Factors involved in sustained use of point-of-use water disinfection methods: a field study from Flores Island, Indonesia

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ABSTRACT

Many scientific studies have suggested that point-of-use water treatment can improve water quality and reduce the risk of infectious diseases. Despite the ease of use and relatively low cost of such methods, experience shows the potential benefits derived from provision of such systems depend on recipients' acceptance of the technology and its sustained use. To date, few contributions have addressed the problem of user experience in the post-implementation phase. This can diagnose challenges, which undermine system longevity and its sustained use. A qualitative evaluation of two household water treatment systems, solar disinfection (SODIS) and chlorine tablets (Aquatabs), in three villages was conducted by using a diagnostic tool focusing on technology performance and experience. Cross-sectional surveys and in-depth interviews were used to investigate perceptions of involved stakeholders (users, implementers and local government). Results prove that economic and functional factors were significant in using SODIS, whilst perceptions of economic, taste and odour components were important in Aquatabs use. Conclusions relate to closing the gap between factors that technology implementers and users perceive as key to the sustained deployment of point-of-use disinfection technologies.

Key words | chlorine disinfection, Indonesia, solar disinfection technology, sustainability, user acceptance

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INTRODUCTION

The incidence of waterborne and water-related diseases caused by unimproved water sources has long been evidenced by epidemiological studies and experimental research (Fewtrell *et al.* 2005; Clasen *et al.* 2007). Diarrhoeal diseases, typically caused by lack or inadequate water, sanitation and hygiene (WASH) are one of the main leading causes of child deaths in developing countries, resulting in 850,000 children under the age of five dying each year (Liu *et al.* 2012). For decades international efforts have addressed the problems of inadequate drinking sources through transfer of appropriate water treatment technologies, with the International Drinking Water Supply and Sanitation Decade, from 1989 to 1998 being the first systematic global effort. More recently, the United Nations have recognised, through Target 10 of Millennium Development Goals (MDGs), the urgent need to halve the proportion of people with no 'sustainable access to safe drinking water'. However, although progress towards the target has been made (WHO & UNICEF 2012), a significant effort is still required to ensure that improved water resources are delivered, used sustainably and remain of good quality.

Many epidemiological studies (Conroy *et al.* 1996; Quick *et al.* 2002; Sobsey *et al.* 2003) have suggested that point-of-use (POU) treatment methods (e.g. chlorination with appropriate storage, UV disinfection, solar disinfection (SODIS) by means of heat and UV-A irradiation), coupled with appropriate storage and sanitation and hygiene practices can improve the microbiological quality of water and reduce the risk of infectious diseases (Clasen *et al.* 2007).

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While other studies have questioned whether POU water treatment methods are consistently effective in reducing the risk of diarrhoeal disease (Schimdt & Cairncross 2009; Mäusezahl *et al.* 2009; Boisson *et al.* 2013), these remain a key part in the provision of safe drinking water, particularly when combined to hygiene and sanitation interventions.

Specific examples of POU technologies are SODIS and Aquatabs. SODIS, developed by the Swiss Federal Institute for Aquatic Science and Technology, exploits the synergetic effects of UV-A light and high temperature (45–65 °C) to destroy and/or inactivate pathogens in contaminated water using specially designed polyethylene terephthalate (PET) bottles. Meanwhile, Aquatabs (Medentech Ltd) are chlorine containing tablets, designed to inactivate most pathogens in water within 30 min. Such technologies are particularly needed in areas beyond water supply networks, i.e. without provision of tap water.

Despite the ease of use and relatively low costs of such treatment systems and the outreach of WASH interventions, disparities among developing regions as well as among different population strata are still present (WHO & UNICEF 2012). Furthermore, although promotion, training and participatory activities are nowadays well-established components of water technology transfer, they are often of insufficient quality to guarantee that modified behaviours are continued after implementation. Experience proves that success in meeting the MDGs depends primarily on recipient acceptance of and responsibility for the technology and its sustained use (Harvey & Reed 2007; Giné & Pérez-Foguet 2008). Defining the problem of POU methods effectiveness on the basis of their sustained use shifts the focus of analysis to the post-implementation phase, on users and implementers of such systems.

Typically, academic studies focusing on the human dimension of water and sanitation technologies have explored predictors of the technology diffusion, or identified users' willingness to pay for the systems. Moser & Mosler's study (2008) of motivators for SODIS adoption in Bolivia identified patterns of diffusions in key figures, such as opinion leaders, as well as on social networks supporting the technology uptake. Heri & Mosler (2008) showed that use and intended use of SODIS were affected by technology perceptions and availability of PET bottles, as well as cost and taste considerations. Similarly, in a study conducted in Central America, Altherr *et al.* (2008) found that intentions to use SODIS were related to its subjective norms (e.g. use by neighbours) and positive attitudes towards the technology. A further body of literature has explored users' willingness to pay for potential water supply interventions in developing countries, often using Contingent Valuation Methods (Whittington *et al.* 1993, 1998).

Although highly useful in identifying predictors which shape technology promotion and diffusion strategies, these contributions have primarily focused on the adoption aspects of those systems, confining their perspective to the pre-implementation phase of technology transfer. An important observation is that the benefits and effectiveness of POU treatment systems may become meaningless if the longevity of the transferred systems is not guaranteed (Brown *et al.* 2009). Challenges that may infringe the sustained use of the systems have been widely discussed in the literature. Communities and households may have not been convinced (or appropriately motivated) of the necessity of using the systems introduced (Ademiluyi & Odugbesan 2008; Figueroa & Kincaid 2010); financial costs, which users are expected to pay, for technology upkeep may prove unaffordable or unacceptable (Harvey & Reed 2007); benefits in terms of service quality may not be internalised by recipients; and lack of institutionalised monitoring and support may prevent quality assurance control (Ongley 2001).

The post-implementation challenge appears to be defined by the discrepancy between users' intentions and willingness to use and adopt technologies, and their actual behaviours after installation. In developing countries, however, the discrepancy between motivations and willingness in pre-implementation and subsequent experiences of use in post-implementation remains largely unexplored. To date, few academic studies have addressed the problem of acceptability from the temporal perspective of post-implementation (Rainey & Harding 2005; Brown *et al.* 2009). Such a perspective enables diagnosis and evaluation of emerging challenges that may undermine the sustained use of the introduced systems. The high number of technologies abandoned or misused at the end of the IDWSS Decade was cited as criticism of the failure of the 10-year global effort to provide universal WATSAN access to developing countries (Warner & Laugeri 1991). Regrettably, evidence of unused water supply systems is also provided in more recent contributions (Gutierrez 1999; Mackintosh & Colvin 2002), re-affirming the importance of diagnosing problems after implementation.

A novel approach to assess technology performance and acceptance in the post-implementation phase was developed by the authors. This is based on a conceptual tool, called RECAP (Receptivity and Attribute Perceptions) (Roma & Jeffrey 2011), which facilitates diagnosis of emerging problems by giving voice to both technology users and providers, allowing for analysis of the experiential and performance components of the systems. This study aims to evaluate the discrepancy between the intended performance and user experiences of two alternative methods for drinking water treatment, SODIS and Aquatabs, introduced in three villages in Flores Island, Indonesia. By evaluating factors favouring or hindering the sustained use of these technologies, this investigation aimed to provide fresh perspectives on those aspects of technology adoption, which might progress to sustained use and compliance.

METHODOLOGY

The development of the RECAP tool rests on the Receptivity model conceptualised by Jeffrey & Seaton (2004) to analyse stakeholders' adoption of water innovation options in industrialised countries. The Receptivity framework enables us to explore users' perceptions of problems related to water and sanitation and their ability to scan for new knowledge (*Awareness*); their understanding of the potentiality of knowledge exploitation and its association with needs and capabilities (*Association*); the process of learning to gain the knowledge and skills necessary to adopt a technology (*Acquisition*); and their ability to internalise a new artefact into their routine, organising maintenance and managing risk (*Application*). The focus on users' perceptions of technologies leads to investigating the multidimensional characterisation of technology systems through lenses of the stakeholders involved and exploring its *attributes*. These are properties of a technology, which recipients consider relevant and describe in their own terms and values. Drawing on Linstone *et al.*'s (1981) framework, we argue that water treatment technologies can be evaluated on the basis of a combination of attributes (i.e. economic, social, environmental, etc.) perceived by stakeholders, which constitute important determinants of the system and its acceptance and use. The methodology adopted for RECAP assessment stems from the Service Quality literature, which relates the service quality problem to a gap between its suppliers and consumers (Krepapa *et al.* 2003). The underpinning principle of gap analysis, employed in this research, is the possibility to evaluate quality of a service through a customer/user-centred approach. Its methodology fulfils the main premise for RECAP development: it is concerned with users and focuses on the process of delivery of a service, a technology or policy. The RECAP assessment (illustrated in Figure 1) aims to investigate the presence of a discrepancy between the performance and users' experience of water treatment methods and suggest appropriate solutions.

Two data sets were generated in the investigation: (i) the intended performance of SODIS and Aquatabs in the three villages of Flores island; and (ii) users' experiences of such technologies and factors affecting their sustained use. The first set of data was derived from the analysis of existing documentation and in-depth interviews with six stakeholders involved in the provision and implementation of SODIS and Aquatabs: the Project Manager of the local implementing non-governmental organisation (NGO) (one respondent), the village leaders (two respondents), the

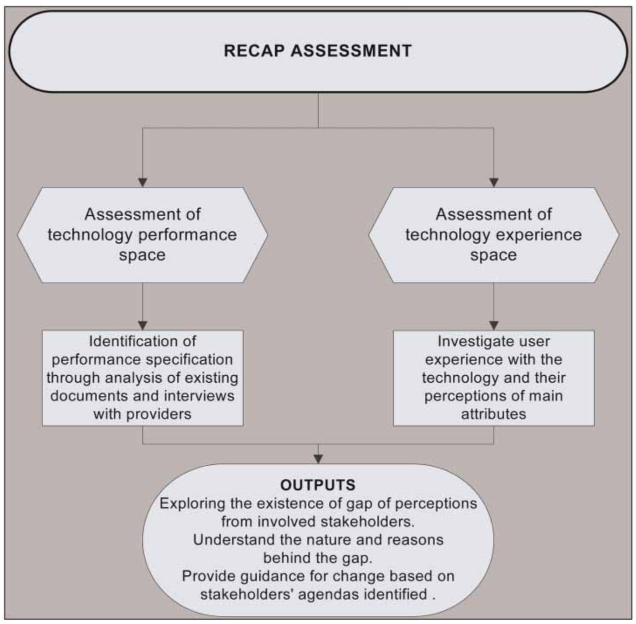

Figure 1 | RECAP assessment.

heads of two health clinics (two respondents) and the head of the Environmental Health Department at the local government (one respondent). Responses from in depth interviews were processed in Nvivo 8. Deductive coding was employed to sort responses along two specific aspects explored in the course of the interviews: benefits and challenges related to acceptance and sustained use of SODIS and Aquatabs. A second coding cluster was inductively generated within interview responses, to identify providers' perceptions of technology attributes. The co-occurrence of the two clusters (for example when 'economic aspects' of a POU method is indicated as a challenge), of coding was investigated by performing a matrix query that analyses frequency of responses co-occurring within the two clusters.

The second data set was collected through semi-structured interviews in three villages where the treatment methods were introduced. Questionnaires were back-translated into Bahasa Indonesian and pre-tested for validation in a small pilot. Due to the recognised role played by women in collecting supplies of drinking water (Arku 2010), female members from households (where possible), randomly selected during transect walks in the villages, were invited to participate in the interviews. From the entrance point of each village, every fifth house was selected. Interviews were conducted in the evenings to ensure household members were available. The survey questionnaires were administered by enumerators trained by the NGO and in depth interviews were conducted by local translators. Responses from the survey were inputted in SPSS and descriptive statistics were conducted. Finally data on incidence of diarrhoea from May 2007 to December 2008 in the three villages studied were supplied by respective local health clinics.

RESULTS

Overview of drinking water provision in the study area

Our study was undertaken in August 2009 in three villages of the East Nusa Tenggara province in Flores Island, which lies east of Java in the Indonesian archipelago. East-Nusa Tenggara is one of the poorest provinces of Indonesia, with 28% of its inhabitants living under the national poverty line and an economy based on subsistence agriculture (ADB 2006; Barlow & Gondowarsito 2009). The combination of dry climate, unfertile land and remoteness of this area makes poverty a chronic problem in the province, which is further exacerbated by the lack of basic water and sanitation services and the subsequent high prevalence of waterborne and water-related diseases (typhoid and diarrhoea) (Del Rosso 2009). These data were reported in Del Rosso (2009) as provided by Riskesdas Province Report (2007) and relates to school-aged children (5–14) in the East Nusa Tenggara province.

In the study area, each of the investigated villages was coded by the dominant method of disinfecting potable water, which in village S (Kolisia), village A (Gunung Sari) and village B (Watuliwung) were SODIS, Aquatabs and boiling, respectively. Before the two POU technologies were disseminated, boiling water was commonly undertaken in villages S and A. Table 1 presents a demographic overview of the three villages.

SODIS was disseminated by the local implementing NGO in May 2007 in villages S and B and in 2004 in village A. To counter the problem of SODIS 'seasonal use', with the technology primarily used in the dry season (April–-September), when average daily hours of sunlight are higher, in 2008 the local NGO introduced an alternative

Table 1 | User sample characteristics

Villages	Kolisia (Village S)	Gunung Sari (Village A)	Watuliwung (Village B)
Estimated households	603	325	468
Number of households surveyed	100	98	100
Mean household size	4.9	5.04	4.8
Mean age of respondents (years)	40.7	35.1	41.3
Proportion of poor households[a]	65%	22%	73%
Proportion of female respondents	91%	97%	81%

[a]Poor households earned less than 650,000 IDR (56.7 USD) per month and lived in anyaman bambu (bamboo) dwellings.

Table 2 | Technology performance

	SODIS	Aquatabs
Preparation procedure and time	– Plastic bottles, preferably of PET material are required – Contaminated water filtered to reduce suspended solids (<30 NTU) and placed in clear plastic bottles of 1–2 L volume – Water is oxygenated through shaking in contact with air – Bottles are exposed to full sunlight for a period of 6 h (or longer if the sky is cloudy)	– Water filtering into a 20 L appropriate container – Immerse Aquatabs tablet for 30 min
Benefits	– Simple preparation and easy to understand – Relatively low-cost after bottle acquisition – Minimal taste and smell in treated water – Documented reduction of infectious diarrhoea in users – Reported inactivation of viruses, protozoa and bacteria in water	– Easy to prepare and practical disinfection method – Safe to handle and transport – Minimal chlorine taste is provided – Relatively low cost – Documented reduction of infectious diarrhoea – Effective against cholera, typhoid, dysentery and other waterborne diseases
Implementation strategy	– Village demonstration and training on preparation and use conducted by local the NGO – Introduced in village A in 2004 and in villages S and B in 2007 – Field facilitators appointed to undertake promotional activities, sell bottles and monitor use in the villages – Initially 10 PET bottles distributed for free to each household, thereafter a price of 1,000 IDR (0.08 USD) per bottle applied. Since December 2007, the price increased to 2,000 IDR (0.17 USD) per bottle (2,500 IDR–0.21 USD in Gunung Sari due to additional transport costs)	– Village demonstration and training on preparation and use conducted by the local NGO – Introduced in all villages in December 2007 – Field facilitators appointed to undertake promotional activities, such as sell tablets and monitor use in the villages – Five Aquatabs tablets were distributed for trial to households – Pricing system: tablets sold at 500 IDR (0.04 USD) each

technology for household treatment in the three villages. Aquatabs are chlorine tablets, whose active chemical constituent is sodium dichloroisocyanurate (NaDCC). One of the main benefits of this technology is that it provides a chlorine residual in treated water. The design performance of SODIS and Aquatabs is summarised in Table 2.

Table 3 | Code co-occurrence frequency

	Benefits	Challenges
Behavioural	3	4
Economic	2	4
Environmental	1	1
Functional	1	1
Health	3	1
Institutional	0	1

Stakeholders' perceptions of technology implementation and sustained usage

Interviewed stakeholders shared great awareness of the benefits and challenges related to the implementation and sustained use of SODIS and Aquatabs (Table 3).

The main benefits identified related to behavioural changes (three responses) infused on those villagers who received training and promotion of SODIS and Aquatabs, as these activities generated new awareness of the importance of treating water.

Other reported benefits related to the use of SODIS and Aquatabs were of economic nature (two responses), since users can save money spent on buying water from vendors or for purchasing fuel and wood.

Different types of challenges to implementation and sustained use of the two technologies were reported by interviewed stakeholders. In the case of SODIS, these related to what was perceived as being the high price introduced (four responses) by the local implementing agency for purchasing bottles; whilst for Aquatabs perceived challenges related to objections to taste of the treated water (four responses). Further perceived problems that may undermine the sustained use of the technologies related to the recognition that people in the villages were still reliant on free provision of water supply and sanitation (one response).

User experiences of SODIS and aquatabs

At the time of investigation, a distinctive pattern of use was present in the three villages (illustrated in Figure 2). Although SODIS was introduced in all the villages investigated, its uptake was successful only in village S (Kolisia), where 87% of households used it regularly. In village A (Gunung Sari), Aquatabs tablets were the most used treatment method, in 91% of households investigated; whilst in village B (Watuliwung), neither of the methods transferred were commonly used by households, 89% of which boiled water as a disinfection method.

In village S, while 87% of households used SODIS at the time of the investigation, 12% had previously abandoned SODIS. The reasons for stopping SODIS were mainly of economic nature: once the free sample bottles donated by the local implementing agency broke, users were unable and/or unwilling to purchase PET bottles. Of households in village S, a very high appreciation of the taste (99%) and smell (100%) of SODIS-treated water was reported. SODIS was reported by 86% of users to provide enough water for household consumption; while 94% of households showed strong confidence in the ability of SODIS to prevent diarrhoea. Among those households using SODIS, only a few members, 8%, preferred other methods and/or believed that SODIS-treated water had caused them health problems, such as diarrhoea, stomach pain and diabetes. Interviewed respondents reported high trust in the local NGO (90%), whereas trust in medical and health structures was much lower at only 10%. Among current SODIS users, the reported willingness to continue to purchase bottles at the price of 2,000 IDR (0.17 USD) was high at 85%.

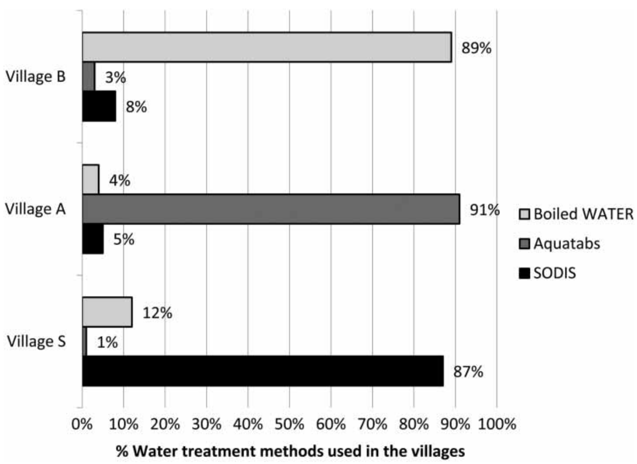

Figure 2 | Pattern of technology use in the three villages.

Conversely, the introduction of Aquatabs tablets in village A generated a contrasting pattern as households began to replace SODIS with Aquatabs, the latter being used by 93% of respondents. The system was preferred by 74% of households, mainly for its lower cost (49%), and ease of preparation and use (37%) than other methods. Only 7% of interviewed households did not use Aquatabs anymore, despite being exposed to promotional activities. The preferred methods used in those households were boiling water and SODIS. The reasons why 7% abandoned Aquatabs were mainly related to lack of appreciation of taste and odour of the treated water. Among those 93% of households who used Aquatabs as the main treatment method, 96% appreciated the taste of Aquatabs-treated water, whereas only 14% were satisfied with its smell. Only a few respondents reported to have experienced occasional problems with Aquatabs use, mainly related to lack of time to prepare the water. In village A, willingness to continue to use Aquatabs was high at 99%. The reported level of trust in the NGO was high (77%); whilst 23% trusted medical and health structures. Households' patterns of use of SODIS and Aquatabs technologies in village S and A, respectively, are illustrated in Table 4.

In village B, both SODIS and Aquatabs were introduced in 2007. The investigation of households experience revealed that the percentage of SODIS users decreased to 8% at the time of investigation. This may be related to the approach adopted by the local implementing agency, who freely distributed PET bottles to village users to create an incentive for trying SODIS. After the trial bottles finished, users showed reluctance to purchase PET bottles and instead used boiling water as their main disinfection method. Similarly, the 26% of households initially used Aquatabs, following a communal demonstration and distribution of free tablets, decreased to 3% at the time of interviews. Interviewed households reported that they

Table 4 | Patterns of use of SODIS and Aquatabs

	Village S (Kolisia) SODIS (% households)		Village A (Gunung Sari) Aquatabs (% households)	
Household water supply source used	Hand dug well	71	Hand dug well	100
Reported source more than 300 m from household		39		86
Household member responsible for preparation*	Female	71	Female	79.5
	Male	11	Male	12.5
	Children	18	Children	8
Reported container used for treatment	PET bottle 1.5 L	100	Gallon bottle 20 L	57
Reported filtering method used in household	Use of cloth to filter water	99	Use of cloth to filter water	93
Reported acquisition patterns in household	Purchase bottle	91	Purchase tablets	77
Reported treatment time in household	24 or 48 h if cloudy	79	30 min	70
Respondent knowledge of methods preparation	Very accurate	68	Accurate	98

preferred to boil water by using firewood, readily available in the village surroundings. Despite having abandoned SODIS, households' perceptions of the health benefits derived from it were high at 79%. Of these, 53% of households believed SODIS to have a healing power, since water was perceived as capable of treating diseases like kidney infections and stomach pain. Moreover, 17% believed SODIS-treated water to be of good quality due to its ability to prevent contamination, while 15% believed it to be of good quality because of a capacity for killing bacteria. Conversely, 16% of respondents perceived SODIS as a causative agent of diseases such as flu, diarrhoea and kidney infection. Perceptions of benefits to health generated by Aquatabs-treated water were reported only by 8% of interviewed households. Levels of trust in village B were markedly different from those elicited in villages S and A. In village B, trust in the local NGO was relatively low at 22%, whilst the majority of households (74%) reported to trust personnel from the health clinics.

Aggregated data from the three villages ($n = 298$) were employed to explore a range of factors correlated to determining use of SODIS and Aquatabs, reported in Figures 3 and 4, respectively. The main reasons that influenced SODIS use related primarily to functional aspects (48%) and to a lower extent to economic factors (37%). Compared to other disinfection methods occasionally used in the three villages, respondents deploying SODIS reported they had more time to conduct other activities, and to save money used for wood. Conversely, reported reasons for not using

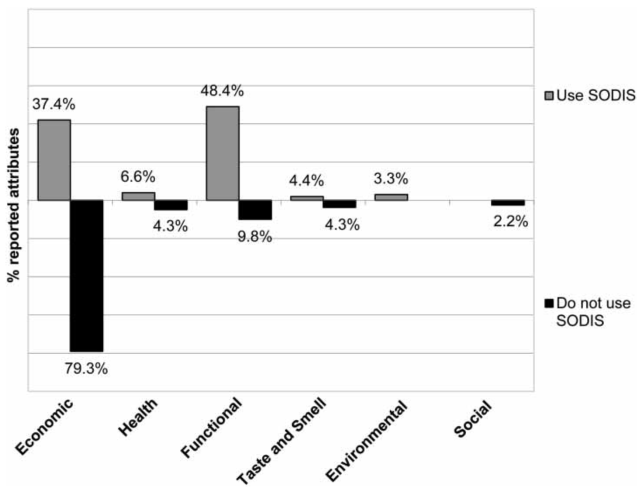

Figure 3 | Attributes declared as influencing use and non-use of SODIS.

SODIS were mainly economic (79%), such as the inability reported by households to afford PET bottles after their increase in price.

Economic aspects were reported as the main reason for using and continuing to use Aquatabs (63%), since tablets were sold at lower price than PET bottles. Conversely, the most important factor, given by 68% of respondents, for not using Aquatabs related to users' negative perceptions of taste and odour aspects of the treated water. This factor was coupled with a social attribute (20%), namely the decision not to use Aquatabs because friends or neighbours reported that Aquatabs-treated water tasted of medicine.

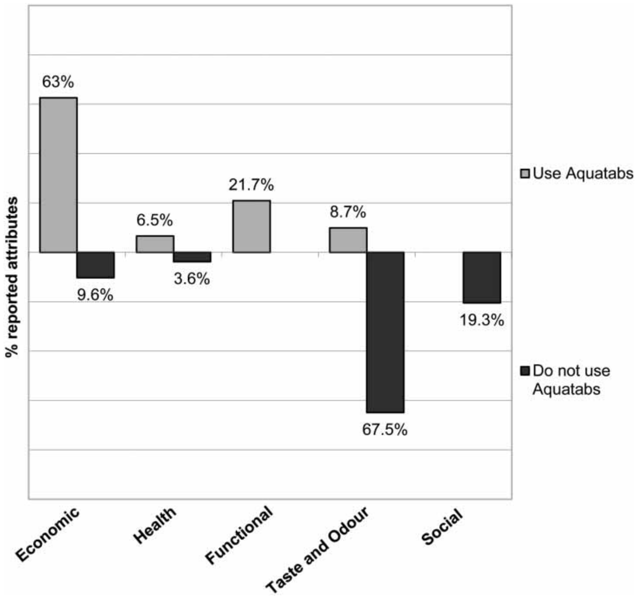

Figure 4 | Attributes declared as influencing use and non-use of Aquatabs.

Interestingly, in all three villages perceptions of health benefits generated by the SODIS and Aquatabs constituted a relatively less significant factor for use than economic, functional and taste and odour aspects.

DISCUSSION

This study highlighted key factors involved in sustained use, as well as abandonment, of point-of-use potable water technologies. Three villages formed the basis of the investigation. In the first, village S (Kolisia), SODIS was the predominant disinfection method. Meanwhile, in village A (Gunung Sari) and village B (Watuliwung), Aquatabs and boiling respectively were used by the vast majority of inhabitants. Pooled data for all three villages illustrated that, with regard to SODIS, economic and functional attributes of the technology, particularly affordability of PET bottles and ease of use, played a definitive role. In the three villages an increase in the price of SODIS bottles, coupled with the introduction of a less expensive competitive technology (Aquatabs), undermined patterns of sustained SODIS use. As a corollary of this, economic aspects were the most commonly reported factor for using Aquatabs. Conversely, in village B, where use of Aquatabs was previously widespread, taste and odour aspects were reported as the most significant reasons for ceasing to use the method. This is consistent with other studies where smell and taste have been identified as barriers to the use of chlorine-based water disinfectants (Lantagne & Clasen 2009).

Another important aspect of the results refers to users' perceptions of health. Although respondents showed awareness of the advantages generated by disinfecting water, in none of the villages were health risk considerations reported as factors influencing technology use. Consequently, the results of the current study emphasise two particular issues related to POU technology implementation where improvements are needed. The first is related to education and health. In all villages distorted perceptions of health benefits or problems of SODIS and Aquatabs were reported. In village B, for instance, 16% of respondents believed SODIS to heal diseases, such as stomach pain or kidney infections. Similarly, those respondents refusing to use SODIS or Aquatabs reported to have experienced diseases resulting from technology use. Cultural factors may explain this result. In line with other research findings (as reported in Figueroa & Kincaid 2010) water may be considered to have healing or alternative negative properties. Users' inability to prioritize the link between health benefits and technology use, as well as distorted perceptions of SODIS and Aquatabs-treated water, reveals either poor messages delivered within villages and/or the presence of a communication gap between implementers and users of these technologies. This may be linked to lack of message development that effectively communicate the nature of the methods and their benefits using language and agendas which are relevant to and understood by users. Low involvement, due to insufficient resources, of health professionals in the promotion and discussion of SODIS and Aquatabs may also contribute to development of this gap. As previous studies on behaviour change interventions have shown, non-health variables appear to be the main motivators for behaviour change (Curtis 2003; Figueroa & Kincaid 2010). Thus, the role of health professionals could be strengthened by greater involvement in formative research to understand users' needs and motivators for change. Whilst a continuous support by health operators is deemed an essential step to guarantee sustained use of the technologies, a similar approach should be adopted by local institutions.

The second issue is the need for pre-implementation studies to take into account factors promoting sustained use, which are likely to include non-economic indicators. As part of the current study, in-depth interviews were conducted with six providers. Overall, the comparison between the stakeholders' intended performance of point-of-use potable water treatment technologies and the users' reasons for sustained technology acceptance reveals a marked discrepancy. Whereas stakeholders focused upon economic indicators as motivating technology dissemination, taste and odour issues were largely behind users abandoning Aquatabs. The importance of framing intervention strategies so that they are well adapted to user agendas, target perceived barriers, and so address context-specific issues is further illustrated by results obtained in this study. Thus, the local government's role could be strengthened by its involvement in the provision of micro-finance credit to villages to acquire PET bottles, as well as the development of campaigns to reinforce the messages and motives for behavioural change which reflects users' perceptions and needs. Moreover, technology demonstrations at putative implementation locations may help to highlight, in particular, functional and health indicators of sustained usage. These would provide an opportunity for potential users to comment upon the attributes they perceive as being involved in sustained use of selected technologies. In fact, stakeholder interviews revealed that the local NGO was already supportive of involving local health clinics and other relevant institutions in repeated educational and promotional activities, as a strategy to advance technology longevity.

In this section it is also pertinent to discuss limitations of the methodology used in the current study. Firstly, it is important to highlight that SODIS is more efficient in the dry season, when average daily hours of sunlight are higher, and that SODIS and Aquatabs were not introduced at the same time, which may have affected levels of uptake. Secondly, the in-depth interviews with technology providers included a relatively small number of respondents. However, although six stakeholders is a limited number, efforts were made to gather a representative range of views towards the POU methods. These included the heads of the villages, the heads of two health clinics, one representative of the local government (head of the Environmental Health Department) and the project manager of the local NGO.

CONCLUSIONS

This study investigated factors involved in the implementation and sustained usage of two point-of-use potable water disinfection technologies, namely Aquatabs and SODIS. The key original findings from the study are as follows:

- Interviewed stakeholders concentrated upon economic factors as underlying the intended use of both Aquatabs and SODIS. However, from the users' perspective, while 37% of respondents gave economic reasons for their use of SODIS, for a higher proportion – 48% – functional aspects were the most important technology attributes. For a majority of users, 79%, reasons for not using SODIS were economic, particularly the inability to afford the SODIS bottles.
- Regarding Aquatabs, over half of users – 63% – gave economic factors as the reasons behind sustained use. Conversely, the majority of potential users who chose alternative technologies – 68% – gave taste and odour issues as explanations behind their decision not to deploy Aquatabs.
- This suggests that a gap exists between reasons stakeholders have for implementing point-of-use potable water disinfection and those underlying sustained technology usage. Thus, technology implementation should more seriously consider non-economic technology attributes and involve potential users in the decision making process.
- In village B, previously widespread use of SODIS and Aquatabs had been abandoned in favour of boiling water. This indicates that the improvement and expansion of existing techniques (such as boiling water) should not be discarded.
- The results highlight that due to the scarce importance of health motives in the sustained adoption of POU water treatment technologies, other motivational factors should be explored and employed in promotional activities. Hence, the importance on developing the right messages based on what people know, do and desire.

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