>> PROJECT BRIEF

This is part of a series of project briefs discussing the activities, research findings, and field experiences of PATH's Safe Water Project.

AUGUST 2010

Extended User Testing of Water Treatment Devices in Andhra Pradesh

PATH/Quicksand Design

Extended user testing helps identify product attributes that influence the adoption and correct use of HWTS products.

Background

Safe drinking water is essential to good health. However, in resource-poor settings, water often comes from unsafe sources and carries deadly pathogens. The World Health Organization estimates that 1.8 million people die each year from diarrheal diseases, many of which are attributed to unsafe water. Safe drinking water is one of the United Nations Millennium Development Goals—by 2015, the United Nations hopes to decrease the proportion of people without sustainable access to safe drinking water by 50 percent.

To increase access to clean water among low-income households, PATH's Safe Water Project is working to identify, adapt, and develop appropriate products and business models for household water treatment and storage (HWTS). The goal is to build a sustainable commercial market for HWTS for low-income households. While there are many dimensions to the project, some of the most fundamental questions involve the products themselves: how well do they meet the specific needs of low-income consumers and how can the design of HWTS products more specifically meet the needs and aspirations of low-income consumers?

To gain insights into the needs and preferences of low-income consumers in India, PATH

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commissioned Quicksand Design to conduct a longitudinal ethnographic study on user experiences with HWTS products in India. We call this study "Extended User Testing (EUT)" because it reflects the depth and breadth of the study characteristics. The study ran from March to December 2009 in the state of Andhra Pradesh. Researchers observed how households interacted with commercially available water filters and purifiers over a six-month period that captured the full ownership cycle, from purchase, setup, and assembly to ongoing use, maintenance, and repair.

The study relied on ethnographic research methods—including extended observation, semi-structured interviews, participatory research, and rich media documentation—which have become a mainstay of product design research in recent years. This approach offers clear benefits for products designed for low-income consumers.

Typically, organizations emphasize the practical benefits of technologies when designing and marketing products for low-income consumers, yet it is product aesthetics and user experience that have a proven impact on consumer demand and sustained use. Developers of HWTS products need the kinds of insights into user-product interactions that ethnographic research methods can offer if they are to overcome pervasive barriers to the adoption and use of HWTS among low-income consumers.

Study Objectives

The objectives of the EUT study were twofold:

- To gain a deeper understanding of low-income user experiences with and preferences for HWTS durable products.
- To identify key product attributes that influence the adoption and sustained, correct use of HWTS durable products.

Table 1. Overview of the HWTS devices distributed to study households

Product	Technology	Manufacturer	Capacity (in liters)	Cost in rupees (and approximate US dollars)
Ceramic water pot 	Mechanical filtration: earthenware filter treated with colloidal silver	International Development Enterprises (IDE), Cambodia	10	519 ($11)
LifeStraw Family 	Mechanical filtration: hollowfiber ultrafiltration	Vestergaard Frandsen, Switzerland	2	950 ($20)
Stainless steel gravity filter 	Mechanical filtration: ceramic candle filters	Rama, India	34	1,500 ($32)
AquaSure 	Multi-stage mechanical filtration and chemical disinfection	Eureka Forbes, India	18	1,800 ($39)
PureIt 	Multi-stage mechanical filtration and chemical disinfection	Hindustan Lever, India	18	2,000 ($43)

Methods

Sampling

The study relied on a selected sample of families living on less than US$5 a day per capita. Twenty households were selected from four districts in Andhra Pradesh (Medak, Rangareddy, Warangal, Mahbubnagar), based on residence, family size, education, water access and quality, income, and relationships with other community members. The sampling objective was to maximize the diversity of the households studied. The sample included ten rural, six semi-urban, and four urban households.

Products Tested

PATH selected five different durable HWTS products to test in study households (Table 1). Each of these products was designed specifically for low- or middle-income consumers, and all are in commercial production: two are being actively marketed to low-income Indian consumers (AquaSure and PureIt), one is widely used by low-income consumers in other countries (ceramic water pots), and one offers a radically different design (LifeStraw Family). The products were chosen to represent as much diversity as possible in product form factors, aesthetics, usability, complexity, and filtration methods. None of the products tested requires electricity, and all are effective in removing microbiological contaminants from water.

Data Collection

After obtaining the informed consent of study participants, research teams made a series of six visits to each household over a six-month period. Each visit lasted four to six hours. During the first visit baseline information on participants' attitudes, perceptions, behaviors, and motivations related to water, HWTS, and health was gathered. A water treatment device was randomly assigned and introduced to each household at the second visit. Some households received an unopened package without any further instructions. In other cases, members of the research team posed as shopkeepers, who provided cursory instructions about how to set up and use the product; or as travelling salespeople, who set up the product for the family and demonstrated cleaning and maintenance procedures. Yet another group of households were sent to an actual retail store and given money to purchase the product. Over the course of the final four household visits, the research teams observed family members' experiences with the HWTS products and tracked changes in their attitudes and behaviors.

Activities conducted during the home visits ranged from the purely observational to interactive and participatory exercises, including:

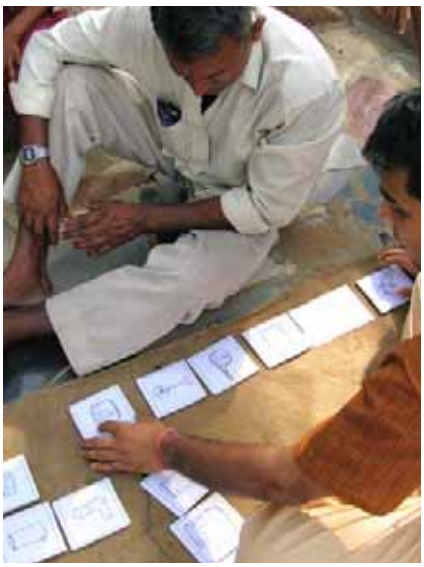
- Video ethnography and shadowing.
- Structured individual interviews.
- Unstructured contextual discussions.
- User journals.
- Photography by participants.
- Role-play by participants.
- Card-sort exercises.

These qualitative research methods provided a rich description and deep understanding of experiences with the HWTS products.

Extended contact times with study households (30-40 hours per household) allowed researchers to build trust with participants and collect highly detailed and nuanced information. The longitudinal nature of the study design also permitted observation of seasonal changes in water quality and their impact on treatment behaviors.

Toward the end of the study, the team conducted two focus group discussions with members of the study households, who by then were experienced users of HWTS products. The focus groups mined deeper insights about the products and solicited reactions to new product concepts.

Researchers also conducted a co-design workshop in Hyderabad to explore the potential for incorporating end users into product design and evaluation.



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A card-sort exercise allows participants to rank the value of HWTS products against other household goods.

Findings

Household Water Practices

Water sources. Only two study households have piped water connections in their homes; the rest collect water from community sources. Most households access two or three different community water sources and earmark them for different purposes (such as drinking, cooking, and cleaning) based on their perceived quality. Where available, water from government tanks is preferred for drinking because it looks, tastes, and smells better than water from other sources and because participants believe the government treats the water. However, government tank water is available for only a few hours a day at unscheduled times. Water from bore wells is available more consistently, but it is used for drinking only in the absence of other alternatives. Rural households sometimes fall back on agricultural bore wells used to irrigate the fields when water is in short supply or if there is a dramatic change in the quality of water from other sources.

All households collect fresh water every morning for drinking and cooking. They feel that water stored longer than 24 hours smells stale and use it only for cleaning and washing. Rather than carry drinking water to work and school, study participants said they generally drink whatever water is available on site. Household members may purchase packaged water—in sachets, bottles, and cans—when away from home or when someone in the family falls ill.

Treatment. Participants generally let water stand in a vessel to allow suspended impurities to settle. About half of the study households actively treat water on occasion by boiling or straining it through a piece of cloth or a sieve. However, water treatment is episodic and needs-based, practiced primarily when someone is ill, when a child is born, or when there are seasonal changes in the quality of source water. Boiling is a therapeutic practice generally adopted during illness or for newborns on the recommendation of a doctor. In contrast, straining is primarily used to remove visible dirt from bore water, especially during the rainy season.

Most study participants recognized the relationship between unclean water and poor health, but they were more likely to attribute illnesses to changes in the weather or the seasons. They also believed that their natural bodily immunity could ward off most waterborne diseases. Participants reported that, because their water was clean most of the year, they had only a transient need for treated water, for example, during the rainy season or while traveling.

PATH / Siri Wood

Most study households perceive that their water (and the way they handle and store their water) is safe.

Storage. Due to the unreliable water supply, all households store a two- or three-day supply of water in vessels and tanks of various sizes. Families own an array of plastic, steel, and clay vessels to collect, transport, and store water. Plastic containers are generally used to transport water because they are lightweight, easy to carry, and relatively inexpensive to replace. However, families do not store water for drinking and cooking in plastic containers because they are difficult to clean and give the water a plastic smell. Drinking water is generally stored in covered steel containers, because steel is easy to clean and durable and its appearance fits in

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Participants found it easier to understand user information and instructions that were presented anecdotally by salespeople or graphically in print materials, rather than in writing.

with the rest of the kitchen. During the summer, most households store drinking water in clay pots to keep it cooler. Clay pots are not used during the rest of the year because they are heavy, easily breakable, and expensive, given how often they must be replaced.

All water vessels, regardless of the materials with which they are made, are washed using soap, ash, or dry earth once a week. They are also rinsed every time before filling. However, the transfer of water from one container to another at multiple points before consumption increases the risk of contamination.

Purchasing Decisions

PATH's early household research confirms that consumers in Andhra Pradesh feel more comfortable assessing and buying goods with which they are already familiar.

And yet water filters and purifiers are still very novel products among low-income households. Most study participants had never seen a HWTS product before. Among those who had, seeing a filter in the house of a friend or relative or in the market was the primary way in which they became aware of HWTS products.

Our research suggests that social influence plays a strong role in purchase decisions for HWTS products. At a fundamental level, low-income and rural consumers are naturally averse to risk, preferring to form opinions about a product based on other people's first-hand experience with it. Participants said they usually try durable products at a relative's or neighbor's house before making a big purchase and consider their opinions when deciding on a product.

Most study households own televisions and acknowledged that television advertising helps build product awareness. However, they said television advertising does not drive actual purchases. Instead, its impact is indirect and depends on how it feeds into social conversations.

Family members play different roles in purchase decisions. Women decide on day-to-day purchases, such as kitchen utensils, cooking ingredients, and other consumables. The male head of the household is usually responsible for deciding on big purchases. Children often act as

"I learn about new products from the TV or from friends and relatives. If there is an item I would like to buy, I speak to friends and relatives. I then visit a shop if I want to know more about the item."

— Study participant, Kondapaka

change agents: they make sense of new products and technologies that can bring about lifestyle transitions. Family members also look to the eldest son, who is the heir apparent, for guidance on major purchases.

Big purchases are invariably tied to festivities and important family occasions, such as weddings, house warmings, or childbirth. Participants usually buy durable products from showrooms in urban areas, because they associate reliability and quality with formal retail markets. They reserve informal retail channels—such as door-to-door salespeople, neighborhood stores, and cart sellers—for inexpensive, everyday purchases.

Durable products that cater to basic needs like transportation, communication, entertainment, and comfort are valued highly. Families may also aspire to own what they see in urban or more affluent homes; this is relevant to rural households because most have family members living and working in a big city. When asked to rank household appliances by perceived value in a card-sort exercise, the majority of study participants ranked a generic HWTS product below a television, mobile phone, bicycle, pressure cooker, and fan.

Participants felt that a water filter or purifier should cost between Rs. 500 and 1,000 (US$11 to 21), depending on its capacity, the quality of the materials, the brand, and the warranty.

Warranties and deal sweeteners like discounts and combination offers are important factors in purchase decisions. Participants expect durable products to last well beyond their advertised operational life if they are properly maintained. They view warranties as an assurance of a product's quality and said a "good product" would not need repair or replacement within its warranty period. The fact that key components of water filters and purifiers need to be regularly replaced contradicts participants' notions of a durable product and puzzled them.

Servicing and ease of repair are also critical factors for some people when deciding between brands. While most durable products come with after-sales services, these are perceived to come at added cost. Participants prefer to make small repairs themselves and take the product to a local repair shop for replacement parts.

User Experiences During the Product Lifecycle

Product discovery and inquiry. This stage is generally a collaborative effort between household members and close neighbors and relatives. In rural households, large audiences of community members participated in the setup and first use of the HWTS products. Most participants said that if they needed help in understanding

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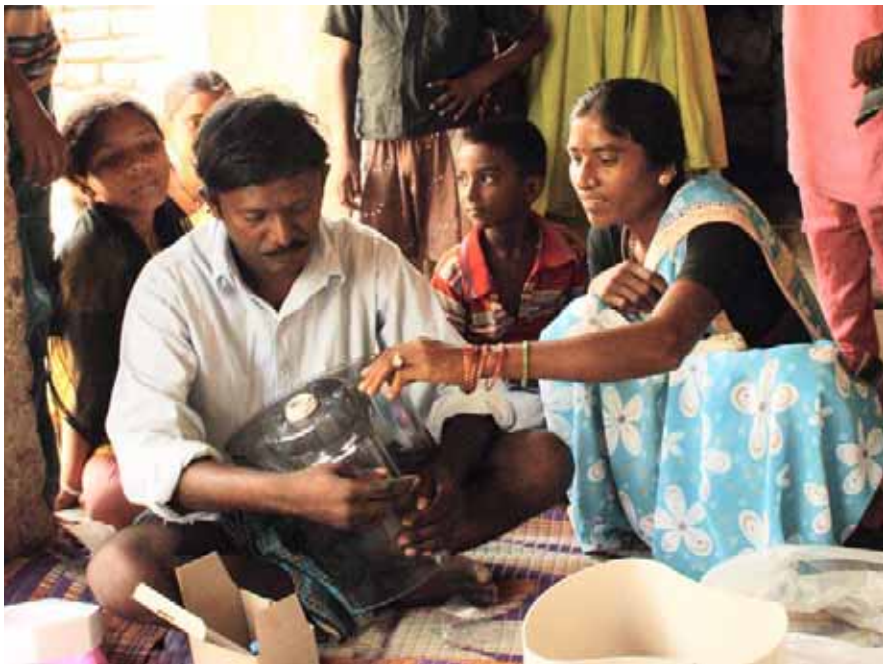
Children make sense of new products and technologies that can bring about lifestyle transitions.

and using a new product, they would ask a neighbor or friend.

Setup and installation. Most households first tried to assemble the water treatment devices by looking at the product illustrations on the packaging. They turned to the instruction manual only when initial assembly attempts failed. However, participants who referred to the manual for complex multi-stage purifiers found that it was of little help: even when their children could read the manual, they were unable to understand words like *carbon trap* and *polisher*. Participants found it easier to understand user information and instructions that were presented anecdotally by salespeople or graphically in print materials, rather than in writing.

Children are often the only educated household members, and they frequently helped adults make sense of both oral and written instructions for HWTS products. They became de-facto experts, to whom adults turned repeatedly for assistance—during the initial setup and use as well as later during cleaning and maintenance activities.

Setting up some of the HWTS products required items not commonly found in low-income Indian households, including tools, stands, and large containers for pre-soaking filter elements. Another problem was that the design of some products permitted components to be assembled incorrectly. At times, the researchers or community members had to intervene to ensure that products were assembled properly and functioned as designed.



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Products shipped disassembled take more time to set up, but participants gain a greater understanding of how the filter works.

Units shipped disassembled took more time to set up and presented more opportunities for assembly errors, but participants gained a greater understanding of how the filter worked. For example, later, some correctly used pumps for back-flushing (cleaning prior to use) because they had a clear idea that the filter elements needed to be cleaned from the inside out.

In contrast, pre-assembled or semi-assembled products were faster and more intuitive to set up, but they obscured the internal workings of the device. In some cases, participants who received semi-assembled filters wanted to take them apart when they first filled them in order to check where the water was flowing.

Once the product was set up, most participants referred to the packaging rather than the instruction manual for cues about how to use it. This sometimes led to improper use. For example, most of the participants who received a LifeStraw Family device incorrectly dispensed the water from the red back-flush outlet rather than from the safe water outlet, which is much less distinctive. Users said that since the red outlet was at the end of the filter, the clean water should come

In rural households, large audiences of community members participants in the setup and first use of the HWTS products.

from there. In most households, packaging was not discarded but was used to store manuals, warranty cards, cleaning tools, and spare parts that came with the product.

Participants had difficulty finding a good location for wall-hung filters and preferred tabletop products. Most of the products tested were placed on kitchen counters or on stools near water storage containers. The goal was to place the filter or purifier where it could be filled most easily, while keeping the top container out of the reach of children.

Product use. Most study households filled their HWTS products every morning and evening and discarded water in the lower container that was more than a day old. Water consumption—and hence the demand placed on HWTS devices—varies seasonally, over the course of the day, and between families:

- People consume nearly twice as much water in the summer as in the winter or rainy season.
- Consumption peaks in the mornings, before family members leave for school and work, and again in the evenings, when the family comes together for the last meal of the day. HWTS products need to be able to treat water quickly enough to meet demand during these peak periods.
- Smaller families got enough treated water from their HWTS products to use for tea, cooking, and washing rice and vegetables, as well as for drinking. In contrast, large families with seven or more members had only enough treated water for drinking.

Table 2. Overview of participant opinions on the form of treatment device

Water Treatment Device Materials		
PRODUCT MATERIAL	**PERCEIVED BENEFITS**	**PERCEIVED DRAWBACKS**
Steel	• Robust, durable material • Good match for home aesthetics	• Sensitivity to the variable quality of stainless steel products
Plastic	• Transparency of the plastic allows for easy viewing • Lightweight	• Questionable durability, although soft plastics were perceived as more durable than hard plastics
Clay	• Able to keep water cool	• Fragile and easily breakable
Water Treatment Device Shapes		
PRODUCT SHAPE	**PERCEIVED BENEFITS**	**PERCEIVED DRAWBACKS**
Cylindrical form	• Visually appealing and fits well with other materials in the home	• Ordinary looking
Asymmetrical form	• Novel appearance improves the look of the home	
Water Treatment Device Technology		
FILTER FORM	**PERCEIVED BENEFITS**	**PERCEIVED DRAWBACKS**
Single-stage mechanical filter	• Removes dirt and dust from the water	• Is not able to change smell or taste
Multi-stage mechanical filter	• Viewed as a more advanced product that treats water better • Assigned a higher aspirational value	• Participants did not understand how this filter functions

Some HWTS products clearly communicate that they are operating. For example, participants found that they could watch the water level change in transparent containers, they could check water

Keeping track of how much water was still available, when to refill the device, and with how much water were challenges for participants.

level indicators, or they could listen for noises, like the sound of water falling. From the user's perspective, visible staining and clogging of the pre-filter provided the most compelling evidence that a HWTS product was working.

Keeping track of how much water was still available, when to refill the device, and with how much water were challenges for participants, who did not want to run out of water and therefore were reluctant to let HWTS products run dry. Participants sometimes refilled the top container before the bottom container was entirely empty, which meant estimating how much water the bottom container could accommodate before overflowing.

Processing time. It took 15 to 20 minutes for treated water to start flowing from most of the HWTS products tested and 30 minutes to filter two to four liters of water. People using the ceramic water pot noted that the processing rate was very slow; they had to wait up to 60 minutes for a small batch of filtered water. While not ideal, they felt that waiting for 30 minutes was acceptable when they did not need "instant" water. In the morning, most households used the water remaining in the device from the previous evening to drink and prepare tea, while they waited for a fresh batch of water to be processed. If a HWTS product worked too quickly, people worried that the water was not being cleaned properly or they thought that the device was malfunctioning.

Most study participants were satisfied with the way the taps functioned on the HWTS products they received. However, some were concerned that the taps were fragile and could be easily damaged. Participants appreciated taps that had adjustable flow rates, which allowed them to control the flow depending on the volume of the container they were filling.

Cleaning. Most of the products tested came with instructions that specified cleaning only every one to two weeks. However, most study participants washed water filters and purifiers daily, along with their other kitchen utensils; they disassembled them for more thorough cleaning every five to seven days. Because cleaning took place in dedicated washing areas inside or outside the house, the HWTS products were moved almost daily.

PATH/Quicksand Design

Most households wash their filters and purifiers daily in dedicated washing areas outside the house.

While water filters and purifiers were handled with more care than other kitchen utensils, daily moving and cleaning may subject them to more wear and tear than they are designed to handle. Due to frequent cleanings with abrasive materials, plastic components showed significant scratching and wear after limited use.

Turbid water in some locations caused premature clogging of pre-filter elements, especially during the rainy season. Most participants cleaned the pre-filter more often than other components because it was visibly dirty.

Most of the products tested came with accessories for special cleaning procedures, such as back-flushing filter cartridges. The existence of these accessories helped users remember that they needed to perform these cleaning procedures periodically. The accessories also led users to interact with components such as the filter cartridge, with which they might not otherwise have engaged. However, the cleaning accessories proved fragile and frequently broke in use.

Service, support, and maintenance. While some products tested came with clear instructions to replace the filter elements every six months, the idea seemed to challenge households' assumptions about durable products. In addition, criteria for replacing filter elements were unclear for most of the products tested, which lacked end-of-life indicators like a flow-stop device. Study participants did not understand why they were supposed to replace the filter elements when the product appeared to still be functioning—although at a slower rate, or in some cases, without actually treating the water. Most participants said they would prefer to pay to replace individual components rather than complete subassemblies.

Implications and recommendations

The EUT study shows that affordable HWTS products in Andhra Pradesh face a challenging environment. Prior research by PATH suggests that awareness of commercial HWTS products is limited, and use is even lower. At the same time, low-income households are extremely demanding of consumer products. This has implications for both product design and commercialization.

Product Design and Development

Design and development efforts need to focus on product features and attributes that improve the user's experience throughout a product's entire lifecycle, while recognizing that users may include all members of the household, including children. Designers must also keep in mind low-income users' extreme sensitivity to quality.

Aesthetics. Designers can make HWTS products more desirable by responding to consumers' preferences for certain materials and forms and also by appealing to their desire for modernity. Steel is respected for its durability and traditional place in the kitchen. Plastic has a more modern appeal, but consumers are extremely sensitive to the grade and quality of plastic. Cylindrical shapes that resemble existing vessels in consumers' homes may be considered old-fashioned when compared with asymmetrical or angular shapes.

Accessibility. The height of a water treatment device helps determine who can access it and for what purposes. Tall filters placed on countertops can be filled only by adults, who are tall enough and strong enough to lift a heavy water vessel that high. Shorter devices, or devices placed on a low stool, permit children and elders to fill them. The dimensions and placement of HWTS products also determine the height of the tap, which may or may not allow children to dispense water. The ideal design permits young children to reach the tap but not the upper container, so they cannot dip their hands in the water.

Mental models. People have preconceived ideas about how water filters work. If designers accommodate these concepts, they can positively reinforce users' behavior and build confidence about a product. For example, low-income consumers believe cleaning is critical to a filter's efficacy, so they appreciate the sight of dirt being visibly removed when they clean its components. Designers can also accommodate users' understanding of the filtration process by having the device clearly signal the extraction of dirt or removal of germs while it is happening, in the same way a pre-filter does.

Capacity. HWTS products need to provide enough water for periods of peak demand, including mornings, evenings, and summers. This means being able to produce at least three to five liters of treated

water within the first 30 minutes after filling and producing five to six liters per family member daily in the summer. HWTS products also need a buffer capacity to accommodate guests, neighbors, and children, who are frequent visitors in low-income households.

Quality of treated water. HWTS products need to meet popular expectations of good water, as well as microbiological performance standards. Color and clarity are important to users, especially during the rainy season when source water turns muddy. Users are also sensitive to odors resulting from chemical treatment or storage in low-grade plastic containers.

Assembly. Simplified, intuitive setup procedures can reinforce user confidence and comfort with the technology. They also contribute to correct assembly, which is essential to HWTS product performance. Designers can facilitate the assembly process by:

- Providing feedback during setup, for example, an audible click when parts are snapped together properly.
- Ensuring that there is only one correct way of assembling a product.
- Not requiring additional tools.
- Supplying semi-assembled devices.
- Providing illustrated and exhaustive instructions.

The assembly process also provides an opportunity to create a sustainable and ongoing support system for a HWTS product by:

- Encouraging users to collaborate with neighbors and relatives when setting up a filter.
- Involving children in the setup process, since they can read, tend to remember instructions, and are relied on by families to make sense of new technologies.
- Relying on oral instructions by salespeople rather than written instructions.

Engaging and informing users. Actively engaging users can heighten their sense of ownership of a HWTS product and encourage them to conscientiously perform all of the tasks needed to keep the device functioning properly. Clear indicators of a product's operational status and prompts for maintenance also have the potential to reduce frustration and enable users to correct problems and maximize a device's performance. HWTS products should be designed to let users know:

- How much water is left, for example, by using transparent containers or water level indicators.
- How much water can be added to the upper container without creating an overflow in the lower container.
- When to refill the upper container, for example, by sizing the upper container to accommodate a familiar measure, such as a 15-liter pot of water.
- When filter components need to be cleaned or replaced.
- How long the filter will continue to operate effectively, by providing end-of-life indicators.
- If the device is operating properly, by providing visual or oral indications.
- If the device is malfunctioning, by providing indicators or shut-off mechanisms.

Durability and maintenance. Devices need to withstand deterioration and clogging due to high levels of salts and dissolved solids in the water and the turbidity of water during the rainy season, especially in rural areas. High-performance mechanical filtration components, such as pre-filters, may be required. To make frequent replacements affordable, the cost of these parts must be relatively low and they must be sold separately from the main filter cartridge.

HWTS products also need to be durable enough to resist the daily cleaning with abrasive materials and constant handling that is customary in low-income households in India.

From the user's perspective, visible staining and clogging of the pre-filter provided the most compelling evidence that a HWTS product was working.

Participants did not understand why they were supposed to replace the filter elements when the product appeared to still be functioning.

This requires using more robust materials and construction than exhibited by plastic multi-stage devices currently on the market.

Durable or consumable? Low-income consumers expect durable products to function indefinitely, with minimal need for replacements and repairs, and to be serviceable locally or by consumers themselves. In contrast, they view consumables as inexpensive products that are readily available for immediate consumption. Because of their need for regular replacement parts, water filters and purifiers do not fit neatly into either category.

HWTS products must be positioned as hybrids. Like consumables, components that are frequently replaced, such as filter elements, should be inexpensive and widely available. Like durables, the remainder of the device (including the housing and water storage containers) should have a long service life and be serviceable locally. Designing HWTS products to allow for simple do-it-yourself repairs, such as replacing taps and pre-filters, may increase their appeal to rural and lower-income consumers, who want to feel that they can extend the life or performance of a product. Training local vendors to repair as well as sell water treatment devices is also an important strategy.

Commercializing HWTS Products

There is almost no penetration of HWTS products in low-income households in Andhra Pradesh, so lack of awareness and availability present immediate barriers to commercialization. It is also important to nurture the larger product ecosystem. Only a balance between product and system design can ensure widespread adoption of HWTS products among low-income populations.

Mobilizing community influence. Community perceptions have a strong influence on purchase decisions made by low-income consumers. Holding community demonstrations of a new product and involving opinion leaders in product trials can trigger word-of-mouth endorsements that spread rapidly and effectively. Shopkeepers and salespeople in India often use product demonstrations to create interest among their customers, and this technique has proven effective at generating demand among low-income consumers.

Experiences tend to be freely shared among low-income consumers, especially in tight-knit rural communities and the shared living spaces of multi-family compounds. When harnessed appropriately, this kind of word-of-mouth has the potential to drive the initial uptake of novel technologies, such as HWTS products. However, it also creates the risk of unanimous and rapid rejection should a product fail to live up to user expectations.

Targeting subpopulations. A user-focused communications strategy that targets specific subpopulations can help overcome some of the barriers to HWTS products in low-income markets. Any marketing campaign directed toward these markets would benefit from a deeper analysis of user demographics, preferences, and segmentation so that messages and marketing strategies can be tailored to audiences most likely to become early adopters of HWTS products.

Effective retail strategies. Both formal and informal retail channels have a place in distributing HWTS products and replacement parts. Formal channels may be unfamiliar and slightly intimidating environments for low-income consumers, but consumers consider them more credible and trustworthy for durable purchases. Formal channels also can reinforce the aspirational value of water filters and purifiers.

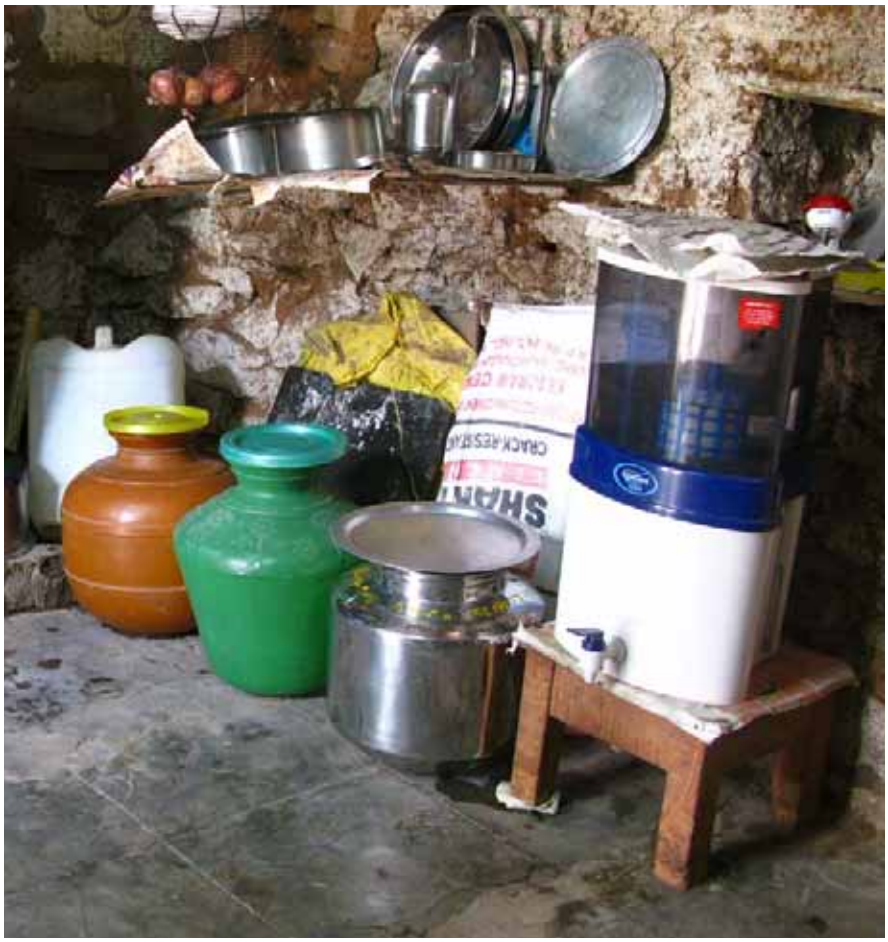
In contrast, informal retail channels are familiar, accessible, and provide an effective outlet for lower-cost HWTS consumables. Consumers feel that they offer an acceptable tradeoff between price and quality for everyday, low-risk, low-value purchases. The ready accessibility of

informal retail outlets can overcome some of the barriers to sustained use of a water treatment device by making it easy to purchase replacement parts. They also can help maintain awareness of and promote continued consumer engagement with HWTS products.

Pricing. HWTS products fall somewhere in the middle of the spectrum of durable goods owned by low-income households. On the one hand, HWTS products fall in the realm of kitchen durables, such as utensils, pressure cookers, and gas stoves, which primarily serve a utilitarian purpose. On the other hand, low-income consumers clearly view HWTS products as aspirational goods, which—like mobile phones, bicycles, televisions, and refrigerators—are calculated indulgences purchased in the hope of improving one's lifestyle. Therefore, their price point should fall midway between purely utilitarian and purely aspirational durable products, somewhere between Rs. 500 and 1,000 (US$11 to 21).

Offering a product warranty is also an important part of the pricing strategy for low-income consumers, because it reaffirms their expectations of trouble-free operation without any further investment on the owner's part.

Service and repair. In India, household durables, such as refrigerators and televisions, typically have a well-developed repair ecosystem, with local fixes, work-arounds, and replacement parts that are readily available or scavenged from more expensive variants. Training and equipping local repair workers to handle repairs and unscheduled maintenance is an important part of a HWTS product strategy. Designers can anticipate and expedite this process by creating products for low-income consumers that can be easily integrated into the service and repair market that already exists for more expensive HWTS products targeted to affluent households.



PATH/Quicksand Design

Low-income consumers expect durable products to function indefinitely, with minimal need for replacement or repairs.

"We bought an Onida TV, and not a Sony or LG because spare parts are easily available."

— Study participant, Selmijalatanda

PATH/Siri Wood

Next steps

Insights generated by the EUT will be leveraged by the Safe Water Project going forward and utilized in a number of different product development activities, including efforts to:

1. Development of functional HWTS prototypes. Many of the study insights are currently being integrated into an accelerated design program that will result in functional consumer product prototypes. Informed by the EUT results, these product concepts and prototypes will be designed specifically to address the needs, aspirations, and use practices of low-income populations in India. Ultimately, a successful durable HWTS product concept may serve as a performance and design reference for commercial and noncommercial entities developing HWTS products. Such a reference design provides a tested product performance objective and lowers the price of research and development for any commercial partner who adopts it.

"During the rainy season, the tap water is dirty, so measures are taken to clean the water. . . . Two-three years ago, during the rainy season, we had thought of purchasing a filter but could not afford it."

— Study participant, New Ganj

2. Identification of appropriate research methodologies for development of products for people at the base of the economic pyramid. Through the EUT, PATH learned which exploratory research methods can be most effective to gain specificity in the product design and development process. PATH honed the wide range of techniques employed in the EUT to select the most useful approaches for field-testing of concepts and features to ensure usability and appeal among potential end users, and to generate advanced prototypes. Use of rich media such as video and photos, for example, proved particularly useful to complement ethnographic and traditional research methods such as focus groups and interviews. Exploratory methods yield a detailed and empathetic understanding of the user experience that serves as the basis for effective development and product specifications.

3. Formation of design guidelines for product development and design. PATH is incorporating the lessons learned from the EUT and related research into a set of design guidelines for HWTS product designers and developers. These guidelines can provide foundational information to help design and develop HWTS products for low-income populations. The design guidelines will provide the HWTS community with a comprehensive set of evidence-based recommendations for devices that are functionally effective, commercially compelling, and meet or exceed user needs and expectations. By providing benchmarks, the guidelines are intended to catalyze competitive innovation among developers interested in engaging in low-income consumer markets.

4. Informing marketing approaches. The insights gained from the EUT study and related research provide PATH with a unique opportunity to identify product attributes and configurations, offering the best chance of satisfying consumer aspirations and potentially generating demand while enabling commercial sustainability. The study also helped to inform PATH's understanding of price versus performance tradeoffs in the eyes of low-income consumers. Through user-design research, PATH gained invaluable learning about how low-income users in India value and prioritize product attributes and which tradeoffs are needed to optimize product design configurations for eventual uptake and use. As a marketing tool, the EUT study forms the basis of deeper consumer research and segmentation analysis, allowing marketers to tailor retail strategies, prices, messages, and products to the right kinds of consumers at the right time and place.

Conclusion

In summary, the EUT study enabled PATH to document key elements of the daily lives, needs, and preferences of typical low-income consumers in Andhra Pradesh in the context of household water treatment and storage. The findings provide valuable insights and direction for future work to improve water treatment and storage for this underserved market segment in India.

PATH encourages other organizations and businesses to expand on this approach. Applying this method within different contexts and geographic areas and sharing the results broadly will contribute to a sustainable market for water treatment and storage products to improve health among low-income consumers in India and elsewhere around the globe.

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PATH/Quicksand Design

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