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The Need for Safe Water as a Market Opportunity

There is a huge unmet need across the globe for access to safe drinking water. This problem kills millions of our brethren each year—780,000 in India alone.[1] Diarrheal disease causes 1,600 deaths a day—more than any other. While we in the U.S. and other Western nations simply turn the handle on a faucet to access drinking water, people in many parts of the world spend a major portion of each day seeking sources of water and gathering wood or other fuel to boil the water in order to destroy potentially deadly microorganisms. This burden falls primarily to women and young girls. It is revealing that seven of the eight Millennium Development Goals (MDGs) are associated with having access to safe water. These include achieving gender equality; combating extreme poverty (73 million working days are lost each year in India due to waterborne disease); providing primary education (37.7 million Indians are sick from waterborne disease each year—many of them school-age children); and preventing child mortality (diarrheal disease kills 400,000 to 500,000 Indian children under age five each year).[2] Promoting maternal health, combating disease, and ensuring environmental sustainability are other MDGs related to having safe water.

Global trends suggest that both ground- and surface-water sources, especially in developing countries, are becoming more, not less, polluted. These conditions constitute an enormous social challenge that has persisted despite significant efforts by governments and international agencies to relieve them. Another way of looking at this problem, however, is to observe that it constitutes a large unmet demand and hence a potential business or social-enterprise opportunity. In fact,

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while commercial approaches to urban-scale water treatment have encountered well-known difficulties when attempting to reach beyond city limits, a new wave of social entrepreneurs has not been discouraged from tackling the problem on a smaller, community-level scale. Their efforts in bringing down technology-related costs, such as working closely with local governments and communities to influence the way they relate to water, have resulted in a willingness to pay for clean water (and, in some cases, sanitation services), even in very poor communities, as experiences in India, rural Africa, and parts of Latin America have shown. Indeed, we believe—and this article documents—that community-scale water treatment is potentially ready to take off and spur truly transformative change.

COMMUNITY-SCALE TECHNOLOGIES AND CAPITAL FLOWS

By community scale we mean that water sources and treatment facilities are sized to serve all or part of a community or village (e.g., populations between 2,000 and 10,000). We distinguish these from point-of-use water treatment devices designed to serve an individual or a household—of which there are many, all of which face significant distribution challenges for both the devices and replacement filters. We distinguish them further from systems designed to serve an entire urban area, which usually pipe water to individual houses.

Many different technologies for improving water quality are available, and their general effectiveness is well understood. The options include:

- Treatment by natural geological processes—such as filtration through sand, gravel, and layers of soils—that can remove many contaminants; wells that tap groundwater sources depend, in effect, on geological filtration to maintain the quality of that groundwater
- Physical or chemical treatment processes such as coagulation and sedimentation or treatment with lime, which can remove many inorganic contaminants, or chlorination, which can kill biological contaminants such as bacteria and viruses
- Absorption by activated carbon or other materials, which is particularly useful in removing pesticides and organic contaminants
- Ion-exchange processes, often used to remove iron, manganese, or calcium (hardness)
- Treatment by ozone or ultraviolet light, typically used to kill biological contaminants
- Membrane processes such as reverse osmosis, which can be effective against a wide range of contaminants, including saltwater intrusions.

The costs of these treatment options vary widely and depend to some extent on the scale, context, and purpose of treatment. The technologies used most commonly to deal with contaminants are ultraviolet (UV), ultra-filtration (UF), nanofiltration, and reverse osmosis (RO). UV completely filters out bacterial contaminants but does not address the chemical contaminants. Light-emitting diode (LED) UV-based devices are a promising technology due to their low energy con-

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sumption, long lamp life, and ease of deployment. UF takes care of both bacterial and chemical contaminants, although it fails to fully address the dissolved solids. Nano-filtration is not as fully developed commercially, although it may emerge as the future of water filtration. RO technology addresses both bacterial and chemical contaminants and dissolved solids. Although filtration technologies in general have higher up-front costs, they are declining due to expiring patents and manufacturing being shifted to Asia. When applied to aggregated or community-level needs, per-customer capital costs for many of these treatment options are attractive and likely to become more so. This, together with innovation in business models, is changing the environment for investing in safe water.

Community-scale social ventures, unlike public systems, typically do not provide piped water. They instead provide water at a central point from which community members can fetch water in containers, which reduces the capital expenditures associated with this approach. A World Health Organization report suggests that the barriers to investment flows to these areas are attributed to the problems of market creation, distribution, and financing models:

- Market creation entails developing customer awareness of the link between water quality and human health, as well as the need to understand consumer preferences—in taste, convenience, health benefits, and aspirations.
- Distribution involves the ability to design a reliable supply chain for deploying and maintaining treatment plants that can provide treated water at affordable prices.
- Financing solutions must cover the up-front capital costs of water purification technology.[3]

Over the last 20 years, water-sector investment has been modest relative to the rapid growth of investment directed at telecommunications (especially mobile telecommunications) and energy, particularly when it comes to investment in infrastructure and services for low-income communities in developing countries. In India, for example, investment in the overall water sector grew at more than twice the rate of GDP from 2003 to 2006 (15-20 percent versus 8.5 percent), but this growth was concentrated in the bottled- or packaged-water sector (growing at 40 percent a year) and municipal water treatment, with middle- to upper-income urban households as the target beneficiaries.[4] Only 24 percent of India's population is served by a household water connection and stands to benefit from municipal treatment.[5] Seventy percent live in rural areas, with 750 million people spread across more than 600,000 villages.

BENCHMARKING BEST PRACTICES AND DOCUMENTING OPPORTUNITY

As part of its sector strategy, the Global Social Benefit Incubator (GSBI) of the Center for Science, Technology, and Society at Santa Clara University set out to explore the implications of the declining cost of water-treatment technologies, new business models pioneered by social enterprises, and the foreseeable increase in

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capital flows to community-scale safe-water solutions, as reflected by numerous announcements from investment funds that focus on emerging market infrastructure.

The GSBI integrates Silicon Valley mentoring expertise, distance-based education, and an intensive in-residence boot camp to develop and validate innovative business models for promising social enterprises. It emphasizes developing earned-income or market-based solutions where they are applicable. The sector strategy adopted by GSBI in 2007 involved recruiting a cluster of social enterprises in the business of providing safe drinking water to communities for the 2008 GSBI class, and conducting research on the community-scale water-treatment sector. This included the geographic distribution of challenges, technology alternatives, business models for replication, and insight into how governments might accelerate the deployment of financially sustainable solutions. In addition, they sought to benchmark best practices for the sector based on intensive interaction and discussion with the social enterprises being mentored, as well as follow-on case studies and field visits where relevant. The result was the creation of intellectual capital to inform and inspire future entrepreneurial efforts, and to define the potential for expanded investment in the sector.

The water-sector cluster included four enterprises, three from India and one from Africa. As a result, some of the research (such as water-quality challenges) was localized to focus on India. One of the enterprises, WISH (Pump Aid is the parent organization) operates in areas in rural Africa, where water supplies from groundwater sources and appropriate sewage management are the primary concern, not water treatment (although additional treatment could be added if necessary). One of the Indian enterprises, Riverbank Filtration Technologies, provides treatment of surface waters with an approach that improves water quality but in some instances may not remove all pollutants, depending on local conditions. Here, too, additional treatment could be added as needed. Both WISH/Pump Aid and Riverbank Filtration Technologies in some sense constitute "primary-stage" water operations, and both are able to provide water at lower prices than other local options. The other two enterprises, Naandi Foundation and the Environment Planning Group Limited (EPGL), supply and provide more intensive treatment of either ground or surface waters. These "secondary-stage" water operations are primarily focused on communities that have no source of safe drinking water—which in India includes a very large number of communities.

Together, these four enterprises span a wide range of conditions, types of treatment, and institutional character—including a nonprofit that leverages a corporate social responsibility (CSR) royalty revenue stream (WISH), an NGO that works closely with government (Riverbank), a hybrid business model that incorporates both a social enterprise and an NGO (Naandi), and a fully commercial operation (EPGL). The main lessons learned from the work with these enterprises can best be summarized by three key attributes of their operating models: a business model, financing sources, and strategic partnerships.

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Business models

Business models refers to an analysis of the income and expense drivers of these ventures, which in turn determines the legal structures they choose to adopt and the financing sources they're able to tap into. In terms of income generation, both Naandi Foundation and EPGL operate under fee-for-service models and derive 100 percent of their revenue from the sale of treated water in containers, charging a fixed amount per liter to their final users. Neither Naandi nor EPGL derives revenue from the sale of water-treatment equipment to local governments or to any constituency. It is interesting to note that the distribution infrastructure (kiosks) developed by both Naandi and EPGL has the potential to offer other services to communities and thus to generate additional streams of revenue in the future. In fact, the centers where water is treated and collected could potentially be used to provide low-cost health care, Internet access, and other services valuable to local communities.

WISH, on the other hand, doesn't contemplate deriving its revenue from the sale of water but from the sale, installation, and recurring maintenance of water pumps and toilets in rural communities. Corporate advertising on the surface of the pumps and toilets is another potential revenue stream being explored. However, this revenue model is still not able to cover all of WISH's costs and expenses, which forces the venture to rely on sources of revenue such as grants and corporate royalties from Pump Aid. Lastly, Riverbank Filtration predicts that the recurring costs and expenses at the treatment plants will ultimately be covered by revenues generated by the sale of treated water (per liter) to nearby communities, although it is seeking donor funds to help launch the model. Given its experimental nature (the technology has not yet been rolled out in India) and the character of the organizations backing the project (an NGO in India and a university in the United States), Riverbank Filtration operates under a not-for-profit structure.

Fee-based approaches allow Naandi Foundation and EPGL to cover all of their operating costs. Like all of the foundation's activities, Naandi's safe-drinking-water program does not intend to realize a profit. Its business model, however, has been designed to cover all costs and produce a surplus, which is then reinvested in community-development programs in the villages in accordance to agreements made with village governments. EPGL, on the other hand, shares much of Naandi's program in terms of technology used, operations, maintenance, costs and fees charged, but it works under a fully commercial structure that offers a return to potential investors.

WISH is a good example of a nonprofit model exploring ways to transition into a commercial, market-based model. The social enterprise has its beginnings in Pump Aid, a CSR initiative of Thirsty Planet bottled water that operates a water-pump technology called Elephant Pump, which has been successfully rolled out in many African countries over the last six years. It has also developed a sanitation solution labeled Elephant Toilet. Since its inception in Malawi, Pump Aid has seen growing demand and a willingness to pay among various communities. This led

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Pump Aid to explore the possibility of engaging with microfinance institutions to offer these communities a comprehensive solution that would consist of water pumps, toilets for sanitation, and gardens for nutrition. This would occur within a partially subsidized commercial model, whose subsidy portion would be expected to decrease gradually over time, potentially enabling WISH to become a fully commercial venture.

Financing

The source of capital for safe water enterprises depends on legal status. While nonprofits rely on grants and donations, social enterprises with earned-income business models, replicable economic units, and a track record can attract commercial capital. A third model is the hybrid or blended-income model, with revenue streams that combine earned income with grants and, in some instances, revenue streams from third-party economic buyers, including government and multilateral agencies. With strong social-impact metrics to balance somewhat lower financial returns, hybrid models have added operating flexibility due to their ability to attract capital at rates of return below market. We believe that the declining cost of treatment technologies, new business models being pioneered by social enterprises that show significant potential for scaling, and the numerous funds announced recently that are focused on emerging market infrastructure will increase capital flows to community safe-water solutions.

Again, Naandi Foundation and EPGL are examples of this trend. Naandi partners and works closely with state governments, which at present provide a large source of financing for its water activities. However, Naandi has also been able to tap into commercial finance sources, which it expects will become more central to the growth of the water business. In contrast to this public-private model, EPGL is exploring commercial capital as its main source of financing. Both organizations have received financing from local banks in India, as well as financial support from Acumen Fund, a nonprofit venture fund based in New York City. However, international financial institutions are still wary of investing in water businesses, especially those designed to serve low-income communities. Business-plan strategies that mitigate perceived risks will be key to accessing commercial capital.

Riverbank Filtration and WISH are examples of charitable models in which philanthropic capital is still the main source of financing. WISH has secured corporate royalties from Pump Aid, which will subsidize a significant portion of the materials and labor required to install the pumps and toilets. The remaining portion will be financed through microfinance institutions that will provide loans for communities to supply the matching funds the model requires.

Riverbank's experimental phase has been funded by the leading organizations—TERI, a not-for-profit corporation that provides education financing and information services, and the University of Rhode Island—while capital expenditures related to installing the technology on site are expected to be financed through grants from multilateral institutions and, ultimately, from user fees.

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Strategic partnerships

Although partnerships are not formally considered part of a company's business model, it is important to make a specific note on this issue and to signal ways it could be seen as a source of both risks and opportunities for the long-term sustainability of the models described above.

The first type of partnership that can be found in the four models analyzed relates to technology development. Naandi Foundation and Riverbank Filtration have employed this kind of partnership to incorporate specific technologies into their fundamental mission of providing safe drinking water to the poor. Naandi's case shows the value of partnering with different technology providers. Naandi is itself not a manufacturer of water-treatment technologies. Instead, it has developed skills in social marketing and other areas critical to working closely with communities and local governments, leaving the technology end of its solution open to vendors that are able to deliver tailored solutions. For instance, the enterprise began its water work with a provider of UV and chlorination technologies, but then added a provider of RO technology in order to solve a wider range of water-quality issues. Partnerships are also key for both WISH and Riverbank Filtration, especially for funding and technology development. However, there is one crucial partnership for all of the models described in this document: partnerships with local governments and regulating authorities. Government participation in one form or another has been key to the successful participation of the private sector in providing safe drinking water to rural villages.

Based on the benchmarking exercise, Naandi's hybrid model offers many lessons for addressing the global water challenge. It combines CAPEX ("capital expenditures," or generally expenditures that create future benefits) start-up funding from grants and loans with a private-sector approach that provides water for sale at affordable prices and includes intensive marketing and a businesslike approach to continuous process improvement. Its financial model provides substantial economies of scale, with increased market penetration and the replication of units. A more detailed description of Naandi's model and an analysis of some key factors for its success follows.

DIGGING DEEPER: A CASE STUDY

The water-treatment model developed by Naandi Foundation of Hyderabad, India, is now to our knowledge the largest community-scale water-treatment program in the world. Focused almost entirely on rural villages that heretofore have had no widespread access to clean drinking water, the program has grown in three years to around 800 units located in four states that serve three million people daily.[6] The scaling momentum continues: Naandi expects the number of units to nearly double in the current fiscal year.

The Naandi model takes advantage of water-treatment technologies (reverse-osmosis filtering and irradiation with ultraviolet light) that has been rapidly declining in price, but that is not what sets it apart. Nearly a half-dozen for-profit

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and NGO entities within India alone are using similar equipment for similar purposes, but for the most part without similar results.[7] The keys to Naandi's success are:

- An efficient business-like approach that optimizes the entire value chain
- Forming trusted partnerships with state and local governments that aid business development
- Intensive, sophisticated marketing designed to change community perceptions and behavior—convincing individuals to value clean water and to pay for it instead of getting free water that is often contaminated.

Naandi is an NGO with a focus on alleviating poverty. However, its board of directors features a number of prominent CEOs and public figures and, unlike many NGOs, it hires its staff primarily from the corporate sector by offering them a highly professional work environment with excellent financial and nonfinancial incentives. Naandi's chairman, Dr. K. Anji Reddy (founder and chairman of Dr. Reddy's Labs, a major generic pharmaceutical manufacturer), personally recruited Amit Jain to head the water project. At the time, Jain had about 12 years of experience leading and building what became large social-marketing businesses across rural India. At Naandi, he has fostered dedication to constant experimentation with the value chain, such as changes in the size and construction of the water-treatment building; constant improvements, such as jointly, with IDEO, designing the jerry cans villagers use to collect their daily water; customizing the capacity of the water-treatment unit to meet the requirements of catchment-area populations ranging from 2,000 to 20,000; fine-tuning the marketing and health-awareness strategy employed; and the recent pilot introduction of an automated water-dispensing system driven by stored-value magnetic cards. Naandi's experimentation with this approach may reduce labor costs and has the potential advantage of offering customers flexible payments and providing the ability to gather systematic end-user information from customers.

Jain has also worked with various suppliers—for example, in close technical partnerships with WaterHealth International, TATA Projects, and Malthe Winje, Norway—to drive procurement and deployment efficiencies steadily higher and costs lower. He has shown an ability to build relationships with key government officials and to close deals that have helped expand Naandi's water business. Recent examples include establishing a working-capital loan facility of three million dollars with a leading nationalized bank, and a successful bid to deploy about 100 additional units in Punjab State. Naandi's plants have been financed by a combination of state grants, donor funds, modest community contributions, and, recently, commercial loans. Despite pricing its water lower than many other providers ($.04 to $.05 per 20 liters, the quantity needed for a day's use for drinking and cooking by a family of 5-6) and planning for a 4-5-year recovery of capital for a typical water plant, the Naandi water program closed its third full fiscal year with an approximately $500,000 operating surplus.

Now Naandi is taking steps to spin off part of its water activity and capitalize it as a social for-profit water-services company that will build and service water

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units for Naandi and other water vendors, enabling that company to capture even greater economies of scale. The proposed company also plans a foray into the hitherto untapped but vast potential area of supplying water in peri-urban slum areas, where Naandi's research suggests a willingness to pay higher prices among residents who are often denied formal access to municipal water connections.

Naandi's model, often with backing from the state government, approaches the Gram Panchayat (village-level government) with a partnership, offering to build and operate a water-treatment plant and create 1-2 local jobs, in return for a rent-free piece of ground, a source of raw water (surface or well), and an electrical hookup. Naandi builds a modern-looking building featuring a bright blue color and large glass windows, through which the stainless steel treatment equipment can clearly be seen. Originally the buildings were made of brick and mortar; now they are made of a prefabricated modular panel with a multilayer design that can be erected within a week. They are typically nicely landscaped and feature a raised platform that makes filling the jerry cans from the multiple faucets easier. These features make the water unit clearly stand out in the village, and they convey transparency and the high-tech character of the treatment process, thus reinforcing the promise of high-quality water. The water-unit structure and what it stands for are thus inspiring, even for those earning less than $2 per day. Although the building tends to more than double the cost of the water plant, the confidence it evokes in the potential client is key to Naandi's marketing strategy and clearly differentiates Naandi from more marginal, low-cost providers.

Making clean drinking water synonymous with high-tech equipment and modern, urban-quality services also addresses the feeling many villagers have that they are slipping behind and not participating in the advances of urban India. In addition, Naandi trains its water operators a month ahead of inaugurating each unit, and has them go door-to-door to make villagers familiar with the new water service that is arriving soon. It also pays for wall paintings and other visual advertisements to raise awareness. When the water plant opens, it offers free samples and stages an event attended by village leaders, shows videos explaining the health benefits of clean drinking water, and conducts school and community programs. Finally, it hires a part-time safe-water promoter, usually a village woman, who conducts a continuing campaign on the benefits of clean water and hygienic sanitation practices, and who interviews households that have not subscribed or any dropouts from the program to ascertain their reasons—data that is rigorously analyzed to understand consumer patterns and thus refine marketing approaches.

Water is pre-sold on a subscription basis. Registered subscribers bring their prepaid card to be punched as they pick up their daily allotment; the cards expire at the end of the month. This eliminates handling cash daily and also acts as an important inducement to use clean water every day, since it's already paid for, rather than buying it only when it is financially convenient—a practice that Naandi found often negated the health benefits of its efforts.

This systematic and intensive marketing approach pays big dividends. A recent survey of a half-dozen community-scale water-treatment enterprises in India

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found that the typical village penetration rates typically hover around 30 percent, while Naandi frequently reaches 55 percent to 60 percent (with a range from 30 percent to 80 percent).[8] Combined with Naandi's successful market-development efforts and its systematic development of the value chain, this explains why Naandi stands out as a premier water-treatment model.

But there is no magic here—simply excellent and intelligent execution. The approach is potentially replicable, if others follow Naandi's pioneering strategies. Moreover, there appears to be strong interest in both private and public sources of capital in supporting scalable clean-water solutions. These factors argue strongly that the sector is positioned to scale, and that a businesslike entrepreneurial approach can play a significant role, whether carried out by an unusual NGO like Naandi, by a commercial entity, or by a hybrid value chain involving both types of organizations.

CONCLUSION

The need for clean water is universal and the unmet demand huge. We believe this article shows that there are sustainable, scalable solutions that could apply to many rural and peri-urban communities, providing fee-for-service water at affordable prices. Deployment of these private-sector solutions could markedly improve health and productivity in highland communities in Central America, in the peri-urban slums of Africa, or in the rural areas of south and southeast Asia. Moreover, this is a bottom-up entrepreneurial approach that creates jobs and wealth, not a top-down development project—hence it necessarily taps local talent resources. One of the authors, visiting a water plant in India, found it quite competently run by an 18-year-old girl who had not finished high school—her mother, the original entrepreneur, had gone on to a better market opportunity but had trained her daughter to run the business, effectively doubling the family's earning power. We believe this private-sector approach may be the most effective and most reliable way to achieve the water-related Millennium Development Goals.

We think there is a vast opportunity for more Naandi-style operators, whether for-profit or NGO or hybrid. However, there may be an equal opportunity to franchise a community-scale water solution, with local entrepreneurs, local NGOs, or other community groups as the franchisees and the franchisor providing the technology, training, and branding. Franchise solutions tend to scale more rapidly and have the virtue of providing significant technical and business-model support to franchisees. We believe that community-scale water-treatment businesses are potentially less risky than many others. Aside from the up-front capital costs, the main cost of goods sold for a water-treatment plant with access to a raw water supply is electricity: even intermittent power is not a significant problem because treated water is readily stored; margins therefore are generally high. And a water business, because it draws daily traffic, can be combined easily with other retail or services businesses. Marketing, as the Naandi experience suggests, can be key, but franchisors can provide marketing materials and protocols along with their tech-

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nical support. Primarily, potential water entrepreneurs—whether franchisors or franchisees or stand-alone operators—need to become aware of the opportunity, and they need access to capital.

That in turn suggests an opportunity for social investment funds, sector-specific private equity, innovative venture capital groups, and foundation PRI money. Bilateral and multilateral development agencies could play a significant role, both in financing and in capacity-building for entrepreneurs and potential franchisees. Where are the franchise training institutes, the McDonald's University for developing regions? Public-private partnerships may work well in many countries, as long as operation of the units is clearly in private-sector hands. Even microfinance funds seeking growth may find opportunity in financing the local water-treatment franchisee, although the loans—typically $5,000 to $10,000—would be a bit larger than the typical microfinance range.

If the technology is available, the business models viable, and the financing achievable,, might we have a transformative market opportunity at hand?

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7. Personal communication, Pat Guerra, cofounder of the Global Social Benefit Incubator and co-investigator for water for the Acumen Fund Ripple Effect project analysis. Like Naandi Foundation, Byrraju Foundation is also a best practice organization in community-scale water treatment. Their expertise in market creation and segmentation is demonstrated in an average adoption rate of 53 percent, broadly comparable with Naandi Foundation.
8. Jacob Verghese of the Byrraju Foundation in a personal communication recently described the barriers to overcoming non-consumption of water as consisting of awareness, acceptance, access, and affordability. Based on its experience across 60 villages, Byrraju found that awareness was seldom a hurdle (less than 2 percent in a village with a new water treatment facility are unaware of this fact), but acceptance was the reason for non-adoption among fully 45 percent of nonusers. These individuals were not sufficiently convinced of the link between drinking safe water and health to spend money on water over other priorities. For another 40 percent of nonusers, Byrraju Foundation found that access was the driving factor in adoption, and 75 percent of these nonusers were willing if home delivery could be provided. Price was cited as a reason for non-adoption by only 15 percent of nonusers. Katz and Mohnot, *Bringing Safe Water to India's Villages and Communities*.

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