal, replacement and rehabilitation costs that go beyond routine maintenance – prioritization based on risk-based water and sanitation safety planning is a strong basis for such investments. These costs occur at the level of the local service provider.	This has three common sources of funding:
		• taxes:
		  ○ through rehabilitation programmes;
		  ○ complemented by common funds created through tariff payments;
		• tariffs:
		  ○ paid into common funds created at a larger level of scale (such as for several small-scale systems);
		  ○ paid into public maintenance funds organized by

		national or subnational governments;
		• transfers:
		  ○ for rehabilitation programmes;
		  ○ as contributions to common funds.

Expenditure on direct support	This includes the costs of ongoing support by the local government to users and local stakeholders, and any associated license fees or charges – for example, the costs of surveillance and providing operators of small-scale water supply and sanitation systems with technical assistance and advice.	This has two common funding sources: • taxes, mostly when services are provided through local authorities and sometimes complemented by tariffs; • tariffs, mostly when the services are provided by utilities and sometimes complemented by taxes.
Expenditure on indirect support	This includes the costs of higher-level support, such as government planning, policy-making and regulation and any associated license fees or charges. These costs occur at the level of the national or subnational government.	This has two common funding sources: • taxes; • transfers, which include grants and soft loans for sector reform or institutional strengthening from one country to another.
Cost of capital	This includes the costs of servicing capital, such as repayment of loans or payment of dividends and the costs of tying-up capital. These costs occur at the level of the local service provider.	This has two common funding sources: • taxes; • tariffs, a component of which may be used to pay back the costs of loans complementing other resource-generation mechanisms.

Source: adapted from Fonseca et al. *(109)*.

Taxes

Taxes are a financial source whose influence falls within the area of responsibility of policy-makers. Most countries in the WHO European Region have achieved high levels of water and sanitation services largely through public finance – or rather, through taxes *(112)*. Many of the capital investments required are financed from general taxes raised by national or local governments.

Costs for capital maintenance expenditure are often covered through rehabilitation programmes paid for out of general taxes, because including them in tariffs is often not feasible, even in well resourced countries (see Case study 12 from Scotland and Case study 4 from Finland on sanitation). Capital maintenance costs are frequently financed in an inefficient and ad hoc manner, however, as in many countries no ongoing provisions are made for such work *(113)*. One option for increasing sustainable financing for capital maintenance costs is to pay dedicated parts of tariffs into common funds, which can be complemented by public taxes.

Case study 12. A private water supplies grant scheme in Scotland

In Scotland small-scale water supply systems, referred to as "private water supplies", serve more than 188 000 people, and a much larger number use them occasionally in any year, typically when on holiday. In 2006, the Scottish Government updated drinking-water quality legislation to reflect the requirements of the EU Drinking Water Directive *(16)* for private water supplies.

Recognizing the financial implications for rural communities and businesses, the Scottish Government simultaneously introduced a private water supplies grant scheme. This is administered by local authorities to assist with capital improvement costs; it is intended to assist those dependent on private water supplies with the financial implications of bringing them up to modern standards and to ensure that rural consumers are not disadvantaged. In order that the available funds are used effectively towards solutions that offer good value for money, individual grants are capped at a maximum of £800 per premises (domestic or commercial).

The grants system has been well received since it was introduced, and in the 2014/15 financial year grants were awarded to improve 241 supplies serving 574 properties. During 2006–2013, approximately £8 million was spent on private water supply grants.

Taxes are also often the main source of funds for direct support. National policy-making can account for direct support costs by providing indications on the parts of the budget to be spent on surveillance of and support to small-scale systems. It can also take into account the different needs for funding of small-scale systems in rural areas (where surveillance has to cover remote areas) and urban systems.

Indirect support costs are usually covered by taxes, but in some instances they may be supported by transfers – for example, for specific pieces of work like the development of policies on small-scale systems or sector reform programmes.

Costs of capital (such as paying back interest rates) are often neglected but can be quite substantial. Depending on how the capital was obtained, it will be paid back either via general taxes, or via tariffs. For example, if a country takes a loan for investments it usually pays it back via taxes, but if a utility issues a bond for investments the costs of interest on the bond will typically be included in the tariff.

Tariffs

Tariffs are usually expected to cover the operation and minor maintenance costs, and a large part – or all – of the capital maintenance costs. A framework of sound tariff-setting rules and mechanisms established at the national or subnational level promotes more efficient provision of water services. In some countries such frameworks are established by independent economic regulators. A tariff-setting framework needs to take into account the economic realities of small-scale systems, as well as affordability and social criteria. Ultimately, regulation needs to support service providers in setting tariffs that allow them to recover operational costs and protect them against undue (local) political interference (see Case study 13 from Portugal).

Case study 13. Protecting tariffs from undue interference through economic regulation in Portugal

The Portuguese Water and Waste Services Regulation Authority (ERSAR) is an independent economic regulator. It has established tariff rules that consider the particularities of small-scale water supply systems, which were set out in its first published economic regulation instrument on tariff guidelines.

In Portugal water supply services are divided into bulk and retail activities. Bulk activities are provided by operators with several retail operators as clients; these can be either small or large systems and provide water services to domestic and non-domestic end users. Bulk systems apply only the variable tariff to retail systems and these are protected from undue (for example, political) interference as they have to be approved by ERSAR. The retail operators charge end users a fixed tariff for each contract, and a variable tariff for each cubic metre of water used.

For retail systems, ERSAR guidelines recommend a structure with both fixed and variable tariffs (see Table 13.1). The fixed tariff is the value applied to each time interval in which the service is available to the end user, in order to repay the operator for fixed costs incurred in construction, conservation and maintenance of the systems required for service provision. The fixed tariff is cheaper for domestic than for non-domestic end users. For uses that do not result in wastewater collected by the public sewerage service (for example, supplying water to swimming pools or large gardens), domestic end users may have a second meter and will be charged the non-domestic fixed tariff for water consumption for these.

Table 13.1. Tariff structure recommended by ERSAR for retail activities

Tariff component	End use	
	Domestic	Non-domestic
Fixed	Lower fixed tariff for domestic uses	For water uses that do not result in wastewater collected by the public sewerage service, the higher non-domestic fixed tariff shall be applied
Variable	Four blocks: first block: =<5 m^3/30days second block: >5 and <=15 m^3/30days third block: >15 and <=25 m3/30days fourth block: >25 m^3/30days	One single variable block with the same value of the third block of domestic uses

Source: adapted from Rodrigues *(114)*.

Retail system tariffs are approved by the municipalities, but to protect them from undue interference changes were made to the legislation approved in 2013. The process of tariff-setting starts with the operators asking the regulator's opinion about the proposed tariff. This is followed by a decision from the municipality, which has to justify any major divergences from the regulator's recommendation. Thereafter, the approved tariffs are reported to the regulator. ERSAR has implemented a financial audit programme to evaluate the approved tariffs' compliance with the guidelines and other relevant binding rules. If breaches occur, the regulator initiates an enquiry that may result in a requirement to correct the tariffs.

This tariff-setting process can be illustrated with a practical example. The Municipality of Castelo de Vide has an area of 265 km² and a population of 3780 inhabitants. It manages the water supply

service directly. On the basis of its audit, ERSAR assessed the municipality's tariff structure; it found that neither tariff was billed on a 30-day basis and that the municipality did not have a single fixed tariff for all domestic consumers with a meter not exceeding 25 mm. Although the average price of the water supply service was €0.84/m³, only 70% of costs were recovered by tariffs – the other 30% were directly subsidized by the Municipality.

Thanks to this subsidization, ERSAR found that the water supply service was affordable: 120 m³ of water consumption per year cost consumers 0.53% of the average income in Castelo de Vide.

Sources: Rodrigues *(114)* and Andrade I, unpublished poster presentation at 9th IWA World Water Congress and Exhibition, Lisbon, September 2014.

To set tariffs that allow coverage of operation and maintenance costs, service providers must have good insight into their cost structures. Sound asset management (for example, taking an inventory of all infrastructure assets within a system and noting their condition as a first step, followed by creating a schedule of preventive maintenance) can provide a good basis for identifying current and anticipated costs, and for prioritizing the use of limited financial resources. Regulators can provide guidance and training for operators of small-scale systems on how to set tariffs and estimate costs at the system level.

Public consultations – for instance, through consumer associations, when rehabilitation or construction of facilities are being planned or when tariff structures are being set – can help to make tariffs that cover operating expenses more acceptable to the public, especially if these are accompanied by service level improvements.

Transfers

Raising external funds for investing in small-scale water supply and sanitation systems requires policy-makers to enunciate a strong economic rationale *(115)*. Guidance on considerations for making social cost–benefit analyses of drinking-water interventions with special reference to small-scale systems can be found in the WHO publication *Valuing water, valuing livelihoods (116)*.

Exercises such as estimating the investment that would be required for universal coverage can help in assessing whether total revenues from taxes and transfers are sufficient to fund capital cost investment. If the outcome of this exercise is not satisfactory, an argument can be made for mobilizing additional investments, including accessing loans from banks.

External support is typically a one-off or temporary source that may be used to establish infrastructure in the first place or for major rehabilitation works (capital maintenance costs). Nevertheless, this needs to be supported by, for example, taxes for sustainable financing of continuous safe management of the systems (see Case study 14 from Tajikistan).

Case study 14. The Water Trust Fund in Tajikistan

The aims of the Water Trust Fund are to establish a mechanism to promote increased investment and financial sustainability in the drinking-water sector and improve good governance and coordination between stakeholders at the district level *(117)*. The Fund provides resources for rural water supplies; it is an effective mechanism for streamlining donor funding to the district level and for merging these resources with funds already committed by the Government of Tajikistan. Every external financial contribution leverages additional financial commitment from the government, as the Ministry of Finance has encouraged different government entities to contribute 30% to the Water Trust Fund (15% from the central government budget, 10% from

district budgets and 5% from operators) in line with the 70% received from donors.

The Water Trust Fund has so far been established in the districts of Muminabad, Rudaki and Kuliab, and more districts and organizations are exploring options to follow suit. The fund is chaired by the district government and has a board of trustees comprising relevant stakeholders, including local government officials and representatives of civil society. It was established through a memorandum of understanding and a local decree of the Government of Tajikistan, outlining the financial and institutional structure of the fund. Communities submit funding applications to the board; these are reviewed in a transparent and accountable manner. The Fund promotes ownership by local administrative divisions, while community-based organizations act as operators. The concept of the Water Trust Fund was developed by the NGO Oxfam GB in the framework of the TajWSS project financed by the Swiss Government (see Case study 1 from Tajikistan).

4.5.2. Financing, affordability and subsidies

In achieving equitable access to drinking-water and sanitation services, financing systems should take into account the affordability of these services for all consumers, including the poor. If no country-specific data are available, as a rule of thumb spending a maximum of 3–5% of household income on water and sanitation can be used as an indicator of affordability for planning purposes *(118)*. Policy-makers have a number of different options to improve affordability and/or equity for users of small-scale systems.

Block tariffs that have a first subsidized block and increase gradually with the level of water consumption are now widely used in many OECD countries and are also applicable to small-scale systems. Some controversy exists, however, about whether use of increasing block tariffs is efficient for targeting subsidies to the poor. Block tariffs require metering of connections, which might exclude the poorest from accessing the service; they are therefore not always an option when targeting those who need the service most (for example, in settings where there are no household connections).

Public subsidies from general taxation are an option to support the poorest water users, but they require a financial transfer from a public authority to the water or wastewater operator, or to the individual household after a demonstration of eligibility. Income support is mostly based on household income and size, but may also include health, disability or age criteria. One key aspect of subsidized tariffs is that the criteria for accessing them must be clear and verifiable.

If embedded into a sound legal framework, cross-subsidies are another option. These can be applied within a single system – where better-off users' tariffs subsidize the costs of poorer users – or across systems – where users in large urban systems subsidize small-scale system costs. For small-scale water supply and sanitation systems it is helpful to create a larger level of scale to reduce operational costs. This can be achieved, for instance, by establishing cooperation between several communities that share tasks of operating and maintaining water and sanitation systems, within which the responsibilities of all stakeholders should be clearly defined (see section 4.8 on cooperative arrangements and networking).

Alternatively, regulators can establish discrete supply zones, where large supplies are combined with small ones, and across which cross-subsidies can be applied; this is a particularly useful option for small-scale supplies in periurban areas. At a larger scale, arrangements for cross-subsidies can be included more easily (see Box 12 and Case study 15 from Belgium for examples of solidarity mechanisms in different countries). It should be noted, however, that cross-subsidy approaches require very clear accountability frameworks so that citizens can see what costs their tariffs cover.

Box 12. Examples of solidarity mechanisms in different countries

- Hungary has a subsidy system targeted at areas that face very high costs of services, within which an interministerial committee allocates the total available budget appropriation.
- In Spain the Aragonese autonomous community has designed the financing of the construction and operation of new wastewater treatment plants in agglomerations of more than 1000 inhabitants, such that the inhabitants of the capital city, Zaragoza (home to over half of Aragon's population of approximately 1.3 million), effectively cross-subsidize the costs for rural areas. In this setting, the costs for sanitation services are the same for all users, irrespective of the actual costs of the service *(6)*.

Case study 15. Solidarity mechanisms in Belgium

In Belgium the three regions (Flanders, Wallonia and Brussels-Capital) are individually responsible for the application of European directives, so each has its own policy *(119)*. In the Flemish region the water tariff is composed of three elements: a guaranteed free minimum supply of 15 m³ water per person per year; a variable cost depending on the amount consumed beyond this minimum quantity; and a basic fee covering fixed costs of the connection, independent of household consumption. The variable cost depends on the quantity of water consumed and is established by the distribution company in accordance with regional authorities. While drinking-water is paid by tariff, sanitation is included in the regional tax regime, and everyone in the region has to pay a sanitation tax except the poorest citizens living below the minimum subsistence level. This group includes retired people with a minimum pension, people with a low income who have the right to receive social aid and people with disabilities who are supported by welfare schemes.

In the Walloon region guaranteed access to safe drinking-water and operation of water services by public entities are established by law for all citizens. The region introduced a tariff with four categories relating to consumption levels and a social fund for the 10% of poorest households, which receives 1.9% of the revenues from public water users. Up to 30 m³ per household per year (82 litres per household per day) are provided at a lower price than all other blocks, thus facilitating access to a minimum quantity of water for all *(120)*.

4.6. Education, qualification and training

Knowledgeable personnel who understand good practices in management, financing, operation and maintenance are an important prerequisite for ensuring safe water supply and sanitation services. To empower operators to do their jobs and to update their knowledge it is crucial to establish and offer training and qualification programmes, including vocational and on-the-job peer-to-peer training arrangements. These have a number of benefits:

- greater understanding of the water or sanitation systems by their operators and increased awareness of the causes and consequences of failure – this facilitates better technical, administrative and financial management and operation of the system, potentially leading to less frequent water quality incidents, near misses or failures;
- increased operator awareness of the principles and benefits of risk assessment and risk management principles and improved capacities to implement them;
- better prioritization by operators of necessary improvements and upgrades, including greater understanding of associated investment needs and thus better allocation of respective funds;

- better protection of sources of drinking-water and minimized risk of water pollution by human excreta and wastewater through safe management of decentralized sanitation systems;
- increased recognition, reputation and morale of trained personnel;
- increased commitment to work;
- initiation of better cooperation and networking with other operators and institutions, leading to improved exchange of knowledge.

It is important that training helps to inspire operators and to convince them that their input is essential to improving the living and health conditions in the area they service. Offering operators an adequate salary and future prospects contributes to the avoidance of both high staff turnover and the presence of untrained and undertrained staff, which might counteract the success of the qualification and training programmes.

4.6.1 Minimum qualification requirements

A good way to ensure that staff have sufficient knowledge to manage water and sanitation systems safely is to put in place legislation and regulations that require minimum levels of education and qualification and/or competency testing of staff, reflecting the size and complexity of the systems. This may cover both aspects of initial level of education and requirements for regular training and further qualifications. Case study 16 from Finland provides an example of national legal specifications of minimum competence requirements for those working in small-scale water supplies.

Case study 16. Competence tests for waterworks employees in Finland

In order to reduce the number of water quality incidents and waterborne disease outbreaks, especially in small-scale drinking-water supplies, Finland introduced legislation requiring competence testing for all employees whose work might have a direct impact on water quality *(121)*. This includes all people working at abstraction sites, waterworks or distribution networks for installation, maintenance, control and adjustment of devices and handling of chemicals – including construction workers laying pipelines.

All such employees of waterworks serving more than 50 people or delivering more than 10 m^3 of drinking-water per day must be certified by the National Supervisory Authority for Welfare and Health in technical utility operations and water hygiene skills, showing competence and experience in the field of drinking-water quality and technology. This is evaluated by a test comprising 30 multiple-choice questions covering water intake, treatment, distribution systems, water quality legislation, operational and surveillance monitoring, water chemistry and microbiology, as well as contingency planning. A tester authorized by the Authority organizes the evaluation. As a minimum, the tester needs to be competent and experienced and must hold a bachelor's degree or similar educational level. Certification is valid for five years and is awarded to an employee who passes the test. The legislation entered into force at the beginning of 2007; by 2013 approximately 30 000 employees had passed the test.

Box 13 gives further examples of countries' legislation and activities regarding education, qualification and training for operators of small-scale supplies.

Box 13. Examples of education, qualification and training requirements

Of the countries responding to the survey on small-scale water supplies conducted under the Protocol on Water and Health *(2)*, 52% stated that minimum qualification or competence requirements were in place for operators of small-scale public supplies. Furthermore, about half

of the countries stated that relevant qualification or training programmes were provided for the operators of small-scale public water supplies.

In the Czech Republic, according to the Act on Water Supply and Sewerage Systems for Public Use *(122)*, operators of small-scale public supplies supplying between 50 and 5000 people must have a licence or approval from the water authority concerning their qualifications. An operator or a designated representative of the operator must comply with the following minimum education and qualification requirements:

- secondary education (technical high school) in the field of water management or equivalent level of education, as defined in the Act;
- four years of practice in the field of water supply management.

Minimum qualifications are also required for operators of small-scale public wastewater systems.

In Hungary the 21/2002 Ministerial Decree of the Environmental Protection and Water Ministry *(123)* lays down the specific qualification requirements for those working in different areas of water supplies and wastewater collection and treatment systems. These include different types of technical qualification, bachelors' degrees and various post-graduate degrees: they are specified for different categories defined by the volume of water supplied or treated, increasing with the size of the system. For example, a manager of a groundwater abstraction facility needs the following qualifications:

- for a facility providing less than 500 m^3 per day: technical qualification (for example, for industrial water management, water and wastewater or water technology);
- for a facility providing 500–3000 m^3 per day: bachelor's degree (or equivalent) in civil engineering with a water supply or sanitation focus;
- for a facility providing 3000–10000 m^3 per day: bachelor's degree (or equivalent) including specialization as a water supply engineer;
- for a facility providing more than 10 000 m^3: post-graduate degree in water supply and sanitation.

In Scotland no specific minimum qualifications or competence requirements are in place for employment of staff to run small public water supplies. Once employed, however, operators are required to obtain a national water hygiene card (for which they need to undertake training followed by an assessment) and are enrolled in the Scottish Water Competent Operator Scheme, which is a United Kingdom-wide scheme.

In Slovakia the requirements for operators of all public water supplies are set according to the Ministry of Agriculture Regulation No. 124/2003 Coll. *(124)*, which stipulates details on professional capability to operate public mains and public sewage.

It may not be feasible to require the same level of education and qualification for smaller as for larger systems; therefore, agreeing on minimum levels of skill, training or competence specifically for operators of small-scale water supply and sanitation systems and fulfilling them gradually may be a more realistic aim.

4.6.2 Approaches to increase knowledge levels of operators

While professional education forms the basis of required knowledge for operational staff and responsible bodies, regular training and periodic checks of competence help to keep that knowledge up to date and in line with recent developments. Approaches to improve the knowledge of those involved in the operation of small-scale water supply and sanitation systems fall into four main areas.

- Higher education: inclusion of aspects of water, sanitation and hygiene in relevant degree courses' curricula (such as engineering and public health) plays an important role in qualifying students and preparing them for a potential future role in operating water supply and sanitation systems.
- Training: ongoing vocational training is required, for both staff with a level of education in water supply and/or sanitation and those without formal qualifications. Regular training can help to inform and qualify personnel in a step-by-step way and/or keep their knowledge up to date. Single training activities may be embedded in broader training programmes for a large number of people across a wide area.
- Recommendations and guidance: summarizing the essentials of operational procedures (such as good disinfection practices) in technical sheets produced in easy-to-understand language to make them more applicable by operators of individual or small centralized systems.
- Networking: sharing knowledge and experience in workshops or seminars for operators from several communities is a valuable form of peer-to-peer education and training. Especially for small-scale water supply and sanitation systems, where only a limited number of people in each community are responsible for operations, such networking can effectively build capacity and increase motivation.

Training and qualification programmes may address, among other things, health consequences that might arise from poor operation of the systems; legal and regulatory aspects relevant to small-scale water supply and sanitation systems; good practices in environmental and resource protection; available treatment processes (including criteria for their selection); good practices in risk management, operation and maintenance; and economic and financial aspects. It is particularly important that educational, qualification and training programmes highlight the links between drinking-water supply and sanitation by addressing safe sanitation practices for those working on drinking-water and vice versa. Such programmes can be stipulated or initiated at the national or subnational level.

Other stakeholders can also benefit from training and qualification programmes. This is especially important for:

- local authorities – to increase their knowledge of surveillance approaches, technical installations and/or good management practices relevant for small-scale systems;
- mayors or local community leaders who are commonly responsible for the provision of water and sanitation services – to increase their understanding of not only the skills required to operate small-scale water supply and sanitation systems adequately but also the need to have well qualified staff in place;
- owners and operators of individual wells and/or onsite sanitation systems – to increase their knowledge of potential hazards and hazardous events to water quality and effective controls, as well as health consequences that might arise from faulty operations.

Important partners for public authorities in designing and implementing educational and training programmes for communities and operators are water associations, professional associations, professional training providers, NGOs, research institutions, universities and consulting agencies. Case study 17 from Germany and Case study 18 from Switzerland show how water associations and subnational authorities can initiate and support vocational training for operators of small-scale systems, including by outlining requirements in their guidelines.

Case study 17. Training for operators of small-scale water supplies in Germany

The German association DVGW (see Case study 6) provides training programmes, among other services, for technical staff of small-scale water supplies in the 16 federal states. These are vocational programmes that include basic and follow-up modules for groups of geographically neighbouring water supplies. Topics covered include aspects of liability, legal requirements, relevance and details of technical rules, health and safety requirements, qualification requirements and technical aspects of managing drinking-water safely, including protection of sources of drinking-water, water abstraction, treatment, storage, distribution and operational monitoring. The programmes support the qualification needed to meet the conditions of DVGW's technical rule W 1000, which specifies general requirements for the qualification and organization of drinking-water supplies.

In the Federal State of Schleswig-Holstein several public authorities, together with regional associations, developed the training platform Forum Trinkwasserversorgung Schleswig-Holstein particularly to support small and medium-sized water supplies *(125)*. Funding is provided by the authorities and associations involved, as well as by the Regional Association on Water and Soil, DVGW and associations of city and municipal utilities. The programme is based on the water supplies' requirements, which were assessed via a questionnaire exercise undertaken ahead of the training. The presentations are available online free of charge.

Case study 18. Training programmes for operators of water supplies in Switzerland

At the federal or canton level in Switzerland no specific requirements or qualifications are defined as prerequisites for employment as a water supply operator. Nevertheless, the guidelines for the preparation of a water supply operator job description prepared by the industry association, SVGW, highly recommend employment of someone with professional education in the field. SVGW therefore offers suitable training programmes.

The further education course *Wasserwart* (for which a loose translation is "skilled workers who have been trained in maintenance and supervision of water supply facilities") is specifically geared to the needs of operators of simple, small-scale water supplies. It lasts six days and conveys basic knowledge of quality assurance, operation and maintenance of a water supply. The course focuses on SVGW Regulation W 1002, which offers recommendations for a simple quality assurance system for water supplies *(91)*. These guidelines were developed to satisfy the needs of small-scale water suppliers with regard to the legally required establishment of WSPs. The course has been offered since 2004 and runs four times a year, with 24 participants per course.

In addition, a six-week course offers preparation for the national professional examination to become a "water supply operator with a federal certificate of higher vocational education and training". This SVGW course is aimed at water supply operators who have already gained at least three years' practical experience.

A further one-day SVGW course for municipal policy-makers focuses on strategic management of water supplies, including responsibilities, quality assurance, financing and communication. Its aim is to inform participants of their tasks and responsibilities with respect to water supplies.

In the case of small-scale water supply and sanitation systems, for which sometimes only one person is responsible, operators can learn about new developments through education and networking programmes for sharing information with other professionals in the local context. Case

study 19 from Germany demonstrates how networking and peer-to-peer training can be implemented in collaborative arrangements of small-scale wastewater treatment plant operators at the local level.

Case study 19. Wastewater treatment plant neighbourhoods – networking and peer-to-peer training in Germany

In 1968 the first German wastewater treatment plant neighbourhoods were introduced by DWA (see Case study 6) with the aim of training operational staff efficiently. Each neighbourhood covers about 15–20 wastewater treatment plants located close to each other; they are voluntary associations without legal status. In some federal states financial support is provided to the neighbourhoods by the Ministry of the Environment; elsewhere funding is based on annual membership fees. There are currently 310 neighbourhoods.

Neighbourhoods meet about 2–4 times a year to receive training from an external expert and exchange experiences. These meetings are organized and carried out with a focus on issues of day-to-day practice in management and operation. They intensify personal contact among practitioners: this leads to mutual consultation, assistance and support, which includes not only lending of equipment but also substitution during absence in emergencies.

This regular training and exchange of experiences means that the operators' knowledge and qualifications improve continually, which also leads to significant cost savings through more efficient operations. The strong contacts built among members of neighbourhoods are also beneficial in the acquisition of plants and machinery. In addition, word spreads quickly within a neighbourhood about whether a company's technical service is bad or expensive and who does good work.

The wastewater treatment plant neighbourhoods do not necessarily stop at national boundaries. For example, operational staff of the treatment plants around Lake Constance meet annually within the framework of the International Lake Constance Neighbourhood, in which Switzerland, Austria and Liechtenstein are also involved.

DWA's Neighbourhoods Committee has developed uniform framework conditions and ensures professional exchange throughout Germany and even internationally. In addition to organizing the training, DWA publishes target-oriented professional journals for the neighbourhoods, providing information on a regular basis. The neighbourhood concept has also been shown to work in Croatia, Poland and other countries.

Involving skilled trainers and facilitators and tailoring training programmes to the prevailing conditions, technical equipment employed and personnel and financial realities have proved to be factors in the programmes' success. Free access to information and educational materials in the national language and online availability may also enhance the application of advice.

Local budgets for water and wastewater services need to consider the costs of staff training to ensure sustainable financing for safe management of small-scale water supply and sanitation systems. Availability of training offers and qualification requirements need to be communicated effectively so that the information reaches the target groups at the local level.

4.7. Advocacy and awareness-raising

The main goal of raising awareness is to inform local decision-makers, other local stakeholders and the general public about drinking-water and sanitation safety as key factors for public health

protection, and consequently for economic development and sustainable livelihoods. It is important that all parties understand the importance of small-scale systems for rural communities, including the challenges they experience, the solutions available and the health and economic benefits of improving the situation. It is vital to tailor the messages to appropriate target audiences, considering their priorities and needs. Guidance on planning campaigns and information on approaches to awareness-raising are available from the United Nations Organization for Education, Science and Culture (UNESCO) publication *Principles of awareness-raising for information literacy (126)*.

Awareness-raising increases public access to information; this is a prerequisite for public participation in decision-making processes *(127)*, which fosters transparency within and efficiency of decision-making and implementation. Both informing and involving the public not only help to ensure that the services provided are aligned with people's perceived needs but also contribute to transparency and acceptance of the decisions taken and measures implemented.

Cross-sectoral approaches are critical in the context of small-scale systems, particularly to explain the link between drinking-water and sanitation. Advocacy efforts need to address those who can have an impact on small-scale systems but do not work on water and sanitation directly, and awareness-raising activities need to consider that in rural areas those receiving water from small-scale water supplies typically also use the catchment area, which could lead to pollution risks.

4.7.1 Supporting local action at the national level

Awareness-raising activities are usually conducted at the local level – for example, in community meetings, consultations or media appearances. This may happen in the context of broader water, sanitation and hygiene programmes or in the context of related topics such as community health. Local awareness-raising activities can be supported at the national or subnational levels. Options include:

- planning of campaigns, incorporating:
  - communication and dissemination schemes and mobilizing partners accordingly, such as involvement of local government and NGOs;
  - use of mass media (newspapers, radio, television, Internet);
  - reaching young people via schools and kindergartens (see Case study 20 from the Republic of Moldova and Case study 21 from Ireland);
  - different campaign approaches – for example, combining communication at public meetings with individual consultations, in order to reach a broad share of the target audience;
  - making use of, among others, prominent occasions like the annual World Water Day (22 March), World Health Day (7 April), Global Handwashing Day (15 October) and World Toilet Day (19 November);
- making finances available for broad national campaigns and/or local awareness-raising activities;
- developing the content, messages and basic materials of campaigns, including:
  - allowing flexibility for adaptation at the local level;
  - tailoring information to relevant target audiences;
  - using easy-to-understand language and images;
  - organizing translations into local languages;
- providing data and information that can be used for awareness-raising and advocacy (see section 4.1 on baseline analysis and target-setting);

- promoting awareness-raising activities to be integrated into other water and sanitation activities at the local level (see Case study 3 from Georgia);
- making arrangements so that women and marginalized groups can be reached through awareness-raising activities;
- integrating provisions on awareness-raising into policies or legislative requirements (see Case study 22 from Serbia).

Case study 20. WSPs involving schools in the Republic of Moldova

The WSP approach is a tool for safe management of drinking-water supply. It focuses on the identification of locally relevant hazards and hazardous events, assessment and continuous management of risks to prevent keep drinking-water from becoming unsafe (see section 5.3 on water and sanitation safety planning). It can be used as a tool to raise awareness and mobilize communities. The NGO Women in Europe for a Common Future (WECF) developed a WSP approach involving schools *(128)*, in which teachers were trained to support WSP development for their local water supply systems and to carry out associated activities with their pupils, with the involvement of local authorities. During the initial stage the schools investigated their own local situations by analysing the water sources, investigating appearances of disease associated with water, inviting contributions from the local doctor or other experts and performing rapid water quality tests with the children. The results of the analysis were mapped, leading to identification of possible sources of pollution. The resultant map informed the villagers about the quality of wells and pointed out those to avoid.

In the community of Tohatin in the Republic of Moldova the mismanagement of human and animal waste was identified as the main source of contamination of water sources. Former deposits of pesticides were identified as additional risk of water pollution. The results of the investigations were presented to the authorities and local citizens. An action plan for 2012–2019 – focusing on recovering, protecting and monitoring the wells, with a particular emphasis on the sanitary requirements for safe management of human, animal and other organic waste – was adopted by the local council in January 2012. The action plan included the estimated implementation costs of the plan, potential funding sources and evaluation and reporting procedures. An extension of the sewage system in Tohatin was initiated.

Case study 21. Irish protect your well application

In 2014 the Irish EPA launched its online "Protect your well assessment application" (app) *(129)*. The app was developed to improve the sanitary status of private wells and to raise awareness among their owners of drinking-water quality issues. It introduces a short risk assessment by a video explaining the health risks from unsafe water, the benefits of testing well-water and the possible risks to drinking-water from wells. This is followed by a short set of easy questions, such as "Do you know if your well-water has ever been tested?" and "Does your well-water smell?" After all the questions are answered, the assessment culminates in advice and contact information for the responsible authorities in the private well owner's location. The information submitted through the app is transmitted to EPA, which can, on the basis of the data submitted, estimate the status of wells and their respective geographical distribution.

The app has a public use licence so that other interested authorities can adapt it to their circumstances, translate it and use it in their countries, as long as its development by EPA is acknowledged. A link to a blank version of the app is available *(130)*.

The app's launch was accompanied by a social media awareness-raising campaign. These generated significant public interest, including a story on the national evening news, around 20 interviews on national and local radio and TV stations and around 50 articles in national and local newspapers and magazines. The campaign also involves direct communication with stakeholder groups such as farmers, drillers and health professionals, which is intended to continue. In the future it is planned to integrate this campaign with the Green-Schools Ireland programme for schools in rural areas to raise awareness among a younger audience and encourage them to use the app on their own wells *(131)*. An assessment of the effectiveness of the campaign – including examinations of target audience awareness, engagement with the material provided and the effect on behaviour – will be carried out. This will include assessing indicators of behavioural change, such as testing rates on private wells and applications for private well grants, to determine the effectiveness of the awareness of the risks. Initial indications are that it has led to a significant increase in awareness of the risks associated with private wells. Public and private laboratories reported a significant increase in number of requests for testing of private wells, while requests for well grants rose significantly.

Case study 22. Raising awareness as a legal obligation in Serbia

In Serbia raising awareness about personal and collective hygiene, the usage of safe drinking-water and adequate waste disposal is a legal obligation prescribed by a national regulation and a programme on protection of the population from communicable diseases since 2002 *(132, 133)*. This legal document stipulates priorities, specific goals and measures in the fields of epidemiology, hygiene and health promotion, including in emergency situations. Raising the level of knowledge and forming and promoting good habits are important for the prevention and control of communicable diseases: they are thus priority goals in the field of health promotion envisaged by the programme.

Various measures are set out to achieve the goals concerning personal and collective hygiene, the usage of safe drinking-water and adequate waste disposal:

- informing the population about the importance of these factors through cooperation with the media, health forums, exhibitions and health campaigns, and introducing health education in schools;
- organizing education that contributes to the formation of good habits and attitudes through health lectures; discussions (individual, planned and additional); working in small groups; organized meetings, seminars and individual counselling; and multimedia access (educational television and radio programmes, articles in newspapers and magazines and the Internet);
- changing attitudes and behaviours that contribute to the occurrence and spread of infectious diseases, supporting active attitudes and training the population in self-protection through formation of networks and committees, developing educators' programmes, community mobilization, active teaching methods (creative workshops, roleplaying), environmental demonstrations, individual counselling, working in small groups and creation of innovative methods and models for health education and promotion.

The regulation also defines participants in the implementation of the programme. These include the entire national population and society as a whole, as well as specialized health institutions at the local, subnational and national levels with specific prescribed tasks and obligations for programme implementation.

4.7.2 Suitable content for awareness-raising activities

When developing the content of awareness-raising activities, the following elements are particularly suitable in the context of small-scale water supply and sanitation systems:

- the duties of and possibilities for local stakeholders to protect sources of drinking-water (see section 5.1 on protection of sources of drinking-water), improve wastewater management and maintain drinking-water and sanitation facilities;
- the impact of changing technologies or increasing the standard of services – for example, replacing latrines with flush toilets will greatly augment the amount of wastewater generated that then needs to be safely managed by the community;
- the interaction of water, sanitation, hygiene behaviour and health – particularly where households operate individual onsite water supply and sanitation systems, people need to be informed about the adequate management of the systems and the health risks related to inadequate management (see Case study 5 from Germany and section 5.3 on water and sanitation safety planning);
- the costs and benefits of the provision of safe water and sanitation, including the costs of operation and maintenance of the systems – people need to understand that the provision of safe water and sanitation services has a price (see section 4.5 on costing and financing);

- the health benefits of handwashing and the features of good hygiene behaviour, including during collection, transport and storage of water;
- measures that can be taken at the household level both if drinking-water quality is compromised and to prevent contamination (see Box 14);
- stakeholders who can help and provide assistance in the local and regional context, and existing regional and national support programmes.

Box 14. Awareness-raising for household water treatment and safe storage

Drinking-water may be stored at the household level if it is collected from outside the premises or in the case of intermittent supplies, and treatment may be required if the quality is poor at the point of collection. As household water treatment and safe storage are typically outside the area of responsibility of the water supplier, this is an important subject for awareness-raising and capacity-building. Research has shown that accompanying the introduction of household water treatment with behavioural, motivational, educational and participatory activities increases their success *(134)*. A favourable political climate, the presence of standards and certification for the relevant products and technology, favourable import regulations and government ownership of household water treatment and safe storage affairs have been shown to be enabling factors for sustainability and scale-up of such practices *(135)*.

Evidence, including from the WHO European Region *(136)*, indicates that even when drinking-water is of good quality at the point of collection people may still inadvertently introduce faecal contamination during collection, transport and storage *(137)*. This is particularly recognized in the case of off-plot water supplies, from which people must bring water back to the household in containers. Research has further shown that in the context of intermittent water supplies the risk of contamination at the household level can be significant. This risk can be eliminated or minimized through targeted awareness-raising activities *(138)*.

Awareness-raising campaigns should emphasize that using safe storage containers can have a beneficial effect on the quality of drinking-water at the point of consumption *(139)* and that treating the water is an effective option, if it is of poor quality at the point of collection. Available processes for household water treatment include filtration, boiling, chlorination and ultraviolet disinfection *(134)*; information on these should also be provided in campaigns. More information about household water treatment and safe storage, including on advocacy and communications, is available from WHO *(140)*.

Users of small-scale systems should also have access to up-to-date and relevant information, such as the water sources of their supplies, existing standards and limit values or quality of drinking-water supplied. Access to information on drinking-water quality helps to create trust in the management of the supply system and prevents users from turning to other, potentially unsafe sources. Users should also be aware of the elements relating to the tariffs requested from them for the services provided. Whereas information on the system needs to be provided locally, this can be complemented by information at an overarching level on the general underlying principles, such as what makes up the costs of services for small-scale systems.

School education can play an important role in raising the level of knowledge about drinking-water, sanitation and hygiene issues and how these are interrelated. Schools can inform students about these issues, thereby improving their hygiene behaviour, and can also help to spread the message further in the community when students report at home what they have learnt. Particularly in rural

areas, this may have a significant effect on the contribution of the community to the safety of water supply and sanitation systems (see Case study 20 from the Republic of Moldova).

4.8. Cooperative arrangements and networking

It has proved beneficial for small-scale systems to join forces with neighbouring municipalities and communities or with bigger utilities by forming cooperative partnership arrangements. In such arrangements, capacities and efficiency increase as a result of extended human, technical and financial resources.

Cooperative arrangements can lead to the pooling of knowledge and experience of staff and thereby to higher levels of professionalism and better conditions for improved management and operation of small-scale water supply and sanitation systems. Rather than giving staff in a municipality numerous responsibilities of which water supply and/or sanitation is just one, partnership arrangements facilitate training of staff in one specific area of expertise that can serve several municipalities, thereby ensuring that several systems benefit from the training that one person receives.

Other advantages include the joint implementation of technical innovations and rationalization in the procurement of equipment and spare parts. Costs can be shared, with increased flexibility in applying funds if several municipalities contribute and agree jointly on priorities for their use. Further, overall operational costs may be reduced through sharing of facilities and equipment. Case study 23 from Italy provides an example of how policy-makers can support the formation of cooperative arrangements.

Case study 23. National reform of regional associations in Italy

The water supply organization in Italy has been characterized by extreme fragmentation for many years. In 1987 the country had 13 503 individual waterworks, of which 83% were operated at the municipal level *(144)*. A reform process started in 1989 and new general provisions on water source management (known as "Galli's Law") were enacted in 1994 *(145, 146)*. The primary objective of the reform was to overcome the fragmentation by introducing an entrepreneurial organizational model for integrated management from water abstraction to sewerage. In line with the legislator's intentions, the reform enabled a reduction in the high number of water suppliers to a few hundred. As part of the reform, minimum catchment areas called "ambiti territoriali ottimali" [minimum catchment areas] (ATOs) were defined, each administered by an ATO authority composed of representatives of local authorities.

Galli's Law divided responsibilities among the following entities:

- regions, which approve implementation rules, determine territorial boundaries and the institutional form of ATOs and adopt a standard convention to regulate the relationships between local authorities (provinces and municipalities) and water companies;
- provinces and municipalities, which organize the integrated water service by instituting ATOs and nominate their representatives to serve on ATO authorities;
- ATO authorities, which carry out checks on existing works, develop plans for the adaptation of infrastructure and improvements in the provision of services, assign the integrated water services to operators (public, private or joint stock water companies) by drawing up agreements and control operator activities;
- one or more public, private or joint stock water companies per ATO, each of which operates the integrated water service by collecting or distributing water from several small and/or large supplies and collecting or treating wastewater.

4.8.1 Types of cooperative arrangements

Various types of cooperative arrangements are possible, including formal or informal individual agreements, creating organizational entities and transfers of responsibility (see Table 2).

Table 2. Options for cooperative arrangements

Type of cooperative arrangement	Characteristics	Examples
Formal or informal individual cooperation	Includes joint capacity-building, sharing of equipment and giving mutual advice	• Water operator partnership arrangements between a larger and one or more smaller entities • Informal cooperation and/or networking between two or more small entities
Creating an organizational entity	Management (operation, maintenance, tariff-setting) carried out jointly across several communities or municipalities, using joint professional staff, office and materials	• Water, wastewater or combined associations
Transfer of responsibility	Handing over operations and/or maintenance to an existing larger entity for a fixed period of time and price	• Public–private partnerships • A large public utility taking management responsibility for small systems in the same area (see

Type of cooperative arrangement	Characteristics	Examples
		Case study 24 from Serbia)

Case study 24. A cooperation initiative in Odzaci municipality, Serbia

In Serbia municipalities are obliged to provide access to and undertake quality control of drinking-water supplies, but these provisions are not fully implemented in practice. In 2012, Odzaci municipality conducted a baseline analysis of eight small-scale water supply systems providing drinking-water for eight villages within the municipality. This brought to light several challenges, including noncompliance in the management of the supplies, a lack of legal responsibility within the local community in the case of system failure, little or no relevant professional education among those managing the systems and compromised drinking-water quality, which had not been identified previously because of inadequate surveillance.

On the initiative of the municipality the local government adopted a new Decision on municipal services *(143)* in December 2012. As a result, six local communities handed over the management of their water supplies to a larger water utility – the public water supply system of the town of Odzaci. The new service provider used the money from tariffs to restore wells and install all necessary equipment to ensure that a sufficient quantity of water is supplied.

Operators of onsite systems, often with limited knowledge and resources, particularly benefit from organized support and supervision by local administrations. This may include providing supporting materials in local languages and/or information and training from regional support centres. Case study 25 from France provides an example of municipalities joining forces to establish public sanitation services and support safe operation of onsite sanitation systems.

Case study 25. SPANCs – public services for onsite sanitation in France

With 15% of the population living in 36 000 municipalities, France has a high ratio of scattered dwellings. During the 1980s state services ensured that all new houses without connection to public sewers had efficient onsite technologies such as septic tanks, treatment by subsoil spreading (when permeable) or sand filter-based substitutes.

Since the local health administrations had insufficient capacity to monitor these onsite systems, the Water law of 1992 *(141)* required the creation of local public services for onsite sanitation (SPANCs) by 2005. Small municipalities (often with fewer than 500 inhabitants) could team up and create a SPANC with two or three qualified technicians. Around 4000 SPANCs have been created to date. They have two mandatory tasks:

- offering technical advice on sanitation before building a house, taking into account municipal zoning, soil and hydrological conditions and similar, in parallel with building permit procedures;
- examining the sanitation system at the end of the building phase or when an existing house is sold, and assessing the design and maintenance of existing installations within their territory at least every 10 years.

Additional optional tasks include:

- ensuring restoration or maintenance (including emptying septic tanks every 3–5 years and at least when the tank is 50% full of solid matter), often twice a year for the sludge of an aerobic mechanical device;
- ensuring valorization of sewage (for example, by composting or soil injection/spreading) or transfer to an adapted wastewater treatment plant.

The cost of visits to complete the mandatory tasks is covered in a fee paid by the owner of the house; the mean value of the fee is €100 but there are disparities between different SPANCs.

In many settings drinking-water supply systems are more developed and receive greater attention than wastewater collection and treatment systems. This situation could be improved by establishing entities responsible for the management and operation of both water supply and sanitation systems, as shown by the examples in Case study 26 from the Czech Republic and Case study 27 from Germany. The notional starting-point for promoting such a holistic approach is the idea that all water supplied in a community creates wastewater that needs to be treated. Jointly covering small public drinking-water and wastewater services within one entity generates synergetic effects – for example, through construction cost savings when pipes for both systems are placed at the same time and strong communication channels between staff of drinking-water and wastewater organizations.

Case study 26. Municipal association for water supply and sewerage in the Czech Republic

From the 1950s in the Czech Republic 11 large state enterprises exclusively operated drinking-water supplies and sewerage systems. They were organized on a regional basis and took care of the management and development of the respective infrastructure. In 1993 the government entrusted all water supply and sewerage infrastructure, as well as the responsibilities and rights to manage these services, to the relevant municipalities; this led to the creation of more than 1200 small operators. Rural municipalities in most cases owned their water supply infrastructure and in some cases also operated it.

Small villages soon realized that it would be better to join forces with neighbouring municipalities, and several municipal associations were established to manage drinking-water supply and sewerage systems. One such example is Vodovody a kanalizace, svazek obci se sidlem v Trebici [Water Supplies and Sewerage Association of Municipalities in Trebic], which was established in 1993 by 75 municipalities, mostly small towns and villages but also including the former district capital Trebic. By 2012, 123 municipalities had joined. The Association has an agreement with Vodarenska a.s. (a water management company), which operates under licence all supply and sewerage systems owned by the Association, serving about 100 000 people in total. Although local conditions and operational costs differ, there is a unified price for water in all municipalities, which has to be agreed by all members of the Association.

The main advantage for municipalities is that they need only invest a small effort to secure regular water supply and wastewater removal. The five employees of the Association manage preparation, financing and implementation of all construction activities.

Case study 27. Municipal association for water supply and sewerage in Germany

In Germany the municipalities are responsible for drinking-water supply and wastewater disposal. In the administrative district of Vogtlandkreis, 39 cities and municipalities with a population of approximately 240 000 established the Vogtland Association for Water and Wastewater Management (ZWAV). Since 1993 ZWAV has been responsible for the technical and economic management of drinking-water supply in all 39 municipalities and wastewater disposal in 37 of the municipalities. It has around 280 employees and operates 83 wastewater treatment plants, about 80 spring sources, 45 small waterworks and water distribution networks interconnected within around 80% of the municipalities, through which temporary local water deficiencies can be compensated.

A uniform price for drinking-water applies across the entire region, irrespective of the length of water supply pipelines required, thus removing the financial burden for remote municipalities. For bigger investments, prioritization is based on the urgency of the measure rather than the financial capabilities of the municipality affected.

ZWAV is not responsible for the operation of decentralized sanitation facilities, but it has entered contractual maintenance agreements with the operators of some of these facilities.

4.8.2 Supporting activities for networking

Networking platforms among operators of several communities or municipalities enable sharing of knowledge and experiences and provide a good opportunity for peer-to-peer support. Through networking, operators can gain access to technical support from national or regional administrations and can thereby make use of others' expertise. Networks can facilitate the distribution of information on, for example, the latest regulatory developments or available sources of funding.

While networking arrangements for small-scale systems could be initiated at the national or regional levels, they should be organized at a relevant scale (such as local or subnational) to allow for broad participation, taking into account the systems' remoteness and the operators' options for travel.

Supporting activities for networking and the cooperation of stakeholders could have different forms, aims and extents.

- Existing national, regional or local water and wastewater associations and professional networks could develop special programmes and/or activities to involve operators of small-scale systems or new support tools aimed at the needs of those systems. As small-scale systems are often located in rural areas, local chapters could be established and financial support provided for participation in network meetings (see Case study 19 from Germany).
- New networks focusing on small-scale systems could be promoted and established, provided that due consideration has been given to their continuous operation in terms of finances and network management.
- National or regional institutions could function as "resource centres" that provide access to expertise and support. They might provide platforms where operators from the local areas meet and network on dedicated occasions, such as "small-scale system days". Local health and environment offices could also act as knowledge brokers for operators of local small-scale water supply and sanitation systems.
- Online platforms, particularly for remote areas (if access to the Internet is possible) are another important tool for sharing information materials and/or for requesting remote advice or assistance. One example is provided in Case study 28 from Switzerland; another is the United States Environmental Protection Agency, which hosts an online platform offering technical, managerial and financial capacity resources for small-scale drinking-water supplies and points of contact for further advice *(142)*.

Case study 28. Swiss networking – water suppliers helping water suppliers

Of the nearly 3000 municipal water supplies in Switzerland, more than 90% belong to the category of small-scale supplies serving fewer than 5000 inhabitants. To share the knowledge held in the six laboratories of the large water supplies and to support small-scale water supplies – in particular with quality assurance, drinking-water quality, management of nitrate pollution, treatment and disinfection, protection zones and self-checking – the laboratories formed the Aquaexpert network *(147)*. The Aquaexpert motto summarizes its aims: "water suppliers help water suppliers". The key element of the network is its Internet platform, which is managed by SVGW (see Box 11 and Case study 18), through which any water supplier searching for support can contact any one of the laboratories or the network as a whole. The first expert consultation by a laboratory is free of charge; further consultations, onsite inspections, study of documents and lab analyses are chargeable, the price being set bilaterally between the laboratory involved and the water supplier.

The Aquaexpert network and the Internet platform were established in 2007 and are now an important way for small-scale water supplies to obtain support. Nevertheless, potential users need to be reminded regularly of the network and its advantages to ensure frequent usage.

5. Good practices for improving small-scale water supply and sanitation systems

The following sections provide good practice examples of how the principles and tools presented in Chapter 4 can be applied to small-scale systems in the context of water resource protection, sanitation planning and water and sanitation safety planning. These examples focus on selected practices that have already been applied successfully in the European Region, and particularly on case studies showing how policy-makers have supported them by creating an enabling environment.

5.1. Protection of sources of drinking-water

A well protected source of drinking-water and high-quality raw water is vital for supplying safe drinking-water and protecting public health. Effective protection of water resources is the first step in the multibarrier approach, which aims to have several controls in place along the supply chain from catchment to point of consumption to prevent hazards (such as pathogens or chemicals) from reaching consumers. Through proactive resource protection measures, hazards are prevented from entering the water supply chain in the first place; this reduces requirements and costs for later steps in treatment and disinfection and increases the long-term safety and sustainability of the water supply system. This step is particularly relevant for small-scale systems, where treatment is often lacking or limited in scope and availability, and where potentially contaminating activities are often in close proximity to the source of drinking-water.

Detailed guidance on the principles of the protection of groundwater and surface water as sources of drinking-water, and particularly on the identification, assessment and management of risks to health, is available from WHO *(148, 149)*. Specific measures in resource protection that may be addressed in policies and regulations include:

- establishing protection zones;
- restricting access to catchments;
- restricting potentially polluting activities – permitting such activities only with specific controls in place (such as requiring application of specific codes of good practice) or moving them away from sensitive locations;

- requiring implementation of WSPs to systematically identify, assess and manage catchment-related risks (see section 5.3 on water and sanitation safety planning);
- establishing monitoring requirements for sources of drinking-water;
- establishing abstraction licences for small-scale water systems and possibly requiring minimum protection measures as a prerequisite;
- restricting water use for other purposes to preserve sufficient quantities for drinking-water supply;
- stipulating cooperation agreements with farmers and offering incentives for limiting polluting activities or using fees for water abstraction to fund protection measures.

Examples of regulations for resource protection of small-scale water supplies are given in Box 15.

Box 15. Regulations for source protection measures in small-scale water supply catchments in the WHO European Region

Of the questionnaires returned under the survey on small-scale water supplies conducted under the Protocol *(2)*, 37 responses (80%) from 35 countries stated that regulations for source protection measures in small-scale water supply catchments are in place.

In Denmark a 25-metre protection zone is obligatory around supplies providing water for 10 or more households. In addition to this, paragraph 24 in the Law on Environmental Protection *(69)* creates an instrument for regulating the catchment of water supplies. This applies to both small (supplying fewer than 10 households) and larger water supplies. Delineation of the catchment is calculated and designated by municipalities. Within the catchment area the municipalities are authorized to impose the restrictions deemed necessary to safeguard existing or future water supplies.

According to the Water Act of Estonia *(152)*, each point from which groundwater or surface water is abstracted for drinking-water purposes must have a water protection zone. The scope of the zone is set according to the amount of water used. The owner of the water abstraction point is responsible for enforcement of the requirements of the protection zones. Surveillance of the implementation of the requirements falls within the remit of the Environmental Inspectorate.

In Lithuania sanitary protection zones are required for all drinking-water sources. Their size and the requirements for their establishment are based on the groundwater extraction rate. Municipalities are responsible for enforcement.

All waterworks in Norway that serve more than 50 people must have at least two hygienic barriers, one of which should (if possible) be a protected catchment area. This is part of the waterworks approval process.

In the Russian Federation a regulation sets specifications for setting up and operation of three levels of sanitary protection zones around sources of water supply, including groundwater sources that – in the overwhelming majority of cases – are the sources feeding small-scale water supplies *(153)*.

To protect the source water of drinking-water treatment plants supplying more than 10 m^3 per day in Sweden, water protection areas can be established. This includes restrictions on wastewater treatment plants, grazing by animals and other activities. Permits from regional authorities are required for wastewater treatment plants and other activities considered potentially harmful to the environment.

Implementation of protection measures may encounter conflicts of interest regarding land use; it therefore requires legislative and planning processes at the subnational and national levels. To encourage and implement broader catchment management approaches, it is important to establish bodies charged with the responsibility for influencing land use planning and management. This can be an efficient tool to control activities in the catchment area that may adversely affect source water quality (such as sanitation, agriculture, industry and transportation) and to sustain access to water resources of sufficient quality and quantity for drinking-water production, especially where there may be competing claims from other uses. In such cases the interests and voices of small-scale systems need to be represented in the management body. Introducing the combined needs of several small-scale systems in a larger region into such processes may mean that they have more influence than if one system tries to achieve protection on its own.
Small-scale water supplies may find protection measures particularly hard to enforce and implement beyond the local context where they have limited influence. Simple measures including regular site inspections and follow-up on identified risks (such as fencing the area around the abstraction point to prevent direct contamination), as well as ongoing communication with local actors (such as famers) to influence their activities positively in the vicinity of abstraction, will be possible in most settings, however, even for individual supplies.

Poorly managed and/or sited sanitation and the resulting contamination are one of the main risks to safe drinking-water (see section 5.2 on sanitation planning). While connecting to a central wastewater treatment plant may often not be possible or feasible, measures such as positioning decentralized sanitation facilities at safe distances or downstream from the drinking-water abstraction point are effective for protecting sources of small-scale water supplies.

An established approach for resource protection is to designate an area around the resource or abstraction point that is subject to protection measures. This approach is applicable to all water supplies, irrespective of their size and of whether they use surface water, groundwater or spring sources. The criteria for determining the dimensions of the protection area will typically be defined at national levels, as should the types of activity to be restricted or banned. More detailed identification of such activities and the potential need for their restriction will need to take place at the local level within a water safety planning process (see section 5.3 on water and sanitation safety planning). The resource protection area may be divided into several zones: restrictions on activities typically increase the closer the zone is to the abstraction point. Case study 29 from Switzerland shows how resource protection zoning can be integrated into legislation and Case study 30 from Serbia gives an example of legislation adapting protection zoning requirements to the context of small-scale systems that may find it challenging to implement stricter measures.

Case study 29. Protecting drinking-water supplies in Switzerland

In Switzerland groundwater is the most important source of drinking-water. To prevent it from being polluted by human activities and to keep the requirements for water treatment as low as possible, groundwater protection is included in federal environmental legislation in regulations on water protection (Federal Act on Water Protection *(150)* and Federal Ordinance on Water Protection *(151)*).

In particular, the regulations on spatial planning related to groundwater protection are of the utmost importance for water supplies. Accordingly, three groundwater protection zones (S1–S3) must be designated around all groundwater wells serving the public, in which significant restrictions are imposed on human activities. These restrictions become less stringent from the

centre to the periphery. Around the wellhead (zone S1) only construction work and activities connected with drinking-water supply are permitted. The inner zone (S2) is primarily designated to prevent contamination of drinking-water with pathogenic microorganisms and to ensure that groundwater flows are not adversely affected or obstructed as they approach the well. Here, for example, liquid manure may only be applied in exceptional cases and infiltrating wastewater is forbidden. The outer zone (S3) is designed to ensure that – in the event of an accident – sufficient time and space are available to ward off any hazards to drinking-water. Thus, facilities that pose a risk to groundwater (such as petrol stations) are not allowed in this zone. Furthermore, the infiltration of wastewater, the handling of liquid fuels or lubricants and the storage of heating oil above the quantity required to heat the relevant building for two years are prohibited.

In general, restrictions within zone S1 amount to an expropriation; therefore, the drinking-water supplier is advised to purchase and fence in the area. In contrast, restrictions in zones S2 and S3 are normally less severe and the water supplier is not obliged to reimburse the affected landowners.

The process of designating groundwater protection zones is defined in the Federal Act on Water Protection and is applicable to all sizes of water supply except private wells. Regulations summarize the specific protection measures for the groundwater protection zones. Based on this information the water supplier should draw up a plan of regular controls for these protection measures. SVGW (see Box 11 and Case study 18) has published guidelines for quality assurance in groundwater protection zones to support water suppliers in self-surveillance of the catchment area and implementation of groundwater protection zones and measures.

Case study 30. Sanitary protection zones in Serbia

Serbia's 2008 regulation defining and maintaining the sanitary protection zones of water supply sources *(154)* refers to all drinking-water supply systems intended for public supply, which includes all those producing more than 10 m^3 per day. Its provisions are obligatory for all systems supplying more than five households or 20 inhabitants and individual water facilities intended for the production and trade of food, schools, restaurants and other public facilities. The regulation defines protection zones according to the type of drinking-water source and activities in the basin and requires the establishment of three protection zones (immediate, inner and outer), with restrictions on human and animal access.

The regulation requires complex documentation to be prepared on sanitary protection zones, the restricted activities within the zones and the marking of zones for approval by sanitary inspectors within the Ministry of Health. The required documentation is demanding and costly for small-scale water supply systems and local self-governments. As a result, no claim for the approval of sanitary protection zones has yet been submitted to the Ministry of Health for small-scale water supplies in rural areas.

In 2013 the Ministry of Health initiated an amendment to this regulation and drafted a new provision for small-scale water supply systems, which has not yet been adopted. Accordingly, such systems will be required to establish, maintain, fence and mark only the immediate protection area surrounding a groundwater well to protect the catchment area from pollution, without submission of complex documentation and/or payment for the study on sanitary protection zones. This specification for small-scale systems should make it easier for the legislation to be implemented through local self-government.

Successful protection of water resources needs to be tailored to the unique concerns and circumstances of the local setting. Effective involvement of landowners and stakeholders in the catchment area at an early stage is particularly critical: where protection requires activities to be restricted, their cooperation is essential for the implementation of such restrictions. Financial incentives for applying water protection practices or for limiting land use may significantly increase acceptance and implementation of source protection measures (see Case study 31 from Germany and section 4.2 on legislation and regulations).

Case study 31. Cooperative agreements with farmers in Germany

In Germany the Federal Water Act *(155)* empowers federal states to establish "drinking-water protection areas" to protect catchments of public drinking-water supplies from adverse impacts, issuing a separate legal decree for each area. The development of such decrees is typically the responsibility of the regional water authority. Voluntary cooperative agreements between water suppliers and farmers are also an important instrument for protecting drinking-water resources in designated protection areas in some federal states; these have been developed in recent decades in additional to the legal decrees.

In the Federal State of North Rhine-Westphalia the German Association of Energy and Water Industries and the Chamber of Agriculture signed a framework agreement to promote farming practices that protect drinking-water resources. The framework agreement strongly encourages water suppliers and farmers to create voluntary but formalized and binding local cooperation agreements. These typically contain specific goals, the main targets being to prevent the introduction of pesticides and pathogens, and the reduction of nitrate levels in groundwater. About 120 such local cooperation agreements currently exist in North Rhine-Westphalia; they include advice for farmers from specially trained advisors of the Chamber of Agriculture on techniques and farming practices that protect water resources. Specific advice typically includes guidance on fertilization regimes; optimization of manure use; catch cropping practices (a crop grown between successive plantings of a main crop); erosion control; and pesticide control, including advice on storage practices, application techniques and choices of alterative active substances. Specific guidance on water-protecting farming practices is issued by DVGW, providing a sound basis for the work of the advisors.

In the Federal State of Lower Saxony cooperative agreements have the main goal of reducing nitrate pollution in drinking-water resources. As part of the cooperation model, agricultural advisors provide guidance on farming practices in individual and group consultations, during site visits and through circular letters. The fee for abstraction of water for drinking-water purposes is regulated in the Lower Saxony Water Act *(156)*, and at least 40% of this fee has to be used to finance water resource protection measures such as cooperative agreements. The money is spent on advising farmers and implementing the terms of the agreements. In 2011 there were a total of 75 such agreements, covering more than 90% of the agricultural areas located in drinking-water protection areas in Lower Saxony. Financial aid for the cooperative arrangements is granted when the implementation of an established protection concept exceeds €50 000, so smaller drinking-water supplies have merged to form subregional cooperatives to be eligible for financing.

To support risk assessments of water resource contamination at the local level, establishment of publicly available systems providing geological and environmental information has proved useful. While this does not replace a detailed onsite assessment of risks, such data can support this process and thus support small-scale water suppliers who may not have the resources to carry out comprehensive vulnerability assessments. Case study 32 from Ireland provides examples of such publicly available information systems.

Case study 32. Public information systems in Ireland

Authorities in Ireland have produced publicly available information that can be used by water suppliers to assist in the identification of risks to their water quality. The Geological Survey of Ireland has produced detailed groundwater vulnerability maps and mapped drinking-water protected areas, as well as providing details of groundwater resources *(157)*, which can be used to determine the vulnerability of water supplies. The Geological Survey of Ireland and the Irish EPA have also delineated zones of contribution for several small supplies and published these reports on the EPA website *(158)*.

This information is combined with other environmental information on the EPA GeoPortal website *(159)*. Here water suppliers can get details of discharges to surface water, water quality, land use, soil cover and general information on environmental quality. The website also has a "My local environment/Timpeall an ti [around the house]" section, where operators of small-scale systems can enter an exact location and get details of soil/subsoil type, aquifer type, aquifer vulnerability and domestic wastewater risk category. This information can be used to assist in the determination of the vulnerability and risks to a water supply.

5.2. Sanitation planning

Sanitation planning means making informed choices about sanitation solutions that are appropriate and affordable in the local context and fit for avoiding or reducing health risks through exposure to wastewater and excreta. There is no one uniform blueprint sanitation planning procedure to follow; rather, it is important to consider, inter alia, the following aspects and principles.

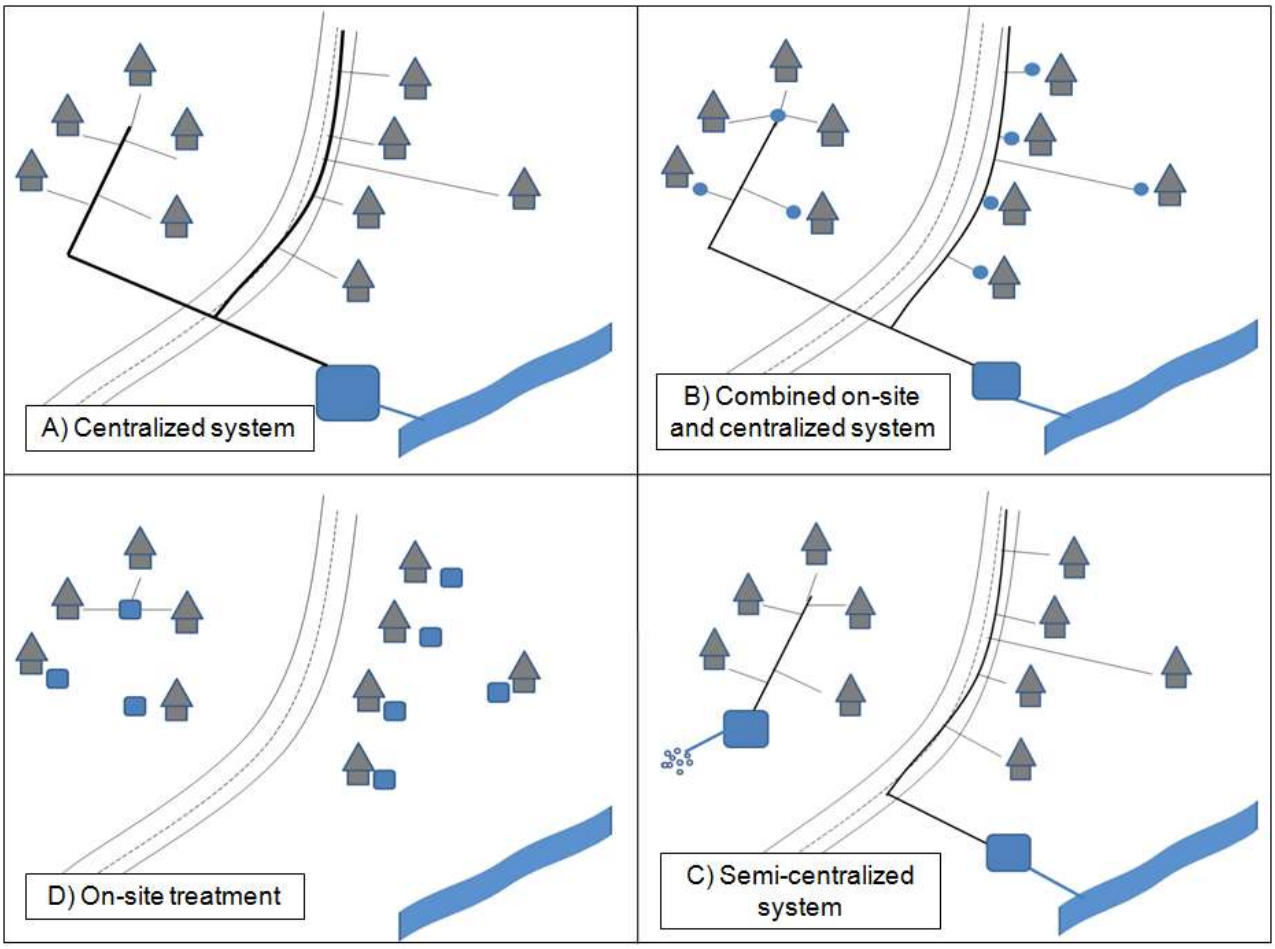
- Integrated sanitation systems: any sanitation solution should take into account the full sanitation service delivery chain from household-level facilities; safe containment, collection and transport; onsite or offsite (centralized) treatment; and safe disposal and/or reuse of wastewater and human waste.
- Siting of sanitation systems: for local sanitation solutions the space required needs to be considered, as well as suitable siting in order not to influence, for example, downstream drinking-water abstraction through upstream wastewater discharges and/or reuse practices. Siting, including in relation to downstream uses, will also inform needs for wastewater treatment levels to reach established quality standards for wastewater discharge.
- A focus on service: any sanitation strategy should aim for improved service levels and not be limited to specific types of technology. Service providers and/or communities need to adopt the most cost-effective and appropriate technologies to achieve the defined service levels. When assessing the feasibility of specific sanitation solutions it is important to consider:
    - available sanitation technologies;
    - population densities in rural areas;
    - water supply patterns and expected changes thereof (for example, piped water at premises affecting the quantity of generated wastewater and thus disposal solutions);
    - capacities of local and regional authorities to provide technical support and advice;
    - sociocultural factors (such as users' acceptance of technologies).
- Affordable and financially viable services: funds should be available to cover the ongoing operation and maintenance costs of the sanitation infrastructure. All small-scale sanitation systems should aim for sustainable cost recovery to cover operations and regular maintenance (see section 4.5 on costing and financing).
- A demand-responsive approach: building a partnership of trust between local or district authorities and communities, involving all relevant stakeholders, is vital for developing

sustainable sanitation solutions. Decisions on priorities for action should be based not only on data on the level of existing services but also on the demand for better services, as expressed by the community or municipality, and the inhabitants' willingness and ability to make own contributions to maintaining the services.

Available sanitation planning tools are often tailored to urban systems. Their principles may, however, be applied to the rural context if tailored to the respective conditions. Examples of such tools include the guidance for community-led urban environmental sanitation planning, which presents comprehensive guidelines for the planning and implementation of environmental sanitation infrastructure and services *(160)*, and Sanitation 21, which presents a five-stage planning framework considering a wider range of aspects related to sanitation planning *(161)*.

For the best results, sanitation planning should be integrated with regional planning. To understand the existing context and define priorities it is useful to map relevant information about existing systems and services along the entire sanitation service delivery chain at the district, municipal or catchment area levels. In rural areas sanitation services typically comprise different scales of operation: collective solutions with a centralized sewerage network and offsite treatment facilities; decentralized or onsite solutions with either onsite or offsite treatment; or a combination thereof (see Fig. 4). The optimal scale for water supply may not be the same as for sanitation, and it is important for policy-makers to support identification of suitable and affordable local sanitation solutions by providing information to inform this decision-making process.

Fig. 4. Options for sanitation and wastewater collection and treatment systems



Source: Wendland & Albold *(162)*.

In many countries in the WHO European Region local government bodies are responsible for providing water and sanitation services. Nonetheless, policy-makers at the national level can facilitate proper planning and implementation of effective solutions for rural sanitation by:

- developing enabling and coherent national strategies, legislation, regulations and standards that support locally appropriate choices about technologies and scales of operation to sustain reliable, effective and affordable services in rural areas (see Case study 33 from Slovenia, which provides an example of a national sanitation strategy that specifically addresses small-scale systems);
- making institutional arrangements with clear roles, responsibilities and capacities to support rural sanitation services effectively, including those for involving and cooperating with concerned stakeholders from private and civil society organizations (such as NGOs and universities) or for allowing arrangements where the obligation to construct, operate and maintain onsite systems is conferred on a special service institution (see, for example, Case study 25 from France);
- providing central budget transfers or subsidies for local government bodies to implement adequate infrastructure (see section 4.5 on costing and financing);
- improving tariff-setting procedures that allow different tariff structures – such as for poor rural areas – and ensuring proper operation and maintenance (see Case study 15 from Belgium);
- making the information necessary to plan and operate small-scale sanitation systems available, including to citizens about possible onsite sanitation solutions (see Case study 34 from Germany) and staff of local and other subnational agencies on available decentralized sanitation technologies, the overall design and scale of sanitation solutions and proven service and financial models;
- supporting local experts through training and coaching on construction, operation, maintenance and management of sanitation systems (see section 4.6 on education, qualification and training).

Case study 33. National and local planning of small-scale wastewater treatment in Slovenia

In Slovenia 98% of settlements have fewer than 2000 inhabitants; these small settlements represent 51% of the total national population. The hilly and mountainous landscape, high settlement dispersion and low population density render the conditions for wastewater collection and centralized treatment unfavourable. Onsite and semi-centralized systems have therefore been selected in many cases as more appropriate solutions from financial, operational and ecological perspectives.

On the basis of Council Directive 91/271/EEC on urban wastewater treatment *(57)*, Slovenia adopted a national programme on the collection and treatment of urban wastewater, which defines guidelines and timelines for the period 2005–2017. Although the Directive refers to agglomerations with more than 2000 inhabitants, the Slovenian programme also covers smaller settlements.

As a first step, sanitation zoning was carried out and agglomerations were mapped for each municipality. An agglomeration in this context is a settlement or concise part thereof with more than 50 PEs and a density of more than 10 PEs per hectare; 80% of the Slovenian population lives in such agglomerations, which are equipped with public sewers. Settlements and individual houses that are not included in agglomerations need to be provided with private onsite wastewater collection and treatment facilities within defined timelines. Deadlines for the establishment of wastewater collection and treatment and discharge limits are defined according to settlement size, population density, catchment area and the specific treatment demands for special areas (such as water protection areas, areas sensitive due to eutrophication and water bodies used for recreation).

Additional programmes and activities have emerged at the regional and local levels. Regional development agencies, municipalities and companies offering wastewater treatment plants have begun to promote onsite and semi-centralized wastewater treatment, including special information campaigns and demonstration wastewater treatment plants for up to 50 PEs.

Despite the engagement of regional development agencies and some local decision-makers, the main problem in reaching the set deadlines for wastewater collection and treatment is the lack of appropriate funding. Treatment plants for individual households and buildings not included in agglomerations are financed by private owners, while those for agglomerations are financed by municipalities. Some municipalities have adopted programmes to co-finance onsite wastewater treatment plants for individual households in remote areas; these encourage the owners to arrange wastewater treatment before the legislation deadline.

Case study 34. Demonstration Centre for Decentralized Wastewater Treatment, Germany

In 2002 the Bildungs- und Demonstrationszentrum für Dezentrale Abwasserbehandlung e.V. (Demonstration Centre for Decentralized Wastewater Treatment – BDZ) was established with partners from administration, research and industry to support decentralized wastewater management. BDZ offers an independent service at the national and international levels composed of three main elements: a demonstration site; education and training; and research and development. The work is financed by membership fees, funding and participation fees from seminars and conferences.

On a converted former wastewater treatment plant, members of the BDZ have installed various decentralized and onsite treatment technologies that can be seen in operation running with municipal wastewater, demonstrating 10 different processes and 38 plants. The general public, representatives of local governments, stakeholders and technicians can find out more about the designs, application range and maintenance of the different systems. Approximately 1500 visitors visit BDZ every year.

The foremost purpose of BDZ is to raise awareness and to inform households about onsite treatment options. Citizens living in areas without collective wastewater systems, who need to invest in and operate their own certified onsite treatment systems, can get an impression at BDZ of different technical solutions and use this information as the basis of a choice that best fits their requirements. They can also see an overview of the different companies providing services for the installation and maintenance of the onsite system.

Centralized sanitation services and infrastructures typically bear high capital expenditure, operational and maintenance costs and require specialized operators. As a result, such systems are not always feasible in rural areas and small towns, and alternative solutions may be required. Sanitation solutions such as dry toilets with urine separation or constructed wetlands may provide viable, low-cost alternatives in many local contexts. Overviews of the variety of systems and technologies are available (see Bodík & Ridderstolpe *(163)*; EC *(66)*; Tilley et al. *(89)*). Evidence has shown, however, that a lack of knowledge and experience of such innovative solutions hampers their acceptance and introduction. Further, national regulations and technical standards may restrain the application of alternative solutions. Local demands need to be considered to ensure that alternative sanitation technologies are accepted and properly utilized, and pilot projects play an important role in gathering experience in the local context. Case study 35 from Bosnia and Herzegovina shows how a bottom-up initiative and pilot project informed national policy-making. Case study 36 from the Republic of Moldova further illustrates how local projects inform national policy-making and amendment of regulations and norms to allow feasible sanitation solutions.

Case study 35. Piloting constructed wetlands in Bosnia and Herzegovina

Lake Modrac, next to the capital of Tuzla province, is an important drinking-water reservoir for the whole region. An artificial lake, it was created in 1964 with the purpose of securing the water needs of the region, but became polluted soon afterwards. Since 1999 the lake has been under environmental protection, with enforcement initiated by the Centre for Environment and Energy in Tuzla, a local NGO.

A pilot project of a constructed wetland was set up in a rural town outside Tuzla next to the lake – this would later serve as a reference project for multiplication. The rural context was chosen as many people in Bosnia and Herzegovina live in small villages and need easy-to-operate and no-input-needed small-scale wastewater treatment plants, such as a constructed wetland. The goal of the project was to raise awareness about wastewater treatment options and water conservation: it set out to present a real-life example of an eco-friendly alternative small-scale wastewater treatment plant. The mayor of the village, the province's environment ministry and a local women's association supported the project.

In a bottom-up approach, the project raised a lot of attention and received high media coverage; as a result, the environment ministry showed strong interest in replicating this kind of experience and the University of Tuzla started research activities in the field of environmental sanitation. A pilot project was needed to gather initial lessons, attract policy-makers and finally translate the results into adapted policies. Since the project raised awareness of the issue of rural sanitation, two wastewater treatment plants for 1500 and for 30 000 people have been built in the area. Several local stakeholders, including local authorities and representatives of two ministries, established a working group for the protection of Lake Modrac – this has become an expert board advising the government.

Case study 36. Ecological sanitation programme in rural areas of the Republic of Moldova

The absence of a formalized service provider is a typical situation in rural areas in the Republic of Moldova – public service providers for water and sanitation are mainly active in urban areas and in larger rural communities. When it comes to sanitation, a major issue is the lack of knowledge and experience of alternatives to sewerage systems. National experience has shown that sewerage is not a feasible sanitation solution in rural areas: they incur relatively high capital expenditure plus operational and maintenance costs, and local authorities frequently lack funding and technical and human resources. In addition, in many rural settlements there are insufficient amounts of water to create the sheer forces needed in a sewer. As a consequence, poorly constructed pit latrines and septic tanks with soak pits are widely used sanitation systems in rural areas of the Republic of Moldova.

An ecological sanitation programme was initiated among multiple donors and organizations to support the Republic of Moldova in implementing sustainable sanitation solutions in rural villages. Within this programme, the ApaSan project, in close collaboration with the National Centre of Public Health and local authorities, supported the construction of dry toilets with urine separation (also called Ecosan toilets) in schools, mayors' offices and households. ApaSan is a project ongoing until 2019 and supported by Switzerland and Austria *(164)*.

Ecological sanitation systems have been implemented in over 50 schools since 2007. The technology was first received with scepticism, but after extensive awareness-raising, training, site visits to existing ecological sanitation systems in other countries and pilot plants organized by several local NGOs and WECF, consumers and decision-makers were quick to notice that these toilets are more comfortable to use than the old unhygienic and uncomfortable latrines.

These good experiences at the local level have also informed national policy-making. The government is amending its regulation on school sanitation and construction norms on wastewater treatment to refer to a code of practice on ecological sanitation systems, which is also under development. In 2014, the Ministry of Health facilitated the use of dry toilets with urine separation by adopting provisional requirements on the use of human waste (urine and faeces) in agriculture.

School authorities at the district level work with ApaSan on the implementation of Ecosan toilets in schools by co-funding their construction. The authorities mobilize resources at the local level and the contribution covers up to 50% of the total costs. Alongside the financial participation is an institutional incentive: the regional educational departments are involved in the selection and implementation process. The drivers of change include the comfort offered, the status of a school with improved sanitation facilities, concern for children's health and hygiene habits.

Sanitation planning can go beyond wastewater collection, treatment and discharge by also considering nutrient and water recycling, especially in water-stressed areas. In the face of water scarcity, competing demands for water and increasing demands for food, the safe reuse of wastewater and other sanitation waste increasingly becomes an appropriate option. Wastewater reuse may be substituted for freshwater withdrawals, for example, in irrigated agriculture and horticulture, in watering public parks and green spaces and in groundwater recharge.

While the reuse of wastewater in agriculture and horticulture has several benefits – such as the possibility of partial cost recovery of wastewater treatment through selling or better harvests through higher levels of nutrients – they must be weighed against the possible health risks. These may include higher exposure of the population to faecal pathogens; for example, farmers handling

treated or untreated wastewater and sewage sludge or community members consuming contaminated produce or drinking-water.

In countries where wastewater reuse is practiced, policies and legislation should make provision for its safe management to protect public health and the environment. These may be based on the WHO guidelines for the safe use of wastewater, excreta and greywater in agriculture, which provides an overview to regulators and policy-makers of the nature and scope of options for protecting public health *(67)*. Furthermore, the sanitation safety plan (SSP) approach assists in the application of the guidelines and provides a practical risk-based management tool to help sanitation system operators minimize health risks from their system *(165)* (see section 5.3 on water and sanitation safety planning).

Case study 37 from Italy provides an example of a legislative framework for reuse. Case study 38 from Sweden illustrates the introduction of a framework for safe reuse through a certification system.

Case study 37. Wastewater reuse in agriculture in Italy

At the national level, two laws have been issued to regulate wastewater reuse practice in Italy: Legislative Decree 152/2006 (Environmental framework legislation) *(166)* and Environmental Ministry Decree 185/2003 *(167)*. The latter defines quality requirements for wastewater reuse according to three different categories of final use: agriculture, non-potable urban and industrial use. The different regional authorities have the right to make some water quality parameters stricter than those defined by the national laws.

Case study 38. Certification system for reuse in Sweden

Sweden has introduced an optional certification system for quality assurance of the wastewater fraction blackwater (wastewater containing excreta, as opposed to greywater, which is waste from washing and similar) from small-scale onsite sewage systems serving up to 50 PEs and the wastewater fraction of human urine collected in urine-diverting toilets as approved fertilizer *(168)*. The system was introduced in 2012 under an initiative led by the Swedish Federation of Farmers, JTI – Swedish Institute of Agricultural and Environmental Engineering, Telge Nät (a utility) and SP Technical Research Institute of Sweden.

SP Technical Research Institute acts as the certification body: it has created certification rule SPCR 178 *(169)*, which contains quality requirements for certified reuse on agricultural land of plant nutrient-rich fractions from onsite sewage systems. The basic requirements are that the fractions should be "hygienically safe" and "valuable as fertilizer". For urine from urine-diverting toilets, for example, the certification rule stipulates requirements such as storage time, temperature conditions and specific applications to ensure safe reuse. For wastewater fractions, several treatment methods are specified, as are the limits that need to be achieved for each parameter. After treatment according to the specified methods, the wastewater can be used for the cultivation of cereals, oilseeds, sugar beets and potatoes for starch production.

The certification rule also contains requirements for continuous control of quality assurance for both urine and wastewater fractions. This consists of self-inspection by the fraction producer and supervising inspection by the certification body. The self-inspection includes, among others, testing of the end-product; the certification body's supervising inspection is done at the treatment facility and includes consideration of the producer's self-inspection results.

The certification systems allows Swedish farmers to sell agricultural products that have been produced with safe urine and blackwater on the Swedish market, as certified urine and blackwater are approved as biological fertilizers for food and fodder production.

5.3. Water and sanitation safety planning

The WSP approach is recommended by the WHO guidelines for drinking-water quality *(68)* as the most effective means of ensuring the safety of water supplies, addressing the entire supply chain from catchment to the point of consumption. The WSP approach is suitable for all sizes of system and levels of development.

Water safety planning is a proactive process at the level of a water supply system. It focuses on the identification of locally relevant hazards and hazardous events, and the assessment and continuous management of risks to keep drinking-water safe. Needs for improvement and upgrade are prioritized based on the risk assessment (see Fig. 5). While WSPs for small-scale systems will typically be less complex than those for larger utilities, the underlying principles are the same. WHO provides detailed guidance on the steps of WSP implementation in small-scale systems, including guides to applying the WSP approach to community-managed supplies and offering templates in a simple "cookbook" style *(170, 171)*.

Fig. 5. The six tasks to develop and implement a WSP

Source: WHO *(170)*.

The introduction of the WSP approach for small-scale water supplies is associated with a range of benefits resulting in improved water quality and reliability, and eventually in reduced risks to health. Initial scientific evidence has shown reduced incidence of diarrhoeal diseases following WSP implementation *(42)*, as illustrated by Case study 39 from Iceland. Further benefits for small-scale systems include the following *(170–172)*.

- WSPs lead to improved understanding of the water supply system and prevailing risks among operators; they foster better management, particularly through improving operation, maintenance and monitoring procedures.
- WSPs stimulate continuous improvement and are a good basis for decision-making: areas that need the most urgent attention are identified, thereby enabling better targeting of resources and investment. WSPs can also be used for attracting and prioritizing financial support for improvements and upgrades, showing due diligence in identifying the financial requirements.
- WSPs bring together local stakeholders – both those already involved in the water supply and external stakeholders – and improve cooperation.
- WSPs support surveillance authorities in setting priorities for the selection of the most relevant parameters for water quality monitoring and/or systems in rural areas that require attention and support (see also section 4.4 on surveillance).

Case study 39. Health and water quality benefits resulting from WSPs in Iceland

- In 2013 over 80% of the population in Iceland received their drinking-water from utilities with a WSP. This relates to 31 towns, of which 23 have fewer than 5000 inhabitants. Once introduced as a mandatory requirement through new legislation in 1995 *(173)*, the WSP approach was initiated within large and small utilities alike. The requirements for its implementation range from full WSPs for water supplies serving more than 5000 inhabitants to sanitary checklists for supplies serving 100–500 inhabitants or serving food processing activities. Specific WSP guidelines for small utilities were developed in 2004.
- Research in Iceland revealed that the introduction of WSPs resulted in substantial and measurable reductions in drinking-water noncompliance and that a population serviced by water supplies under a WSP is 14% less likely to develop clinical cases of diarrhoea *(42)*.
- Early in 1998 three small towns in southern Iceland (with populations of 1600, 2000 and 7000) started to work jointly on the implementation of a WSP. The whole process was beneficial for the three communities: health data showed that the incidence of diarrhoea decreased significantly following the implementation of the WSP in two of the towns: from 6 to 1 and from 12 to 2.6 incidences per month per 1000 inhabitants. In the third town it was not possible to correlate the water service area with public health data as the town's health care system also serves a large neighbouring rural area. In this town, however, water quality improved: mean annual noncompliance with the Icelandic drinking-water regulation *(174)* fell from 5% during 1999–2006 to 0% during 2007–2009 *(42)*.

Typical stages of a step-wise approach to embracing and supporting the WSP approach at the national level are described in the WHO roadmap document *Think big, start small, scale up: a road map to support country-level implementation of water safety plans (175)*. National strategies to support uptake and scale-up of WSPs in small-scale systems include, among others:

- requiring WSP application in policy and regulatory instruments that consider the specifics and feasibility in a small-scale system context (see Box 16 and Case study 40 from Scotland);
- financing and supporting the implementation of pilot projects to attain evidence of the added value, success factors and challenges in the national context and resources required for scaling up this approach in small-scale supplies (see Case study 41 from Tajikistan);
- encouraging WSP application by sharing information on WSPs, their benefits and success stories – for example, at advocacy and capacity-building workshops and through publications – to inspire uptake;
- establishing ongoing support mechanisms, including:
    - nationally adapted WSP guidance documents, tools and templates in local languages (see Box 17);
    - training programmes for WSP facilitators with necessary skills and experience in water supply, drinking-water quality, sanitation and hygiene who can advise and support local operators and communities in WSP development and implementation (see Case study 41 from Tajikistan);
    - mechanisms providing financial support for implementing improvements identified within the WSP process;
- establishing programmes and tools for WSP auditing that are tailored to the needs of small-scale systems, including improving the capacity of local health office staff to provide external support and audit WSP implementation (see WHO's guidance on WSP auditing requirements for small-scale systems *(176)*).

Box 16. Framework for action for the management of small drinking-water supplies

The EC's Framework for Action for the management of small drinking-water supplies *(49)* identifies four key components to be formalized through legislation to enable the successful introduction of a risk-based approach to small-scale water supplies. These are:

- the duty to keep and maintain a register of water supplies so that Member States know the location, type and ownership of every small-scale water supply;
- the duty to define and record certain information in the register;
- the duty to carry out a risk assessment to improve effective decision-making;
- national reporting on small-scale systems to increase the information basis and transparency.

In preparing for national scale-up strategies, it is paramount that an enabling environment is created and that local support for operators of small-scale water supply systems is available to ensure efficient WSP implementation and compliance. An example of how the implementation of national WSP legislation was supported by local environmental health staff is provided in Case study 40 from Scotland.

Case study 40. Creating an enabling environment for WSP legislation in Scotland

In Scotland 5% of the population receive their drinking-water from about 20 000 private water supplies (small community supplies). Updated legislation for private water supplies came into force in 2006 *(107)*, introducing a legal requirement for WSPs of risk assessment of all Type A supplies (those providing water for larger numbers of domestic properties, as well as businesses and public buildings such as hotels and food producers) and an annual review of these risk assessments. The assessments are carried out by environmental health staff based in local authorities across the country, while WSPs are developed by those with responsibility for operating or managing the Type A supplies, with the support of environmental health staff. Training and guidance material was provided by the Scottish Government to both environmental health staff and owners; ongoing support is provided by the Scottish Government and the Drinking-water Quality Regulator for Scotland. If owners or users of Type B supplies (individual supplies for domestic properties) request a risk assessment, local authorities are also obliged to provide assistance. Experience in Scotland has shown that professional input, support and time from agencies are required to deliver an effective WSP, review it and keep it up to date.

Case study 41 from Tajikistan shows how practical implementation can be stimulated by encouraging and supporting pilot projects, developing nationally adapted guidance and training materials in local languages and building pools of trained facilitators who can support the development of WSPs for small-scale systems. Further examples of national WSP tools are given in Box 17.

Case study 41. Pilot projects, facilitator training and tools for WSP implementation in Tajikistan

In Tajikistan the WSP approach was implemented in pilot projects in two districts (Panjakent – Navobod village and Hamadoni – Qaragoch village). The purpose of the pilots was to gain first-hand experience with WSPs and evaluate their feasibility in the Tajik context.

A number of local community leaders and representatives of district health offices from different Tajik regions were trained as facilitators to assist with implementing community WSPs in local water supplies, conducting sanitary inspections of the water supplies and their vicinity, raising awareness and educating community members on drinking-water quality and general hygiene issues. Short-term improvements included quick one-off infrastructure fixes, improved monitoring, inspection and maintenance procedures and increased community awareness. The population's confidence in the water supply and its management increased and appreciation of the improvements achieved resulted in an increased willingness to pay water fees. The WSP was also used to leverage external financial support by demonstrating a proactive approach.

Based on the pilot project experiences, a field guide on WSPs was developed in the Tajik language for dissemination through local health offices in order to facilitate broader application of the WSP approach throughout the country, particularly for small-scale water supplies *(177)*. The field guide gives background information on water safety planning, presents the outcomes of the pilot studies to demonstrate that the approach "works next door", and provides templates to facilitate practical development and implementation of WSP.

After the project's completion, the WSP approach was reflected in Oxfam's water programme. In August 2014 Oxfam organized a high-level workshop on WSPs in Tajikistan to increase awareness and support among national stakeholders, international organizations and NGOs. Its aim was build appreciation of the value of the WSP approach and to support development of a longer-term vision and national roadmap towards WSP scale-up in the country.

Box 17. National WSP tools adapted for small-scale systems

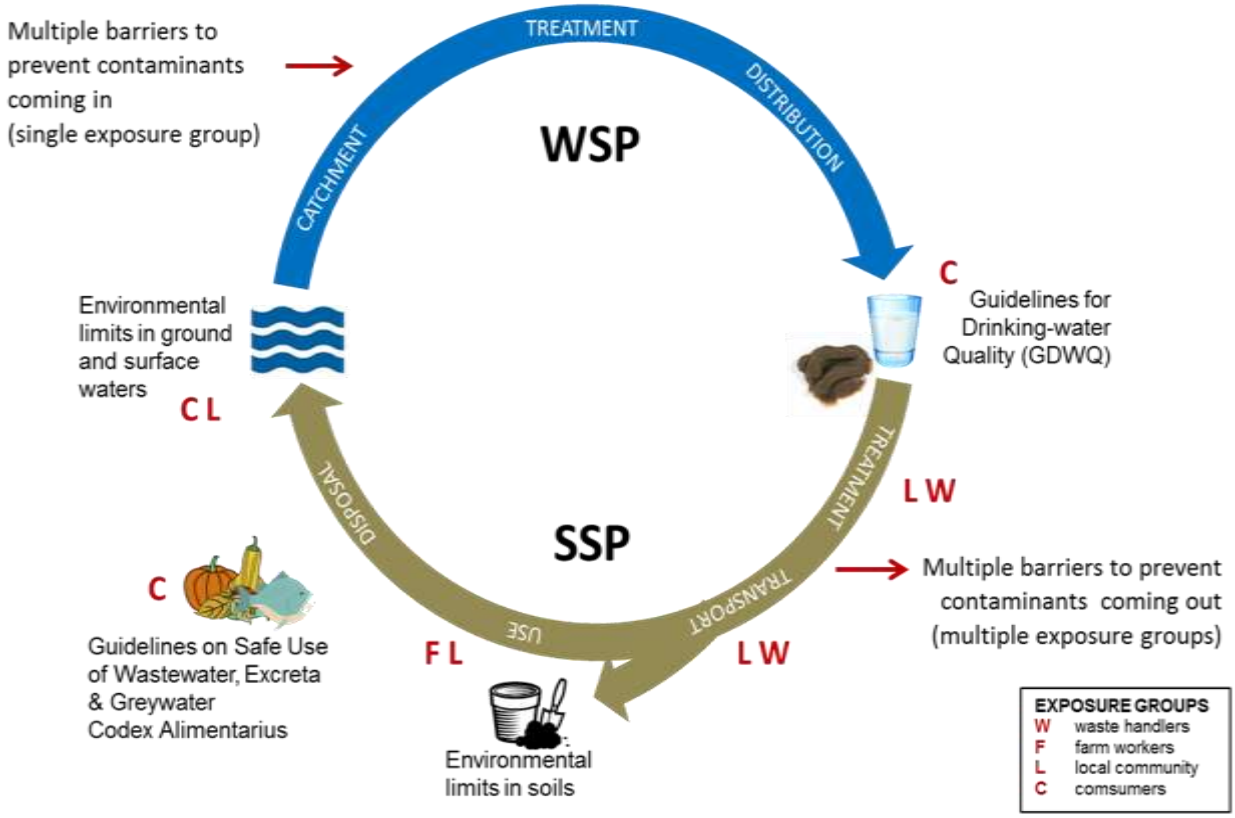
- Austria: the Austrian Association for Gas and Water published guidance for implementation of a simple WSP in 2008 *(90)*. The guidance document includes step-by-step working instructions, illustrative examples and templates to support operators of small-scale systems in developing WSPs.
- Finland: the Finnish Ministry of Health launched a web-based WSP tool in 2015 to guide water supply operators through the WSP process. The tool also integrates sanitation aspects in the application. It is complemented by a hands-on Excel-based version, which is specifically targeted at operators of small-scale suppliers *(178)*.
- Germany: the German Environment Agency and the Water Technology Centre published a manual for implementation of the WSP approach in small-scale water supplies in Germany in 2014, which complements DVGW's technical rule on WSPs with practical explanations, recommendations, examples and supporting tools *(179)*.
- Iceland: the Association of Icelandic Waterworks (Samorka) has developed a five-step guidance tool for small water utilities. The guide was first published in 2004 and updated in 2009; it provides a simplified WSP framework while including all critical WSP elements such as risk assessment and management *(180)*.
- Ireland: the Irish EPA launched an online tool in 2014 to support water supply and local authority staff in the completion of WSPs in both large and small-scale systems *(181)*.
- Switzerland: SVGW published Regulation W 1002, which offers recommendations for a simple quality assurance system for water supplies, based on WSP principles and against which small utilities can be certified by SVGW *(91)*.
- United Kingdom: the Scottish Executive's technical manual for private water supplies *(99)* includes guidance and case studies on how to perform a risk assessment. In England and Wales in 2014 the Drinking Water Inspectorate issued tools to assist local authorities undertaking risk assessments of private water supplies according to Regulations 8, 9 and 10. The tools can also be used for supplies to single domestic dwellings *(182)*.
- WECF: the NGO published its water and sanitation safety plan compendium for small communities in 2014 *(183)*. This integrates sanitation aspects into its WSP methodology for small-scale water supplies. The compendium aims both to assist users to develop a step-by-step water and sanitation safety plan for their community and to support training. It has particular emphasis on involving schools in developing such plans *(128)* (see also Case study 20). The tool is available in English, Macedonian, Romanian and Russian.

SSPs are, like WSPs, based on preventive risk assessment and management principles. WSPs provide a systematic approach to assessing, managing and monitoring risks from catchments to drinking-water consumers. Similarly, SSPs apply the approach from the point of sanitation waste generation to the waste's release to the environment through final use and/or disposal. For example, in the case of reuse/recycled waste in agriculture for food production, the SSP goes "from toilet to farm to table". The SSP approach aims to eliminate or reduce adverse health effects from the use of wastewater, excreta and greywater, addressing sanitation-related exposures among waste handlers, farm workers, local communities and consumers, including the potential for sanitation facilities and human waste handling and reuse practices to contaminate sources of drinking-water.

SSPs are intended to complement WSPs by closing the loop from sanitation waste generation, through safe treatment, transport, use and/or disposal, to the protection of source waters used for drinking-water production (see Fig. 6), leading to holistic risk assessment and management. There are, however, notable differences in the two approaches. SSPs are typically applied in a less defined

regulatory environment, have multiple objectives, involve more stakeholders and address risks to multiple exposure groups *(165)*.

Fig. 6. SSPs and WSPs in the water cycle



The development of an enabling environment for SSPs, including the integration of risk assessment and management approaches in the national policy framework, will have many similarities to those outlined above for WSPs. Given the strong intersectoral nature of sanitation and resource recovery and reuse operations, the process requires careful policy attention to achieve sector-wide endorsement and intersectoral cooperation.

The WHO guidance document *Sanitation safety planning: manual for safe use and disposal of wastewater, greywater and excreta (165)* provides step-by-step details on how to develop SSPs. The SSP approach has been piloted in several countries – Case study 42 showcases the benefits experienced from implementing it in Portugal.

Case study 42. Combining WSPs and SSPs in the Portuguese town of Benavente

The water supply for the Portuguese town of Benavente (population 9570) is managed by Águas do Ribatejo. Having completed a WSP for its water sources and catchments, Águas do Ribatejo agreed to develop a complementary SSP. The pilot project was to develop a full understanding of the risks to the water sources from all sanitation activities, including storm water collection, septic tanks, treated sewage sludge handling and farming. The project aimed to develop the SSP for the wastewater drainage and treatment system, with the main objectives of safeguarding human health, promoting the safety of workers and users and enhancing environmental protection. It also aimed to promote national discussion on how SSPs could be developed and implemented in Portugal. It complemented a target set under Portugal's Strategic Plan for Water Supply and Sanitation for 2007–2013 (PEAASAR II), now being replaced by PENSAAR 2020, to reuse ≥10% of treated wastewater and promote the use of sludge in agriculture.

To undertake the project a multistakeholder team was formed, composed of those who could affect or be affected by activities in relation to the sanitation system and those who could be involved in the implementation of risk reduction measures and provide input or support to the successful completion of the project. The team comprised ERSAR, environmental authorities, agriculture authorities, the catchment authority, the health authority, Benavente municipality, waste businesses, the farmers' association, the water sector association, civil protection and emergency response services and research partners.

One of the major achievements of the project was to bring together national representatives of several stakeholders with the potential to promote and coordinate SSPs and to help Portugal meet the goals of PENSAAR 2020. The benefits of SSPs reported by the various stakeholders included:

- safeguarding human health and promoting the safety of workers and users;
- enhancing environmental protection;
- assessing and managing risks in a holistic manner;
- establishing mitigation plans and identifying ways to improve the quality of service provided in a cost-effective and sustainable way, thus increasing the robustness of the whole water and wastewater service;
- promoting the efficient use of water and management of sludge produced in water treatment plants, and minimizing the contamination of land and water courses while safeguarding the quality of food produced;
- focusing investment;
- promoting integrated management of water resources.

Source: Based on Martinho C, Mendes R, Smith S. Sanitation safety planning: Benavente's case study (Portugal) [unpublished report for acquawise], 2014.

To protect health effectively it is beneficial to take an integrated approach to drinking-water, sanitation and hygiene at the community level, as systems and behaviours are more interlinked at a small scale. For small-scale water supply systems it is indispensable to address sanitation and hygiene aspects in WSPs, especially in the assessment of risks related to drinking-water quality. Awareness-raising campaigns and educational programmes addressing safe water, sanitation and hygiene practices (see Box 14) generally play an important role when developing WSPs for small-scale systems. They may foster an understanding of the connection between drinking-water quality, safe disposal or use of sanitation waste and good hygiene behaviours, their relation to health in the community and the need for safely managed water and sanitation systems.

Developing complementary WSPs and SSPs seems to be an appropriate option, although evidence on how to integrate the approaches at the community level is currently limited. The holistic approach of drinking-water, sanitation and hygiene safety plans has recently been tested in a limited number of locations *(184, 185)* to protect public health through the integrated assessment and management of risks to improve safe water supply, adequate sanitation and good hygiene practices.

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