Do sales models influence the purchase and use of ceramic filters in rural areas of Kenya and Bolivia?

Regula Meierhofer, Ava Carina Flückiger and Heiko Gebauer

ABSTRACT

Demand for safe water, as well as access to adequate and affordable products for drinking water treatment, is key for household water treatment (HWT) in low-income countries. Critical barriers, particularly in rural areas, are the lack of adequate marketing and sales models and the challenge of setting up distribution channels that reach low-income customers, leading to the unavailability of HWT products. Trials with four different social marketing and sales models, involving local entrepreneurs, staff of a non-governmental organization (NGO), community health workers and members of community-based organizations, were conducted in Kenya and Bolivia to test which marketing and sales strategies, as well as which behavioural determinants, influence product purchase and water treatment practices in different local contexts. Selling filters through the water utility, a community-based enterprise, was a promising retail model in Kenya and in Bolivia. Most successful were sales done by a women's group in Bolivia. We found that community education activities, independent of the stakeholder carrying out the activity, are an important element to create demand for water treatment products. Other factors influencing product purchase and practice are very context specific and include: the turbidity of water, risk perception, socio-economic status, social norms and emotional attributes.

Key words | base of the pyramid (BOP), ceramic water filters, developing countries, household water treatment, sales approach, social marketing

Regula Meierhofer (corresponding author)
Ava Carina Flückiger
Heiko Gebauer
Eawag,
Swiss Federal Institute of Aquatic Science and Technology,
Ueberlandstrasse 133,
8600 Dübendorf,
Switzerland
E-mail: *regula.meierhofer@eawag.ch*

INTRODUCTION

Although almost 80% of the world's population used an improved drinking water source by the end of 2011, 768 million people remain without such access. Large disparities exist between rural and urban areas and different regions worldwide. Eighty-three per cent of those without access to an improved source live in rural areas, and less than 50% of the population in sub-Saharan Africa enjoy access to an improved drinking water source (WHO/Unicef 2013). An 'improved drinking water source' is defined as a source with low risk for water contamination (WHO/Unicef 2005) that, however, does not provide a guarantee for the quality of the water. It is estimated that 1.8 billion people lack reliable access to safe drinking water (WHO 1914).

Household water treatment (HWT), if applied correctly and consistently, is a strategy that reduces the health risks related to the consumption of unsafe drinking water. Despite this, efforts to promote and scale up HWT practices have been challenging. Clasen (2009) estimated that 18.8 million people use a method to treat their water before consumption, such as chlorination, solar disinfection, filtration through ceramic filters or bio-sand filters, while 350 million people boil their water.

An important constraint encountered during HWT promotion programmes is the lack of willingness on the part of a majority of households from low-income segments to invest resources in HWT products. The need to create demand for HWT is evident. Without well-conceptualized community education, behaviour change and social marketing interventions, it is unlikely that broad populations, particularly the most vulnerable households, would take

doi: 10.2166/aqua.2015.069

Downloaded from https://iwaponline.com/aqua/article-pdf/65/1/87/398951/jws0650087.pdf
by guest

up consistent drinking water treatment and hygiene practices (Heierli 2008; Clasen 2009; Mosler & Kraemer 2012).

In addition, drinking water treatment is only taken up and sustained if people have reliable access to the products needed to carry out the behaviour. In many areas, however, the lack of product supply chains and, therefore, the lack of access to products for drinking water treatment, poses a serious constraint to the promotion and sustainable application of HWT (Hystra 2011; PATH 2012).

Different models to promote and market HWT or safe water products have been deployed in low-income countries, but none of the models realized so far have shown that they could be financially viable or sustainable. The highest numbers of product sales were realized by Population Services International's marketing efforts for liquid chlorination, a low-value product with relatively high turnover rates – much in line with the private sector's practice to offer products for base of the economic pyramid (BOP) markets in single serve packages (Rosa & Clasen 2010). With a few exceptions, the private sector has been hesitant to take up the sale of higher priced products to low-income segments due to the financial risks related to the high investment costs, long payback periods and long turnover times.

Interestingly, no full-cost recovery business model, including models addressing safe water, has been deployed successfully at BOP so far. BOP is defined by the 1990 World Development Report as the 'extremely poor' people of the world, those who are currently living on no more than 1 USD per day per person, measured at the 1985 purchasing power parity exchange rate, as well as the 'poor', those who live on under 2 USD per day (WDR 1990). Probably the most critical element hindering the successful operation of business models marketing safe water at BOP is the low willingness and low ability of low-income households to pay for safe water.

This challenges the theories put forward by Prahalad & Hart (2002) in 'The fortune at the bottom of the pyramid', that there is much untapped purchasing power at the bottom of the pyramid and that large multinational companies could play a crucial role in actively involving the poor in the economic process. Anderson & Billou (2007) identified corruption, poor infrastructure, non-existent distribution channels, illiteracy, lack of robust and enforceable legal frameworks and religious or racial conflict as hindrances that stop people at BOP from being more than only marginally integrated into the global economy. Anderson identified the four As – availability, affordability, acceptability and awareness – as success factors for businesses at BOP. To ensure availability, companies need to explore alternative methods to deliver their products, and products need to be delivered at a price that enables consumption by the poorest consumers (affordability). Products need to be adapted to the unique needs of customers and distributors (acceptability) and customers need to be aware of and have demand for the product or service (Anderson & Billou 2007).

A critical barrier, particularly in rural areas, to the availability of products is the challenge of setting up distribution channels due to inadequate transport and market infrastructure. Vachani & Smith (2008) suggest that socially responsible distribution strategies could be established through developing benchmarks for retail locations and ensuring that performance meets benchmarks by designing a centrally operated management and control system. However, they suggest outsourcing the last mile to BOP entrepreneurs to avoid the heavy investments required to set up decentralized distribution systems. In addition, they propose pursuing collaborations across the sector to reduce costs by shared distribution (Vachani & Smith 2008). Different forms of cross-sectoral partnerships and collaborations with social networks at BOP could serve as a source of innovation, supporting the viability of BOP business models. In their BOP marketing trials, Chikweche & Fletcher (2011) found that social networks could be successfully used to franchise product sales with buying clubs, self-help groups and professional associations being responsible for retail distribution.

Karnani (2007) questions Prahalad's claim of the economic potential of the BOP market, since weak infrastructure and high dispersion increase marketing and distribution costs, make it difficult to exploit economies of scale and further add to product prices. People are very price sensitive, and the poor spend 80% of their meagre incomes on food, clothing and fuel alone. This does not leave much room for additional expenses. Business models following the BOP proposition often fail because companies overestimate the purchasing power at BOP and set prices too high (Karnani 2007). However, Banerjee & Duflo (2007) show that the poor could save more without getting

Downloaded from https://iwaponline.com/aqua/article-pdf/65/1/87/398951/jws0650087.pdf
by guest

less nutrition by spending less on alcohol, tobacco and food items, such as sugar, spice and tea.

With our study, we want to contribute to a better understanding of how health products can be marketed more successfully at the BOP. In particular, we wanted to assess if the purchasing behaviour and decisions of the poor can be influenced towards spending more for safe water if comprehensive community education activities to increase demand are combined with different sales models for water treatment products.

Local entrepreneurs, non-governmental organization (NGO) promoters (employed staff of a national development organization with experience in community education), community health workers (CHWs) and community-based organizations (CBOs, a group of members from the local community in the respective intervention sites), were identified as potential stakeholders for community education and sales activities because each of these stakeholders had previously been involved in other projects that supplied or promoted health products. One particular characteristic stood out: local entrepreneurs are representatives of the private sector and have the richest experience in running financially viable businesses, but they usually do not reach out to people's households through marketing activities. In Kenya as well as Bolivia, the organizations operating the local water supply schemes comprised representatives of local entrepreneurs together with a number of shopkeepers. NGO promoters have much experience in approaching and training local communities at the household and community level, and they work regular hours in accordance with their employment contracts, but they might not always have much sales experience. The profile of CHWs is similar to NGO promoters. They have much experience in training the local community in health-related aspects, and their messages are respected by the local community, but they lack sales experience. In addition, the working time of CHWs might be limited because they usually engage as volunteers. CBOs, however, are closely linked to the local communities and are often involved in some kind of locally oriented income generating activities.

The specific objective of our study was to evaluate whether any of the organizations involved in the sales models has a particular influence on the purchase and use of ceramic filters or on other methods for HWT.

METHODS

The four social marketing and sales models were implemented in Kenya and Bolivia between January 2012 and April 2013.

Research area

In Kenya, rural intervention sites were selected in the Munyu and Thuthua areas in Thika East District and in Yathui and Muthethein in Mwala District. The sites in Thika East District are about a 1-hour drive from Nairobi, while the sites in Mwala District are about a 2-hour drive from Nairobi. All intervention sites in Kenya are rural, but the sites in Mwala were found to be more agriculturally oriented than those in Thika. In all intervention sites, the majority of people get their drinking water from local rivers. In Munya, households are connected to a water supply scheme delivering untreated water from the Thika River for a monthly fee of about 1,000 KSH (11.5 USD) on average.

In Bolivia, two of the chosen areas were peri-urban areas within the municipality of Cochabamba: Villa Granado and Valle Hermoso. Most people have access to piped water in these areas, although it is of low quality. The city of Cochabamba supplies water only twice a week, therefore most people rely on water trucks. The source of this water is mostly unknown and contaminated. As a consequence, some people buy 20 l water bottles for drinking at a price of approximately 12 Bs (2 USD). The third intervention site was in the Province of Arbieto, about a 45-minute drive from Cochabamba. Households in this area get their drinking water through water trucks, or collect it from a river. The fourth intervention site selected was in the Province of Chapare: Villa Tunari. Households in this area are connected to a gravity water supply system supplying untreated water for a monthly fee of 24 Bs (3.6 USD).

The marketing trials were non-randomly assigned by the authors and the coordinating NGOs to one of the four areas in each country. Criteria for the selection of the rural intervention sites were: a supply of untreated water; not having participated previously in safe water promotion activities, i.e., no distribution of free products had taken place in the

Downloaded from https://iwaponline.com/aqua/article-pdf/65/1/87/398951/jws0650087.pdf
by guest

area; sufficient distance between the sites to avoid cross-flow of information; interest in the public health sector to participate in the marketing trials, and support from the community leaders.

Study design

The four social marketing and sales models implemented were identical in Bolivia and Kenya. In Model 1 (MO1), the community education was done through two NGO promoters, while a local entrepreneur (a shopkeeper) or the organization operating the local water supply scheme (water utility) handled the sale of products. In Model 2 (MO2), the community education and product sales were done through three to five (CHWs) of the official public health system. In Model 3 (MO3), CBOs were trained and motivated by the NGO promoter to do community education and product sales (one CBO was involved in Bolivia, while two CBOs were involved in Kenya) and in Model 4 (MO4), the communication, as well as the sale of products, were done through two promoters of the NGO (see Figure 1). Except for the NGO promoters that received a salary, none of the organizations or individuals involved in the sales models received any allowances or incentives beyond the profit margin generated through product sales.

At least 450 households at each site received information during household visits and community training events, which were conducted by the promoters of an NGO (MO1 and MO4), CHWs (MO2) or the members of a community-based organization (MO3). In Kenya, ceramic filters, chlorination products and improved hygiene were promoted, while supply chains for the chlorination product WaterGuard and ceramic filters were set up. In Bolivia, information on chlorination, SODIS and ceramic filtration was provided through community education, while the development of a supply chain, only for ceramic filters, was actively supported. Bottled water and products for chlorination were already available in the markets in Bolivia.

In Kenya, the ceramic filter was purchased from the Kenya Ceramic Project, an organization producing the pot-shaped filter design developed by Potters for Peace (CDC 2011). In Bolivia, the candle filters promoted during the intervention were assembled by the NGO involved in the project intervention: candle filters produced by Stephani were imported from Brazil and fixed into locally purchased plastic buckets, consisting of a raw water reservoir as well as a safe water storage bucket with a tap. The pot-shaped filter produced in Kenya, as well as the ceramic candle filter assembled in Bolivia, both have a flow rate of about 1–3 l per hour. No other filter products were available in the local markets in all the intervention sites.

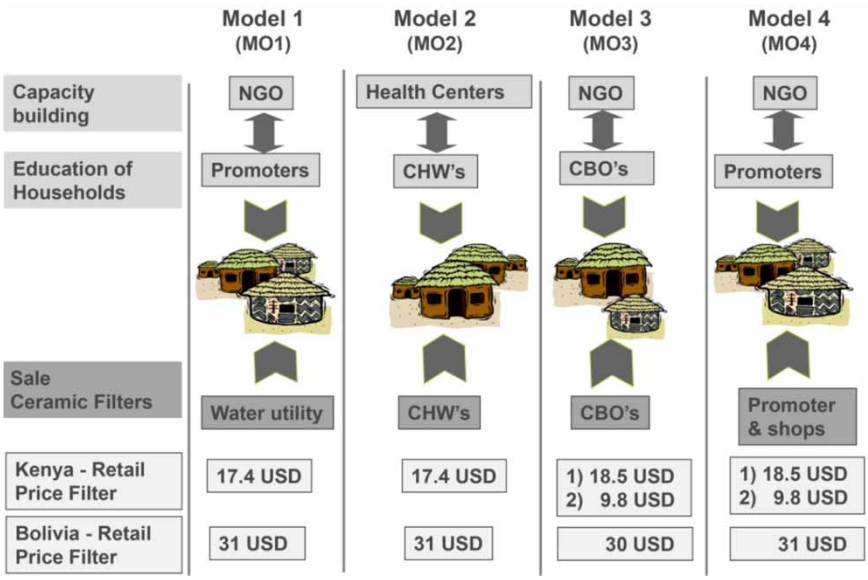

Figure 1 | Design of the intervention.

Downloaded from https://iwaponline.com/aqua/article-pdf/65/1/87/398951/jws0650087.pdf
by guest

In both countries, the NGOs set up and maintained the supply chain of the products, ensuring bulk purchases from the manufacturer, transport to project sites and product sales to the retail distributors. In all models, retail distributors received the first batch of filters upfront on credit. Payment for the filters was collected from the distributors after product sales. The coordinating NGOs, as well as the public health centre, were also responsible for building up the capacity of the NGO promoters, CHWs and CBOs in providing training on safe water and hygiene, as well as in sales strategies and bookkeeping.

Filters were sold in Bolivia for a retail price of 30–31 USD. In Kenya, the filters were initially sold for a retail price of 17.4 to 18.5 USD, but the retail price had to be reduced to a subsidized price of 9.8 USD in Mwala Districts as only one filter had been sold in the first five months of implementation. In all implementation models, households had the option to pay for their filters in instalments. The frequency of payments and the amount of a single payment could be defined by the customer. In three distribution models, filters were only handed out after the full payment was received. In MO1, in which the water supply utility handled the retail distribution, filters were provided to customers upfront and partial payments were added to the water bill.

Data collection

Baseline data were collected from 1,800 households (450 households at each site) in spring 2012. Product sales activities and community education were implemented during 11 months in Kenya and during 10 months in Bolivia. Final data were collected from 1,800 households (450 households at each site that had received promotion activities) in spring 2013. The required sample size to detect a small to medium effect in Cohen's f 2 at the type I error probability of 0.05 and a statistical power of 0.95 with 15 predictors was estimated with G*Power 3.1 (Faul *et al.* 2009) and yielded a required sample size of at least 1,400 households. Households interviewed were randomly selected, every xth household was selected in accordance with the procedure described in Graf *et al.* (2010).

Quantitative data were collected from households using structured questionnaires during face-to-face interviews with closed ended, multiple choice questions and were coded, mostly in categorical variables, but also Likert-scale answer categories and some scale variables. The questions addressed were: household demographics, water sources used, water treatment and consumption practices, attitudes towards different methods for water treatment, beliefs related to risks associated with water, hygiene practices, purchasing behaviour of households, income and expenditure, willingness to pay for ceramic filters and household assets. In addition, interviewers conducted direct observations of the conditions in the households, using a structured observation format, and sales records were collected from retail distributors. Printed questionnaires were used during baseline data collection, while mobile phones were used for digital collection of final data.

Interviewers received a 3-day training, covering topics such as household selection procedures, interviewing techniques, content and use of the questionnaire and, for the final data collection, the procedure for using mobile phones for data collection. Questionnaires were translated into local languages and pre-tested. Informed consent was obtained from households prior to conducting the interview.

Data analysis

Data were imported into SPSS for statistical analysis. Water consumption patterns were analysed, using descriptive statistics. Links between categorical variables were analysed with Pearson's chi-square test. Multivariate analysis on 'Frequent use of HWT, excluding boiling' and 'Filter available in the household' as outcome variables was conducted by calculating logistic regression models.

A wealth index was calculated, using principle component analysis, following the methodology described in Rutstein & Johnson (2004), Vyas & Kumaranayake (2006) and Filmer & Pritchett (2001). The following variables were included in the wealth index: education level of interviewee, type of sanitation facilities used, type of durable assets (electricity, radio, TV, mobile phone, bicycle, motorbike, car, fridge or watch), number of animals owned, type of fuel used the most for cooking, owning or renting a house, type of walls of the house, type of roof of the house, type of floor of the house, number of rooms in the house, and number of rooms per adult in the house. A

Downloaded from https://iwaponline.com/aqua/article-pdf/65/1/87/398951/jws0650087.pdf
by guest

description of the sample in the intervention sites is provided in Table 1 for Kenya and Table 2 for Bolivia.

RESULTS AND DISCUSSION

Sale of ceramic filters

Sales numbers collected from the different retailers demonstrated that in Kenya, as well as in Bolivia, the water utility was very effective in selling ceramic filters to their customers (Table 3). A particular element in this set-up in MO1 was that the water utilities in both countries provided filters upon request to customers and did not require upfront payments. Instead, payment in instalments were added to the regular water bill.

Kenya

Shops that initially were intended to sell ceramic filters in MO1 faced the challenge of stocking the filters due to space limitations and, therefore, concentrated on the sale of chlorination products. In MO3, two CBOs were trained to educate the community, and to sell chlorine products and ceramic filters. After five months of implementation, only one filter was sold in Mwala District. The price of the ceramic filter at these two intervention sites, therefore, was lowered from 18.5 USD to a subsidized price of 9.8 USD. The CBO with prior sales experiences sold 11 filters for 9.8 USD as well as chlorination products, while the other CBO without such experience did not sell any filters and hardly sold any chlorine. In MO4, households expected to receive free chlorine products from the NGO promoter as they were used to NGOs distributing free products. The sale of chlorine products, therefore, was handed over to local shops, while the NGO promoter concentrated on the sale of ceramic filters.

Bolivia

The highest sales of filters in Bolivia were achieved by the CBO, a women's group with prior sales experience. However, the women's group did not limit their filter sales to the intervention area only. Therefore, only 12 filters could be found in households living in the MO3 area during the final data collection. In Bolivia, the CHWs under MO2 were not motivated to participate in the product sales and, as a consequence, no filters were sold. The NGO promoters under MO4 were only able to sell two filters.

Comparing the results of the different sales models in Kenya and Bolivia, consistent sales were achieved in both countries under MO1. However, the results obtained under MO2 and MO3 were inconclusive. While the filter sales through CHWs worked quite well in Kenya, it was a complete failure in Bolivia, and while the CBO in Bolivia reached the highest filter sales numbers of all implemented models, the CBOs in Kenya sold only a few filters. Qualitative information gathered from the different stakeholders involved in product sales revealed that previous marketing experience on the part of the sales representatives was an important factor to realize sales: the highest filter sales numbers were achieved by the women's organization in Bolivia, which had already been engaged in selling products. In Kenya, a clear difference was visible between the CBO with previous marketing experience and the CBO that had no prior sales experience. The CBO without marketing experience did not manage to sell any filters. The sales experience of the people involved thus had a greater influence on product sales than their organizational affiliation.

In both countries, product sales through NGO promoters were not particularly successful. It could be that the salary received by the promoters negatively affected their motivation to generate additional income through product sales.

Use of HWT products before and after the intervention in Kenya

In Kenya, the frequent use (defined as using the method often to always) of HWT (filtration or chlorination, excluding boiling) increased by an average of 27.6 to 53.7% in all intervention areas. A significant increase in the availability of chlorine in households was observed in Mwala District, which is more agriculturally oriented than Thika District (27.3% in Area 3 (MO3) and 10.3% in Area 4 (MO4)). At the sites in Thika (MO1 and MO2), there was a decrease in the availability of chlorine products in the households, but more people said they would be boiling their water. Five per cent of the households in MO1 and 10% in MO2

Downloaded from https://iwaponline.com/aqua/article-pdf/65/1/87/398951/jws0650087.pdf
by guest

Table 1 | Sample characteristics of intervention sites in Kenya

	Area code																					
	1 = Munyu (Thika District)						2 = Thuthua (Thika District)						3 = Yathui (Mwala District)						4 = Muthetheni (Mwala District)					
	n	Mean	SD	Min	Max	%	*n*	Mean	SD	Min	Max	%	*n*	Mean	SD	Min	Max	%	*n*	Mean	SD	Min	Max	%
Age	432	42.5	16.4	17.0	95.0		451	38.1	14.6	17	89		426	39.0	13.9	18	90		382	40.8	14.6	18.0	89.0	
Number of adults in household	455	2.4	1.5	0.0	12.0		438	2.1	2.4	0	45		438	2.5	1.8	0	28		428	2.6	2.8	0.0	55.0	
Number of children in household	416	2.2	1.4	0.0	8.0		419	2.2	1.3	0	7		392	3.3	1.7	0	9		397	3.2	1.7	0.0	11.0	
Socio-economic index in quintiles	381	3.5	0.6	3.0	5.0		343	3.3	0.6	1.00	5.00		370	3.0	0.3	1.00	5.00		337	3.0	0.3	1.0	4.0	
Education level of the person interviewed: 1 = Primary; 2 = Secondary; 3 = College	464	1.5	0.6	1.0	3.0		413	1.4	0.5	1.0	3.0		438	1.3	0.5	1.0	3.0		429	1.3	0.5	1.0	3.0	
Education level of the spouse: 1 = Primary; 2 = Secondary; 3 = College	326	1.7	0.7	1.0	3.0		268	1.5	0.6	1.0	3.0		343	1.4	0.6	1.0	3.0		360	1.3	0.6	1.0	3.0	
Education level of the person interviewed: college completed	464					7.5	413					2.9	438					3.0	429					4.9
Education level of the person interviewed: secondary completed	464					33.2	413					34.6	438					22.8	429					15.9
Current source of drinking water: piped water supply	466					75.1	456					1.1	452					2.4	456					11.4
Current source of drinking water is turbid	466					86.7	456					37.5	452					2.7	456					22.6
Received promotion on water, sanitation and hygiene	466					61.2	456					58.1	452					80.5	456					91.9
Received information through the health centre	466					10.9	456					16.9	452					6.6	456					5.9
Received information through the CBO	466					21.5	456					17.5	452					60.2	456					7.9
Received information through the promoter	466					23.4	456					16.2	452					24.1	456					84.4

(*continued*)

Downloaded from https://iwaponline.com/aqua/article-pdf/65/1/87/398951/jws0650087.pdf
by guest

Table 1 | continued

	Area code																					
	1 = Munyu (Thika District)						2 = Thuthua (Thika District)						3 = Yathui (Mwala District)						4 = Muthetheni (Mwala District)					
	n	Mean	SD	Min	Max	%	*n*	Mean	SD	Min	Max	%	*n*	Mean	SD	Min	Max	%	*n*	Mean	SD	Min	Max	%
Received information through the shop owner	466					7.5	456					4.4	452					0.9	456					0.4
Received information through the community health worker	466					16.7	456					32.7	452					0.2	456					1.1
Received information through the community meeting	466					6.7	456					3.5	452					0.7	456					0.0
Received information through a demonstration in town	466					1.1	456					0.0	452					0.4	456					0.2
Received information through TV/ radio/ newspaper	466					5.8	456					5.3	452					0.2	456					0.7
Found the promotion helpful	466					57.9	456					54.8	452					79.9	456					90.8
Said that promotion changed behaviour	466					56.0	456					53.1	452					72.1	456					89.7
Importance of treating your drinking water: 1 = not important at all; 5= very important	466	4.5	0.8	1.0	5.0		456	4.5	0.7	2.0	5.0		452	4.7	0.6	1.0	5.0		456	4.6	0.6	2.0	5.0	
Neighbours using drinking water treatment method: 1 = 25%; 2 = 50%; 3 = 75%; 4 = 100%	456	2.2	0.9	1.0	4.0		454	2.1	1.0	1.0	4.0		440	2.9	1.0	1.0	4.0		432	2.9	1.0	1.0	4.0	
Is untreated water good or bad for your health: 1 = very bad; 2 = bad; 3 = quite bad; 4 = neither good or bad; 5= quite good; 6 = good; 7 = very good	466	1.9	0.9	1.0	7.0		456	1.9	0.7	1.0	4.0		452	2.3	1.9	1.0	7.0		456	2.3	1.8	1.0	7.0	
Sanitation facility used: 1 = no toilet; 2 = shared toilet; 3 = own pit latrine; 4 = own VIP latrine	466	3.1	0.7	2.0	4.0		456	2.8	0.7	2.0	4.0		452	2.7	0.7	1.0	4.0		456	2.7	0.8	1.0	4.0	

n = number of households interviewed.

Downloaded from https://iwaponline.com/aqua/article-pdf/65/1/87/398951/jws0650087.pdf
by guest

Table 2 | Sample characteristics of intervention sites in Bolivia

	Area code																					
	1 = Valle Hermoso (peri-urban)						2 = Villa Granado (peri-urban)						3 = Arbieto (small town)						4 = Villa Tunari (small town)					
	n	Mean	SD	Min	Max	%	*n*	Mean	SD	Min	Max	%	*n*	Mean	SD	Min	Max	%	*n*	Mean	SD	Min	Max	%
Age	459	38.8	13.3	10.0	93.0		375	39.4	14.8	4.0	86.0		412	37.2	11.0	14.0	74.0		424	41.2	12.5	3.0	89.0	
Number of adults in household	457	3.6	3.4	1.0	63.0		426	3.7	1.3	1.0	12.0		436	2.3	1.6	0.0	29.0		447	2.7	2.6	0.0	47.0	
Number of children in household	421	2.4	2.2	0.0	35.0		385	1.5	1.2	0.0	7.0		412	2.4	1.5	0.0	8.0		334	1.6	1.3	0.0	7.0	
Socio-economic index in quintiles	443	2.5	0.7	1.0	5.0		409	4.0	0.8	2.0	5.0		420	2.0	0.7	1.0	5.0		433	3.5	0.7	2.0	5.0	
Education level of the person interviewed: 1 = Primary; 2 = Secondary; 3 = College	464	1.7	0.7	1.0	3.0		443	2.5	0.6	1.0	3.0		437	1.4	0.6	1.0	3.0		454	1.7	0.7	1.0	3.0	
Education level of the spouse: 1 = Primary; 2 = Secondary; 3 = College	296	1.7	0.7	1.0	3.0		230	2.5	0.6	1.0	3.0		389	1.5	0.6	1.0	3.0		354	1.8	0.7	1.0	3.0	
Education level of the person interviewed: college completed						12.5						58.0						3.9						14.8
Education level of the person interviewed: secondary completed						48.1						35.4						33.2						42.7
Current source of drinking water: piped water supply	471					38.0	460					66.7	443					2.0	464					97.0
Current source of drinking water is turbid	471					3.2	460					27.8	443					13.1	464					23.9
Received promotion on water, sanitation and hygiene	471					46.5	460					48.9	443					12.0	464					72.2
Received information through the health centre	471					0.6	460					1.5	443					7.9	464					1.9
Received information through the CBO	471					34.8	460					3.9	443					0.7	464					1.7
Received information through the promoter	471					10.8	460					44.6	443					0.7	464					71.1
Received information through the shop owner	471					0.0	460					0.0	443					0.2	464					0.2
Received information through the community health worker	471					0.6	460					0.2	443					0.0	464					0.4
Received information through a community demonstration	471					0.0	460					0.9	443					0.0	464					0.4

(*continued*)

Downloaded from https://iwaponline.com/aqua/article-pdf/65/1/87/398951/jws0650087.pdf
by guest

Table 2 | continued

	Area code																					
	1 = Valle Hermoso (peri-urban)						2 = Villa Granado (peri-urban)						3 = Arbieto (small town)						4 = Villa Tunari (small town)					
	n	Mean	SD	Min	Max	%	*n*	Mean	SD	Min	Max	%	*n*	Mean	SD	Min	Max	%	*n*	Mean	SD	Min	Max	%
Received information through TV/ radio/newspaper	471					0.2	460					5.0	443					0.2	464					0.0
Found the promotion helpful	220					83.6	225					79.6	53					88.7	336					88.4
Said that promotion changed behaviour	220					69.5	225					54.7	53					75.5	336					85.7
Importance of treating your drinking water: 1 = not important at all; 5= very important	471	4.1	0.6	1.0	5.0		460	4.2	0.5	2.0	5.0		443	3.7	1.1	1.0	5.0		464	4.3	0.6	1.0	5.0	
Neighbours using drinking water treatment method: 1 = 25%; 2 = 50%; 3 = 75%; 4 = 100%	471	2.0	1.0	1.0	5.0		460	2.4	1.5	1.0	5.0		443	1.8	0.9	1.0	5.0		464	2.4	0.8	1.0	5.0	
Is untreated water good or bad for your health: 1 = very bad; 2 = bad; 3 = quite bad; 4 = neither good or bad; 5= quite good; 6 = good; 7 = very good	471	1.8	0.8	1.0	6.0		460	1.9	0.8	1.0	7.0		443	2.1	1.1	1.0	6.0		464	1.3	0.6	1.0	7.0	
Sanitation facility used: 1 = no toilet; 2 = shared toilet; 3 = own latrine; 4 = own flush toilet	471	3.0	0.4	1.0	4.0		460	4.0	0.2	3.0	4.0		443	2.1	1.0	1.0	4.0		464	3.9	0.4	1.0	4.0	

n = number of households interviewed.

Downloaded from https://iwaponline.com/aqua/article-pdf/65/1/87/398951/jws0650087.pdf
by guest

Table 3 | Number of filters sold under different intervention schemes in Kenya and Bolivia

Model	MO1	MO2	MO3	MO4
Community education	Promoters of NGO	CHWs	CBOs	Promoters of NGO
Sale	Water utility	CHWs	CBOs	Promoters of NGO
Kenya				
Area	Thika Area 1	Thika Area 2	Mwala Area 3	Mwala Area 4
No. of filters sold	51 @ 17.4 USD (CWP); 4 @ 17.4 USD (shops)	40 @ 17.4 USD	11 @ 9.8 USD	1 @ 17.4 USD; 26 @ 9.8 USD
Bolivia				
Area	Villa Tunari Area 4	Arbieto Area 3	Valle Hermoso Area 1	Villa Granado Area 2
No. of filters sold	46 @ 31 USD	No filters sold	114 @ 30 USD	2 @ 31 USD

switched to using a ceramic filter, while only very few ceramic filters were used in the sites in Mwala (MO3 and MO4) (Figure 2).

As Figure 3(a) demonstrates, the number of filters found in households after the intervention in Kenya were significantly correlated with the socio-economic status of the household, ($\chi^2(4) = 19.07$, $P = 0.001$) with the highest number of filters found in the fifth quintile where 15.8% of the households had purchased a filter, while 0% of the households in the first and second quintile, 4.2% in the third and 8.8% in the fourth quintile had a filter available after the intervention.

Use of HWT products before and after the intervention in Bolivia

Figure 2 also presents data on the use of HWT, excluding boiling, in Bolivia. As the use of boiling could not be verified in the households, it is questionable whether boiling was really practised. Frequent HWT in all areas increased by 21.2 to 40.2% (filtration, chlorination, solar water disinfection, and bottled water, excluding boiling). Ceramic filter use increased by an average of 7.6% in all intervention areas – and by 16% in MO1. The average use of bottled water (20 l gallons) increased by 7.6 to 25.5%. Chlorination

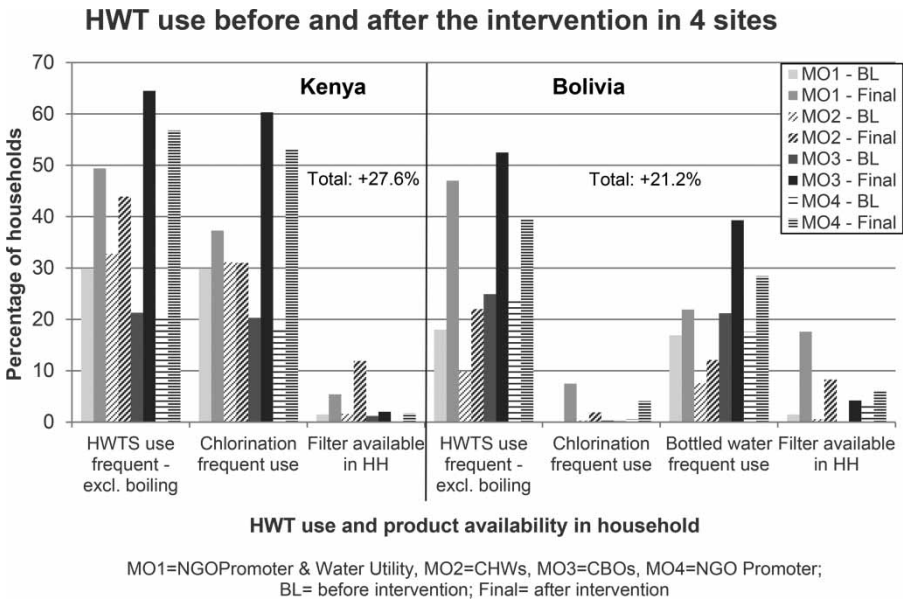

Figure 2 | HWT use before and after the intervention in Kenya and Bolivia.

Downloaded from https://iwaponline.com/aqua/article-pdf/65/1/87/398951/jws0650087.pdf
by guest

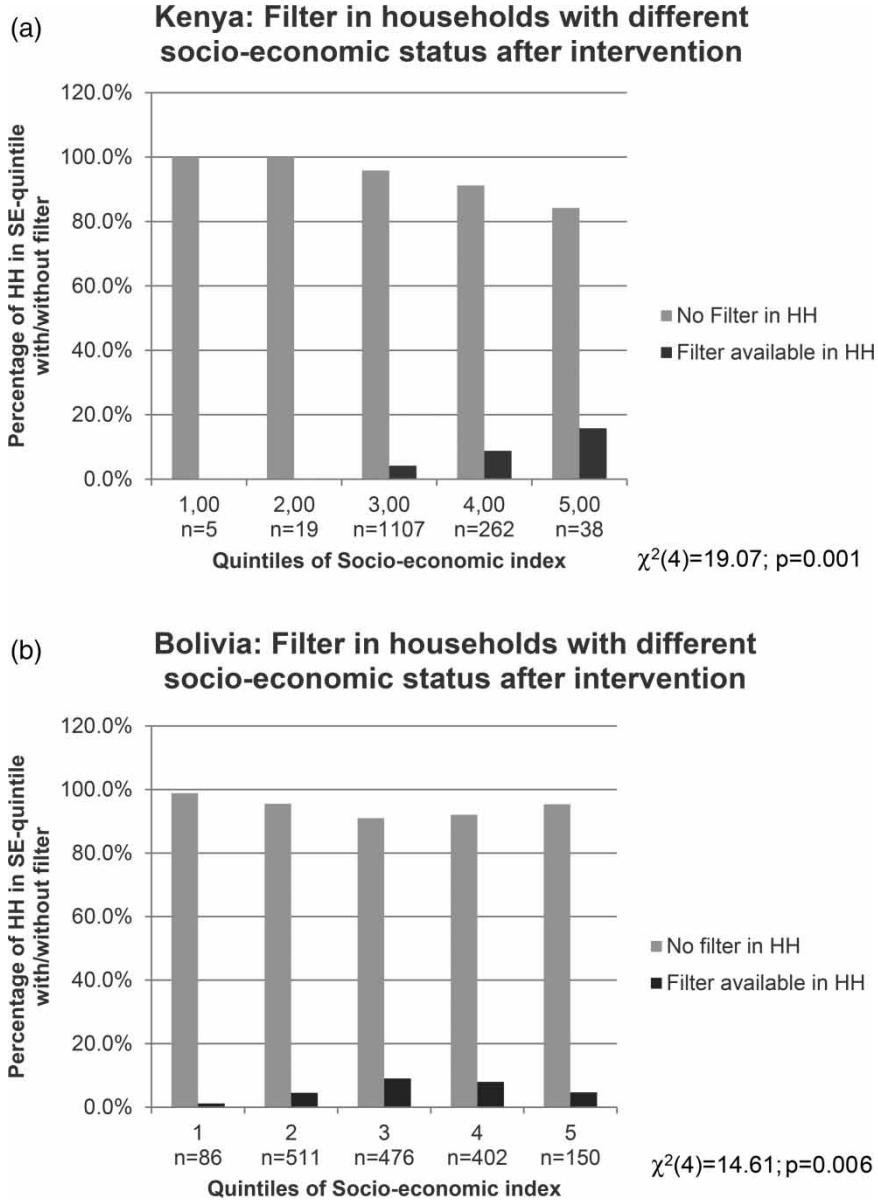

Figure 3 | Filter available in households with different socio-economic status after intervention in (a) Kenya and (b) Bolivia.

and solar disinfection were only marginally used at baseline and after the intervention. The number of filters found in households in the MO3 area of Bolivia did not correspond with the sales numbers of filters, as the CBO sold filters in areas outside the intervention area.

As Figure 3(b) demonstrates, in Bolivia, the number of filters found in households after the intervention significantly correlated with the socio-economic status of the household, ($\chi^2(4) = 14.61$, $P = 0.006$). However, the number of filters found in the households in Bolivia did not increase as their socio-economic index increased. The highest number of filters were found in the third quintile, where 9% of the households had purchased a filter, while 1.2% of the households in the first, 4.5% in the second quintile, 8% in the fourth quintile and 4.7% in the fifth quintile had a filter available after the intervention.

Downloaded from https://iwaponline.com/aqua/article-pdf/65/1/87/398951/jws0650087.pdf
by guest

Factors influencing frequent HWT use and the purchase of ceramic water filters

For Kenya and Bolivia, logistic regressions were calculated for the outcome variables 'Frequent use of HWT, excluding boiling' and 'Filter available in the household' after the intervention. The following factors were included in all four regression models that were calculated: turbidity of water; if a promotion was received; whether information was received through the health centre, a CBO, a promoter, a shop owner, a community health worker, a community meeting, or through other sources; if the promotion was perceived as helpful; if the promotion changed the interviewees' behaviour; if the user liked the method used; the perceived importance of drinking water treatment on the part of the interviewee; the percentage of neighbours using HWT; beliefs about whether untreated water is good or bad for one's health; money available per week; willingness to pay for ceramic filters and the socio-economic index. Tables 4–7 present the factors that were found to be significantly related with the respective outcome variables in the logistic regression models. Non-significant factors are not listed.

Although in Kenya education was significantly correlated with the frequent use of HWT and the availability of filters in households in single factor analysis, education was not directly included in the model as it was included as a factor in the calculation of the socio-economic index, which was a factor in the model. In Kenya, 16% of the interviewees with a college degree had a ceramic filter, as well as 6.7% of the interviewees with a secondary school degree and 3.7% of the interviewees with a primary school degree ($\chi^2(2) = 27.7$; $P = 0.000$). In Bolivia, education was not significantly correlated with the availability of filters in households.

Frequent use of HWT after the intervention

For Kenya, the logistic regression revealed that the frequent use of HWT was not significantly related to any of the sales and community education models implemented (Table 4). A significant relationship was found between the frequent use of HWT and whether people found a promotion on water treatment and hygiene helpful (OR: 3.9; CI: 1.0–15.2), if people liked the method they used (OR: 2.2; CI: 1.8–2.6), if neighbours used a HWT method (OR: 1.8; CI: 1.5–2.0), if people thought it was important to treat their water (OR: 1.7; CI: 1.4–2.1) and if households had a high willingness to pay for ceramic filters (OR: 1.5; CI: 1.2–1.8). Also significant, but with a lower odds ratio, was if the household received a promotion on water, sanitation and hygiene, if information on HWT was provided through mass media and if they felt that the promotion changed their behaviour. This indicates that psychological behavioural determinants, such as emotional factors and social norms, together with risk knowledge, had a stronger influence on the practice of

Table 4 | Factors related with the frequent use of HWT (except boiling) in Kenya

Logistic regression for the frequency of HWT in Kenya

					95% C.I. for OR	
	B	S.E.	P	OR	Lower	Upper
Did you find the promotion helpful	1.379	0.686	0.044	3.971	1.035	15.235
Do you like the method used most	0.767	0.087	0.000	2.153	1.817	2.551
Neighbours using HWT	0.578	0.072	0.000	1.783	1.548	2.054
Importance of treating your drinking water	0.525	0.102	0.000	1.690	1.383	2.066
WTP for ceramic filters	0.402	0.099	0.000	1.495	1.233	1.814
Promotion on water, sanitation and hygiene	−1.248	0.596	0.036	0.287	0.089	0.923
Information through TV/radio/newspaper	−1.709	0.441	0.000	0.181	0.076	0.430
Did promotion change your behaviour	−2.140	0.471	0.000	0.118	0.047	0.296
Constant	−5.637	1.416	0.000	0.004		

Model $\chi^2(19) = 417.74$; $P = 0.000$; Cox and Snell $R^2 = 0.26$; Nagelkerke $R^2 = 0.35$.

Downloaded from https://iwaponline.com/aqua/article-pdf/65/1/87/398951/jws0650087.pdf
by guest

Table 5 | Factors related with the frequent use of HWT (except boiling) in Bolivia

Logistic regression for the frequency of HWT in Bolivia

	B	S.E.	P	OR	95% C.I. for OR	
					Lower	Upper
Information through promoter	1.823	0.456	0.000	6.190	2.534	15.122
Information through CBO	1.170	0.447	0.009	3.223	1.343	7.735
Turbidity of water	−0.763	0.214	0.000	0.466	0.306	0.709
Information through TV/radio/newspaper	−0.986	0.522	0.059	0.373	0.134	1.039
Constant	1.039	1.794	0.562	2.827		

Model $\chi^2(18) = 67.16$; $P = 0.002$; Cox and Snell $R^2 = 0.08$; Nagelkerke $R^2 = 0.11$.

water treatment in Kenya than the type of stakeholder carrying out sales and community education activities.

In Bolivia, however, the stakeholders carrying out sales and community education activities had a critical influence on the frequent use of HWT (Table 5). The highest odds ratio (OR: 6.2; CI: 2.5–15.1) was found for the category: information provided through a promoter. This indicates that the training activities of promoters strongly related to HWT practices in Bolivia. Also, the CBO was effective in convincing households to treat their water (OR: 3.2; CI: 1.3–7.7). Significantly related with HWT use, but with a lower odds ratio, was if the household used a turbid water source and if the household had received information on HWT through mass media.

Filters available in households after the intervention

The picture looks different for the use of ceramic filters (see Table 6). In Kenya, the sales and education activities of the CHWs had a significant influence on the use of ceramic filters (OR: 2.5; CI: 1.1–5.5). Equally important were financial aspects, such as the willingness to pay for ceramic filters (OR: 2.6; CI: 1.8–3.7) and the socio-economic status of the household (OR: 1.7; CI: 1.1–2.8). However, also here, emotional factors did influence the purchase and use of ceramic filters (OR: 2.4; CI: 1.5–3.7 for the factors 'people like the method used'). Also significant, but with a lower odds ratio, was if the household had received a promotion on water, sanitation and hygiene.

Contrary to the use of other HWT methods, the use of ceramic filters in Bolivia was not influenced by any of the sales and community education models (see Table 7). In Bolivia, ceramic filter purchases were most strongly influenced by the turbidity of the water (OR: 3.5; CI: 2.0–6.2), if the interviewees liked the filter (OR: 1.7; CI: 1.0–2.8) and by risk awareness (if they thought it was bad for their health to drink untreated water (OR: 0.6; CI: 0.4–1.0)).

Table 6 | Factors related with the availability of ceramic filters in households in Kenya

Logistic regression for 'Filter available in household' in Kenya

	B	S.E.	P	OR	95% C.I. for OR	
					Lower	Upper
WTP for ceramic filters	0.954	0.177	0.000	2.596	1.834	3.675
Information – CHW	0.902	0.409	0.027	2.465	1.107	5.492
Do you like the method used most	0.867	0.230	0.000	2.381	1.516	3.739
Socio-economic index (quintiles)	0.554	0.235	0.018	1.741	1.098	2.759
Promotion on water, sanitation and hygiene	−3.085	1.466	0.035	0.046	0.003	0.809
Constant	−8.016	3.543	0.024	0.000		

Model $\chi^2(19) = 132.2$; $P = 0.000$; Cox and Snell $R^2 = 0.09$; Nagelkerke $R^2 = 0.275$.

CONCLUSION

A comparison of the output achieved under the different sales models revealed that involving the water supply utility

Downloaded from https://iwaponline.com/aqua/article-pdf/65/1/87/398951/jws0650087.pdf
by guest

Table 7 | Factors related with the availability of ceramic filters in households in Bolivia

Logistic regression for 'Filter available in household' in Bolivia

					95% C.I. for OR	
	B	S.E.	P	OR	Lower	Upper
Turbidity of water	1.259	0.292	0.000	3.522	1.988	6.241
Do you like the method	0.539	0.254	0.034	1.714	1.043	2.818
Untreated water good or bad for health	−0.530	0.253	0.036	0.588	0.359	0.965
Constant	12.614	25,620.984	1.000	300804.164		

Model $\chi^2(18) = 82.84$; $P = 0.002$; Cox and Snell $R^2 = 0.11$; Nagelkerke $R^2 = 0.22$.

in filter sales achieved consistently high product sales in Kenya, as well as Bolivia. A reason for the success of this model could be that filters were handed out immediately after training and customers did not have to make any upfront payments. This set-up was possible because the utilities were in a position to secure their payments in instalments by adding an additional amount to the regular water bill to cover the pay back rates for the filters.

The results of sales models involving CHWs and CBOs were inconclusive. The sales experience of the people involved in these models had a greater influence on product sales than their organizational affiliation to the public health sector or to their community.

Using the promoters of an NGO as sales agents proved to be challenging. In Bolivia, they were the most important factor regarding the increase in overall water treatment, yet they were not able to realize any product sales. In Kenya, people perceived them as representatives of organizations that often hand out things for free and were, therefore, hesitant to buy water treatment products from them.

In all models, a significant increase in HWT practices could be observed after the intervention. The data available, however, revealed that the factors significantly correlated with having a filter available in the house or with the frequent use of HWT were not directly related to the type of sales model implemented, but related more to site-specific factors. Having received information during a household visit by a promoter, CBO or CHW had an important influence on water treatment practices in Kenya and in Bolivia, but was not relevant for filter purchases in Bolivia. Our study found that various very site-specific psychological behaviour determinants, such as emotional factors (liking the method used), social norms (neighbours treating their water) as well as risk perception, have a critical influence on water treatment practices.

In Kenya, financial aspects influenced the use of ceramic filters: households with a higher socio-economic status were more likely to use a filter for water treatment. This correlation could not be found in Bolivia. In Bolivia, the turbidity of the water source and emotional factors had a significant correlation with the availability of water filters in the household.

These findings suggest that it would be beneficial for future HWT sale and promotion campaigns to identify the site-specific psychological behaviour factors determining HWT use prior to the start of the campaign and that it would be important to address these specific factors. Social marketing strategies for HWT products have to address a variety of different factors tailored to local contexts and, therefore, have to be formulated with an understanding of the local context in order to achieve the highest impact.

ACKNOWLEDGEMENTS

The authors would like to extend thanks to the NGOs KWAHO in Kenya and Fundación SODIS in Bolivia for their support during the implementation of the field activities, and the Medicor Foundation for providing financial support.

Downloaded from https://iwaponline.com/aqua/article-pdf/65/1/87/398951/jws0650087.pdf
by guest

REFERENCES

Anderson, J. & Billou, N. 2007 Serving the world's poor: innovation at the base of the economic pyramid. *Journal of Business Strategy* **28** (2), 14–21.

Banerjee, A. V. & Duflo, E. 2007 The economic lives of the poor. *Journal of Economic Perspectives* **21** (1), 141–167.

Centers for Disease Control and Prevention (CDC) 2011 *Best Practice Recommendations for Local Manufacturing of Ceramic Pot Filters for Household Water Treatment*. The Ceramics Manufacturing Working Group, Atlanta, GA, USA.

Chikweche, T. & Fletcher, R. 2011 Franchising at the bottom of the pyramid (BOP): an alternative distribution approach. *International Review of Retail, Distribution and Consumer Research* **21** (4), 343–360.

Clasen, T. 2009 *Scaling up Household Water Treatment Among Low-Income Populations*. Public health and environment. Water, Sanitation, Hygiene and Health. World Health Organization, Geneva, Switzerland.

Faul, F., Erdfelder, E., Buchner, A. & Lang, A.-G. 2009 Statistical power analyses using g*power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods* **41**, 1149–1160.

Filmr, D. & Pritchett, L. H. 2001 Estimating wealth effects without expenditure data – or tears: an application to educational enrollments in states of India. *Demography* **38** (1), 115–132.

Graf, J., Togouet, S. Z., Kemka, N., Niyitegeka, D., Meierhofer, R. & Pieboji, J. G. 2010 Health gains from solar water disinfection (SODIS): evaluation of a water quality intervention in Yaoundé, Cameroon. *Journal of Water and Health* **8** (4), 779–796.

Heierli, U. 2008 *Marketing Safe Water Systems*. Swiss Agency for Development and Cooperation, Berne, Switzerland.

Hystra 2011 Access to safe water for the base of the pyramid. www.hystra.com (accessed 20 April 2015).

Karnani, A. 2007 The mirage of marketing to the bottom of the pyramid: how the private sector can help alleviate poverty. *California Management Review* **49** (4), 90–111.

Mosler, H. J. & Kraemer, S. 2012 Which psychological factors change when habitual water treatment practices alter? *Journal of Public Health (Germany)* **20** (1), 71–79.

PATH 2012 *Perspectives. Commercial Approaches to Delivering Household Water Treatment and Safe Storage Products and Solutions to Low-Income Households*. Program for Appropriate Technology in Health, Seattle, WA, USA.

Prahalad, C. K. & Hart, S. L. 2002 The fortune at the bottom of the pyramid. *Strategy + Business* **26** (26), 54–67.

Rosa, G. & Clasen, T. 2010 Estimating the scope of household water treatment in low- and medium-income countries. *American Journal of Tropical Medicine and Hygiene* **82** (2), 289–300.

Rutstein, S. & Johnson, K. 2004 *The DHS. Wealth Index*. DHS Comparative Reports No. 6. ORC Macro, Calverton, MD, USA.

Vachani, S. & Smith, N. C. 2008 Socially responsible distribution: distribution strategies for reaching the bottom of the pyramid. *California Management Review* **50** (2), 52–84.

Vyas, S. & Kumaranayake, L. 2006 Constructing socio-economic status indices: how to use principal components analysis. *Health Policy and Planning* **21** (6), 459–468.

WDR 1990 *World Development Report 1990*. Poverty. Oxford University Press, The World Bank, New York, USA.

WHO 1914 *Investigating in Water and Sanitation: Increasing Access, Reducing Inequalities. UN-Water Global Analysis and Assessment of Sanitation and Drinking Water*. GLAAS 2014 Report. World Health Organization, Geneva, Switzerland.

WHO/Unicef 2005 *Water for Life. Making it Happen. Decade for Action 2005–2015*. World Health Organization, Geneva, Switzerland.

WHO/Unicef 2013 *Progress on Sanitation and Drinking Water. JMP 2013 Update*. World Health Organization, Geneva, Switzerland.

First received 21 May 2015; accepted in revised form 8 September 2015. Available online 19 October 2015

Downloaded from https://iwaponline.com/aqua/article-pdf/65/1/87/398951/jws0650087.pdf
by guest