International Journal of Hygiene and Environmental Health 222 (2019) 615–627

Contents lists available at ScienceDirect

International Journal of Hygiene and Environmental Health

journal homepage: www.elsevier.com/locate/ijheh

Capacity building and training approaches for water safety plans: A comprehensive literature review

Giuliana Ferrero[a,*], Karen Setty[b,1], Bettina Rickert[c,1], Shannan George[b], Angella Rinehold[d], Jennifer DeFrance[d], Jamie Bartram[b]

[a] IHE Delft Institute for Water Education, Westvest 7, 2611, AX, Delft, the Netherlands
[b] The Water Institute, Department of Environmental Sciences and Engineering, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, Chapel Hill, NC, USA
[c] German Environment Agency, Schichauweg 58, 12307, Berlin, Germany
[d] Department of Public Health, Environmental and Social Determinants of Health, World Health Organization, Geneva, Switzerland

ARTICLE INFO

Keywords:
Capacity building
Training
Water safety plans
Drinking-water
Water supply

ABSTRACT

The World Health Organization has recommended Water Safety Plans (WSPs), a holistic risk assessment and risk management approach, for drinking-water suppliers across low-, middle- and high-income countries, since publishing its 2004 Guidelines for Drinking-Water Quality. While rapid WSP adoption has occurred, capacity is still catching up to implementation needs. Many countries and regions lack case examples, legal requirements, and training resources for WSPs, corresponding to widespread capacity shortfall in the water supply sector. We undertook a comprehensive review of the literature on capacity building and training for WSPs, with the goal of providing recommendations for multiple stakeholder groups at the scales of individual utilities, national governments, and intermediate units of governance. We propose a WSP training taxonomy and discuss it in relation to the stages of learning (introduction, practice, and reinforcement); describe the importance of customizing training to the target group, local language and circumstances; highlight the relevance of auditing for evaluating change over time; and call for robust methods to monitor WSP capacity development.

1. Introduction

Water Safety Plans (WSPs) are a comprehensive risk assessment and risk management approach that encompass all steps in water supply from catchment to consumers. Their goal is ensuring safe drinking-water (WHO, 2017a). Since the 2004 recommendation of WSPs within the World Health Organization (WHO) Guidelines for Drinking-Water Quality and the International Water Association (IWA) Bonn Charter, numerous guidance documents and support tools have been developed, and WSP implementation has risen sharply. WSPs have been implemented at different scales in at least 93 countries (WHO, 2017b). The uptake of WSPs is both driven and constrained by an enabling environment composed of regulations, guidelines, tools, resources, public health support, and context-specific evidence of the feasibility and benefits of WSPs (Baum and Bartram, 2018).

At the global level, Sustainable Development Goal (SDG) 6 (UN, 2015) reflects the relevance of water safety on the international agenda. SDG target 6.1 concerns achieving equitable and universal access to safe drinking water by 2030, and the related indicator (6.1.1) is the percentage of population using “safely managed” water supplies. To monitor this, data must be collected on whether water sources are improved, accessible on premises, available when needed, and free from contamination. Though the target wording aligns with the WSP process, indicator 6.1.1 does not explicitly consider whether a WSP is in place. Target 6.a of the SDGs calls for expanding international cooperation and capacity building support to developing countries (UN, 2015). Target 6.b focuses on “local communities” and their participation in improving water and sanitation management. While it acknowledges, supports and strengthens the involvement of local decision makers, this target has been challenged as it addresses neither the right to information nor the roles of users in decision-making (Bartram et al., 2018).

The rapidity and extent of WSP implementation is in part attributable to the capacity development efforts of numerous multilateral organizations, governments, non-governmental organizations (NGOs), universities, and water practitioners. Capacity is the ability to “perform

* Corresponding author.
E-mail address: g.ferrero@un-ihe.org (G. Ferrero).
[1] These authors contributed equally.

https://doi.org/10.1016/j.ijheh.2019.01.011
Received 26 November 2018; Received in revised form 22 January 2019; Accepted 31 January 2019

functions, solve problems, and achieve objectives" (UNDP, 2010). It is a multi-dimensional concept, encompassing financial, human resources, institutional, socio-political, and technical issues (Lebel and Reed, 2010). Capacity is essential for effectively responding to current global economic, environmental and social development challenges, including achieving the SDGs. In contrast, insufficient capacity limits water resources development and management, including water-related risk management, across most developing countries (UN, 2018). This shortfall may slow WSP scale-up, limit effectiveness, and threaten sustainability.

The Delft Declaration (IHE Delft and UNDP, 1991) defined the three elements of capacity building in the water sector as (a) the creation of an enabling environment with appropriate policy and legal frameworks; (b) institutional development, including community participation; and (c) human resources development and strengthening of managerial systems. In relation to policy and legal frameworks, the WHO classifies national WSP policy progress by countries as "WSP policies or regulations formally approved, WSP policies or regulations under development, WSP policies or regulations anticipated, or no WSP policies or regulations" (WHO, 2017b). The global status report on WSPs suggests strong political support, with policy or regulatory instruments in place or under development in 69 countries to promote or require WSPs (WHO, 2017b).

In relation to institutional development, the UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS) provides data on investments in water, sanitation and hygiene (WaSH). The latest GLAAS report shows that official development assistance for water sector policy and administrative management increased by more than 30% between 2010 and 2015 (885 million vs. 1.164 billion US dollars), whereas it declined by 18% (50 vs. 41 million US dollars) for education and training in water supply and sanitation during the same period (WHO, 2017c). Financing safe and sustainable services is challenging, with 70% of countries indicating insufficient financing for continuous operation and management (WHO, 2014a). While engagement and contribution of the community to WSP development is crucial for community water supplies (WHO, 2012a), less information is available on the status of community participation in WSPs across all water supply institutions (WHO, 2017b).

In relation to human resources development, insufficient staffing constrains the water sector, especially in rural areas (WHO, 2014a). Only one-third of countries participating in the GLAAS survey have comprehensive human resource strategies in place for WaSH (WHO, 2014a), and some countries report that insufficient qualified human resources and staff retention issues preclude them from spending donor funds to achieve WaSH goals (WHO, 2017c). IWA (2014) highlighted low levels of access to, and inadequate coverage of, courses in tertiary education institutes, and that education and skill development requirements for operating and maintaining specific technologies have not been appropriately assessed.

The relevance of capacity building for WSPs is reflected in the Reykjavik Principles (WHO, 2006), which outline the general requirements for ongoing sustainability of local water supplies in small systems. Numerous publications comment on the importance of capacity development to sustain and accelerate WSP implementation and spread (Gunnarsdottir et al., 2012; Magtibay and Chong, 2011; Parker and Summerill, 2013; Rinehold et al., 2011; Ringwood, 2017; String and Lantagne, 2016; Vieira, 2011; WHO, 2014b, 2017a, 2017b).

In this study, we reflect on lessons learned from 15 years of WSP capacity development. This is the first study to collate and analyze information on approaches to capacity development for WSPs. The goal is to provide recommendations for water practitioners, policy makers, international agencies, and donors on the most appropriate ways for improving and scaling-up capacity development and training initiatives. We assess gaps and determine which approaches have proven most successful. This paper begins with reflection on stakeholders and capacities specific to WSPs, the enabling environment, and stages of WSP scale-up. It then takes a deep dive into training, exploring types of training, teaching strategies, stages of learning, and ways of measuring changes in training capacity. Lastly, it considers ways of tracking and sustaining capacity building.

2. Methods

We adopted a systematic search approach to review scientific literature on WSP capacity building and training. Searches were conducted between 20 March 2018 and 27 June 2018 on the following databases: Scopus, PubMed, Web of Science, and Articles+. Grey literature as well as peer reviewed articles were identified using a Google Scholar search limited to the first 200 results. The search terms used were: 'drinking water' AND 'capacity building' OR 'capacity development' OR training* (in the article) AND 'water safety plan*' OR 'risk management' OR 'safety plan*' AND 'drinking water' (in the title). Inclusion criteria were that the article either mentioned or critically discussed capacity building in relation to WSPs and was written in English. Additional documents came from expert consultation and the authors' own libraries.

The original searches yielded 377 results, reduced to 283 documents after removing duplicates (Fig. 1). These documents were screened by searching the full text for the words 'capacity', 'training' and 'water safety plans,' excluding 213 that lacked this language. Thus, 70 documents were identified via searches or author submissions, and five were added following backward citation checks. Closer review excluded 18 topically distant documents, such that 57 articles were used in the final narrative synthesis (listed in Table S1 in supplementary information).

3. Results and discussion

The majority of included articles were peer-reviewed scientific publications (n = 37) and the rest were grey literature (n = 20). About 38% of the scientific publications and 65% of the grey literature sources critically reviewed different components of capacity building and/or training on WSPs, while the remaining sources discussed these factors to a lesser degree. Regarding geographical setting, both peer-reviewed sources and grey literature covered high-income (44%) and low- and middle-income settings nearly equally. Most sources involved local or regional case studies. Eight of the sources were review papers, four were guidance manuals, two represented commentary, four were conference reports, and three were theses or dissertations. Source characteristics are summarized in Table 1, with detail in Table S1.

3.1. Stakeholder groups and capacities

A number of stakeholders and actors are interested or involved in producing safe drinking-water, and may be targeted by capacity building activities. They include persons who operate and maintain larger drinking-water supply facilities (operators) and smaller systems (caretakers), local health agencies, national public health and environmental authorities, auditors, consumers, civil society organizations (CSOs), multilateral organizations, consultants, and the research community. Depending on the setting, some groups are primary stakeholders, who play a role in or are directly affected by WSP implementation, while others are secondary stakeholders with an indirect interest. Because functions and responsibilities related to WSP implementation are diverse, the capacities required by each stakeholder group vary (Table 2).

Operators of drinking-water supply facilities are responsible for supplying safe water, and developing and implementing WSPs at the water supply level. The operator can be, for example, a public or private utility or local government employees or contractors with direct responsibility for operations and maintenance. Generally, training is provided for staff involved in WSPs, such as operational staff. However, the literature advises involving all categories of staff in the process

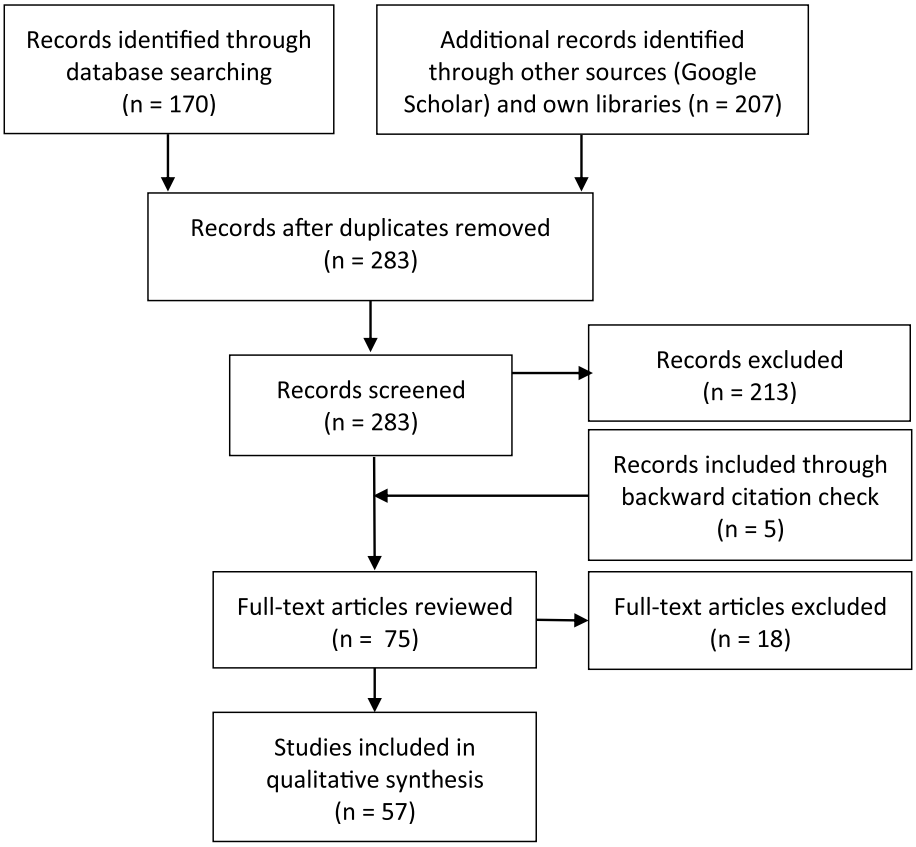

Fig. 1. Process of selecting studies to include in the review (adapted from Moher et al., 2009).

(Loret et al., 2016), including subcontractors as well as responsible executives or "champions" such as technical managers (Maelzer et al., 2010) and senior managers (Bartram et al., 2009). Rand Water in South Africa, where training on WSPs is provided to all staff, has discussed the relevance of providing training at all levels (Ringwood, 2017).

In rural water supply systems, community committees and caretakers are often responsible for WSP activities, and should be trained accordingly (Greaves and Simmons, 2011). Community-based water supplies in high-income as well as low- and middle-income countries share common limitations (Marks et al., 2018), such as limited access to skilled technicians. Most small rural water supplies are community-managed, the technologies used are typically simpler, and water treatment is rare (Mahmud et al., 2007). In different settings, responsibility for operating the rural water supply may also lie with a community chief, local authority, collaborative board, or small utility.

Local health agencies are typically responsible for independent surveillance of drinking-water supplies. They may act as regulators and directly audit WSPs. For small systems, they may also facilitate WSP implementation, as in the case of rural communities in the Pacific Islands (Hasan et al., 2011). Various publications recommend co-operation between operators and health authorities and encourage training of health officers in preventive risk management methodologies (Gunnarsdóttir, 2012; Gunnarsdottir et al., 2012; Aghaei et al., 2017). Other relevant functions of local health authorities include incident and outbreak investigation (Rehfuess et al., 2009).

Auditors provide systematic checks of WSPs completeness, implementation in practice, and effectiveness. Internal auditors are employed or contracted by the water supplier, whereas external auditors come from national or local government authorities (e.g., health agencies), private companies, or other stakeholder groups that are not employed or contracted by the water supplier. Where regulations are in place for WSPs, independent auditing provides a means to ensure that

Table 1
Summary of literature source characteristics.

Type of publication	Focus on capacity building and training on WSPs		Type of settings			
	Critically reviews	Only mentions	High- income	Low- and middle-income	All types	Not applicable
Peer-reviewed literature (n = 37)	14	23	14	16	4	3
Case study (n = 29)	11	18	12	15	1	1
Review paper (n = 6)	1	5	2	–	3	1
Commentary (n = 2)	2	–	–	1	–	1
Grey literature (n = 20)	13	7	4	7	5	4
Conference paper/report (n = 6)	3	3	2	3	1	–
Guidance manual (n = 5)	5	–	–	1	1	3
Report (n = 5)	4	1	–	2	2	1
Thesis (n = 3)	1	2	2	–	1	–
Magazine article (n = 1)	–	1	–	1	–	–
Sum	27	30	18	23	9	7

Table 2
Capacities needed for each stakeholder group.

Capacities to be developed	Stakeholder groups								
	Operators of water supply facilities	Community committees and caretakers	Local health agencies	Auditors	Consumers	National/sub-national authorities	Local civil society organizations	Multilateral organizations	Researchers and educators
Understand principles of WSP	x	x	x	x	x	x	x	x	x
Gain knowledge on regulatory requirements	x	x	x	x		x	x	x	x
Implement WSP	x	x							
Establish policy and regulatory instruments for WSP						x			
Establish strategy to scale-up WSP implementation	x[a]		x			x		x	x
Perform water quality monitoring and surveillance	x	x	x			x	x		x
Perform auditing	x		x	x					
Teach and transfer knowledge	x		x				x	x	x

[a] It refers to operators that manage more than one water supply system.

regulations are being met. Both internal and external WSP auditors should be trained in the WSP process and in WSP auditing (WHO and IWA, 2015). Capacity building is needed for auditors (WHO EURO et al., 2014), but WSP auditing courses or training programs are not widely available (WHO and IWA, 2015).

Consumers are responsible for keeping delivered water safe, preventing contamination during storage and handling, refraining from and discouraging vandalism and polluting activity, and providing feedback on service quality (Bartram et al., 2018). Consumer feedback can become an accountability mechanism, especially where consumers organize, advocate for services, or participate in "town hall" meetings to question and share concerns with utility personnel. One capacity-building example from rural India recommended events to raise awareness at village level alongside introduction of WSPs, including preparation of leaflets particularly targeted at women's groups (Rouse et al., 2010). Raising awareness of the importance of water safety and the principles of WSPs is also relevant to other settings, such as urban areas where intermittent supply encourages household storage of drinking-water. Furthermore, consumers play an important role in identifying and reporting system problems such as breakdown, deterioration, or misconduct (e.g., vandalism, polluting activity). Consumer satisfaction is one of the pillars of verifying WSP effectiveness, and consumer feedback is an important source of information on whether the water supply operates effectively (WHO, 2012b; Kumpel et al., 2018; Setty et al., 2018).

National authorities influence the enabling environment by setting the legislative framework and developing health-based targets. With respect to WSPs, they play both regulating and facilitating roles. In Germany, national stakeholders played a key role in translating the WSP approach to the national technical standard on WSP, and in gathering experience through pilot projects to support German water suppliers seeking to implement a WSP (Maelzer et al., 2010; Schmoll et al., 2011). For countries participating in the WHO-AusAID Water Quality Partnership for Health in the Asia-Pacific region, the ministries of health and public works played leading roles in propagating and facilitating WSPs (WHO, 2017d). In these cases, the national government agencies were responsible for training a team to promote WSPs to all relevant parties.

Local CSOs include non-governmental and not-for-profit organizations. They can support WSP implementation through training and supporting WSP preparation (Mahmud et al., 2007). Multilateral organizations have long been facilitating capacity development and supporting WSP development and implementation (Sutherland and Payden, 2017). They often provide tools and documents, which are an important basis for developing national guidance and supporting resources. Finally, the research community is a prominent actor, often working on several fronts: supporting training and capacity building; conducting research on the costs, effectiveness, and impacts of WSPs; and providing information on hazards and on the effectiveness of control measures (ESR, 2016; Vieira, 2011).

While the balance of capacities among various stakeholder groups is context specific, Table 2 presents a general guide to high-priority capacities by group, inferred from the literature (especially WHO and IWA, 2010; 2015). Common denominators are a basic understanding of the WSP approach and appreciation of its benefits. In short, the capacity component to be developed and strengthened depends on the stakeholders' role in implementing, scaling-up, and sustaining WSPs.

3.2. Components of the WSP enabling environment

As a component of the enabling environment, legislation supports appropriate distribution of roles and responsibilities (nationally and sub-nationally), as well as the application of tools, training resources, certification programs, and third-party oversight (Baum and Bartram, 2018; Mercer and Bartram, 2011). Legal requirements can mobilize resources for WSP implementation, particularly for small systems

(Schmoll et al., 2011). They drive WSP engagement by water suppliers (e.g., by requiring participation in training and other capacity building activities) and underpin WSP auditing (e.g., by local health agencies as part of drinking-water surveillance programs).

The global status report on WSPs (WHO, 2017b) showed that regulatory instruments promoting or requiring WSPs were in place in 46 countries, and under development in a further 23 countries, indicating substantive uptake at the policy level. Capacity for WSP policy development could be further bolstered through policy-specific training (WHO, 2014b). Some high-income countries, like the USA, may appear to have resource capacity to implement programs but face an overwhelming web of regulations or other contextual barriers (Amjad et al., 2016; Baum et al., 2015). In some cases, adding flexibility to national regulations that prescribe only one type of approach could help to increase capacity for site-specific risk management (Setty, 2019).

Other activities to establish an enabling environment, recommended by the European Strategic Workshop on Water Safety Planning (WHO EURO et al., 2014), include:

- Developing national WSP tools and resources, including guidance documents, templates and training materials in the local language;
- Providing tools and guidance for identifying hazards/hazardous events and assessing risks;
- Offering training, preferably tailored to the needs of different groups (e.g., operators of small supplies, public authorities, WSP auditors); and
- Providing platforms and opportunities for networking to exchange experiences among water suppliers and responsible authorities.

Reykjavik Principle 8 suggests that long-term sustainability of small community water supplies depends on human capital development. In Nepal, for example, a study suggested institutionalization of WSPs at all levels would require support to ensure water committees in villages and towns are able to implement improvements and abide by water quality regulations (Nam and Heijnen, 2011). Moreover, socio-political dimensions, including the operators' relationship with local decision-makers (e.g., members of council) and the provincial liaison officer were identified as bridges for WSP implementation in small supplies in Canada (Perrier et al., 2014).

Evaluating awareness about drinking-water safety and overall readiness can increase capacity and advance progress toward WSPs (Kot et al., 2015). Readiness refers to a capacity of a community or organization to change to accomplish specific goals, usually measured prior to program initiation, and comprises current program status, knowledge, leadership, climate, and resources (Kot, 2015). Many water suppliers, especially smaller utilities, perceive staffing or time limitations (Amjad et al., 2016; Parker and Summerill, 2013). Communities and organizations already struggling with an overwhelming amount of forced change or temporary lack of capacity (e.g., from employee turnover) may find it impossible to take on additional programming, and prefer flexible timing, external support, or a gradation of implementation options. Thus, implementers may want to consider evaluating readiness prior to WSP implementation (Kot et al., 2017), for example by applying the Community Readiness Model (Kot, 2015).

A supportive organizational culture within the water suppliers and among other stakeholders helps WSP implementation (Summerill et al., 2010a), and qualitative research has parsed and classified cultural constructs as enabling, neutral, or barriers (Omar et al., 2017). For example, depending on the socio-cultural context, employees may view WSP training as either a reward or punishment (Omar et al., 2017). Recognizing dynamics such as cultural barriers can help to identify strategic solutions. Because of the importance of developing sustainable internal capacity for the WSP team (Bartram et al., 2009; String and Lantagne, 2016), relief or aid agencies working in low- or middle-income settings should facilitate rather than directly implement WSPs, as this may affect ownership (Day, 2009; Rinehold et al., 2011). In Nepal, some communities became dependent on government and donor support to implement WSPs (Nam and Heijnen, 2011), which can cause efforts to suffer if or when external support is withdrawn. This dependency can be reduced by strengthening the WSP team through utility leadership, interagency support, or securing senior-level commitment within each participating organization (Summerill et al., 2010b).

3.3. Stages of WSP scale-up

In this section, we focus on the process wherein WSP implementation spreads, rather than within-utility WSP implementation. In 2010, WHO and IWA published a road map to support country-level implementation of WSPs, comprising eight steps: 1) understand and appreciate the benefits of a WSP approach; 2) establish a preliminary WSP vision; 3) attain practical WSP experience; 4) establish a national strategy to scale-up WSP implementation; 5) establish mechanisms for ongoing support of WSPs; 6) establish policy and regulatory instruments to support WSP implementation; 7) implement WSPs and verify their effectiveness; and 8) review overall WSP experiences and share lessons learned.

These steps can be compared with lessons learned from the WHO-AusAID Water Quality Partnership for Health in the Asia-Pacific region, which summarized the stages of WSP scale-up as: 1) set the foundations for WSPs and pilot WSPs; 2) scale-up WSPs through policy, increased training and WSP implementation; and 3) consolidate WSP sustainability through regulatory frameworks, model WSPs, WSP experts, institutional development for long-term training and support, and piloting of surveillance activities (Sutherland and Payden, 2017). In merging these two sources, we identified a process to move from

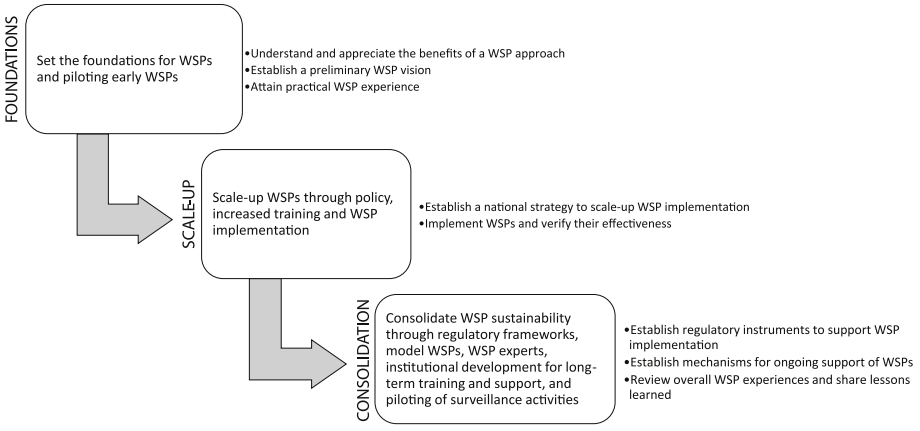

Fig. 2. Stages of WSP scale-up based on Sutherland and Payden (2017) and WHO and IWA (2010).

initially learning about WSPs to providing training at scale (e.g. regional, national, global), with resources to support steps such as initial learning, piloting, and development of training packages (Fig. 2). This confirms the fundamental role of training at multiple stages and for multiple stakeholders in WSP scale-up.

3.4. Training

Capacity building is a multi-level learning process, and training is one of its components. Training taxonomy has been well developed in the educational field, but is less clear for water professionals. We therefore collated training and educational theory to describe WSP training opportunities. The idea of training is usually associated with preparing someone for performing a task or role (Tight, 2003). Training can be distinguished from education, which involves broader and deeper learning activity. Moreover, education has to do with general levels of understanding, whereas training is more likely to involve the development of specific skills (Tight, 2003). Training represented a central component of the literature review, since it can bolster all of the capacities presented in Table 2.

Training approaches to build WSP capacity differ by format (e.g., face-to-face, online, blended), provider groups (e.g., higher education, water operators partnership (WOP), peer-to-peer), and target group (see section 3.1). Different approaches are suited to building different skills. When deciding which approach to offer, providers should avoid promoting a "solution in search of problems" (Biswas, 1996). That is, training should reflect the purpose of the initiative and needs of the audience, both to ensure relevance and to develop the capacity to effect change (Biswas, 1996; Jetoo et al., 2015). We summarize various training characteristics based on their format, providers, and audience groups, noting that more than one category could apply to a single training effort (Fig. 3).

3.4.1. Training format

3.4.1.1. Face-to-face training. Face-to-face training is any form of instructional interaction where the trainer imparts knowledge or practical skills "in person" and in real time to a target group. It is suitable for all target groups and should be adapted to their specific needs. Numerous publications refer to face-to-face training when discussing training generally (Hasan et al., 2011; Hubbert, 2013; Khatri et al., 2011; Magtibay and Chong, 2011; Mahmud et al., 2007; Rouse et al., 2010). Advantages of face-to-face training include enhanced opportunity for group activities and exchange of experiences. In-person delivery allows field visits to implementation locations, which can offer pertinent and concrete local examples and evidence to potential WSP implementers (Hasan et al., 2011; Rouse et al., 2010). Hasan et al. (2011) describe the benefits of using local facilitators, since they can describe the WSP process in their local dialect, using local jargon and knowledge of local settings, circumstances, and cultural sensitivities, increasing the chances of successful uptake of the WSP framework.

The objective of the training (e.g., training those who will implement the WSP or sensitizing decision makers to help champion WSPs) affects the content and duration of a course, as do practical constraints. For example, operators of small systems may be unable to leave their systems for training for an extended period. Face-to-face training can be one-off or phased. Only a limited number of individuals can participate (e.g., groups of up to twenty people per trainer), usually at high costs for the venue, printed materials, time of employees away from their posts, trainer hours preparing materials and conducting training, and often travel costs for trainers and participants. Some short courses are provided by national authorities or professional associations, or conducted within a project framework. An example comes from Lao PDR, where a three-day WSP module was integrated into standard operator training (WHO and DFAT, 2017). Gunnarsdottir et al. (2015) also recommended this practice based on the Icelandic experience.

Face-to-face training is sometimes offered by higher education institutes such as universities. For example, in 2012 the IHE Delft Institute for Water Education (Netherlands) introduced classes, assignments, and role-playing games on WSPs in the Master of Science courses in Urban Water and Sanitation and Water Management. In Bangladesh, the WHO regional office and ITN-BUET Centre for Water Supply and Waste Management in 2014 jointly developed WSP teaching material for university (technical/engineering) curriculum. This material provides an overview of WSPs to undergraduate students over two to three hours of classes. Other universities in Sri Lanka, Cambodia, and Mongolia also have developed curricula on WSPs for university students (WHO and DFAT, 2015, 2017).

To systematically reach a greater number of individuals, a training of trainers (ToT) model can be used. ToT is a popular method of knowledge dissemination where participants become trainers who are then expected to teach others. The ToT model is widely applied for scale-up and sustainability (Yarber et al., 2015). It has been successfully used in large projects such as the WHO-AusAID Water Quality Partnership for Health (WHO, 2014b; WHO SEARO, 2014). In the context of WSPs, ToTs may target participants who will support WSP implementation in future projects (Hasan et al., 2011; Rouse et al., 2010). In India, the World Bank (Rouse et al., 2010) proposed ToT programs

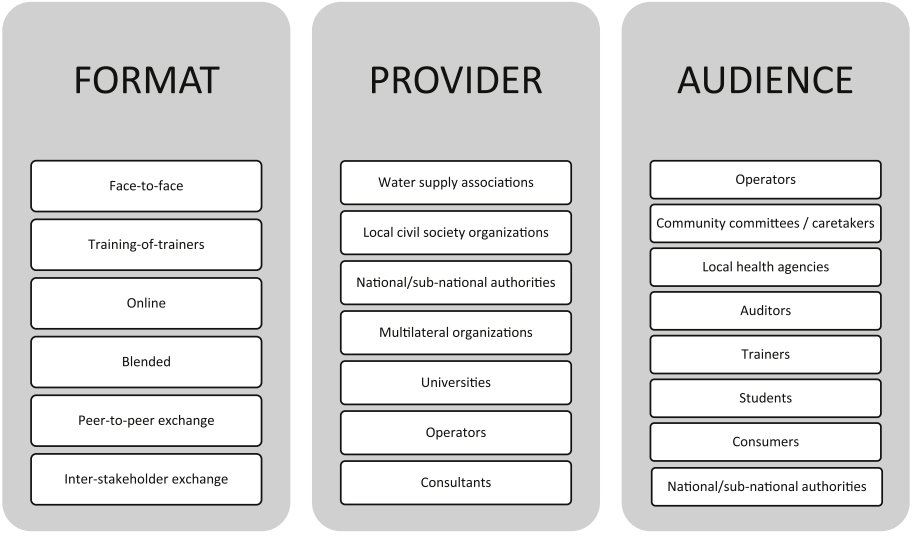

Fig. 3. Summary of existing or potential training approach characteristics for WSPs.

targeting block-level facilitators who would then train village-level representatives. Similarly, facilitators were trained in Tajikistan to support WSP training and implementation in small rural water supplies (WHO EURO, 2016a).

3.4.1.2. Online and blended training. Online (remote) training targets individuals who have computer and internet access, and are not necessarily able to travel or attend training in person. For example, the Water Institute at University of North Carolina at Chapel Hill (USA) has a 10-week online course on WSPs aimed at those in the water industry with management, engineering, or operational responsibilities (The Water Institute at UNC, 2018). This course presents content through readings, videos, problem-solving scenarios, and case study examples. A series of modules progressively build knowledge and illustrate real-world WSPs. A trainer oversees the course, providing continuity and personal interaction. Participants work in cohorts and interact through a discussion forum. A similar initiative is a virtual WSP course in Spanish, launched in May 2016, which reached more than 1000 participants from 22 countries in Latin America and the Caribbean through 2017 (WHO, 2017b).

Online training may reach more individuals than face-to-face training, but start-up costs are high. Once established, a course can run repeatedly; however, periodic updates and adaptations are advisable. In online training, interaction among individuals is possible only through digital fora and email communication, and integration of field elements is difficult and rare. Furthermore, it requires a reliable and stable internet connection, which is not universally available.

Blended learning combines online digital media with classroom methods. Its use has increased rapidly, driven by evidence of its advantages over either online or classroom teaching alone (Jeffrey et al., 2014). However, teachers have been found to value classroom components more highly than those online, and poor integration between online and classroom components has been observed (Jeffrey et al., 2014). No blended learning programs have yet been developed for WSPs. The nearest example is hybrid distance learning for local staff in Ethiopia (Visscher et al., 2009). This combines e-based learning, CD-ROM, and paper-based material, supported by a network of trainers and resource persons.

3.4.2. Provider groups

Training may be provided by diverse provider groups (Sutherland and Payden, 2017; WHO EURO et al., 2014). They include national authorities providing training to local health agencies, water supply associations providing training to water supply operators, universities providing training to future professionals, and water supply operators providing guidance to other water suppliers. Other provider groups include international NGOs, experts, or consultants. The audiences served by different provider groups may vary in numbers, degree of specialization, and resource level.

To complement more formal training, peer-to-peer exchange between neighboring communities implementing WSPs has been recommended (WHO EURO, 2014a). It combines in-depth guidance with practical experience and person-to-person consultations. The personal bonds developed may contribute to sustainability after initial collaboration. Informal peer support networks may also be valuable, especially during periods of rapid scale-up, to ensure implementers have the opportunity to learn from each other. In the case of utilities, a WOP is a collaboration between two or more operators, conducted on a not-for-profit basis, which can have diverse objectives and durations.

There have been WOPs created for WSP implementation. In 2014, the *Companhia de Saneamento de Minas Gerais* (COPASA) in Brazil and the *Empresa Municipal de Saneamiento Básico de Puno* (EMSAPUNO) in Peru created a WOP with the objective of exchanging experiences and developing capacity for implementing a WSP for the water supply system of the city of Puno (UN-HABITAT, 2016). Analogously, in 2012 Kisumu Water and Sewerage Company Limited (KIWASCO, Kenya), National Water and Sewerage Corporation (NWSC Uganda), and Mwanza Urban Water and Sanitation Authority (MWAUWASA, Tanzania) signed an 18-month partnership for peer learning on WSPs (Flood and drought management tools, 2018).

Peer learning is also applied by local and national governments. For example, an ongoing WSP peer exchange between Indonesia and the Philippines reviews local government engagement, capacity development needs, delivery mechanisms, and quality assurance and quality control, among other topics (USAID, 2018). Magtibay and Chong (2011) described the 'big brother' approach used in the Philippines, where a big water utility in the same water catchment mentors a small water utility in developing and implementing its WSP. In Nepal, water user groups displayed successful WSPs and directly supported WSP capacity building for neighboring villages (Terceiro Jorge et al., 2013).

Experience from Iceland highlighted the importance of inter-stakeholder exchanges. Support for WSP implementation was provided by the water sector and health authorities, with particularly the latter pushing for WSP implementation in water utilities (Gunnarsdottir et al., 2012), showing the importance of exchange among these stakeholder groups. In Germany, dialogue and communication with key stakeholders - including regulators, water suppliers, surveillance authorities, and professional associations - was considered important (Schmoll et al., 2011). An organized and moderated piloting and evaluation process involved different stakeholder groups to raise the awareness and to secure their involvement in WSP uptake. Globally and regionally, peer-to-peer learning and inter-stakeholder exchange could be facilitated by large professional networks such as the IWA for water utilities, the Protocol on Water and Health for national authorities (WHO EURO, 2014b), or the International Network of Drinking-water Regulators (RegNet; an international forum to share and promote best practice in drinking-water regulation and protection of public health among regulators). Curated information may also come from mailing lists mediated by WHO, IWA, or the Rural Water Supply Network.

Even if focused on education rather than on training, universities and higher education institutions have a prominent role in developing capacity and preparing future professionals for their careers in the water sector. Interdisciplinary groups can interact in active learning environments to develop students' problem-solving capabilities. As it is not always clear at the time of the course which career path students will choose, this approach not only reaches those who will go on to work in the drinking-water field, but it also sensitizes those who will work in other fields about issues of drinking-water safety.

3.4.3. Training tools and resources

Training plans typically apply a combination of:

- Lectures to explain the context, benefits, and elements of WSP implementation;
- Case studies (Greaves and Simmons, 2011; Schmoll et al., 2011);
- Practical exercises and technical training elements to gain firsthand experience with WSP development, either based on water supplies known to the participants or a fictional water supply;
- Role-play and other games (Barrington et al., 2013; Ferrero et al., 2018);
- Field elements such as visiting a water supplier to gain practical experience on the theoretical knowledge gained in the classroom (Shamsuddin et al., 2005);
- Supervised "on-the-job" training (WHO, 2014c), and
- Participatory approaches for community members (Kayaga, 2013; Khatri et al., 2011).

A list of WSP guidance and training material available in English was developed by WHO (2017e). A number of tools have been developed to support WSP training, including a WSP training package (WHO, 2012b), training modules on urban WSPs (WHO SEARO, 2016), and a training workbook on WSPs for urban systems (WHO Western Pacific

Region, 2008). The Techneau project funded by the European Commission likewise developed supplementary guidance for water utilities, detailing a range of potential methods and tools for application within the WSP framework (Rosén et al., 2007).

Numerous authors stress the importance of nationally adapted background documents, manuals, templates, and other tools in local languages (Schmoll et al., 2011; Sutherland and Payden, 2017; Visscher et al., 2009) to facilitate learning and sustain WSP implementation after initial training courses. Australia has developed thorough national guidance for WSPs by integrating the process into the Australian Drinking Water Guidelines (NHMRC, NRMMC, 2011). The New Zealand Community Water Planner, accompanied by a field guide, is a tool for smaller communities for generating a WSP (Hubbert, 2013). National or sub-national guidance is particularly relevant in the case of small supplies (WHO EURO et al., 2014), and examples from Germany, Iceland, Austria, Ireland, Switzerland, the United Kingdom of Great Britain and Northern Ireland, and Finland have been reported (WHO EURO, 2016a). In Alberta, Canada, an adapted Excel tool was pre-populated with common risks addressed in the state, including tables for each main component of the water supply (Reid et al., 2014). In rural Nepal, a partnership between local and international NGOs helped to develop adapted training programs for WSP implementation (Barrington et al., 2013). This included customized training tools and games in English and local languages, such as “Snakes and Ladders”. Another initiative developed by Women in Europe for a Common Future (WECF) provided a tool called “Water Safety Plans in Pictures” to schoolchildren and local communities in rural Europe to improve water safety (Summerill et al., 2010b).

Vieira (2011)and String and Lantagne (2016) remark on the importance of exemplifying successes and failures as a pedagogical tool through a national or international database of case studies, existing tools, and platform for web-based exchange. WHO and IWA (2018) established the Water Safety Portal (http://www.wsportal.org), a platform originally designed to promote interaction among governments, practitioners and implementers and that serves as a resource library specific to WSPs (Schmoll et al., 2011; String and Lantagne, 2016).

3.4.4. Stages of learning

When selecting a training approach, consideration should be given to the stages of learning. A phased approach allows for practice between training sessions, reflecting the three simplified stages of learning outlined in Fig. 4: introduction, practice, and reinforcement. This stems from different theories of learning, such as instructional design (Wood et al., 1976), andragogy (Knowles et al., 2005) and experiential learning (Kolb, 1984). These three steps can be broken into activities and skill sets. In instructional design, “scaffolding” is a technique used to move learners from basic knowledge to a deeper understanding and greater autonomy in the learning process (Sawyer, 2006). In this case, scaffolding helps the learner move from simple awareness of WSPs during the introductory phase, to hands-on practice and reinforcement (Fig. 4). Scaffolding helps to fill the gap between learning the principles of WSPs and autonomously implementing them.

Introductory training, whether face-to-face or online, sets the basis for learning about WSP development and implementation in a generalized setting and context. This enables participants to continue to learn of the pitfalls and nuances of implementation for particular systems through their own follow-up activities. The introduction phase should employ a variety of strategies where participants move from lower to higher cognitive levels (Bloom, 1956). For example, in the first stage of WSP training, participants learn WSP principles from common manuals (e.g., Bartram et al., 2009) and packaged material (e.g., WHO, 2012b), using templates to create initial plans (e.g., WHO EURO, 2014a). In a water utility in South Africa, training on each of the WSP steps (introducing the WSP, defining the WSP, setting up the WSP and implementing the WSP) was followed by evaluation, in which participants used worksheets and an assignment that consisted of developing a WSP framework for their own location (Viljoen, 2010). Moreover, the first stage of learning can increase sensitization of stakeholder groups about the benefits of WSPs, since stakeholder groups need to understand the importance of WSPs as a first step to gaining the motivation and support for undertaking WSPs. In some cases, WSP implementation has been unsuccessful because of the lack of this initial buy-in (Summerill et al., 2010b).

Learning continues through the phased process with additional practice (Fig. 4). Malcolm Knowles’ principles of adult education, known as andragogy (Knowles et al., 2005), applies to WSP training. These principles hold that adult learners move from dependency to being self-directed. In WSP training, dependency is most evident during the introduction phase, after which time learners should be given freedom to assume their responsibilities and to fine-tune their learning objectives during practice and reinforcement. Knowles at al. (2005) and Kolb (1984) concur on the importance of experiential learning. In WSPs, adult learners draw from their own life experiences mainly during WSP implementation practice; in this phase, the approach and tools are reviewed and adapted based on lessons learned. Moreover, since adults are problem centered and are most interested in learning subjects that have immediate application, it is particularly relevant to involve “problem owners” (stakeholder groups, as described in section 3.1) in all stages of capacity development. If correctly guided, learners can contribute to customization of training materials to the local WSP approach (WHO SEARO, 2014).

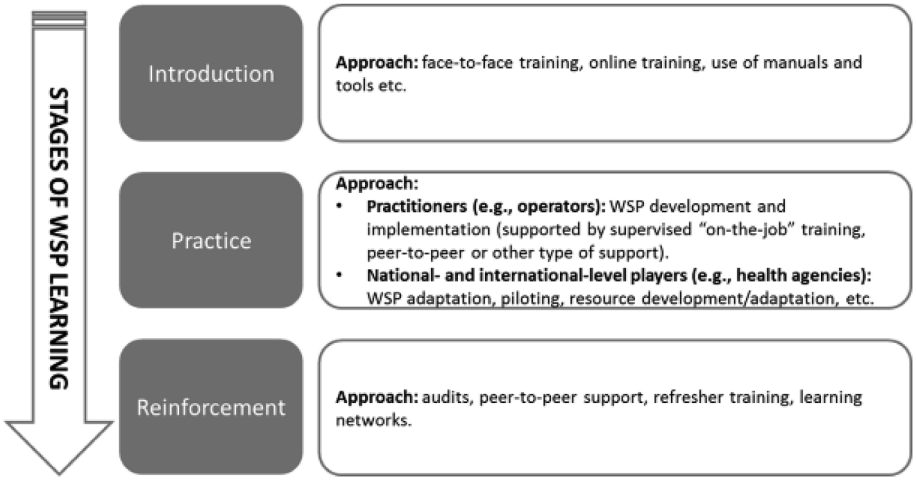

Fig. 4. Stages of WSP learning and related teaching strategies.

Practice and reinforcement take place through follow-up activities aimed at refreshing knowledge, promoting knowledge transfer, and providing sustained assistance in implementing WSPs. Activities aimed at sustaining learning include refresher courses, WOPs, peer-to-peer reviews of WSPs, communities of practice (CoP) both of trainers and implementers, and technical assistance to overcome specific challenges. The "develop supporting programs" step of the WSP offers a pathway for tying-in internal capacity building programs (Jetoo et al., 2015).

Reinforcement is key to ongoing sustainability of the WSP and avoidance of superficiality (Fig. 4; Summerill et al., 2010a). As a summative evaluation step, WSP auditing may represent the highest level of the learning process, since it assumes and builds on previous knowledge application and synthesis. Ideally, further training or a round of feedback and revision could address the gaps identified through the audit process. Internal and external audits offer distinct value (WHO and IWA, 2015). Moreover, auditing has been used in the early stages of training to trigger the learners' critical thinking. For example, a group of Indonesian trainees was given a copy of an existing WSP to audit during their training (WHO, 2017d).

3.4.5. Training evaluation

From this literature review, no standardized method emerged for measuring implementers' capacities, in terms of knowledge and skill sufficiency, prior to a WSP-related training activity. The only pre-implementation method published is the Community Readiness Model (Kot, 2015) described in section 3.2. Some trainers seek to understand the target group by means of intake forms, but this seems not to be a general practice. The WHO WSP training manual includes an exercise aimed at identifying key competencies required for WSP teams (WHO, 2012b), but it is not related to a competency assessment. A survey of small-scale water supplies (which often prevail in rural areas) in the European Region found no minimum qualification or competencies were required to operate a small public water supplies in 48% of the responses; however, 50% of the respondents indicated that relevant qualification or training programs were available for operators of these systems (WHO EURO, 2016b).

Nevertheless, strategies exist for gauging capacities (even without a solid baseline) after capacity building activities. These include competency assessment at the end of a training, trainees' feedback, WSP audits, and trainer certification programs. It is at the discretion of the trainer whether and how to test trainee acquisition of competencies. The Asian Development Bank (ADB) developed a practical guide to support ADB personnel in urban WSPs, recommending training and competency assessment before handing over the WSP to clients (ADB, 2017). The most used approach in training evaluation is Kirkpatrick's model, which considers four levels of training outcomes: reactions, learning, behavior, and results (Kirkpatrick, 1994). When organizing training, it is beneficial to adopt tools such as rubrics detailing how assignments will be compared to a gold standard. Rubrics articulate expectation for a training or an assignment, as they contain evaluative criteria and a scoring strategy (Popham, 1997).

Another important appraisal method is feedback from participants on perceived training effectiveness, which enables the trainer to improve and customize the training. It is particularly relevant to understand if trainees were able to transfer their training into the workplace. Feedback can be gathered through questionnaires, interviews, or classroom discussion. Professional certification might include a series of levels through which operators can progress. Responsibilities should be aligned with certification levels (WHO, 2014c), and should preferably include consideration of both training and experience.

3.5. Capacity evaluation

Locally, WSP auditing and feedback represent key activities in the reinforcement stage of learning (Fig. 4) and the WSP process (Bartram et al., 2009; WHO and IWA, 2015). Auditing supports ongoing quality improvement, as risk management is intended to be an ongoing process (Pollard et al., 2004). An audit has field- and desk-based components. Spot checks and field visits will help to understand whether operators consistently follow the WSP and if the WSPs documentation is accurate and up to date (WHO and IWA, 2015). Audit feedback generally helps the WSP teams to identify areas of misinterpretation of WSP elements and to learn from this (WHO and IWA, 2015). Auditing requirements are in place in 62% of the countries that included WSPs in national regulations, but only 49% of countries requiring auditing reported having established an auditing frequency, suggesting that audit practice is still limited in many WSP implementing countries (WHO, 2017b). Auditing may be required for renewal of certification programs, such as the International Organization for Standardization (ISO) 22000 Food Safety Management System, which has been applied to drinking-water treatment and distribution systems (e.g., Loret et al., 2016).

Globally, we propose more refined data collection to build on baseline knowledge of WSP status and capacity (WHO, 2017b). At scale, multiple measures of capacity and/or combination with qualitative data may provide the clearest picture of capacity status. Understanding causality may be difficult when viewing indicators in isolation, since capacity leads to implementation and *vice-versa*. Potential indicators for the degree of WSP capacity or implementation could include the number, quality, or diversity of documented pilot studies, number of voluntary programs, existence of a national strategy, WSP legislative requirement, proportion of water supply systems affected, and number of WSPs implemented. The measurement approach may vary across or within regions and countries and may differ for utilities of different size, budget, operator type, and setting (e.g., rural vs. urban).

A global status report on WSPs (WHO, 2017b) presented the scale of national WSP implementation. Of the 76 countries that provided implementation details, 45% were reported to be at the scale-up stage of urban and/or rural WSP implementation, 30% to be at the pilot stage, and 25% to have implemented 10 or fewer WSPs; 62% of countries had WSP experience in both rural and urban settings. Applying Rogers' Theory of Diffusion of Innovation (Rogers, 2003), some countries, regions, or organizations will be early adopters, while others will lag behind. Some of this lag may be due to harder-to-overcome barriers, such as geographic remoteness, language differences, existing regulatory frameworks, or cultural factors (Amjad et al., 2016; Omar et al., 2017). Thus, the coverage of WSPs across and within countries (WHO, 2017b) is unlikely to increase linearly, and the late majority of adopters may face greater barriers to implementation and require more resource-intensive capacity building (Setty, 2019).

Increased capacity building and training within the water supplies were reported as top benefits of WSP implementation at the utility level (WHO, 2017b). A study on the impacts of WSP implementation across 99 sites in the Asia-Pacific region (Kumpel et al., 2018) covered both large and small supplies, as well as different types of operating organizations. It found that WSP implementation led to infrastructure improvements, increased financial support, improved operations and management practices, increased stakeholder meetings related to water safety, reduced non-revenue water, increased water analyses, and improved monitoring of consumer satisfaction. Challenges included financial constraints and limited capacity. Information on financial and water supply indicators was less available at rural sites. Three indicators explicitly refer to training (Kumpel et al., 2018), namely indicators O1b-6 "operator or caretaker training programs," O1b-7 "consumer education programs" and I1c "consumer water safety trainings." Indicators I2a "understanding of system" and I2b "understanding of hazards" were designed to measure changes in knowledge of the water supply system and hazards and link to measuring changes in capacity; however, the approach and tools used to measure these knowledge outcomes did not yield reliable data. More robust and standardized methods to measure these indicators are needed so that these indicators can be used in assessing WSP outcomes and impacts at scale (Kumpel et al., 2018; Setty et al., 2018).

It is important to reflect on the relationship between capacity building and capacity sufficiency (OECD, 2012). While capacity building interventions can be related to immediate outputs (e.g., number of trained staff, knowledge management procedures set up or revised, human resources management policies modified), the relationship between outputs and outcomes remains difficult to quantify (Vallejo and Wehn, 2018). The model for WSP evaluation (Gelting et al., 2012) and indicators recommended by Lockhart et al. (2014) and Kumpel et al. (2018) may serve as a useful starting point for evaluating capacity building connected with WSP impacts. WHO and IWA (2013) have developed a quality assurance tool to track completion of each WSP module, and Gunnarsdottir et al. (2012) describe a scoring system for rating the WSP performance of water utilities and tracking progress in implementation. Implementation science frameworks can be useful in identifying and overcoming barriers that impede timely realization of desired endpoints (Setty, 2019).

3.6. Sustainability of capacity building

Although many site-specific or national components of the enabling environment for WSPs are discussed in literature, sustainability of WSP capacity building is likely to differ according to types of supplies and their size, location, and governance. For example, some consider WSP training for rural settings more challenging, because of the need to adapt to local ways of learning and language barriers (WHO, 2014b), as well as the remoteness and the often large number of smaller supplies. In a study of water quality monitoring capacity in sub-Saharan Africa, large suppliers were easier to engage, higher budget often meant higher capacity, and smaller water providers and rural public health offices required greater attention and additional resources (Peletz et al., 2016). Because site-specific context varies greatly, this rule of thumb may not apply in all cases (Setty, 2019).

To achieve sustainable capacity to continually implement WSPs, the local-level enabling environment commonly includes a program champion (e.g., manager, administrator) (Summerill et al., 2010a), community engagement, sustainable financing, and iterative re-evaluation. One study in low-income urban settlements suggests that community-managed WSPs require a high level of community participation in operation, maintenance, and monitoring, such that community members have a high degree of project ownership (Kayaga, 2013). Participation to varying degrees (e.g., in the form of cash contributions, labor, in-kind resources, or meeting attendance) may correspond to sustained buy-in. For centrally-managed systems, the water utility should maintain active oversight, and formalize partnerships with community members and other stakeholders. Kayaga (2013) goes so far as to suggest the roles and responsibilities of utility and the community members be mutually discussed, agreed and tracked in a formal document, such as a memorandum of understanding (MoU). It is therefore advisable to include all target groups in capacity building and training activities at the local level. Regarding monitoring and evaluation, Mahmud et al. (2007) recommend sustained surveillance, if necessary using adapted community-monitoring tools appropriate for the resource level of the setting. Peletz et al. (2016) stress the importance of continuing to process and apply monitoring data to enable re-evaluation of the program.

To apply the WSP approach, knowledgeable staff continuously working at the water supply level is a prerequisite. This suggests that within the utility, initial training plus follow-up is crucial for both continuing and new personnel. However, capacity building may precede or follow allocation of responsibility. Rapid staff turnover and unavailability of experienced staff are challenging (Perrier et al., 2014; Summerill et al., 2010b; Viljoen, 2010; WHO, 2017d), calling for longer-term training programs that also target new staff, either within the water supply, or through externally provided training. In addition to other employee retention efforts, training should inspire operators and demonstrate how their work has a direct positive impact on the livelihoods in the area they service (WHO EURO, 2016a).

Since WSP guidance recommends an iterative process with periodic reviews and updates (Bartram et al., 2009), training programs should support continuing education, for example via yearly refresher courses (Rouse et al., 2010). To achieve the highest capacity levels, WSP-related training might be considered mandatory for individuals working in water supply and treatment. Further, institutional knowledge and memory could be bolstered by using documentation tools such as the WHO and IWA Water Safety Plan Quality Assurance Tool (2013), which is available in multiple languages and follows the requirements of the 2009 WSP manual. Standard operating procedures are another type of documentation valuable to building and sustaining capacity (Jetoo et al., 2015), and should be referred to in training staff and posted in accessible locations.

With WSPs, there is a strong risk of “tokenism,” wherein documentation is developed, but the knowledge generated does not effectively permeate the utility's culture and practices (Summerill et al., 2010a). Human variability is a recognized influence, and Biswas (1996) suggests that people, rather than institutions, may be responsible for inaction or inappropriate action. When scaling-up any complex intervention, attention is necessary to context-sensitive strategies and to which adaptations might result in positive outcomes (e.g., better understanding of training concepts in the local language) versus adverse outcomes (e.g., misunderstanding of training concepts due to poor translation) (Barker et al., 2016; Baumann et al., 2017). Documentation of program adaptations is recommended to improve knowledge over time of which “core components” or “active ingredients” are most important to WSP sustainability (Setty, 2019). External auditing and feedback may help to anchor the utility's implementation approach in standardized or evidence-based practices.

Finally, guidance is needed to establish certification programs for WSP trainers and auditors (WHO, 2017d). Certification programs support good practice and application of WSPs (WHO, 2014c). The International Organization for Standardization recommends auditing and certification services related to the ISO 22000 food safety management program, but the associated fees make these third-party programs less accessible to utilities in low-resource settings. Some countries choose to run their own certification and accreditation programs, benefitting from input from both WHO guidance and local regulations. For example, Victoria, Australia, has an advanced system of auditor certification. This competency-based scheme started in 2007 and, as of 2015, there were 20 drinking-water auditors certified under the scheme (WHO and IWA, 2015).

4. Conclusions

Capacity building and the creation of the enabling environment play a strong role in supporting WSPs. For example, WSP policy development, organizational culture, and community readiness are crucial for uptake (Baum et al., 2015; Kot et al., 2017; Omar et al., 2017). In any given situation, the capacity component or components most in need of development or strengthening depend on the roles of different stakeholder groups involved in implementing, scaling-up, and sustaining WSPs. Numerous training materials and approaches for capacity building on WSPs exist. Selection of materials, approaches and customization of training should reflect the target group, local language, circumstances, and preferred mode of learning, particularly in the case of small systems. Customizing training depending on size, location, and governance structures will boost local ownership and contribute to long-term sustainability.

The educational field is characterized by a well-defined taxonomy of instructional methods, but is less clear for water professionals. Three stages of learning (introduction, practice, and reinforcement) should be taken into account when planning WSP training and capacity development. Some training formats and approaches may be better suited for a particular stage of learning. For instance, face-to-face and online

training are appropriate for the introductory stage, supervised "on-the-job" training is more suitable for practice, and WOPs, peer-to-peer reviews of WSPs, and communities of practice are more suitable for reinforcement. Understanding the most appropriate training approaches for each stage can enhance capacity building.

Auditing is a crucial step for measuring changes in capacity, since it can provide a summative assessment associated with the highest level of learning. Auditing guidance exists, but WSP auditing courses or training programs are not widely available (WHO and IWA, 2015). Further, audit practice is limited and needs to be strengthened (WHO, 2017b). An internationally recognized certification system for WSP trainers and auditors is not in place outside the services provided by ISO. Training and certification of auditors may be included in legal frameworks, although formal auditing requirements and implementation in practice are limited. Follow-up training should address knowledge gaps revealed during auditing.

More robust and standardized methods and indicators are needed to assess WSP outcomes and impacts (Kumpel et al., 2018; Setty et al., 2018). Finally, no standardized method emerged for measuring implementers' knowledge and skill sufficiency prior to a WSP-related training activity. Thus, methods to monitor WSP capacity development both at the training level, and in overall capacity sufficiency should be developed and strengthened. This will contribute to the sustainability of capacity building activities, and water safety planning more generally, assuming facilitators and practitioners apply and review them in practice.

The relevance of capacity building and training may be underscored by adding requirements regarding qualification and training of operators, including WSP training to legal requirements for all operators of water supplies, since legal requirements can mobilize resources, including resources for WSP training, and increase availability of training programs, particularly for small systems.

Acknowledgements

The authors alone are responsible for the views expressed in this publication, which do not necessarily represent the views, decisions, or policies of the World Health Organization, University of North Carolina at Chapel Hill, IHE Delft, or the German Environment Agency.

This research was supported in part by a grant from the National Institute of Environmental Health Sciences (T32ES007018), the Royster Society of Fellows, and by the Dutch Ministry of Foreign Affairs through the DGIS IHE Delft Programmatic Cooperation 2016–2020 (DUPC2).

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijheh.2019.01.011.

References

ADB, 2017. Water Safety Planning for Urban Water Utilities: Practical Guide for ADB Staff. https://doi.org/10.22617/TIM168532-2, Accessed date: 22 November 2018.

Aghaei, M., Nabizade, R., Nasseri, S., Naddafi, K., Mahvi, A.H., Karimzade, S., 2017. Risk assessment of water supply system safety based on WHO's water safety plan. Case study: ardabil, Iran. Desalin. Water Treat. 80, 133–141. https://doi.org/10.5004/dwt.2017.20889.

Amjad, U.Q., Luh, J., Baum, R., Bartram, J., 2016. Water safety plans: bridges and barriers to implementation in North Carolina. J. Water Health 14 (5), 816–826. https://doi.org/10.2166/wh.2016.011.

Barker, P.M., Reid, A., Schall, M.W., 2016. A framework for scaling up health interventions: lessons from large-scale improvement initiatives in Africa. Implement. Sci.: ISCUS 11, 12. http://doi.org/10.1186/s13012-016-0374-x.

Barrington, D., Fuller, K., McMillan, A., 2013. Water safety planning: adapting the existing approach to community-managed systems in rural Nepal. J. Water, Sanit. Hyg. Dev. 3 (3), 392. https://doi.org/10.2166/washdev.2013.120.

Bartram, J., Brocklehurst, C., Bradley, D., Muller, M., Evans, B., 2018. Policy review of the means of implementation targets and indicators for the sustainable development goal for water and sanitation. npj Clean Water 1 (1), 3 ISSN 2059-7037.

Bartram, J., Corrales, L., Davison, A., Deere, D., Drury, D., Gordon, B., Howard, G., Rinehold, A., Stevens, M., 2009. Water Safety Plan Manual: Step by Step Risk Management for Drinking-Water Suppliers. World Health Organization, Geneva.

Baum, R., Amjad, U.Q., Luh, J., Bartram, J., 2015. An examination of the potential added value of water safety plans to the United States national drinking water legislation. Int. J. Hyg Environ. Health 218 (8), 677–685.

Baum, R., Bartram, J., 2018. A systematic literature review of the enabling environment elements to improve implementation of water safety plans in high-income countries. J. Water Health 16 (1), 14–24. https://doi.org/10.2166/wh.2017.175.

Baumann, A.A., Cabassa, L.J., Stirman, S.W., 2017. Adaptation in dissemination and implementation science. In: Brownson, R.C., Colditz, G.A., Proctor, E.K., Baumann, A.A. (Eds.), Dissemination and Implementation Research in Health:Translating Science to Practice. Oxford Scholarship. https://doi.org/10.1093/oso/9780190683214.001.0001.

Biswas, A.K., 1996. Capacity building for water management: some personal thoughts. Int. J. Water Resour. Dev. 12 (4), 399–406. https://doi.org/10.1080/07900629650006.

Bloom, B.S., 1956. Taxonomy of Educational Objectives, Handbook I: the Cognitive Domain. David McKay Co Inc, New York.

Day, S.J., 2009. Community-based water resources management. Waterlines 28 (1), 47–62.

ESR - Institute of Environmental Science and Research Limited, 2016. Keeping People Safe and Healthy through Science.

Ferrero, G., Bichai, F., Rusca, M., 2018. Experiential learning through role-playing: enhancing stakeholder collaboration in water safety plans. Water 10 (2), 227.

Flood and drought management tools, 2018. http://fdmt.iwlearn.org/news/kiwasco-experience-in-the-water-safety-planning-development-and-implementation-and-the-significance-of-the-fd-dss-tool-in-the-implementation-process, Accessed date: 30 October 2018.

Gelting, R.J., Delea, K., Medlin, E., 2012. A conceptual framework to evaluate the outcomes and impacts of water safety plans. J. Water, Sanit. Hyg. Dev. 2, 103–111. https://doi.org/10.2166/washdev.2012.079.

Greaves, F., Simmons, C., 2011. Water Safety Plans for Communities: Guidance for Adoption of Water Safety Plans at Community Level. Tearfund, Teddington, UK.

Gunnarsdóttir, M.J., 2012. Safe Drinking Water: Experience with Water Safety Plans and Assessment of Risk Factors in Water Supply. (PhD Thesis), Retrieved from. https://skemman.is/handle/1946/13274.

Gunnarsdottir, M.J., Gardarsson, S.M., Bartram, J., 2012. Icelandic experience with water safety plans. Water Sci. Technol. 65 (2), 277–288. https://doi.org/10.2166/wst.2012.801.

Gunnarsdottir, M.J., Gardarsson, S.M., Bartram, J., 2015. Developing a national framework for safe drinking water—case study from Iceland. Int. J. Hyg Environ. Health 218 (2), 196–202.

Hasan, T.J., Hicking, A., David, J., 2011. Empowering rural communities: simple water safety plans. Water Sci. Technol. Water Supply 11 (3), 309–317. https://doi.org/10.2166/ws.2011.051.

Hubbert, D., 2013. Identifying Drinking Water Regulatory Frameworks. MPA thesis. https://dspace.library.uvic.ca//handle/1828/4811, Accessed date: 27 July 2018.

IHE Delft, UNDP, 1991. In: A Strategy for Water Sector Capacity Building Proceedings of the UNDP Symposium, Delft, pp. 3–5 June, 1991.

IWA, 2014. An Avoidable Crisis. WASH Human Resource Capacity Gaps in 15 Developing Economies. Seacourt, United Kingdom.

Jeffrey, L.M., Milne, J., Suddaby, G., Higgins, A., 2014. Blended learning: how teachers balance the blend of online and classroom components. J. Inf. Technol. Educ. 13, 121–140.

Jetoo, S., Grover, V.I., Krantzberg, G., 2015. The Toledo drinking water advisory: suggested application of the water safety planning approach. Sustainability 7 (8), 9787–9808.

Kayaga, S., 2013. Effective water safety management of piped water networks in low-income urban settlements. J. Water, Sanit. Hyg. Dev. 3 (3), 402–410.

Khatri, K., Iddings, S., Overmars, M., Hasan, T., Gerber, F., 2011. Implementation of drinking water safety plans and lessons from the Pacific islands. Waterlines 30 (3), 235–247.

Kirkpatrick, D., 1994. Evaluating Training Programs: the Four Levels. Berrett-Koehler, San Francisco.

Knowles, M.S., Holton, E.F., Swanson, R.A., 2005. The Adult Learner: the Definitive Classic in Adult Education and Human Resource Development, sixth ed. Elsevier, Boston, Mass.

Kolb, D.A., 1984. Experiential Learning: Experience as the Source of Learning and Development. Prentice Hall, Englewood Cliffs, NJ, USA.

Kot, M., 2015. Readiness for ensuring safe drinking water in small community systems. PhD Thesis. Dalhousie University Halifax, Nova Scotia.

Kot, M., Castleden, H., Gagnon, G.A., 2015. The human dimension of water safety plans: a critical review of literature and information gaps. Environ. Rev. 23 (1), 24–29. https://doi.org/10.1139/er-2014-0030.

Kot, M., Castleden, H., Gagnon, G.A., 2017. Preparing for success–drinking water safety plans and lessons learned from alberta: policy considerations contextualized for small systems. In: Water Policy and Governance in Canada. Springer, pp. 321–335.

Kumpel, E., Delaire, C., Peletz, R., Kisiangani, J., Rinehold, A., De France, J., Sutherland, D., Khush, R., 2018. Measuring the impacts of water safety plans in the asia-pacific region. In: Int. J. Environ. Res. Public Health 2018. vol. 15. pp. 1223.

Lebel, P.M., Reed, M.G., 2010. The capacity of Montreal Lake, Saskatchewan to provide safe drinking water: applying a framework for analysis. Can. Water Resour. J. 35 (3), 317–338.

Lockhart, G., Oswald, W.E., Hubbard, B., Medlin, E., Richard, J., 2014. Development of indicators for measuring outcomes of water safety plans. J. Water, Sanit. Hyg. Dev. 4, 171–181. https://doi.org/10.2166/washdev.2013.159.

Loret, J.F., Blaudin de Thé, C., Martin Alonso, J., Puigdomenech Serra, C., Kayser, G., Bartram, J., 2016. Assessing the Costs and Benefits of Water Safety Plans. Paper Presented at the IWA World Water Congress & Exhibition, Brisbane, Australia.
Maelzer, H.J., Staben, N., Hein, A., Merkel, W., 2010. Identification, assessment, and control of hazards in water supply: experiences from Water Safety Plan implementations in Germany. Water Sci. Technol. 61 (5), 1307–1315. https://doi.org/10.2166/wst.2010.026.
Magtibay, B., Chong, M.L., 2011. Philippine experience in introducing and scaling up water safety plans. Waterlines 30 (3), 203–211.
Mahmud, S.G., Shamsuddin, S.A.J., Ahmed, M.F., Davison, A., Deere, D., Howard, G., 2007. Development and implementation of water safety plans for small water supplies in Bangladesh: benefits and lessons learned. J. Water Health 5 (4), 585–597.
Marks, S., Kumpel, E., Guo, J., Bartram, J., Davis, J., 2018. Pathways to sustainability: a fuzzy-set qualitative comparative analysis of rural water supply programs. J. Clean. Prod. 205, 789–798.
Mercer, J., Bartram, J., 2011. Worldwide Regulatory Strategies and Policies for Drinking Water. Encyclopedia of Environmental Health. Elsevier B.V.
Moher, D., Liberati, A., Tetzlaff, J., Altman, D., The PRISMA group, 2009. Preferred reporting items for systematic reviews and meta-Analyses: the PRISMA statement. PLoS Med. 6, e1000097.
Nam, R.K., Heijnen, H., 2011. Keeping drinking water safe: adopting water safety plans in rural Nepal. Waterlines 30 (3), 212–222. https://doi.org/10.3362/1756-3488.2011.024.
NHMRC, NRMMC, 2011. Australian Drinking Water Guidelines Paper 6 National Water Quality Management Strategy. National Health and Medical Research Council, National Resource Management Ministerial Council, Commonwealth of Australia, Canberra.
OECD, 2012. Supporting Partners to Develop Their Capacity. 12 Lessons from DAC Peer Reviews. http://www.oecd.org/dac/peer-reviews/12lessonscapdev.pdf, Accessed date: 21 September 2018.
Omar, Y.Y., Parker, A., Smith, J.A., Pollard, S.J.T., 2017. Risk management for drinking water safety in low and middle income countries - cultural influences on water safety plan (WSP) implementation in urban water utilities. Sci. Total Environ. 576, 895–906. https://doi.org/10.1016/j.scitotenv.2016.10.131.
Parker, A., Summerill, C., 2013. Water safety plan implementation in East Africa: motivations and barriers. Waterlines 32 (2), 113–124.
Peletz, R., Kumpel, E., Bonham, M., Rahman, Z., Khush, R., 2016. To what extent is drinking water tested in sub-Saharan Africa? A comparative analysis of regulated water quality monitoring. Int. J. Environ. Res. Publ. Health 13 (3), 275.
Perrier, E., Kot, M., Castleden, H., Gagnon, G., 2014. Drinking water safety plans: barriers and bridges for small systems in Alberta, Canada. Water Pol. 1696, 1140–1154.
Pollard, S.J.T., Strutt, J.E., MacGillivray, B.H., Hamilton, P.D., Hrudey, S.E., 2004. Risk analysis and management in the water utility sector: a review of drivers, tools and techniques. Process Saf. Environ. Protect. 82 (B6), 453–462.
Popham, J., 1997. What's wrong - and what's right - with rubrics. Educ. Leadersh. 55 (2), 72–75.
Rehfuess, E.A., Bruce, N., Bartram, J.K., 2009. More health for your buck: health sector functions to secure environmental health. Bull. World Health Organ. 87 (11), 880–882 PMID: 20072777.
Reid, D.C., Abramowski, K., Beier, A., Janzen, A., Lok, D., Mack, H., Radhakrishnan, H., Rahman, M.M., Schroth, R., Vatcher, R., 2014. Implementation of Alberta's drinking water safety plans. Water Qual. Res. J. Can. 49 (1), 5–9.
Rinehold, A., Corrales, L., Medlin, E., Gelting, R.J., 2011. Water Safety Plan demonstration projects in Latin America and the Caribbean: lessons from the field. Water Sci. Technol. Water Supply 11 (3), 297–308.
Ringwood, F., 2017. Unpacking water safety. Water & Sanitation Africa 12 (6), 28–31.
Rogers, E.M., 2003. Diffusion of Innovations. Free Press, New York.
Rosén, L., Hokstad, P., Lindhe, A., Sklet, S., Røstum, J., 2007. Generic Framework and Methods for Integrated Risk Management in Water Safety Plans, TECHNEAU Report. Deliverable no. D 4.1.3, D 4.2.1, D 4.2.2, D 4.2.3.
Rouse, M., Pilgrim, N., Nair, A., 2010. Water Safety Plans for Rural Water Supply in India. Policy Issues and Institutional Arrangements. World Bank, Washington, DC.
Sawyer, R.K., 2006. The Cambridge Handbook of the Learning Sciences. Cambridge University Press, New York.
Schmoll, O., Castell-Exner, C., Chorus, I., 2011. From international developments to local practice: Germany's evaluation and dialogue process towards water safety plan implementation. Water Sci. Technol. Water Supply 11 (4), 379–387.
Setty, K., O'Flaherty, G., Enault, J., Lapouge, S., Loret, J.-F., Bartram, J., 2018. Assessing operational performance benefits of a water safety plan implemented in southwestern France. Perspect. Public Health 138, 270–278. https://doi.org/10.1177/1757913918787846.
Setty, K.E., 2019. A Complex Public Health Intervention to Improve Drinking Water Safety Shows Contextual Variability in High-Income Countries. Unpublished Doctoral Dissertation. University of North Carolina at Chapel Hill, Department of Environmental Sciences and Engineering.
Shamsuddin, S., Mahmud, S., Ahmed, M., Deere, D., Davison, A., Howard, G., 2005. Developing a water-safety framework in Bangladesh. Waterlines 23 (4), 11–13. Retrieved from http://www.jstor.org/stable/24684699.
String, G., Lantagne, D., 2016. A systematic review of outcomes and lessons learned from general, rural, and country-specific Water Safety Plan implementations. Water Sci. Technol. Water Supply 16 (6), 1580–1594.
Summerill, C., Pollard, S.J.T., Smith, J.A., 2010a. The role of organizational culture and leadership in water safety plan implementation for improved risk management. Sci. Total Environ. 408 (20), 4319–4327.
Summerill, C., Smith, J.A., Webster, J., Pollard, S.J.T., 2010b. An international review of the challenges associated with securing 'buy-in' for water safety plans within providers of drinking water supplies. J. Water Health 8 (2), 387–398.
Sutherland, D., Payden, 2017. Observations and lessons learnt from more than a decade of water safety planning in South-East Asia. WHO South East Asia J. Publ. Health 6 (2), 27–33.
Terceiro Jorge, T., Nam, R.K., Kandel, B., Darnal, K., 2013. Case Study on WSP Implementation and Lessons Learned: Amarapuri Water Supply, Nepal. http://www.wsportal.org/wp-content/uploads/2016/04/Amarapuri-WSP-FINAL.pdf-29-jul-2013.pdf, Accessed date: 12 November 2018.
The Water Institute at UNC, 2018. http://waterinstitute.unc.edu/learning/water-safety-plans/, Accessed date: 30 October 2018.
Tight, M., 2003. Key Concepts in Adult Education and Training. Routledge, London.
UN, 2015. A/RES/70/1 - Transforming Our World: the 2030 Agenda for Sustainable Development.
UN, 2018. Sustainable Development Goal 6. Synthesis Report on Water and Sanitation 2018. . http://www.unwater.org/publications/highlights-sdg-6-synthesis-report-2018-on-water-and-sanitation-2/, Accessed date: 17 July 2018.
UNDP, 2010. Measuring capacity. http://content-ext.undp.org/aplaws_publications/2679640/UNDP_Measuring_Capacity_July_2010.pdf, Accessed date: 17 October 2018.
UN-HABITAT, 2016. Water Operators' Partnership Case Study. Companhia de Saneamento de Minas Gerais (COPASA) and Empresa Municipal de Saneamiento Básico de Puno (EMSAPUNO).
USAID, 2018. Learning from the Philippines to Advance Water Safety Planning in Indonesia. https://www.iuwashplus.or.id/arsip/3343?lang=en, Accessed date: 20 November 2018.
Vallejo, B., Wehn, U., 2018. Capacity development evaluation: the challenge of the results agenda and measuring return on investment in the Global South. World Dev. 79 (1–13) ISSN 0305-750X. https://doi.org/10.1016/j.worlddev.2015.10.044.
Vieira, J.M., 2011. A strategic approach for Water Safety Plans implementation in Portugal. J. Water Health 9 (1), 107–116. https://doi.org/10.2166/wh.2010.150.
Viljoen, F.C., 2010. The World Health Organization's water safety plan is much more than just an integrated drinking water quality management plan. Water Sci. Technol. 61, 173–179.
Visscher, A.J.T., Leta, B.S., Wandera, C.J., Knoop, D.L., de Vos, E.H., Kragic, F.D., Mukherjee, G.R., 2009. Hybrid distance water learning in Ethiopia. In: 34th WEDC International Conference, Addis Ababa, Ethiopia.
WHO EURO, 2014a. Water Safety Plan: a Field Guide to Improving Drinking-Water Safety in Small Communities. http://www.euro.who.int/en/publications/abstracts/water-safety-plan-a-field-guide-to-improving-drinking-water-safety-in-small-communities, Accessed date: 22 November 2018.
WHO EURO, 2014b. Water Safety Plans in Eastern Europe, the Caucasus and Central Asia. Summary of a Workshop on Building Capacities for the Development of Water Safety Plans. http://www.euro.who.int/en/health-topics/environment-and-health/water-and-sanitation/publications/2014/water-safety-plans-in-eastern-europe,-the-caucasus-and-central-asia, Accessed date: 24 September 2018.
WHO EURO, 2016a. Taking Policy Action to Improve Small-Scale Water Supply and Sanitation Systems. Tools and Good Practices from the Pan-European Region. http://www.euro.who.int/en/publications/abstracts/taking-policy-action-to-improve-small-scale-water-supply-and-sanitation-systems.-tools-and-good-practices-from-the-pan-european-region-2016, Accessed date: 22 November 2018.
WHO EURO, 2016b. Status of Small-Scale Water Supplies in the WHO European Region. http://www.euro.who.int/en/publications/abstracts/status-of-small-scale-water-supplies-in-the-who-european-region.-results-of-a-survey-conducted-under-the-protocol-on-water-and-health-2016, Accessed date: 17 July 2018.
WHO SEARO, 2014. WHO-AusAID Water Quality Partnership for Health: Phase 3. WHO Regional Office for South-East Asia. http://www.who.int/iris/handle/10665/206139, Accessed date: 22 January 2019.
WHO SEARO, 2016. Capacity Training on Urban Water Safety Planning - Training Modules. http://www.searo.who.int/entity/water_sanitation/documents/WSP_Training_Modules/en/, Accessed date: 22 November 2018.
WHO Western Pacific Region, 2008. Training Workbook on Water Safety Plan for Urban Systems. http://iris.wpro.who.int/handle/10665.1/6746, Accessed date: 22 November 2018.
WHO, 2006. International Meeting on the Management of Water Quality in Rural and Remote Communities. Alice Springs, Australia 19-22 July 2005. http://apps.who.int/iris/handle/10665/204414, Accessed date: 22 November 2018.
WHO, 2012a. Water Safety Planning for Small Community Water Supplies. https://www.who.int/water_sanitation_health/publications/small-comm-water_supplies/en/, Accessed date: 21 January 2019.
WHO, 2012b. WSP Training Package. http://www.who.int/water_sanitation_health/publications/wsp_training_package/en/, Accessed date: 22 November 2018.
WHO, 2014a. Investing in Water and Sanitation: Increasing Access, Reducing Inequalities. UN-water Global Analysis and Assessment of Sanitation and Drinking-Water. GLAAc2014. http://apps.who.int/iris/bitstream/handle/10665/143953/WHO_FWC_WSH_14.01_eng.pdf;jsessionid=20C47A5068E3267040B006B236F8D7F9?sequence=2, Accessed date: 17 July 2018.
WHO, 2014b. Midterm Review Meeting of Phase 3 of the Water Safety Plan Programme (2012–2016), Manila, Philippines. pp. 24–26. June 2014: report. http://www.wpro.who.int/environmental_health/documents/docs/meeting_report_midterm_review_phase3_water_safety_plan.pdf, Accessed date: 22 November 2018.
WHO, 2014c. Water Safety in Distribution Systems. http://www.who.int/water_sanitation_health/publications/water-safety-in-distribution-system/en/, Accessed date: 22 November 2018.
WHO, 2017a. Guidelines for Drinking-Water Quality, fourth ed. incorporating the 1st addendum. http://www.who.int/water_sanitation_health/publications/gdwq4-with-add1-chapters/en/, Accessed date: 22 November 2018.

WHO, 2017b. Global Status Report on Water Safety Plans. A Review of Proactive Risk Assessment and Risk Management Practices to Ensure the Safety of Drinking-Water. . http://www.who.int/water_sanitation_health/publications/global-status-report-on-water-safety-plans/en/, Accessed date: 22 November 2018.

WHO, 2017c. Financing Universal Water, Sanitation and Hygiene under the Sustainable Development Goals. UN-water Global Analysis and Assessment of Sanitation and Drinking-Water. GLAAS 2017 Report. http://apps.who.int/iris/bitstream/handle/10665/254999/9789241512190-eng.pdf?sequence=1, Accessed date: 17 July 2018.

WHO, 2017d. Development of Action Plans for Achieving and Monitoring SDG Wash Targets–Lessons from Accomplishments of the WHO/DFAT Water Quality Partnership. Manila: WHO Regional Office for the Western Pacific, Manila, Philippines, pp. 20–23. February 2017: meeting report. http://apps.who.int/iris/handle/10665/260155, Accessed date: 22 November 2018.

WHO, 2017e. Water Safety Planning: A Roadmap to Supporting Resources. http://www.who.int/water_sanitation_health/publications/wsp-roadmap-v2.pdf?ua=1, Accessed date: 12 July 2018.

WHO, DFAT, 2015. Water Safety Plans (WSPs) as Normal Practice: Policy and Institutional Strengthening for WSP Mainstreaming. Six-Monthly Report for the Period: 1 January – 30 June 2015. Internal WHO Report. Unpublished.

WHO, DFAT, 2017. Water Safety Plans as Normal Practice: Policy and Institutional Strengthening for WSP Mainstreaming. Final Report for Phase 3 (July 2012 – June 2017). Internal WHO Report. Unpublished.

WHO EURO, UBA, IWA, 2014. European Strategic Workshop on Water Safety Planning. http://www.umweltbundesamt.de/sites/default/files/medien/374/dokumente/berlin_wsp_workshop_report_final.pdf, Accessed date: 11 May 2018.

WHO, IWA, 2010. Think Big, Start Small, Scale up: a Road Map to Support Country-Level Implementation of Water Safety Plans. World Health Organization, Geneva. http://www.who.int/entity/water_sanitation_health/dwq/thinkbig_small.pdf?ua=1, Accessed date: 22 November 2018.

WHO, IWA, 2013. Water Safety Plan Quality Assurance Tool. https://www.who.int/water_sanitation_health/publications/water-safety-quality-assurance/en/, Accessed date: 10 January 2019.

WHO, IWA, 2015. A Practical Guide to Auditing Water Safety Plans. http://www.who.int/water_sanitation_health/publications/auditing-water-safety-plans/en/, Accessed date: 17 July 2018.

WHO, IWA, 2018. Water Safety Portal. http://www.wsportal.org, Accessed date: 30 October 2018.

Wood, D., Bruner, J.S., Ross, G., 1976. The role of tutoring in problem solving. JCPP (J. Child Psychol. Psychiatry) 17 (2), 89–100.

Yarber, L., Brownson, C.A., Jacob, R.R., Baker, E.A., Jones, E., Baumann, C., Deshpande, A.D., Gillespie, K.N., Scharff, D.P., Brownson, R.C., 2015. Evaluating a train-the-trainer approach for improving capacity for evidence-based decision making in public health. BMC Health Serv. Res. 15, 547.