Chapter 18
The Technology Applicability Framework. A Participatory Tool to Validate Water, Sanitation, and Hygiene Technologies for Low-Income Urban Areas

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Abstract Decision-makers as well as practitioners in the water, sanitation, and hygiene (WASH) sector are facing serious challenges to keep existing WASH infrastructure in operation or to ensure provision of lasting and adequate WASH services. In many countries there are no tested procedures for assessing sustainability and scalability of new or existing technologies for providing adequate and lasting WASH services in a specific context. In the EU-FP7-funded project WASHTech, two tools for technology validation and introduction were developed and tested: the Technology Applicability Framework (TAF) and the Technology Introduction Process (TIP). The TAF is a comprehensive decision support tool centered around 18 sustainability indicators. In a participatory process it examines the financial, social, institutional, legal, environmental, technical, and capacity conditions in the given context from three perspectives: (i) users/buyers, (ii) producers/providers, and (iii) regulators/investors/facilitators involving all key stakeholders [e.g., municipality and nongovernmental organizations (NGOs)]. Consequently, the TAF determines the match—or mismatch—of the contextual conditions with the technology being considered and the key requirements for successful introduction. The TAF was field tested on 13 WASH technologies in three countries: Burkina Faso, Ghana, and Uganda. This paper presents the findings from the testing of the TAF and highlights potentials and limits of its applicability for assessing the sustainable application and scalability of WASH technologies. Relevant documents on the methodology, the testing as well as case studies and manuals are accessible in the public domain through www.washtechnologies.net.

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18.1 Introduction

Despite major efforts to increase water and sanitation coverage, many people living in urban and peri-urban contexts in developing countries still lack access to safe water and adequate sanitation (UNICEF 2014). One reason is that often introduced water and sanitation technologies are not sustainable in a given urban or peri-urban context. Even so-called 'appropriate' technologies often fail when the expectations of the users are not met and determining factors to sustain the technology are lacking (Cranfield University 2011).

Successful uptake and provision of lasting services are linked to many different aspects such as the acceptance of technologies, the ability of users to purchase the infrastructure and pay recurrent costs for operation and maintenance, the knowhow and skills to operate and maintain the system, and the resources and capacity of local governments to support user communities (Lockwood and Smits 2011). A technology can be considered successful when it is taken up by a great number of users (scaling up) and when it provides its services over a long time (sustainability) (Fig. 18.1).

Technology introduction and uptake are very complex and resource-intensive processes that involve many actors over a long period of time. Each introduction needs a careful, context-specific assessment of various sustainability aspects, and different market models ask for different roles for the actors involved (Heierli and Katz 2007).

A literature review on assessment frameworks for projects and technologies revealed the complexity of considering sustainability properly in assessment methodologies (Skat Foundation 2011). Most frameworks do focus on assessments of projects or programs with respect to sustainability; yet only some put technologies as the focus of the sustainability assessment, and none of them link the sustainability assessment with key issues around successful technology introduction.

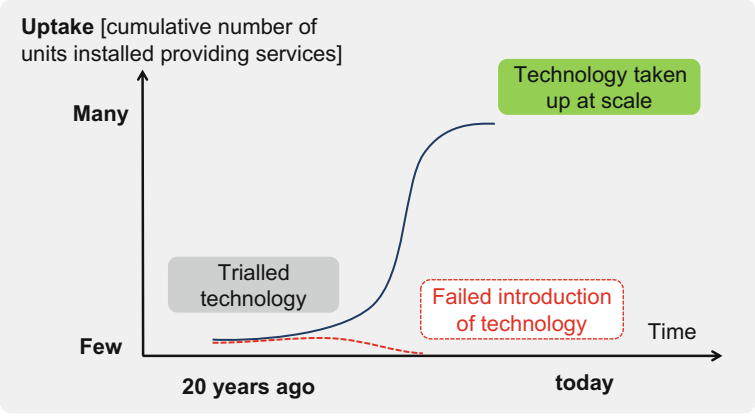

Fig. 18.1 Uptake dynamics for new technologies

Currently, more and more new technologies are being developed and promoted in the water, sanitation, and hygiene (WASH) market. Decision-makers are challenged with assessing the applicability and scalability and to make informed choices on promising technologies and service models that fit a specific context. The choice of the right, context-sound technology is a key requirement for achieving sustainable water and sanitation services (WaterAid 2011).

However, not all promising technologies that have been piloted and theoretically fulfill the requirements to be sustainable end up being scaled up. The reasons for this failure are manifold: for example, they may have not been considered by the national or local sector agencies as potential water and sanitation technologies, or proper maintenance may not be guaranteed due to a lack of skilled service providers.

For urban and peri-urban areas the situation is particularly challenging. Improving access in these areas might be highly sensitive to equity and inclusion issues, as improvements of services are often correlated with the level of wealth of the users (UNICEF 2012). In some areas where new piped systems were introduced, only the well-off benefited, as the poorer parts of the population could not afford these services or were not connected to the service at all (World Bank 2014). Hence, introduction of technologies providing services is very much linked to issues not only around equity, inclusion, and environment, but also accountability and governance.

Decision-makers such as governments, development partners, or private investors need efficient and robust tools for assessing the applicability of WASH technologies. However, so far there are no robust tested tools available which allow a comprehensive assessment of WASH technologies and which also evaluate the procedures around their introduction (Skat Foundation 2011).

The objectives of the WASHTech were therefore (i) to develop a comprehensive tool, the Technology Applicability Framework (TAF), to validate new or existing WASH technologies on their applicability within a specific context, and (ii) to develop a guide, the Technology Introduction Process (TIP) which supports decision-makers at the country, district, or city level in the successful introduction of a validated technology in a given institutional framework. The work was done in the framework of the EU-funded WASH Technologies project (WASHTech), which aimed to facilitate cost-effective investments in sustainable WASH technologies.

18.2 Design and Methods

18.2.1 General Overview

WASHTech was organized as an action research project to develop and test an assessment methodology with close involvement and interaction of partners in Burkina Faso, Ghana, and Uganda. As a starting point, key issues around WASH technologies and their uptake in the African continent were documented and discussed in a literature review (Cranfield University 2011). Additionally, a baseline

study on knowledge, attitudes, and practice (KAP) of sector stakeholders toward WASH technologies and on existing processes for technology approval was carried out in the three African project countries of Burkina Faso, Ghana, and Uganda. It highlighted the different levels of practices, of formal procedures, and of attitudes around technology assessment (Cranfield University 2012). Changes in attitudes of key actors at the national level in these three countries were assessed throughout the project duration by collecting "change stories" and reviewing these using the "most significant change" methodology (Davies and Dart 2005). A strong embedding and communication strategy using learning alliances was designed and established to have full participation of the key sector stakeholders from the onset of the project.

In the WASHTech project the TAF methodology was developed and tested in three steps over a period of 3 years (Fig. 18.2).

In the first year, the activities focused on the definition of objectives and requirements for the tool, on the development of the draft TAF tool and of a methodology to test the usefulness of the TAF. Key requirements of the tool were defined by the project partners and the key actors in the WASH sector in the three countries. Inputs were collected through meetings at national levels and joint meetings and resulted in the following key points:

- the tool should be an assessment tool for the assessment of the applicability and scalability of existing and new WASH technologies;
- the tool should be simple to use;
- the target audience should focus on stakeholders from national and urban/municipal governments, local private sector enterprises, local NGOs, research and development institutions, and also development partners and universities.

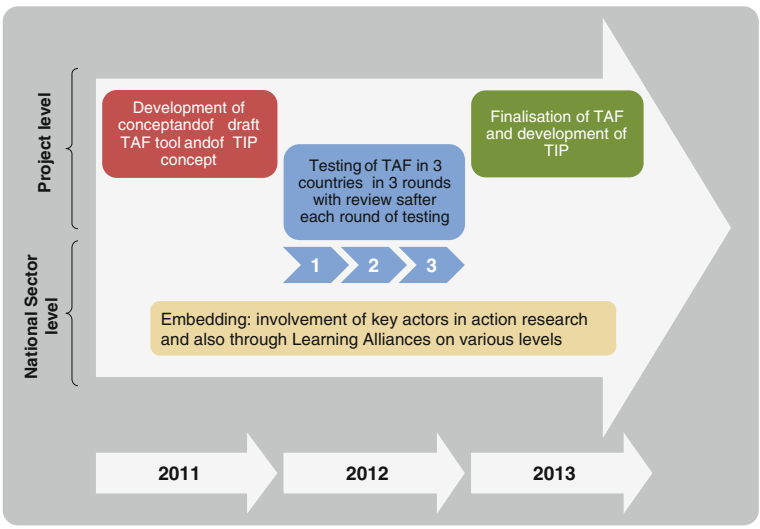

Fig. 18.2 Process of TAF development, testing, and embedding

Based on these inputs a draft methodology of the TAF and of the TIP was developed (Olschewski and Casey 2013). In parallel, the research methodology to test the usefulness of the TAF was developed (WaterAid 2012).

In 2012 the draft TAF tool was rigorously field tested in each of the three project countries. For the testing the TAF was applied to 13 different water, sanitation, and hygiene technologies, which were selected by the countries and which fit in rural, small town, and peri-urban contexts.

The selected technologies included:

- in Burkina Faso: Rope Pump, VIP Latrine, India Mark II, Urine Diversion Dry Toilet (UDDT), Sand Dam, and Water Harvesting Tank;
- in Ghana: Rope Pump, Pour Flush, Enviroloo, Slow Sand filter, Biofil toilet, Ghana-Modified India Mark II, and small piped systems using solar power;
- in Uganda: Rope Pump, UDDT, U2 Pump, Tippy Tap, small piped systems using solar power, and Ferro Cement Tank.

Although the WASH technologies tested with the TAF were situated in rural settings, the TAF is equally applicable for any urban WASH technology.

The field testing was organized in three rounds during which the testing was done in parallel steps in all three countries. Each round was followed by an extensive review of research findings with subsequent adaptation of the draft process and tools (Olschewski and Casey 2013). Testing the TAF in parallel steps allowed the teams to share experiences in review meetings at the end of each round of testing and to discuss and recommend amendments to the TAF. The amended TAF was then tested in the next round. After the final round of testing in 2013, a final version of the TAF was produced, including a short TAF manual which guides the user through the details of planning and application of the TAF.

18.2.2 Research Objectives and Structure for Research

The aim of the TAF testing research method was to evaluate the suitability and usefulness of the TAF for its intended users and intended purpose. To achieve this aim, the WASHTech consortium members agreed on a set of four research questions:

1. How easy do target users find the TAF to use?
2. How useful do target users find the TAF for an assessment of WASH technologies and the methods used to introduce them? Did the findings of the TAF square with people's perceptions of the technologies and approaches?
3. How should the TAF be adjusted to meet the needs of target users?
4. Will TAF users think differently about technologies and approaches after using the TAF?

For testing the TAF was applied at district and subdistrict levels, which means in real situations and workshops where all relevant stakeholders took part to ensure that the TAF reflected reality and could be applied in any rural or urban context. After each round of TAF application, study teams in each country sought the feedback and perspectives of different target users on the four questions and fed this into the further TAF design process.

In order to test the TAF, it was applied to WASH technologies and services at different stages of development, such as technologies considered to be "new," "promising," "successful," or "failed."

- "New" refers here to technologies that have not been tried in a given context but might have been tried in other contexts and are considered to offer opportunities worth investigating.
- "Promising" refers to technologies that are perceived to have yielded some useful experiences but have not yet achieved scale.
- "Successful" refers to technologies that have been tried and tested and are perceived to have achieved impact, scale, and sustainability.
- "Failed" refers to technologies that have been introduced and tried in some locations but have not yielded many successful experiences. "Failed" could mean that the technology itself, the introduction process, or both were not sufficient to produce promising results. However, "failed" does not mean that a technology might never be useful in a particular context.

For each of the 13 WASH technologies, two assessments of the performance of the technology were done by sector specialists: one prior to the TAF testing and one afterward. The purpose of asking about "perceived performance" before and after the TAF application was to gauge perceptions and performance of the technologies.

A combination of methods was used during testing to derive information about the TAF and the technologies being tested. These included focus group discussions, semi-structured key informant interviews, and literature reviews. The field visits enabled sufficient information about different technologies to be gathered. They captured the perspectives of users and local stakeholders and informed the TAF developers of the context in which the technology had been applied. The workshops enabled the outcomes of the field visits to be shared. At the workshops, the TAF was used to score the technologies being assessed in a participatory way and to discuss the findings.

There was not sufficient time and budget available to carry out a statistically significant number of household interviews to assess technologies. This reflects reality, as districts using the TAF would not have the time or budget available for such a survey. The TAF assessments are intended to be rapid, and the research method is likewise intended to reflect this reality.

The application of the TAF also enabled developing specific recommendation for these technologies to be used by the sector. These were published as technology briefs in separate reports.

18.3 Results

As a result of the action research approach and the testing of the TAF, two tools were developed: the TAF for assessing applicability and scalability of WASH technologies and the TIP, which is a generic guidance document to support the WASH sector in the introduction of promising technologies.

The TAF is a decision support tool that functions in three ways within a given context: (1) it identifies an applicable and sustainable WASH technology from those that are not; (2) it reveals risks and supportive factors that influence the successful introduction or roll out of this technology which need to be addressed prior to success; and (3) it triggers exchange and sharing between all key actors involved in the introduction of that technology in its context. Applying the TAF to new and also existing water and sanitation technologies should significantly increase the success of technologies and their introduction and, even more importantly, the sustainability of the water and sanitation service delivery for the urban poor. The target users of the TAF include national and urban/municipal governments, local private sector enterprises, NGOs, development partners, research and development institutions, and universities. The TAF can also be used to monitor current WASH technologies in urban settings to determine success or identify hindering factors toward sustainability.

The core elements of the TAF are:

- a set of **18 indicators for a comprehensive assessment** of the applicability of technologies, and of successful introduction, sustainable use, and operation of technologies providing lasting services;
- a **participatory process of application** of the TAF with involvement of all relevant actors including users of the technology, providers of the technology, and regulators and facilitators in all steps of the assessment, including scoring;
- a **graphical interface** that facilitates transparent presentation and interpretation of results for all actors involved.

18.3.1 Comprehensive Indicator Set on Sustainability and Introduction Issues

The successful introduction of technologies needs to comprehensively address key issues of sustainability, e.g., affordability of costs for users. The analysis of case studies on technology introduction also revealed the urgent need to consider in the assessment methodology the particular perspectives of the key actors involved, as all these actors should take on specific roles in the process of technology introduction. The indicator system of the TAF methodology therefore reflects the six

Perspective / Sustainability Dimension	User / buyer	Producer / provider	Regulator investor facilitator
Social	(1) Demand for the technology	(2) Need for promotion and market research	(3) Need for behavioural change and social marketing
Economic	(4) Affordability	(5) Profitability	(6) Supportive Financial Mechanisms
Environmental	(7) Potential for benefits or negative impacts for user	(8) Potential for local production of product or spares	(9) Potential for negative impacts or benefits for natural resources on a larger scale
Legal, institutional, organisational	(10) Legal structures for management of technology and accountability	(11) Legal regulation and requirements for registration of producers	(12) Alignment with national strategies and validation procedures
Skill and knowledge	(13) Skill set of user or operator to manage technology including O&M	(14) Level of technical and business skills needed	(15) Sector capacity for validation, introduction of technologies and follow up
Technological	(16) Reliability of technology and user satisfaction	(17) Viable supply chains for product, spares and services	(18) Support mechanisms for upscaling technology

Fig. 18.3 The 18 TAF indicators

sustainability dimensions with three perspectives of key actor groups: the user of the technology, the producer or provider (supply chain) and the regulator, and investor or facilitator of the introduction process. For each match of dimension and perspective, one key indicator was selected (Fig. 18.3).

For each of the 18 TAF indicators a specific questionnaire has been developed which includes 4–6 guiding questions and one scoring question. In the assessment workshop after the field visits, the answers to all questions were discussed within the scoring workshop participants, including the representatives of all three perspectives and additional participants. For the data validation and to go through all questions in a scoring workshop setting, usually a one-day workshop was organized. To allow participation of the user community in the workshop, the event was organized within the district of discussion. In their feedback on the TAF testing the actors involved acknowledged that all 18 indicators were needed to allow a comprehensive assessment.

18.3.2 Clear and Participatory Process to Give Everybody a Voice

Technology introduction needs substantial investment of financial resources, e.g., to do market research, product development, and testing, as well as to launch it to the wider market. However, vested interests could influence the process and results of technology assessments. In urban and peri-urban areas these risks are also prominent, as dynamics and driving forces such as from the local private sector or vested interests of key actors such as leaders might be very strong. Decision-making processes for technology introduction are often not transparent in terms of process and communication so that less influential parts of the population have no voice, such as the poorest of the urban population.

The TAF is applied to one technology in one specific context, e.g., technology X in district YZ, and is carried out in four steps (Fig. 18.4). The TAF methodology follows a stepwise transparent process with defined tools and a transparent and participatory process for assessing WASH technologies. In the field visits and in the scoring workshop all relevant stakeholders do participate and have the opportunity for their voice to be heard.

In the first TAF step, the screening, WASH technologies are identified that are found to be unsuitable in meeting users' needs within the specified context. During the step 2, the TAF users undertake a comprehensive assessment of the applicability and scalability of the technology in a specific context using 18 indicators. Both quantitative and qualitative data are gathered from national, local, and community levels and from various other stakeholders using also field visits. Data and information undergo a process of validation in a workshop involving all relevant stakeholders. In the scoring workshop each indicator is designated a score/symbol discussed and agreed upon by consensus of the workshop participants. The scoring bears resemblance to a traffic light

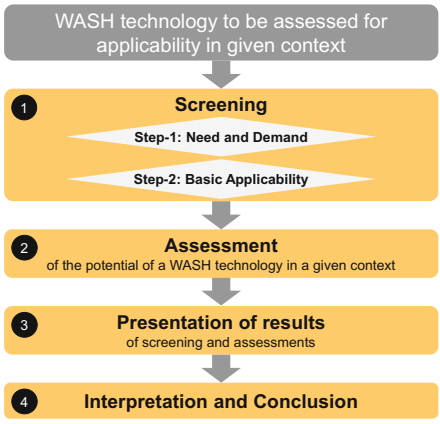

Fig. 18.4 Flow of the 4 TAF steps

system. In step 3 the results of the screening and assessment on the applicability of a technology within a given low-income urban context will be visualized. This forms the basis for the interpretation of the results in the step 4.

In their feedback from the TAF testing the actors involved stressed that they see a clear need to have a well-structured process as basis for an assessment using the four steps. In particular, it was highly appreciated that the TAF foresees the involvement of all key people in key steps of the assessment process such as the users and the regulator.

18.3.3 The TAF Profile Allows Visualization of Results and Offers Transparent Options for Interpretation

Based on the results of the scoring workshop the scores for all 18 indicators given during the assessment (step 2) are presented in a graphic profile following the logic in the matrix (Fig. 18.5).

In this form of presentation, all six dimensions and perspectives are implicitly considered with the same weight. Indicators are not aggregated, e.g., per color or dimension, to keep the detailed information behind each score. This presentation also allows different entry points for interpretation such as per sustainability dimension, per perspective, or for specific topics or as an entire profile. In this form all 18 indicators have the same weight; however, for sensitivity analysis weighting factors can be introduced easily. Visualizing the results in this form allows all target users, including the users of the technology, who often have no technical

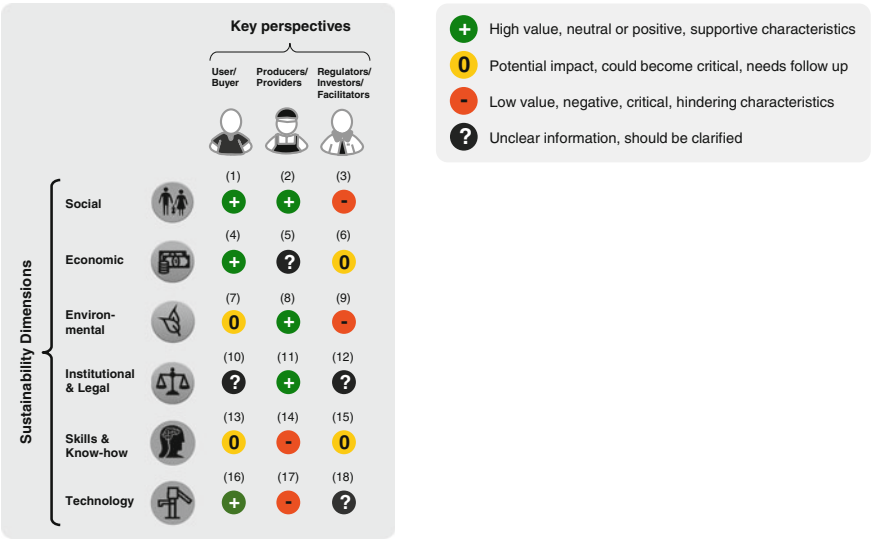

Fig. 18.5 Hypothetical example of TAF profile including scoring rules

background, to better understand the results and arrive at a more transparent and higher level of understanding of sector issues. This presentation fosters transparency of the results and maybe even acceptance of the results. Based on a higher acceptance there is a higher chance to develop and agree upon appropriate introduction mechanisms for adoption and/or scaling up and mobilize support in moving forward with the results of the technology assessed.

The results of the TAF application, including the screening and assessment, are documented in a short report highlighting the context-specific potential concerning applicability of a technology being considered for introduction in a specific context at a city/town or community level. The TAF report also indicates which topics need further attention for the technology to be successful from a sustainability perspective. For example, with areas of risk defined (red button with negative symbol), discussions on developing mitigation measures are better structured. However, the TAF results may also be negative for a technology, that is, the considered technology should not be applied in this context for reasons listed. In combination, the report and the process of the TAF application provide a robust basis for decision-making regarding a technology in an urban or peri-urban context; however, the TAF is not a selection tool that indicates which technology fits best.

In their feedback from the TAF testing, the actors involved liked the graphical way of presentation. There was no need expressed for changing the scoring rules. It was recommended to enrich the scores with verbal explanation and secondary information that is relevant. However, it was stressed that strong speakers could influence the discussion and the scoring. There are limits on how far a participatory approach can deal with these risks. In the TAF manual some concrete suggestions are included for how to deal with this situation. In any case when applying the TAF, a strong and independent facilitator is needed to steer and guide the process.

Actors involved in the field testing of the TAF also raised the issue of the costs for applying the TAF, as it involves field visits to the districts and workshops with participation of different partners from local and regional levels. Based on the experiences from the TAF applications, the costs for applying the TAF are about US$2000 for one assessment of one technology in one region, assuming that the facilitator is already familiar with the TAF methodology. As the methodology is based on field visits and workshops, there is not much space to reduce the costs because many costs, such as for local transport or for workshops, are fixed costs. However, compared to the lost costs that are often experienced in many poorly designed or managed technology introductions, the costs of applying the TAF seem to be rather low. A detailed description on preparatory steps needed when applying the TAF, e.g., identification of the cost figures for operation and maintenance as well as the cost drivers for applying the TAF, are documented in the TAF manual (Olschewski 2013). The TAF manual, technology briefs, and all other document reports on TAF and TIP are in the public domain and available through www.washtechnologies.net.

In all three countries host organizations at the national level were appointed by the leading ministries to host and streamline the TAF and TIP beyond the WASHTech project. The country hosts were the Community Water and Sanitation

Agency and Environmental Health and Sanitation Directorate (MoLGRD) in Ghana, the Appropriate Technology Centre of the MoWE in Uganda, and the Direction d'Etudes et Information sur l'Eau (DEIE) in the newly established Ministry for Water and Sanitation in Burkina Faso. In each of the three project countries, WASHTech also triggered a participatory process for defining and agreeing upon tasks among the various key actors involved in technology introduction based on the TIP. The resulting guidelines were embedded in core sector documents for technology validation at the national level. The TAF was also applied on WASH technologies in countries outside the WASHTech project such as in Tanzania, Afghanistan, South Sudan, and Nicaragua. In Nicaragua, the TAF was applied using the documents available without any further external training or remote support. The TAF users were very satisfied with the process, and results and more applications of the TAF are planned.

Also, in the existing WASHTech partner countries the TAF was further applied in 2014. Recently in Ghana, the Biofil toilet was validated and approved officially by using the TAF methodology. These tests have been initiated without external funding.

18.4 Conclusions

The experiences from the TAF development and testing in various countries and contexts highlighted the importance of allowing for exchange between different actors and participatory approaches when discussing applicability of WASH technologies and the way of introduction. This is also true in urban and peri-urban contexts which offer high potential for dynamics and interferences.

The concept of joint workshops allows bringing in each voice and thus strengthening accountability and governance. It helps to develop a common understanding of issues in the WASH sector, to develop mitigation measures, and to foster more structured sharing and, thus, innovation.

The uptake of the TAF methodology in all partner countries as well as beyond shows that there is a clear need for such tools and that the TAF has the potential to provide the support needed. In combination, the TIP and the TAF can be used as a tool box to support the testing and approval of WASH technologies; however, the results can also be used to support the design of introduction processes and to monitor technologies. More TAF applications are planned in the WASHTech countries as well as elsewhere.

So far the TAF has been designed for assessments of WASH technologies, however, due to its flexible and comprehensive approach it was already modified to allow assessment of WASH approaches such as assessing self-supply and even other technical solutions such as those for housing projects in the Philippines.

In order to extend the scope of TAF, i.e., toward approaches but also to improve its cost effectiveness, more research is needed. Additionally, long-term follow-up should be established to document the impacts of the use of the tools on the performance and level of innovation in all countries that use the tools.

Acknowledgments WASHTech was a 3-year action research project funded under the EU FP7 framework and implemented in the period 2011–2013. WASHTech involved all relevant stakeholders at national level in all three African partner countries Burkina Faso, Ghana, and Uganda throughout the project period to ensure strong embedding and realistic results.

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