Safe Water for All

Harnessing the Private Sector to Reach the Underserved

IFC International Finance Corporation
World Bank Group

ACKNOWLEDGMENTS

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IFC, a member of the World Bank Group, creates opportunities for people to escape poverty and improve their lives. It fosters sustainable economic growth in developing countries by supporting private sector development, mobilizing private capital, and providing advisory and risk mitigation services to businesses and governments.

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Trevor Samson

FOREWORD

Since 1993, IFC, the private sector arm of the World Bank Group, has financed investments in the water sector in developing countries. It also participates in the creation of standards and benchmarks for the measurement of water footprinting as well as the development of a water fact base to provide a framework for prioritizing investment to address water scarcity. IFC's investments have focused on extending reach and access, and on supporting specific water sector technologies. They have primarily followed traditional water supply models based on infrastructure and municipal water system investment rather than supporting innovative business models and technologies that address water scarcity and issues of access to clean and safe water for the underserved.

IFC believes that to meet the Millennium Development Goal for safe water, improved access in low-income countries can be enhanced significantly though creative deployment of the financial and other resources of the private sector. There are a number of safe-water technologies, business models, and financing strategies that can significantly impact Base of the Pyramid markets in developing countries, if they can be appropriately scaled up. This publication is intended to raise awareness and to advance safe-water innovation, with the goal of mobilizing investment with sustained input into the safe-water sector in emerging markets. There are significant opportunities for leveraging IFC's resources and expertise in banking, risk management, and policy development to work along the public-private continuum. In collaboration with its private sector partners, IFC seeks to facilitate an enabling environment in which technologies for safe-water products and services can thrive. However, the private sector itself must realize that water is no longer exclusively a concern for governments; in fact, it is a market opportunity.

This report is built on research conducted in Kenya, Uganda, China, and India. These countries represent emerging markets that offer promising investment opportunities for increasing access to clean, safe drinking water. IFC believes that there are opportunities such as these around the globe in Base of the Pyramid markets.

We believe that the private sector has a strong role in addressing the sustainability of safe-water technologies and business models to reach the underserved in developing countries. The recommendations set forth at the end of this report provide what we hope will be a framework for the effective public-private partnership that will be necessary to meet the Millennium Development Goal for safe water.

Greg Radford
IFC Environment and Social Development Director

TABLE OF CONTENTS

Dominic Sansoni

ABBREVIATIONS

ADB	Asian Development Bank
AED	Academy for Educational Development
BOP	Base of the Pyramid
CASHE	Credit and Savings for Household Enterprise
CDM	Clean Development Mechanism
DFI	Development Finance Institution
DFID	Department for International Development (United Kingdom)
GHG	greenhouse gas
GNI	gross national income
HUL	Hindustan Unilever
INR	Indian rupee
IP	intellectual property
Ksh	Kenyan shilling
LED	light-emitting diode
MDGs	Millennium Development Goals
MFI	microfinance institution
NGO	nongovernmental organization
NSF	National Sanitation Foundation, now NSF-International (United States)
PATH	Program for Appropriate Technology in Health
POU	point of use, synonymous with "household water treatment" in this report
POUZN	Point-Of-Use + Zinc
PLWHA	people living with HIV/AIDS
PSI	Population Services International
RMB	Chinese renminbi
SHG	self-help group
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
USEPA	United States Environmental Protection Agency
UV	ultraviolet
WHI	WaterHealth International
WHO	World Health Organization
WSH	water, sanitation, and hygiene
WSP	Water and Sanitation Program (World Bank)

All dollar amounts are U.S. dollars unless otherwise indicated.

EXECUTIVE SUMMARY

Access to safe drinking water is critical to human health and well-being. Providing safe, reliable, piped water to every household would yield optimal health gains and contribute to the Millennium Development Goal (MDG) targets for poverty reduction, nutrition, childhood survival, school attendance, gender equity, and environmental sustainability. The World Health Organization (WHO), UNICEF, and others have a strong commitment to the MDGs, and to supporting incremental improvements in water supplies via alternative approaches targeting the provision of safe drinking water among vulnerable populations. Among those alternatives are decentralized safe water models, including distributed/vended water and point-of-use (POU) treatment.

An estimated 3 billion people lack consistent household access to clean and safe piped water, and could benefit from these solutions.[1] Despite growing international attention to global safe-water access, investment in adequate safe-water products and services in developing countries remains low. Remote and lower-income populations in these countries are at greatest risk and therefore have the most need for effective and affordable options for safe drinking water. But reaching them presents a particular challenge, and will require the combined efforts of all stakeholders, including governments and non-governmental organizations (NGOs). The private sector also has an essential role in developing appropriate safe-water solutions—and in delivering them to those who are able and willing to pay for them.

An estimated 3 billion people lack consistent household access to clean and safe piped water.

Currently, most investment in safe-water products and services in developing countries is aimed at middle- and upper-income markets, such as the vast emerging middle-income populations in India, China, and other rapidly developing economies. Hundreds of companies in these markets address the needs of wealthier consumers, who tend to be in urban areas, and have more safe-water awareness, higher income, and the access to electricity and pressurized piped water necessary for higher-end household water-treatment technologies. Also, marketing and product delivery are less problematic in urban areas. The most recent Frost & Sullivan report on the POU water sector in India[2] cited reverse osmosis systems (often over $100 each) to be "dominating the market." The "market" they are referring to is the only one many companies look at—that of the relatively well-off. Demand in these markets has sustained strong and consistent growth, and shows no sign of slowing down.

On the other hand, suppliers have few obvious incentives to pursue the riskier, more challenging Base of the Pyramid (BOP) markets. These populations tend to be more rural and thus harder to access, are usually less aware of the need for clean water or the availability of products to treat water. They also have less disposable income and often no access to reliable sources of power or water pressure.

1. WHO (World Health Organization) and UNICEF (the United Nations Children's Fund). 2008. Joint Monitoring Programme for Water Supply and Sanitation.
2. Frost & Sullivan. 2009.

In this report, we examine a range of technologies and revenue models intended to increase safe-water access among lower-income populations, with primary attention on East Africa, India, and China as important emerging markets. Although sanitation and hygiene are key factors of human health and well-being, the survey primarily targeted the safe-water sector, while recognizing that there are several similar applications to business models that provide sanitation services. As the Kenya case study on Ecotact Ltd. demonstrates, opportunities for integrated sanitation and water services hold promise for scaling up. (See page 53)

Our survey[3] identified several major barriers to reaching the BOP markets in the areas listed above and globally, including the following:

Consumer challenges

- High up-front purchase cost
- Low consumer awareness of safe-water technologies
- Competing priorities for limited disposable income
- Limited expressed demand for safe-water technologies

Entrepreneurial challenges

- Business models poorly adapted for local market conditions
- Lack of appropriate and durable safe-water technologies
- Distribution in remote, rural regions
- Poor economies of scale in sparsely populated areas
- Limited business and financial-management skills of entrepreneurs

Enabling environment challenges

- Inadequate product-certification standards
- Inadequate financing for the entire safe-water supply chain
- Inadequate consumer lending for purchasing safe-water products

Physical environment challenges

- Inconsistent or limited water availability
- Chemical contaminants not associated with diarrheal-disease prevention
- Distribution logistics of penetrating remote, sparsely populated areas

To address these challenges, a number of safe-water technologies and business models have evolved that strive to realize both social *and* financial returns. We discuss some of these business models and how they have leveraged different revenue streams, partnerships, and sources of financing to improve access to safe water in BOP markets. To identify appropriate and effective intervention methods, development and investment communities should understand existing safe-water business models and also consider the diverse factors that can influence their scale up. Among these, particular attention should be drawn to consumer demand, product characteristics, marketing/distribution, the manufacturing process, and access to financing. Furthermore, it is important to understand policy issues and the role of the public sector – at both national and international levels.

3. This project was intended to identify promising investment opportunities for safe-water technologies and commercialization of technologies in developing countries. We gathered data from NGOs, governments, and the private sector to inform a broad-based survey at the country level of projects and technologies with potential to provide sustainable access to safe water for underserved users, focusing on technologies that might meet IFC's criteria for investment or intervention in the sector. These data were drawn from various markets (urban, rural, peri-urban, high-income, low-income), technologies and technology types (disinfection, filtration, hybrid), provenance (locally-developed, imported, or licensed), delivery models, and organizations. This summary report presents general findings of this survey.

We discuss some of these barriers and opportunities, and end this report by providing recommendations for market-based approaches that could harness the private sector's power in providing access to safe water for the underserved. The interventions identified as having the greatest potential impact include:

- Strengthening commercial financial intermediaries that can create a more robust investment climate for safe-water products and services
- Creating microfinance initiatives that increase BOP consumer access to widely available, effective, middle-market water-treatment devices
- Strengthening the enabling environment, including through development and enforcement of product-certification standards or other approaches to quality assurance
- Providing flexible financing to a diverse portfolio of enterprises, which offer market-appropriate products and services that cater to the safe-water needs of BOP populations
- Offering non-financial support to entrepreneurs, such as business-skills training
- Investing in research and development of effective, low-cost technologies and piloting of business models with potential for reaching scale
- Providing advisory assistance or co-funding for in-depth market research on BOP consumer segments
- Developing financial incentives for BOP market entry by producers of higher-end water technologies

Curt Carnemark

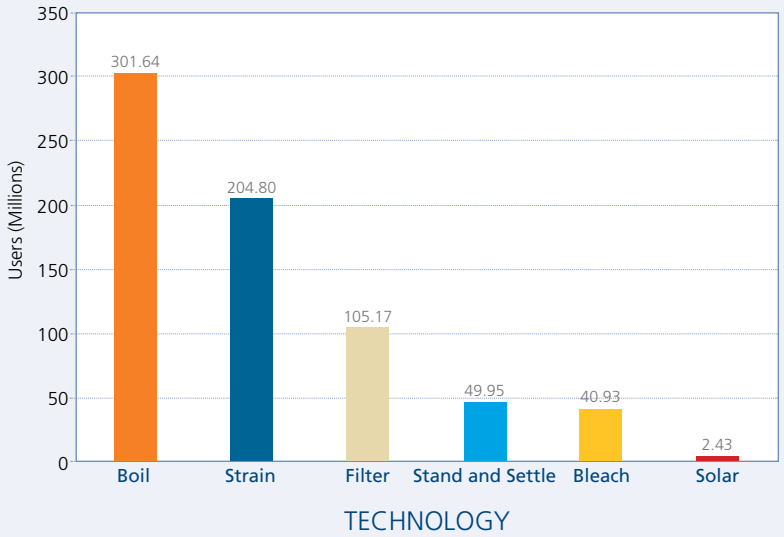
BACKGROUND

Most drinking water in the world should be considered unsafe unless it is treated properly and then protected from recontamination until use. Even where piped water is delivered to the household, point-of-use treatment by boiling or other methods is widespread—and for good reason. Intermittent service, degraded infrastructure, or unreliable water treatment forces many people to question the quality of water they drink. For some, that translates to treating drinking water or purchasing water that has been treated to a high degree, where access to these options exists. Increasing scarcity of high-quality water has led to significant and growing demand for products and services that provide safer drinking water, particularly in the developing world, where water supply infrastructure has not kept pace with economic growth and population shifts.

This report addresses the role of the private sector in increasing access to safer drinking water, as well as identifying challenges and opportunities in the sector. Despite several years of efforts by NGOs and donors to scale up access to safe drinking water technologies, none of these initiatives has achieved its targeted macrolevel impact,[4] although a number of countries have reported boiling as a near-universal practice at the household level.[5] Chart 1 below illustrates the global prevalence of boiling as a means of household water treatment.

Chart 1

Users of Different Safe Water Technologies - Global Estimate
(Data from 32 Countries)



Source: Rosa G. Clasen T. 2009 (in preparation). *The Global Prevalence of Boiling as a Means of Treating Water in the Home.*

Increasingly, the private sector is exploring strategies to capture the demand for safe water worldwide by promoting products and services that are improvements over existing practices or technologies, or introducing access to safe water where alternatives do not exist. Innovative safe-water revenue models, new ways of marketing, and microcredit financing are thus evolving and offer opportunities to reach the underserved.

4. Clasen, T. 2009. *Scaling Up Household Water Treatment: Looking Back, Seeing Forward*. Geneva: WHO. In press.
5. For example, Vietnam (90%) and Mongolia (95%). WHO and UNICEF. 2008. Joint Monitoring Programme for Water Supply and Sanitation.

SECTOR OVERVIEW

SAFE-WATER ACCESS NEEDS TO BE SIGNIFICANTLY IMPROVED.

According to one estimate,[6] nearly 900 million people lack adequate access to improved[7] water sources, and a greater number lack access to microbiologically safe water as defined by the *Guidelines for Drinking-water Quality.*[8] This basic human need is not met for a significant percentage of the world's population and a much higher percentage of the world's poor.[9] Inadequate access to safe drinking water contributes to the staggering burden of diarrheal diseases worldwide.[10] Drinking contaminated water can also reduce personal productive time,[11] with widespread economic effects, especially affecting vulnerable groups such as women, children, poor people in rural areas, and slum dwellers. Over 440 million school days are missed annually due to water, sanitation, and hygiene (WSH)-related illnesses, according to one estimate.[12] Problems associated with poor drinking-water quality are significant barriers to development, both human and economic.[13]

World Bank

6. WHO and UNICEF. 2008. Joint Monitoring Programme for Water Supply and Sanitation.
7. Defined as a household connection, a public standpipe, a borehole, a protected well or spring, or a rainwater system.
8. WHO (World Health Organization). 2004. *World Health Report 2004.* Geneva: World Health Organization. Available online at http://www.who.int. WHO. 2006. *WHO Guidelines for Drinking Water Quality*. 3rd ed. Geneva: World Health Organization. Available online at http://www.who.int.
9. Rheingans, R., R. Dreibelbis, and M.C. Freeman. 2006. "Beyond the Millennium Development Goals: public health challenges in water and sanitation." *Global Public Health* 1 (1): 31–48.
10. Prüss, A., D. Kay, L. Fewtrell, and J. Bartram. 2002. "Estimating the burden of disease from water, sanitation, and hygiene at a global level." *Environmental Health Perspectives* 110 (5): 537–42.
11. Hutton, G., L. Haller, and J. Bartram. 2007. "Global cost-benefit analysis of water supply and sanitation interventions." *Journal of Water and Health* 5 (4): 481–502.
12. Moszynski, P. 2006. "Worldwide water crisis is a 'silent emergency,' UN agency says." *British Medical Journal* 333: 986.
13. Hutton, G., L. Haller, and J. Bartram. 2007. "Global cost-benefit analysis of water supply and sanitation interventions." *Journal of Water and Health* 5 (4): 481–502.

Water-supply systems in developing countries are often poorly designed, poorly maintained, and/or poorly managed. Even those that meet internationally recognized standards for "improved" water supplies often fail to produce water that is safe for drinking.[14] Recent evidence suggests that even occasional failures of conventional water supply systems to reliably provide safe drinking water will leave users at high risk.[15] Moreover, no meaningful enforcement of applicable standards exists for most drinking-water supplies. The massive burden of waterborne diseases suggests there is still much work to do.

So, how can decentralized safe water models (through distributed/vended water or POU water treatment) help? By providing affordable, safe water at the lowest price to at-risk populations. Much of the target population already has a long tradition of taking charge of their own water supplies—digging their own wells, collecting water from distant rivers, or standing in long queues at urban tap stands. They should also be empowered to control the quality of water they drink. Putting control of clean water into the hands of people with limited disposable incomes enables them to prioritize clean water and invest in improving their families' health.

WATERBORNE DISEASES CAUSE SIGNIFICANT SOCIAL AND ECONOMIC BURDENS.

In addition to poor hygiene and sanitation practices, unsafe drinking water is a leading cause of preventable diseases, particularly among the young, the immuno-compromised, and the poor. Waterborne pathogens account for many of the estimated 4 billion cases of endemic diarrheal disease (and 1.7 million deaths) each year.[16] Among children under five years old in developing countries, diarrheal disease accounts for 21 percent of all deaths.[17] For people living with HIV/AIDS (PLWHA), diarrhea can be prolonged, severe, and life-threatening.[18] Due to lack of safe water and sanitation, low-income populations bear much of this disease burden.[19]

Treating water in the home offers the opportunity for significant health gains at potentially dramatic cost savings over conventional improvements in water supplies.

14. WHO and UNICEF. 2007. *Rapid Assessment of Drinking Water Quality*. Geneva: World Health Organization.
15. Hunter, P.R., D. Zmirou-Navier, and P. Partemann. 2009. "Estimating the impact on health of poor reliability of drinking water interventions in developing countries." *Science of the Total Environment* 407 (2009): 2621–24.
16. WHO. 2005. *World Health Report 2005*. Geneva: World Health Organization.
17. Parashar, U.D., J.S. Bresee, and R.I. Glass. 2003. "The global burden of diarrheal disease in children." *Bulletin WHO* 81 (4): 236.
18. Hayes C., E. Elliot, E. Krales, and G. Downer. 2003. "Food and water safety for persons infected with human immunodeficiency virus." *Clinical Infectious Diseases* 36 (Supplement 2): S106–9.
19. Blakely T., S. Hales, C. Kieft, N. Wilson, and A. Woodward. 2005. "The global distribution of risk factors by poverty level." *Bulletin WHO* 83: 118–26.

SAFE-WATER TECHNOLOGY IS EFFECTIVE; SO, WHY ISN'T IT MORE WIDESPREAD?

In many settings, both rural and urban, household water-quality interventions can reduce diarrhea morbidity by more than 40 percent.[20],[21] Treating water in the home offers the opportunity for significant health gains at potentially dramatic cost savings over conventional improvements in water supplies, such as piped water connections to households. And it addresses the MDG for safe drinking water.

Yet, the rapidly increasing demand for water treatment has not yet been translated into widespread uptake and use among lower-income populations on a sustained basis.

Curt Carnemark

According to a recent WHO report,[22] this is believed to be attributable to three factors:

1 *Supply does not meet consumer preferences*: products (e.g. chemical disinfectants) that meet public health objectives but do not address user preferences for convenience, aesthetics, taste, reliability, aspirational quality, safety, and robustness

2 *Inadequate consumer awareness*: limited understanding of the need to treat water and uncertainty about how to do so

3 *Inadequate distribution and financing*: failure of conventional supply chains to reach the target population with effective, affordable, and desirable water-treatment products and to provide financing to cover their up-front cost

Innovation and investment are needed to reach the BOP markets, where safe water is most desperately needed.

20. Clasen T., I. Roberts, T. Rabie, W. Schmidt, and S. Cairncross. 2006. "Interventions to improve water quality for preventing diarrhea" (A Cochrane Review). *The Cochrane Library* (3). Oxford: Update Software.
21. Fewtrell L., R. Kaufmann, D. Kay, W. Enanoria, L. Haller, and J. Colford. 2005. "Water, sanitation, and hygiene interventions to reduce diarrhea in less developed countries: a systematic review and meta-analysis." *Lancet Infectious Diseases* (5): 42–52.
22. Clasen, T. 2009. *Scaling Up Household Water Treatment among Low-Income Populations*. Geneva: World Health Organization.

THE SAFE-WATER MARKET IS GROWING RAPIDLY.

The global water market generates annual revenues of $463 billion.[23] Of this, the POU water market was estimated at $15 billion per year in 2005, with annual growth of 16.5 percent.[24] The expected growth in revenues is due in part to significant sector expansion in *developed* countries where bottled water and household water treatment markets are growing rapidly. In 2007, the residential water-treatment market in Europe generated an estimated $721.2 million in revenues, with forecasted growth to reach $1 billion by 2014.[25] In *developing* countries, larger companies remain focused on the middle- and higher-income segments of the market, where significant growth potential exists and margins are higher.[26] In addition, bottled-water sales in some developing countries are also rapidly increasing, especially in urban areas.[27] There is however, increasing interest in capturing the BOP market[28] through less expensive technologies, community water systems (distributed/vended water), and providing access to higher-end products through microcredit plans.

CHALLENGES OF SAFE-WATER MARKET SEGMENTS DIFFER SIGNIFICANTLY.

Base of the pyramid

The so-called BOP market includes the estimated 4 billion people who are most affected by the problems associated with inadequate access to safe water. A significant portion of this market lives on less than $2–$3 per day, and is unlikely to be able to impact cost-effective scale up of safe water technologies and business models. This segment must be the main priority of public sector and NGO efforts toward ensuring water security.

To capture the BOP market for safe water, companies need to:

- **understand how much the households are willing to pay for improved water**
- **develop products and services that are affordable and acceptable**
- **deliver products and services to markets that substantially differ from middle- and upper-income markets**

However, much of this population does have purchasing power and thus represents a potential market for resourceful suppliers. Securing access to water often represents a substantial expenditure in poor households, and poor households often pay more for water by unit cost than wealthier ones.[29] Capturing this market for safe water requires companies to understand how much lower-income households are willing to pay for improved water, to develop products and services that are affordable and acceptable, and to deliver products and services to market segments that substantially differ from middle- and upper-income

23. 2008 Estimate by Global Water Intelligence: Global Water Market 2008: Opportunities in Scarcity and Environmental Regulation.
24. Frost & Sullivan. 2005. "Global Competitive Environment for Residential Water Treatment Equipment Markets" (November 21). Available from Frost & Sullivan, www.frost.com; contact johanna.haynes@frost.com. Quoted in *PATH Safe Water 2008 Brief*, available at www.path.org.
25. Frost & Sullivan (http://www.environmental.frost.com).
26. *PATH Safe Water 2008 Brief*, available at www.path.org. Contact Glenn Austin: gaustin@path.org. Also, personal communication: Pradeep Kashyap, MART, New Delhi, India.
27. WHO and UNICEF. 2008. Joint Monitoring Programme for Water Supply and Sanitation.
28. Populations at the Base of the Pyramid are those whose annual per capita incomes are less than $1,500 (purchasing power parity). See Hart, S. L., and T. London. 2005. "Developing native capability: What multinational corporations can learn from the base of the pyramid." *Stanford Social Innovation Review* 3 (2): 28–33.
29. Briscoe, J., P.F. de Castro, C. Griffin, J. North, and O. Olsen. 1990. "Toward equitable and sustainable rural water supplies: a contingent valuation study in Brazil." *The World Bank Economic Review* 4 (2): 115–34. "In recent years many have realized that precisely because the benefits of improved water supplies are so great, many people in developing countries can and will pay for improved services. They will do so, however, only if they are provided with services which, in their eyes, constitute significant improvements over their existing supplies. Now the challenge is to identify, under a range of socioeconomic and environmental conditions, the level of service that people want and for which they are willing to pay."

markets.[30] By encouraging the private sector to develop market-based safe-water solutions, governments and NGOs can focus their limited resources on those populations that cannot be reached though commercial strategies.

Tom Oudaw

Middle and upper income

Middle- and upper-income markets are growing quickly in several countries, particularly in India and China. McKinsey and Company projects that the middle-income ($5,000–$25,000 per year) market in India will increase from 8 percent of the population in 1985 to almost 60 percent by 2025, if current trends continue.[31] In 2006, McKinsey also predicted that rural Chinese workers in the process of moving to urban areas and into the lower-middle class[32] will reach 290 million by 2011, with as many as 520 million (half the projected Chinese population) in the middle class by 2025. It remains unclear how the current global economic downturn will affect the emergence of these markets in the short to medium term, and whether or not this may prompt some manufacturers of safe-water products to shift their attention from middle- to upper-income markets.

Projected growth in demand for high quality drinking water, coupled with increased competi-

30. Dunk, D.D. 2004. "Things to consider when marketing a better mousetrap in emerging countries." *Water Conditioning and Purification* (September): 12–13.
31. McKinsey and Company. 2007. *The Bird of Gold: the Rise of India's Consumer Market*. San Francisco: McKinsey and Company. Available online at http://www.mckinsey.com.
32. The McKinsey report defines lower middle class in China as households with an annual income of around $3,000–$5,000, with the middle class earning $5,000–$12,500 per year.

OVERVIEW OF BUSINESS MODELS

Tom Outlaw

tion in other market segments, has led to a proliferation of business models for delivering safe water to lower-income populations. The driver for development of social-enterprise (*double* or *triple bottom line*) business models[33] is that the burden of waterborne disease is largely borne by the poor. For these models, success is based in part on the public benefit derived from providing greater access to safe water for lower-income market segments. Such enterprises are often international and may also be spin-off ventures originating in NGOs.

Safe-water enterprises require business models that can achieve social impact *and* financial sustainability at scale.

Safe-water enterprises require business models that can achieve social impact *and* financial sustainability at scale. The first step in analyzing a business model's viability[34] is to identify the income drivers that monetize an enterprise's value proposition. For water-technology social enterprises such as those reviewed in this report, a portion of the funds needed to operate or scale up comes from *earned income*—received for products or services provided. Earned income is necessary to reduce an enterprise's dependence on *contributed income* from grants or charitable contributions, and to maintain successful and sustainable operations.

Earned income from safe-water-related businesses does not always come from the direct client or beneficiary (poor consumers). Often, it is earned from an indirect beneficiary, such as governments, donors, or NGOs. Vestergaard-Frandsen, for example, earns income from donors and NGOs based on the effective bulk delivery of its *Lifestraw* water filter. A company also may earn indirect income from selling carbon credits generated from the use of its water-treatment systems, which are promoted to its direct customers as an alternative to boiling water (see Appendix IV).

Some companies have explored the carbon-offsetting potential of water treatment options that replace boiling or pasteurization. Most water treatment technologies reduce greenhouse gas emissions because they eliminate the need for burning wood or fossil fuels to boil water. While such benefits are easy to hypothesize, documenting and maintaining the conditions necessary for earning carbon credits can be considerably more difficult to implement. Currently, it is too preliminary to present a comprehensive cost-benefit analysis on selling carbon credits as a source of indirect income.

The success of social enterprises can depend on such factors as legal structure, access to financing, entrepreneurial capacity, strategic partnerships, and revenue models.[35] These factors also influence their relative attractiveness to private sector investors and are examined in more detail below.

33. That is, those business models that define success of the enterprise based on the degree to which it meets social or environmental goals in addition to maintaining profitability.
34. The term *business model* is used here to describe the process(es) by which an enterprise creates economic value for its target consumers, for itself, and for its shareholders and partners. It includes the methods and physical mechanisms required to deliver a product or service to its target markets in ways that its customers desire and that, in the long term, are profitable for the enterprise.
35. Hammond, A. 2008. *Safe Drinking Water for All: A Sector Review of the Opportunity for Community-Scale Social Enterprises*. Washington, DC: World Resources Institute.

LEGAL STRUCTURE

Water enterprises surveyed for this report share a common vision of improving access to safe and affordable drinking water by the poor. But the models vary in how strongly the profit motive is applied to achieving this goal—ranging from the purely "giveaway" model of the public sector and some NGOs to fully commercial for-profit models. Understandably, these variations play a major role in determining both the source (investors versus donors) and the type of available financing (debt, equity, soft financing or grants). In rural India, for example, the Naandi Foundation uses a fee-based approach that provides a potentially sustainable revenue stream. Although its drinking-water program does not intend to generate a profit, its business model is designed to cover its cost of goods sold and to reinvest proceeds from operations in development programs and activities to benefit local communities. Another example, the social marketing strategy pursued by Population Services International (PSI) for POU water-treatment products, is designed to recover the cost of production and distribution, but not promotion and other indirect costs. WaterHealth International (primarily in India) and Ecotact's IKOtoilet model (in Kenya) also provide fee-based services, but use a much more commercial model, designed to generate increasing returns over time for their investors.

ACCESS TO FINANCING

The financing sources available to safe-water enterprises depend on the enterprise's legal structure (for-profit versus not-for-profit) and its business model. Financing sources can change over time as water enterprises evolve from purely not-for-profit models into hybrid or blended-income models and, finally, into fully commercial businesses that are both self-sustaining and profitable. Ecotact, for example, evolved from relying solely on charity and government financing to accessing more commercial sources of financing to scale up. In contrast, WaterHealth International has always been a for-profit business with commercial financing. For any model, accessing commercial sources of capital requires a business plan and track record that adequately address the finance community's risk concerns.

ENTREPRENEURIAL CAPACITY

Programs aimed at increasing access to safe-water technologies should leverage the innovative power of entrepreneurs—especially local or indigenous entrepreneurs—in attempting to reach BOP consumers. One of the most notable findings from the countries we surveyed is the wealth of entrepreneurial talent focused on BOP market segments. For example, there are over 5,000 small businesses located in Kibera—Africa's largest slum—operating[36] everything from laundry facilities, sundry stores, and restaurants to boda-boda (bicycle taxi) repair, micro-lending, and cell-phone-recharging services. More importantly, they focus exclusively on serving Nairobi's urban poor. These entrepreneurs possess many of the skills essential to operating a successful business: internal motivation and work ethic; high risk tolerance; a deep knowledge of their products, markets, and competition; the ability to learn from failure; and a passion to succeed.

What developing- *and* developed-world entrepreneurs lack, however, is not only working capital, but also technical skills in finance, accounting, tax law, and other basic aspects of operating a commercial enterprise. In addition, given the "off the grid" nature of their markets, they lack access to the networks and connections that can provide access to potential investors. Financing institutions interested in maximizing entrepreneurs' ability to scale up the poor's access to safe water should consider not only providing capital but also the management and advisory services necessary to make them self-sufficient. This is already common practice among venture capitalists, who place themselves on the boards and management teams of the start-up companies in which they invest.

36. Personal communication: David Kuria, IKOtoilet. Contact: kuria@ecotact.org.

To maximize entrepreneurs' ability to scale up the poor's access to safe water, financing institutions should consider providing not only capital but also the management and advisory services needed to make them self-sufficient.

Ashoka and the Acumen Fund are two examples of social-purpose organizations working to increase entrepreneurs' management capacity, while simultaneously providing access to working capital and to their global network of contacts and colleagues. A central challenge for these and like-minded social-purpose investors is finding ways to aggregate, vet, and then support enough water entrepreneurs to achieve meaningful economic and health impact at scale. Providing sector-wide financial assistance (for example, through guarantees) and advisory services are potentially highly effective means of broadening the impact of these organizations' individual portfolio investments.

Alice Lin Demas

PARTNERSHIPS

Strategic partnerships can be a critical part of an enterprise's business model. They offer businesses a potential source of risk management and long-term competitive advantage if properly structured and done for the right reasons.

For example, Ecotact outsources the drinking-water portion of its business to Trojan UV, which installs and services its ultraviolet (UV)-based water treatment systems at IKOtoilet outlets. This arrangement enables Ecotact to focus on its core business—providing customers with clean, safe, well-managed public toilets—while also strengthening its relations with local governments that are increasingly in search of entrepreneurs to operate and maintain public toilet facilities. Ecotact's flexibility regarding its choice of technology providers allows it to adapt quickly and easily to changing consumer preferences, different source-water characteristics, and evolving treatment technologies.

Being open to different partners and technologies can be a competitive advantage by allowing companies such as Ecotact to manage risk through diversification and concentrate on addressing key success factors, such as customer service. However, it is important to note that the company also needs to incur costs to coordinate and oversee the quality of its technology providers.

REVENUE MODELS

A revenue model explains the different means by which a business charges for the goods or services it provides to its target markets and thus generates sales. As with any business, revenue models for safe-water social enterprises must be sufficiently robust to cover, at a minimum, all costs associated with manufacturing, marketing, and distributing its products or services. All of these enterprises are earning income by providing drinking water (or other water or sanitation services) to consumers in some form or fashion. What differentiates them is the variation in revenue generation methods used. In India, for example, the Odanthurai Packaged Drinking Water Federation sells treated water, packaged in containers, to consumers at a set unit price. In Kenya, Ecotact's IKOtoilet model provides opportunities for additional revenue streams from non-water-related enterprises, allowing for greater risk management through revenue diversification. Corporate advertising on the walls of IKOtoilet facilities, and leasing of retail space for food vending and shoe shining all generate revenue from different sources by capitalizing on the opportunities provided by consumers' demand for affordable and effective water and sanitation. Finally, diversified revenue streams can also help reduce the perceived risk of commercial lending institutions or investors, thus allowing for more favorable financing terms.

Table 1 gives examples of private sector enterprises and NGOs that have various models for generating revenue by providing safe water access to the underserved.

Table 1: Examples of Revenue Models in the Safe-Water Sector

BUSINESS MODEL	DEFINITION	EXAMPLES	KEY RISKS
Earned income—unit sales	Revenue from volume or unit sales of product	Hindustan-Unilever Packaged-water vendors (such as those found in Ghana, the Philippines, and Indonesia)	Creating aspirational demand through branding, pull-marketing; competition from knock-offs; rural distribution
Earned income—advertising and leasing revenue	Revenue from sale of advertising space and leasing of retail space	Iko-toilet	Maintaining high visibility of facilities
Earned income—microfinance	Deferred payment for product	Safe Water and AIDS Project ACCESS AED/POUZN	Transaction costs; interest rates; long payback period; MFIs' capacity and reputation; credit default
Earned income—franchising	Income from licensing branded water-vending service	Odanthurai Packaged Drinking Water Federation IKOtoilet	Maintaining consistent quality and execution among franchisees
Earned income—blended	Fees from products *and* services	IKOtoilet WaterHealth International	Maintaining adequate revenue mix
Contributed income	Indirect beneficiary (e.g., government or NGO) pays for product or service	Vestergaard-Frandsen	Donor dependence; competing technologies
Hybrid blended income	Earned and contributed income sources	International Development Enterprises Population Services International Naandi Foundation	Donor dependence; market distortion from subsidies; balancing cash flows from different sources; maintaining sustainable ratio of donor versus market revenue sources

FACTORS INFLUENCING SCALE-UP OF SAFE-WATER PRODUCTS AND SERVICES

Alice Lin Demas

USER AWARENESS, CONSUMER DEMAND, AND CONSUMER BEHAVIOR

A frequently cited challenge to expanding coverage of safe-water technologies is the lack of awareness about water-quality issues or the risk of disease from untreated drinking water. Everyone likes clear water, but the message that clear water may be unsafe is often lost. Expansion of NGO- and government-led awareness campaigns, innovative social marketing programs, health education, and advertising campaigns have all been used to raise consumer awareness. (See Box 1.)

Consumers of safe-water products and services have social and behavioral attitudes that influence their decisions about the water they drink. Acceptability of some technologies or services may be poor if their use requires a change in habits or introduces time or resource demands, such as fetching more water from a kiosk or back-flushing a filter. Some efforts to expand coverage of safe-water interventions have failed due to lack of understanding of the target population or market segment's behavioral attitudes. [37]

Some efforts to expand coverage of safe-water interventions have failed due to lack of understanding of the target population or market segment's behavioral attitudes.

The AED (Academy for Educational Development) and POUZN (Point-Of-Use + Zinc) experience in India described in Box 1 highlights these behavioral attitudes as a primary barrier to widespread adoption of water treatment, especially among the rural poor. AED noted that:

> Awareness is particularly a problem in rural areas, where people strongly believe, and often correctly, that their water source is clean. However, many people do not appreciate the possibility of water recontamination between source and use. Traditionally water purification has been considered as an emergency measure which is discontinued as soon as the emergency is over. For example: the doctor recommends giving boiled water when a child is sick or the government agencies distribute chlorine tablets after floods or cyclones.[38]

People must see water quality as a problem before they will act on it. Promotion of water treatment to individuals who typically do not treat their water presents a fundamental behavior-change challenge. But for those who do treat their water, treatment via another—easier or less costly—method may present advantages over the method they currently use (usually, boiling). They generally are the first accepters of novel safe-water methods, devices, or services that present real and clear advantages over existing practices.

37. Rogers, E. 2003. *Diffusion of Innovations.* 5th ed. New York: Simon and Schuster.
38. Personal communication: Deepak Saksena, AED. Contact: dsaksena@aed.org

BOX 1

USING EDUCATION AND MICROFINANCE TO SCALE UP USE OF SAFE-WATER PRODUCTS IN UTTAR PRADESH, INDIA – THE AED/POUZN PROJECT

Background on the POUZN project

The POUZN project[39] works with the commercial sector, self-help groups (SHGs), NGOs, and MFIs to establish commercially viable and scalable models to advance low- to mid-range, high-quality water-treatment methods among lower-income consumers. The project promotes multiple water-treatment methods—boiling, SODIS (a solar disinfection method), chlorine, and POU devices—to generate consumer acceptance and long-term sustainable product use.

The Academy for Educational Development (AED) is leading a pilot POU intervention program in Uttar Pradesh, India, with support from USAID (United States Agency for International Development) under the POUZN program to reduce diarrheal diseases. The intervention pilot includes such options for water treatment as the PSI Safewat product, Aquatabs sodium dichloroisocyanurate tablets, and the Hindustan Unilever (HUL) Pureit device (with access to microcredit).

AED/POUZN asserts that an educational project using microfinance can resolve some of the problems hindering expansion of safe-water solutions in India. AED specializes in providing behavior-change communication programs to target audiences and has increased the awareness of the importance of safe water. The project has trained NGOs in communicating that importance.

POUZN's two NGO partners work with self-help groups: PANI works with 1,200 SHGs (14,000 women members), and Pratinidhi with 150 SHGs (1,500 women members). Baseline data revealed low treatment of water at the point of use. After the pilot marketing effort, data from August 2008 revealed that 82 percent of the urban SHG members and 39 percent of rural SHG members (44 percent of total) have begun using some form of water treatment. Despite a strong preference for filtration, filter purchases are still low (4 percent), because the price (about $40) is still too high for many. Cheaper alternatives with the same advantages of efficacy, consistency, ease of use, and scalability would be highly desirable in this market. Approximately 24 percent of SHG members have purchased filters in the urban markets, largely through microfinance. Notably, 100 percent of POU-device loans have been repaid to date.

Urban populations generally have more income, more water-treatment choices, and greater awareness of health and hygiene issues related to water. The AED/POUZN project highlights the fact that rural populations, in comparison with urban populations, generally have greater access to microcredit through SHGs or NGO microfinance institutions. However, access to small loans for non-income-generating items (such as water filters) is limited.

NGO collaboration with the commercial private sector

Chlorine tablets are purchased in bulk and distributed in small plastic bottles at Rs.5. Chlorine Liquid (Safewat brand) is distributed at Rs.10, allowing for a small margin. AED/POUZN has also entered into an agreement with Medentech (Ireland) to introduce Aquatabs (effervescent chlorine tablets) in the near future. Two safe-water device manufacturers are marketing their products and have created supply chains in rural areas: Hindustan Unilever with its *Pureit* product, and Eureka Forbes with *Aquasure*. NGOs receive sales incentives, and SHGs obtain microloans from PAHEL, an offshoot of PANI, and the commercial POU-device partners.

The POUZN project is pursuing a number of different strategies to facilitate NGO-private sector coordination to maximize market penetration of safe-water technologies supplied by the commercial private sector. Key activities are NGO-led behavior-change communication, SHG-based marketing, demand-generating activities (such as group water testing with hydrogen sulfide-based kits), working with local microdistributors and MFIs, and building on existing NGO-community relationships to promote safe-water products.

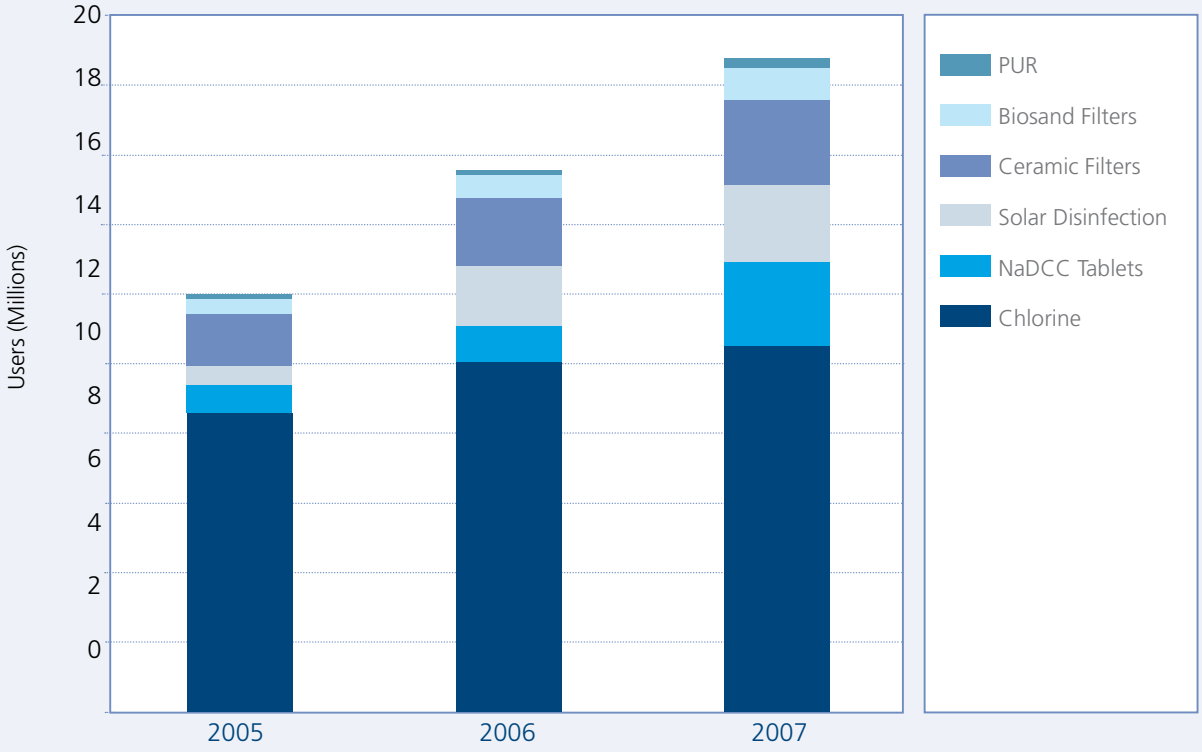
39. Some text provided by Deepak Saksena, AED.

PRODUCT CHARACTERISTICS

The viability of safe-water products and services is ultimately limited by their scalability and sustainability. This section provides a general overview of product characteristics that are most relevant to scalable safe-water interventions. Chart 2 below demonstrates the small but growing utilization of the most commonly used POU devices globally from 2005-2007.

Chart 2

Users of Different Safe Water Technologies by Type of Treatment Used Globally



Source: Clasen T. 2009. *Scaling Up Household Water Treatment among Low-Income Populations. Geneva: WHO*

Products should be effective against a wide range of waterborne pathogens and certain chemicals, as demonstrated by rigorous testing that meets international standards or guidelines.

Technologies should be subjected to rigorous laboratory testing to ensure that they meet or exceed international guidelines for the reduction of waterborne pathogens (see Box 2) and, where appropriate, chemical contaminants such as arsenic, lead, and fluoride. Technologies that rely on novel or unproven disinfectants (for example, silver or other metal compounds) should be tested for toxicity according to standard methods.

BOX 2

WHY THE FOCUS ON MICROBIOLOGICAL EFFECTIVENESS?

Despite a developed-world preoccupation with addressing a growing list of chemicals and their purported but mostly unproven health risks, the greatest risks of waterborne disease globally are still from microbes.[40] Microbes cause illness and death, and contaminated drinking water contributes substantially to the global burden of waterborne infectious diseases. With the exception of a few key chemicals (such as arsenic, lead, and fluoride), the risks of illness and death from chemicals are low, mostly speculative, and unproven. Simply, there is little epidemiological data to support significant health risks from chemicals in drinking water.

In contrast, pathogenic microbes continue to be a major cause of waterborne disease globally, and they cause documented illness and death worldwide. Although efforts have been relatively successful in reducing the burden of disease from some waterborne pathogens, many still pose a considerable risk to human health, and many of the agents responsible are either poorly understood or not even recognized. Successful detection and monitoring for pathogens in drinking water remains a challenge. None of the microbial indicators now used is capable of indicating the presence or predicting the risks of all pathogens, even by using state-of-the-science detection methods.

Environmental Public Health Organization

Products should be constructed with sustained usefulness in mind.

Technologies intended for use in developing countries should embody principles of sustainable design. Examples of problematic technologies include the following:

- Those using consumables for which viable supply chains do not exist (an obvious consideration often absent in household water-treatment technology, intervention-program plans, or marketing efforts)
- Technologies that are operable only with consistent access to power supply or water pressure, neither of which can be depended upon in many areas of developing countries
- Technologies with moving parts, complex electronics, breakable elements, or parts that are not repairable or replaceable locally, and which may not hold up under household-use conditions for extended periods
- Those with fragile or photodegradable elements (ceramic filters, glass tubes used in UV disinfection, plastic and rubber components, any and all moving parts, which *will* break over time if they are used and therefore handled regularly),[41] and that lack a servicing plan to ensure that users can access replacements

40. Prüss, A., D. Kay, L. Fewtrell, and J. Bartram. 2002. "Estimating the burden of disease from water, sanitation, and hygiene at a global level." *Environmental Health Perspectives* 110 (5): 537–42.
41. Brown, J., M. Sobsey, and S. Proum. 2007. *Use of Ceramic Water Filters in Cambodia*. Washington, DC: WSP-World Bank Field Note.

Further, technologies must be easy to operate and maintain: Technologies that present a high user burden, demand significant changes in behavior, or consume inordinate amounts of valuable household time may not be sustainable. If the technology must be supported by significant on-going user education, support, or training to achieve long-term use, the technology may require consistent investment of own resources, or partner organizations with resources, to dedicate to this so-called "software." Technologies intended for disaster relief or for use by mobile or seasonally migratory populations must be easily distributable and movable. In addition, technologies should work in diverse environments; for example, they should not depend on the quality of the water to be treated.

Technologies that present a high user burden, demand significant changes in behavior, or consume inordinate amounts of valuable household time may not be sustainable.

Many filters or other devices have a "usable life" beyond which some or all components must be replaced, cleaned, or regenerated. When to do this must be obvious and effectively communicated to the user to support behavior change. For example, in Hindustan Unilever's Pureit device, a clear color indicator alerts the user that the "battery" (disinfectant and other system components) must be replaced to maintain system effectiveness. This type of communication is a critical element to ensuring effectiveness of technologies with consumable or limited-life components.

Technologies with a high user burden or those that involve substantial behavior change may not reach commercial viability due to potentially significant declines in use after introduction of the technology. Sustained-use issues affect the commercial viability of proposed technologies. Of the suite of technologies and methods on the market, several—including ceramic filters (see Box 3), SODIS, solar cookers, and PUR (sachets)—have been documented to experience substantial, and occasionally dramatic, declines in use following targeted implementation programs. Most of these interventions to date have been NGO-led, and data now suggest that uptake and consistency of use increase following market-based approaches, where users invest in the technology themselves.[42] Technologies need extended field studies and marketing pilot data to show whether they can survive in the marketplace. To prove a business case, investors or other funders of these studies should ensure that they capture all the costs, such as up-front capital investment, education and training costs, and so on.

42. Brown, J., M. Sobsey, and S. Proum. 2007. *Use of Ceramic Water Filters in Cambodia*. Washington, DC: WSP-World Bank Field Note.

BOX 3

COMBATING LOW UPTAKE AND AIMING TO REACH SCALE IN CAMBODIA: CERAMIC WATER PURIFIERS

Ceramic Water Purifiers (CWPs) are pot-shaped ceramic filters, often with the addition of antimicrobial silver compounds. Collectively, an estimated 423,000 people in 21 countries were using ceramic filters as of the end of 2007, producing 2.6 billion liters of water to meet needs of an estimated 2.5 million users. Despite more than 25 years of history, results to date show that there has been little uptake in BOP markets, partly because consumers found the low flow rate and the need to periodically brush (clean) them unattractive. Much of the failure is also attributed to poor planning, lack of technical expertise and support, inadequate funding or localized circumstances that led to early suspension. For example, in Mexico, CWP producers stated that consumer resistance to door-to-door sales of the product rose due to the government campaigns that boiling is more effective for purifying water.

However, in Cambodia, CWPs have shown promise, where three factories have produced an estimated 194,000 filters for more than 760,000 users between 2002 and 2007, overcoming quality challenges and creating demand at full cost-recovery pricing.[43] This has largely been due to the combined efforts of International Development Enterprise (IDE), Resource Development International (RDI), and the Cambodian Red Cross. With targeted marketing, education, improved manufacturing, and collaboration across NGOs over the last seven years, these three organizations have demonstrated the potential of larger-scale CWP production and distribution. In fact, IDE is now beginning a national scale-up of coverage with a planned transition to a fully commercial model, with the support of USAID's WaterSHED (Water, Sanitation, and Hygiene Enterprise Development) program led by the University of North Carolina.


Joe Brown

Products should be supported by studies showing demonstrated effectiveness in preventing diarrheal or other disease.

Some technologies for the provision of safe drinking water are supported by rigorous data showing they improve health,[44] while others are not. Novel or unproven technologies should, in addition to extensive laboratory testing for effectiveness in reducing waterborne pathogens (and certain chemicals where appropriate), be subjected to field testing, specifically for the reduction of diseases associated with drinking water. Such testing should always be performed independently by organizations or individuals with expertise and experience in the design and execution of health impact studies of interventions. Adaptations of known effective technologies may be exempted from this requirement in practice, depending on local testing capacity and regulatory environments.

43. Brown, J., M. Sobsey, and S. Proum. 2007. *Use of Ceramic Water Filters in Cambodia*. Washington, DC: WSP-World Bank Field Note.
44. Clasen, T., W.P. Schmidt, T. Rabie, I. Roberts, and S. Cairncross. 2007. "Interventions to improve water quality for preventing diarrhoea: systematic review and meta-analysis." *British Medical Journal* 334 (7597): 755–56.

Products should be affordable, accessible, and distribution-friendly.

On a unit-cost basis, the poor often pay more for improved water. In household water treatment, the most accessible technologies are often sachets or chemical solutions added to unit volumes of water-comparatively expensive on a liters-treated basis, as contrasted with filters or other treatment devices with higher up-front costs. However, this capital investment required prevents some segments of the population from purchasing them. In an initial safe-water sector analysis, Seattle-based PATH (Program for Appropriate Technology in Health) identifies price and distribution as the two most important limiting factors that keep safe-water technologies from reaching the BOP. Any viable safe-water technology must be affordable and accessible to users, ideally without on-going subsidies. Qualitative research performed by the Academy for Educational Development suggested these issues are the main barrier to increasing the scale of water treatment among the poor in India:

> Boiling requires fuel, a scarce resource in poor areas of Uttar Pradesh, and proves costly in terms of money, effort and time spent by a woman. Chlorine and other chemical disinfectants are more affordable but not readily available in the private market. POU devices have to be purchased from commercial suppliers. The poor's income, especially in rural areas, may not allow purchase in a single payment (one multi-stage water filter costs about $40). Moreover, a majority of the poor families are unable to comply with the documentation process to obtain the credit insisted upon by banks, other formal credit channels and distributors. [And also], the rural areas, where over 70 percent of the population still lives, are underserved by the regular distribution network, not just for POU products, but for a large portion of consumer goods. Rural populations largely live in small villages and hamlets, the remoteness of which makes logistics for direct communication, as well as product availability, difficult to achieve.[45]

Accessing the BOP market requires sensitivity to pricing, unit packaging for affordability, making credit more accessible. Companies used to selling in urban, wealthier markets may also need to accept the trade-off between lower unit margins and higher volume of units sold.

Setting price points based on local willingness-to-pay data is ideal. Accessing the BOP market requires sensitivity to pricing, unit packaging for affordability, making credit more accessible. Companies used to selling in urban, wealthier markets may also need to accept the trade-off between lower unit margins and higher volume of units sold.

MANUFACTURING AND IMPORTATION

Safe water products may depend on international supply chains and therefore be subject to importation taxes, delays and associated storage and handling fees, regulatory approval, requests for bribes, or other obstacles to bringing the product to market. These issues are highly country-specific and may hinder coverage expansion. However, local production of safe-water technology components or entire technologies do exist in some countries (for example, sodium hypochlorite in Kenya and Uganda). When quality- and cost-effective, investors should encourage local entrepreneurship, to decrease reliance on imports and increase local competition in the private sector.

45. Personal communication: Deepak Saksena, AED (Academy for Educational Development). Contact: dsaksena@aed.org. The text in this section is drawn from an August 8, 2008, report by D. Saksena detailing progress on the AED/POUZN project.

DISTRIBUTION

BOP market geographies (rural areas, slums) may not be readily accessible for the distribution of safe-water products and services. Insufficient development of a viable supply chain for safe-water products has limited some NGO-led approaches to scale-up of clean water technologies.[46] Private sector actors may be able to understand and adapt to problems associated with importation of products or product components, distribution of products to retail outlets, the highly localized issues that affect rural marketing (such as seasonality, transport, infrastructure, culture), but may not have sufficient expertise in rural marketing and distribution. Reaching rural markets often means partnering with an organization with significant experience and distribution channels in the area.[47] NGOs, groups such as SHGs in India, or local governments may also help with rural marketing and distribution/logistics, as highlighted in the POUZN project described in Box 1, earlier in this report.

Alice Lin Demas

MARKETING

The marketing of safe-water products and services requires relevant campaigns and tailored messages, as well as the debunking of false claims about ineffective but attractive alternatives.

Creating effective messages and locally relevant value propositions

The development of culturally appropriate and effective marketing strategies for safe-water products and services has improved considerably in recent years due to increased competition and NGO-private sector collaboration. Instead of focusing exclusively on health outcomes and negative reinforcement ("you will get sick unless you use this product"), successful marketing of safe-water products is now led by campaigns that focus on aspirational messages of beauty, cleanliness, overall health, and aesthetic improvements

46. Brown, J., M. Sobsey, and S. Proum. 2007. *Use of Ceramic Water Filters in Cambodia*. Washington, DC: WSP-World Bank Field Note.
47. Dunk, D.D. 2004. "Things to consider when marketing a better mousetrap in emerging countries." *Water Conditioning and Purification* (September): 12–13. Dawar, N. and A. Chattopadhyay. 2002. "Rethinking marketing programs for emerging markets." *Long Range Planning* 35: 457.

to water. This successful approach incorporates lessons learned in marketing to the BOP of other products with health and hygiene benefits, such as soap. One particular lesson is that products need effective branding strategies to scale up. It is noteworthy to the public health and development communities that in addition to the potential benefit of reducing disease through these interventions, another very positive benefit is the emergence of savvier marketing in this sector.

Social marketing has emerged as a highly promising approach to reach groups that may not be reached by the private sector.

Social marketing, developed and promoted by groups such as Population Services International, has emerged as a highly promising approach to reach the underserved. (See Box 4.) The PSI partnership to market chlorine products for household water treatment has been among the most successful safe-water initiatives in recent years, reaching broad coverage in some areas. Marketing campaigns are locally developed to ensure that the messages are relevant to target communities.

BOX 4

MOBILIZING NGO PARTNERS TO TAKE INTERVENTIONS TO SCALE – PSI

The current movement in household water treatment and safe storage had its origins in pioneering work by Centers for Disease Control and Prevention and the Pan-American Health Organization. They introduced the Safe Water System—a combination of sodium hypochlorite (liquid bleach), safe storage, and a hygiene message—as a means for householders to protect themselves against cholera. No single approach has been more extensively tested, and none has reached the same levels of scale, despite some resistance in uptake due to objections to taste and odor.

Along the way, program delivery shifted almost entirely from governments and NGOs to a single social-marketing organization, Population Services International. In 2007, more than 7.6 million bottles of SWS product—enough to treat 7.8 billion liters of drinking water and supply 10.6 million users—were sold for routine (non-emergency, non-outbreak) use in 20 countries. Nearly 60 percent of these sales were in just three countries, Zambia, Madagascar, and Malawi. These countries arguably represent examples of achieving scale in coverage at the national level for household water treatment and safe storage.

Various levels of subsidies support implementation of this product. As a result, local production has shifted to national, and the safe storage vessel was dropped in favor of promoting local storage vessels that can be modified with lids and taps to make them safe. As PSI demonstrates significant track record in marketing water treatment for the poor, private sector companies have begun to harness social marketing for scaling up interventions, often with NGO partners.

Recognizing and countering false advertising

In developing countries, it is not at all uncommon to find plainly false messages in the marketing of water-treatment products. In an initial market survey conducted by PATH[48] in Vietnam, locally produced "mineral stone" countertop filters were sometimes marketed with promises of arsenic removal and other untrue claims. Unscrupulous promotion of these products can pose a real danger to the viability of technologies that are actually

48. McLaughlin, B. 2009. Personal communication.

effective and supported by credible research and development and testing,[49] and whose higher price to the consumer may be a function of the associated development costs. In fact, consumers may actually prefer some characteristics of less effective devices, such as the higher flow rates in poorer-quality gravity-driven ceramic candle filters, aesthetics of clear but unsafe water, or the unique taste imparted to the water from the generally ineffective mineral stone filters.

Adequate development and enforcement of product certification and labeling programs are vital to the growth of the safe-water sector.

People suffering from waterborne disease may not make the connection between their health and drinking water, and users generally do not have access to water testing. For these reasons, there is no reliable market feedback that would increase use of the technologies that are more effective in reducing pathogens. Adequate development and enforcement of product certification and labeling programs are vital to the growth of the safe-water sector. Copycat producers selling imitation products without regard to public health standards are thriving in countries such as Vietnam, and will grow along with the global expansion of small-scale water treatment. Absent standards and the protection of copyright or intellectual property enforcement, legitimate safe water enterprises must tailor their marketing strategies to create stronger brand and quality/labeling awareness.

FINANCIAL BARRIERS

Despite growth in the safe-water sector, investment in businesses that target BOP markets is more limited. This section looks at some financial barriers to scaling up, and at possible solutions to address them.

Low investment levels

A number of new sources of investment in the safe-water sector are emerging. Recent developments indicate growing interest in investing in drinking-water and sanitation projects in both developed and developing countries from private and public-private financing sources, such as IFC, the Global Water Challenge, Acumen Fund, Dow Water Solutions, the Pepsi and Coca-Cola Foundations; and the Global Sanitation Fund. That said, the amount of investment available to support businesses and entrepreneurs focused on BOP markets and technologies remains limited when compared to the amount of capital available in other water-access-related sectors, such as concessions and infrastructure. For sufficient investment capital to become available that can enable sustainable scale-up, continued efforts are needed to encourage new investors to enter this dynamic and rapidly evolving market.

Inadequate credit and risk-management instruments

Access to credit remains limited—for BOP consumers as well as for entrepreneurs interested in scaling up safe-water technologies—especially in the current investment climate related to the global financial crisis. Few investors and creditors are able to assess, minimize, and otherwise manage the risk associated with funding enterprises engaged in the development, piloting, manufacture, sale, or servicing of safe-water products and services, thus restricting funding availability and adding to the cost of capital necessary for scale-up. This is compounded by the lack of knowledge investors and lenders have about the market potential for these products. A dearth of success stories in the safe-water sector and the absence of a viable pipeline have also prevented financial institutions from lending to entre-

49. Jain, Y. 2008. Personal communication.

preneurs and consumers. Development of an aggregated pipeline of opportunity, a reasonable payback scenario, support for capacity building, and a risk-sharing mechanism will be critical for lending institutions to seriously consider a foray into safe water.

Development of an aggregated pipeline of opportunity, a reasonable payback scenario, and a risk-sharing mechanism will be critical for lending institutions to seriously consider a foray into safe water.

Risk-sharing partnerships can help reduce private lenders' risk, while also providing training and advisory services to borrowers and lenders. Increasing the use of such risk-reducing financial products can help maximize returns and development impact simultaneously. Credit guarantees from credible international financial institutions, development agencies, or private sector players can demonstrate to local financial institutions that lending to the BOP market to purchase water-treatment devices can be a growth business. Such guarantees can help mitigate the perceived risks among local financial institutions of developing new loan products or of expanding into unfamiliar sectors or geographic areas. In addition, strategic credit/financing partnerships between safe-water businesses and their suppliers can be a source of risk management and long-term competitive advantage.

Lack of involvement of microfinance institutions

In India, microfinance has had a significant impact on uptake of middle-market water filters among lower-income populations ($2–$5 per day) in multiple pilot projects. According to these pilots, the BOP market has demonstrated appetite for aspirational products. Unless manufacturers of higher-cost products are willing to introduce their own creative financing plans for purchasers, they will likely need to partner with microfinance institutions (MFIs) to reach these populations. However, MFIs may be wary of water-treatment devices that are non-revenue-generating durable goods (although they may save money in reduced illness time and increased productivity). Therefore, it is important to increase the MFIs' awareness of the potential market and risk-mitigation alternatives for developing safe-water financing products.

Tom Outlaw

GOVERNMENT AND POLICY ISSUES

Tom Outlaw

The policy environment for water quality is generally poor, due to the traditional perspective that water supply ranks far above water quality with regard to public health and economic impact. Development priorities in the water sector have traditionally been in water supply, with a (as yet small) shift toward recognizing the public health and economic advantages of improved water quality, primarily in the last decade.[50] For example, the focus of the Millennium Development Goals on "improved" water supply (rather than on *safe water* as defined by WHO) means that safe-water access is not tracked in the WHO and UNICEF Joint Monitoring Programme, and thus water-quality interventions may not contribute to Goal 7, target 10, of the MDGs as currently defined.

Government and donor support, advocacy from local NGOs, and private sector interest are variable across countries. Therefore, countries differ in the degree to which safe-water products and services become part of their local sector approaches, and in the extent to which their efforts involve the private sector.

The public sector, at both local and international levels, can prioritize water quality improvement initiatives and promote safe-water sector development.

THE ROLE OF GOVERNMENT IN LAYING THE GROUNDWORK FOR INVESTMENT

Governments can either aid or hinder the development of a viable safe-water sector. Often, they do both. Some countries now have, or are in the process of formulating, national policies that could influence the emergence of local markets for safe-water products. However, none of the countries surveyed for this report had a clear national policy specifically covering safe-water products or active enforcement of quality standards.

The following are some of the actions national and local governments have considered, or can consider, putting in place to support an enabling environment for the development of safe-water initiatives:

- Reduction or elimination of tariffs or taxes on safe-water supply-chain goods
- Investment in the creation and enforcement of national product safety and effectiveness standards
- Development of a government labeling program
- Other consumer-awareness initiatives, such as public service education on safe water
- Protection of intellectual-property rights related to safe-water technology patents and trademarks
- Coordination of government ministries, donors, and other sector actors to support policies that encourage local entrepreneurial activity and promote investment in safe-water products and services
- Integration of safe-water products and services with national public health or water coverage goals
- Creation of a policy environment that officially sanctions and legitimizes safe-water products and services as a viable intermediate solution to the problems of degraded drinking water, until safe piped water can be delivered to every household
- Support for coordination of concurrent investment in water supply and safe-water initiatives at the national level, to discourage the perception that investment in safe water is in competition with investment in water utilities and supply systems

50. Clasen, T. and S. Cairncross. 2004. "Household water management: refining the dominant paradigm." *Tropical Medicine and International Health* 9 (2): 187–91.

- Support for and active participation in local pilot projects of safe-water products and services
- Development of policies to enable MFIs to accept savings (in countries where they are restricted due to legal statutes)

With the development of these actions, there is a risk that water will then be perceived as a private consumption choice rather than a public good.[51] It is important, therefore, to discourage governments of poor countries from using the promotion of POU solutions to divert attention from their inability to meet the need for public water supplies.

THE ROLE OF THE INTERNATIONAL COMMUNITY IN CREATING STANDARDS

Post-distribution treatment of water is not part of the dominant thinking in the mainstream water-utilities sector, which remains justifiably focused on the end goal of water delivery to all households via piped networks. This thinking is based on the traditional knowledge in the sector (supported by seminal reviews of health impacts associated with WSH improvements)[52] that water quantity is more important than quality for health outcomes, and therefore water-quality improvements should always be a second priority to providing *enough* water for health, hygiene, and all the other non-health benefits of water. An example of this perspective is the WHO and UNICEF Joint Monitoring Programme (JMP), which focuses on measuring access to "improved" water sources (defined by type of water-supply system), with no provision for measuring access to safe water—in the JMP or any other monitoring program internationally. But because there is now evidence that water quality at the point of use is equally important,[53]—and because of the reality that safe, piped water to all households remains an important but elusive goal out of the reach of hundreds of millions, if not billions, of the world's most vulnerable people—the intermediate solution of decentralized vended water and small-scale POU systems has received a growing share of policy attention in the water sector.

National plans are emerging worldwide for bringing safe-water technologies to scale—in some cases supported by WHO assistance.

Since 2003, the WHO International Network to Promote Household Water Treatment and Safe Storage has represented a powerful policy voice globally, advancing the development, testing, and dissemination of safe-water technologies. National plans are emerging worldwide, with progress in Tanzania, Ghana, Nigeria, Vietnam, Cambodia, and other countries whose governments have participated in national dialogue on bringing safe-water technologies to scale—in some cases supported by WHO assistance.

51. Schmidt, W. and S. Cairncross,. 2009. "Household Water Treatment in Poor Populations: Is There Enough Evidence for Scaling Up Now." *Environmental Science and Technology.*
52. Young, B.A. and J. Briscoe. 1988. "A case-control study of the effect of environmental sanitation on diarrhoeal morbidity in Malawi." *Journal of Epidemiology and Community Health* 42: 83–88. Esrey, S.A., J.B. Potash, L. Roberts, and C. Shiff. 1991. "Effects of improved water supply and sanitation on ascariasis, diarrhoea, dracunculiasis, hookworm infection, schistosomiasis, and trachoma." *Bulletin of the World Health Organization* 69 (5): 609–21. Esrey, S.A., J.P. Habicht, M.C. Latham, D.G. Sisser, and G. Casella. 1988. "Drinking water source, diarrhoeal morbidity, and child growth in villages with both traditional and improved water supplies in rural Lesotho, Southern Africa." *American Journal of Public Health* 78 (11): 1451–55.
53. Clasen, T. and S. Cairncross. 2004. "Household water management: refining the dominant paradigm." *Tropical Medicine and International Health* 9 (2): 187–91. Clasen, T., I. Roberts, T. Rabie, W. Schmidt, and S. Cairncross. 2006a. "Interventions to improve water quality for preventing diarrhoea." Cochrane Database of Systematic Reviews (3). Art. No. CD004794. DOI: 10.1002/14651858.CD004794.pub2. Fewtrell, L., R.B. Kaufmann, D. Kay, W. Enanoria, L. Haller, and J.M. Colford. 2005. "Water, sanitation, and hygiene interventions to reduce diarrhea in less developed countries: a systematic review and meta-analysis." *Lancet Infectious Diseases* 5: 42–52.

Tom Outlaw

International performance standards and enforcement are needed to identify and protect legitimate safe-water technologies. Water-treatment technology verification protocols for microbiological performance[54] exist in the United States and some other countries. Current standards for POU water treatment for the United States (and applied in several countries) specify a minimum 6 $\log_{10}$ (99.9999 percent) reduction in bacteria, 4 $\log_{10}$ (99.99 percent) reduction in viruses, and 3 $\log_{10}$ (99.9 percent) reduction in protozoan parasites, demonstrated over a range of conditions, volumes of water, and specific test microbes.[55] Some developing countries, such as Brazil, Cambodia, and Bangladesh, also have or are developing locally adapted technology performance standards, but these are not universally enforced within those countries.

All developed-country protocols are often intended to independently verify a manufacturer's performance claims against country-specific standards, rather than those articulated in the WHO *Guidelines for Drinking-water Quality*.[56]

54. These are often referred to as ETVs after the U.S. EPA's Environmental Technology Verification program
55. NSF (National Sanitation Foundation, now NSF-International). 2003. *NSF P231- Microbiological Water Purifiers*. Ann Arbor, USA: NSF International. Available online at www.nsf.org. USEPA (Environmental Protection Agency). 1987. "Guide Standard and Protocol for Testing Microbiological Water Purifiers." Office of Drinking Water.
56. These protocols typically specify the test pathogens or chemicals, the test (challenge) water quality, the frequency and duration of challenging the technology with contaminant-laden water, the minimum contaminant-reduction requirements, and other procedural and performance specifications. WHO (World Health Organization). 2006. *WHO Guidelines for Drinking-water Quality*. 3rd ed. Geneva: World Health Organization. Available online at http://www.who.int.

No international standards yet exist for the verification of household water-treatment technologies.

Although these protocols can be applied to a wide range of technologies, they were developed principally for devices and unit processes to be used in developed countries and are less suited to conditions and POU water-treatment and -storage practices in developing countries. No international standards yet exist for the verification of household water-treatment technologies, although WHO-led efforts to establish performance and testing guidelines are under way. When developed, such guidelines will need to be flexible by country or region, owing to varying laboratory capabilities, resources, and implementation contexts; emerging and evolving technologies; and the goal of encouraging incremental improvements in performance. However, in the local context, the guidelines should not change so frequently that manufacturers, entrepreneurs, and consumers become confused. Manufacturers, regulators, and implementers can ensure effectiveness of specific POU technologies based on new or modified protocols while considering local conditions and needs.

Curt Carnemark

ON THE HORIZON

Arne Hoel

NEW TECHNOLOGIES

A wide range of highly effective water-treatment devices are marketed in developing countries to middle- and upper-income consumers. The need is for effective middle-market technologies whose costs can be driven down. To reach the BOP, there is a real and pressing need for safe-water technologies that are affordable ($10 or less per unit), accessible, and distribution-friendly. Innovators in the sector have advocated, for example, the development of more affordable products that use the technology of higher-end filters. Companies that leverage these technologies to deliver lower-cost versions for BOP markets could experience rapid growth. (See Box 5.) The challenge is how to incentivize the development of lower-cost models that use higher-end technologies, since companies that have this capacity are often already experiencing rapid growth in middle- and upper-income markets.

BOX 5

HARNESSING UV TECHNOLOGIES – WATERHEALTH INTERNATIONAL'S COMMUNITY WATER SYSTEMS

Ultraviolet radiation from lamps has been used in drinking-water treatment for over 100 years,[57] and its mechanisms for inactivating microbes have now been well documented.[58] The technology's increasing use is due in part to its proven effectiveness against chlorine-resistant protozoan pathogens such as *Cryptosporidium parvum* and, to a lesser extent, *Giardia intestinalis*. A number of drinking-water treatment technologies use ultraviolet light radiation from UV lamps to deactivate microbes.[59] Typically, UV technologies allow water—in a vessel or in flow-through reactors—to be exposed to the UV radiation at sufficient dose to inactivate waterborne pathogens. However, this treatment does not address post-contamination risks, since there is no residual disinfectant in the water. Also, the UV lamps require electricity, which may be challenging in off-grid communities.

For household or small-scale water treatment, most UV technologies use low-pressure mercury arc lamps. A promising new technology is the light-emitting diode (LED) UV-based device. LED devices have a potentially large role in household water treatment, due to their energy efficiency, long lamp life, portability, safety, and effectiveness. A number of water-treatment products that use this technology are currently in development for emerging markets.

California-based WaterHealth International (WHI) utilizes the patented UV Waterworks™ technology, which consists of a unique UV system configuration in which an ultraviolet light source is suspended in air, thus eliminating the technical complexities and related operating costs that have made UV disinfection unsuitable for use in rural contexts of developing countries. WHI has successfully integrated this UV disinfection technology with a multi-stage filtration process and developed an innovative water micro-utilities model that has primarily been implemented in rural India. These WaterHealth Centers allow WHI to take water from highly polluted areas and produce potable water that meets WHO microbial standards.

By partnering with local NGOs such as Naandi Foundation and financial institutions such as ICICI Bank, WHI provides purchase financing, health and hygiene education and ongoing technical support to promote adoption of these systems as well as their long-term sustainability. Their combined efforts have greatly increased safe-water awareness in villages where WaterHealth Centers are installed, and also significantly reduced the upfront capital investment requirement and daily water expenses per household. To address the electricity needs of its systems, the company has configured its WaterHealth Centers to have the capacity to include solar panels—a feature particularly applicable for rural communities in West Africa where WHI is also active. To date, WHI has provided clean-water access to over 1.5 million underserved people around the world.

57. Baker, M.N. 1948. *Quest for pure water: the history of water purification from the earliest records to the twentieth century*. Denver: American Water Works Association. And: Ward, H.M. 1893. "Further experiments on the action of light on Bacillus anthracis." *Proc. Royal Society* 53: 23–45.
58. Sobsey, M.D. 1989. "Inactivation of health-related microorganisms in water by disinfection processes." *Water Science and Technology* 21(3): 179–95.And: Blatchley, I.E.R. and M.M. Peel. 2001. "Disinfection by Ultraviolet Irradiation." *Disinfection, Sterilization, and Preservation*. New York: Lippincott, Williams, and Wilkins.
59. Grabow, W.O.K., C.G. Clay, W. Dhaliwal, M.A. Vrey, and E.E. Müller. 1999. "Elimination of viruses, phages, bacteria and Cryptosporidium by a new generation Aquaguard point-of-use water treatment unit." *Zentralblatt für Hygiene und Umweltmedizin* 202: 399–410.

Alice Lin Demas

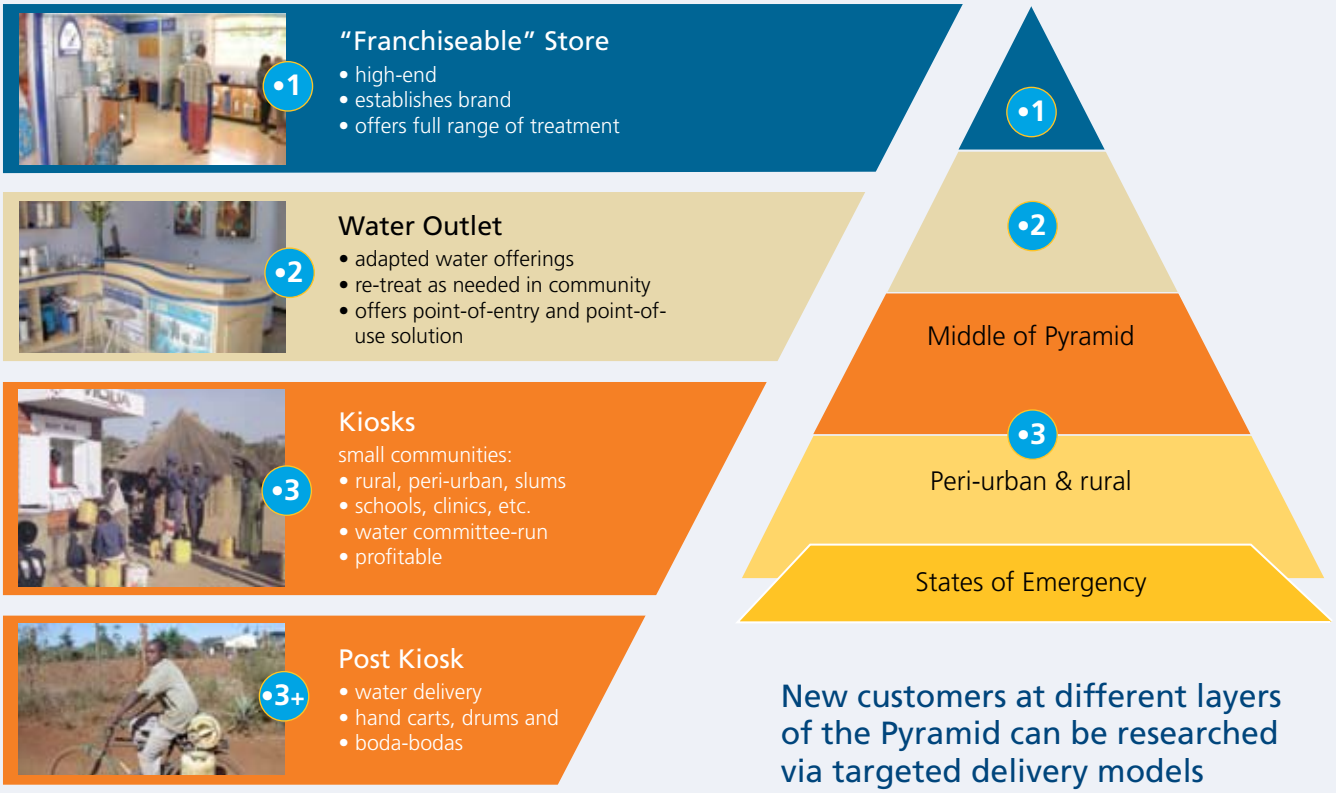
NEW DELIVERY MODELS

Some of the delivery models for vended safe-water in the context of new and expanding markets have great growth potential, such as the community water systems promoted by WHI in India, Ghana, and the Philippines; and Trojan UV in East Africa and elsewhere. In Southeast Asia, the water treatment kiosk industry has grown dramatically over the last seven years, particularly in urban areas of the Philippines and Indonesia. This vended water model uses turnkey purification designs and proven technologies such as UV disinfection or reverse osmosis to treat municipal or trucked water on-site for sale to consumers and resellers. Originally developed to serve upper and middle-income markets, the industry now also serves BOP populations who value the vended water for its image and convenience as costs have been driven down by increased competition.[60]

60. Aquaya. Presentation on *Improving Health through Clean Water Innovation* and conversation with Ranjiv Khush. 2009.

Distributed water technologies, and even some of the larger home systems, also have potential for being adapted to include water-storage systems for clustered households, multi-dwelling buildings, and other settings (such as schools, hospitals, businesses) where the supply of water is intermittent, and where water quality is questionable. These systems can be designed around rainwater harvesting, for example, or even for simply storing municipal piped water that is intermittently available and often unsafe for human consumption. They encompass a range of water-service enterprises, from selling just the water-treatment systems to offering integrated solutions (such as the WHI model described in Box 5) or full-service water-management businesses (such as the Culligan model, which provides comprehensive water-treatment products, water analysis, and service options).

Better channel development is one of the primary needs in BOP market



Source: David Maina, Trojan UV East Africa, 2008.
Photos courtesy of Trojan UV

Business models for distributing durable goods (such as water filters) or fast-moving consumable goods (such as disinfectant sachets) are nothing new, but the shift among some NGOs to learning from the private sector to market these products more effectively to poor consumers *is* a relatively new—and positive—development. (See Box 6.)

Box 6

SELLING FAST-MOVING CONSUMABLE GOODS FOR HOUSEHOLD WATER TREATMENT – THE PUR EXPERIENCE

In the late 1990s, Procter & Gamble, a U.S.-based consumer products giant, began to explore household-based water-treatment products. In 2002, P&G began field testing its own flocculation and disinfectant sachets, marketed under the PUR brand. The product uses ferric sulfate as the flocculant and calcium hypochlorite as the disinfectant, and was designed to address perceived deficiencies in other combination products. Users open the sachet, pour the contents into 10 liters of water, stir it repeatedly for several minutes until the floc settles out in the bottom of the vessel, pour the supernatant through a clean cloth into another vessel, then allow it to stand for 30 minutes. Produced at a cost of $0.035 and intended to retail at $0.10, each sachet treats 10 liters of water, resulting in a cost of $0.01 per liter—high, compared to most other safe-water treatment options.[61] However, based on its experience with soap, shampoos, and other consumer products that it markets and sells in small volumes, P&G focused on minimizing the upfront cost of POU water treatment to make it as accessible as possible.

PUR sachets have been subjected to rigorous testing, both in the laboratory and the field. Laboratory tests demonstrated that the product is highly efficacious, not only against bacteria (more than 99.99999 percent reduction), virus (more than 99.99 percent), and cysts (more than 99.95 percent), but also in reducing levels of arsenic, a significant chemical health hazard in many South Asian water supplies. Besides boiling and the HUL Pureit filter, PUR sachets are the only household water-treatment option designed for use in low-income settings that appear to satisfy the requirements of a microbial water purifier established under the EPA Protocol and NSF (National Sanitation Foundation) P-231 (USEPA 1987).[62] However, early field work also demonstrated that the target residual chlorine level of 3.5 milligrams per liter was objectionable to some consumers. P&G found that it was able to reduce the volume of calcium hypochlorite in the sachets to yield 2.0 milligrams per liter of residual disinfectant without compromising its antimicrobial performance. A series of rigorous health-outcome trials ensued that showed the varying reduction in levels of diarrhea among adults and children.[63]

Sachets combining a flocculant and disinfectant have been marketed for more than a decade, but only the PUR version has been shown to be effective both in killing or removing microbial pathogens (and arsenic) and in reducing diarrheal disease. Although the product has been used extensively in emergency settings, attempts to commercialize it were suspended after they failed to achieve significant levels of repeated purchasers, despite considerable promotion efforts. The strategy of selling fast-moving consumer products in small sachet quantities has been successful in increasing the coverage of many household and personal care products, but this has not been the case with the PUR product. The relatively high cost of routinely treating water with PUR, the need for demonstrations to introduce the product, and the time and effort to use the product limited its ability to achieve widespread uptake. The 10 liters of water treatable by each sachet is less than the desired amount to meet the daily needs of a typical household. Distribution in non-emergency settings is now mainly promoted through Population Services International, using subsidized social-marketing strategies. In 2007, there were an estimated 216,000 regular users of PUR sachets in non-emergency settings in nine countries.

In 2009, PATH[64] reported an almost identical product on the market in Vietnam with reported sales of 9 million sachets per year, with little or no marketing. These sachets had higher treatment capacity than the PUR sachets and could treat up to 200 liters per sachet. However, it is still too early to analyze the reasons for their success and their development impact.

61. Clasen T., L. Haller, D. Walker, J. Bartram, and S. Cairncross. 2007. "Cost-effectiveness analysis of water quality interventions for preventing diarrheal disease in developing countries." *Journal of Water & Health* 5 (4): 599–608.
62. EPA (Environmental Protection Agency). 1987. *Guide Standard and Protocol for Testing Microbiological Water Purifiers*. Office of Drinking Water.
63. Crump, J.A., P.O. Otieno, L. Slutsker, B.H. Keswick, D.H. Rosen, R.M. Hoekstra, J.M. Vulule, and S.P. Luby. 2005. "Household based treatment of drinking water with flocculant-disinfectant for preventing diarrhea in areas with turbid source water in rural western Kenya: cluster randomized controlled trial." *British Medical Journal* 331 (7515): 478–84. Chiller, T.M., C.E. Mendoza, M.B. Lopez, M. Alvarez, R.M. Hoekstra, B.H. Keswick, and S.P. Luby. 2004. "Reducing diarrhea in Guatemalan children: a randomized controlled trial of a flocculant-disinfectant for drinking water." *Bulletin WHO* 84 (1): 28–35. Reller, M.E., C.E. Mendoza, M.B. Lopez, M. Alvarez, R.M. Hoekstra, C.A. Olson, K.G. Baier, B.H. Keswick, and S.P. Luby. 2002. "A randomized controlled trial of household-based flocculant-disinfectant drinking water treatment for diarrhea prevention in rural Guatemala." *American Journal Tropical Medicine and Hygiene* 69: 411–19. Luby, S.P., C. Mendoza, B.H. Keswick, T.M. Chiller, and R.M. Hoekstra. 2008. "Difficulties in Bringing Point-of-Use Water Treatment to Scale in Rural Guatemala." *American Journal Tropical Medicine and Hygiene* 78 (3): 382–87. Doocy, S. and G. Burhnam. 2006. "Point-of-use water treatment and diarrhea reduction in the emergency context: an effectiveness trial in Liberia." *Tropical Medicine and International Health*. 11 (10): 1542–52.
64. Nguyen, Dzung. 2009. PATH: Partnership for Commercialization of Household Water Treatment and Storage Products. WaterSHED Asia project meeting, Bangkok, February 5.


PUR
Use PuR for
safe water everyday.
PUR
Purifier of Water

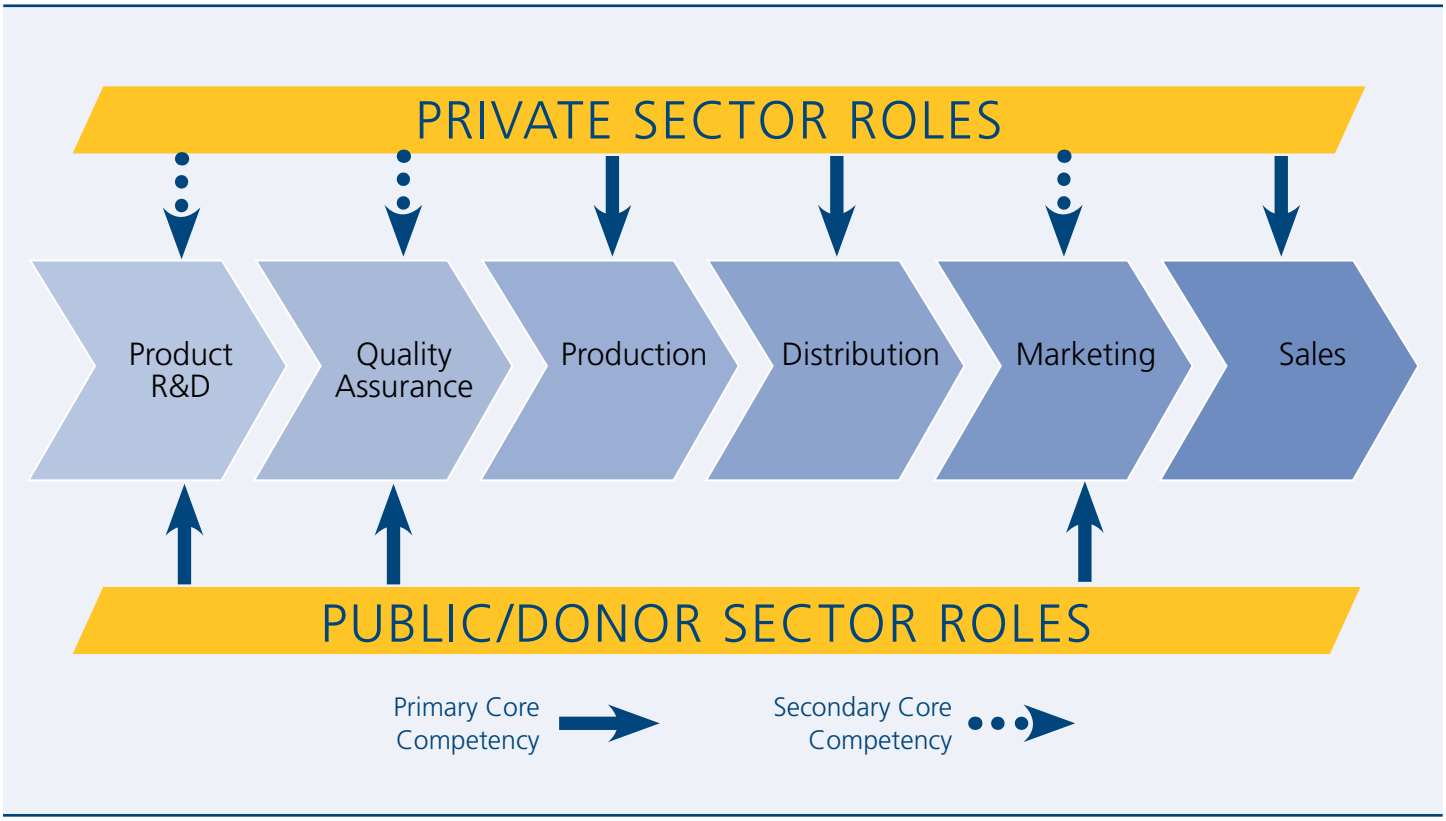
NEW PARTNERSHIPS

Opportunities exist to encourage alliances that in the past may have been considered incompatible. Some of the most promising models draw on the strengths of NGOs and government (behavior change, awareness raising, working with communities and families and individuals) integrated with a market-based approach to safe water.

Some of the most promising models for scaling up global access to safe water draw on the strengths of NGOs, government, and the private sector—working together.

The goal of scaling up global access to safe water will not be achieved simply by putting more resources into existing programs to increase their size, since many are run by heavily-subsidized NGOs that are focused on humanitarian relief. The focus of efforts in the safe-water sector must shift toward better products, more effective consumer education and promotion (demand creation), and more creative delivery mechanisms. The private sector has a clear role in this scale-up, because it possesses not only the expertise but also the economic incentive to develop appropriate products and implement robust delivery models for creating and meeting demand on a large scale.

At the same time, the private sector, acting alone, may not be able to reach particularly vulnerable populations (the poor, the very young, PLWHA) where much of the disease burden (and especially the mortality) associated with unsafe drinking water is believed to occur. NGOs, on the other hand, have existing programs (microenterprise and microfinance, development, health, gender empowerment, and so on) that can reach vulnerable populations. Achieving significant coverage for household water treatment within this target population will require a collaborative effort between the private sector, and NGOs () to reach the underserved, and to provide them with the information and confidence to acquire and use products correctly and consistently.



RECOMMENDATIONS TO ACCELERATE THE BOP SAFE-WATER MARKET

Dominic Sansoni

So far, this report has identified the challenges that impede penetration into BOP market segments. Below is a list of recommendations for how the donor and investment communities can use their financial and technical resources to develop a more robust and mature market among BOP consumers for safe-water products and services.

1. STRENGTHEN THE ENABLING ENVIRONMENT

International agencies' most effective means of achieving market-moving impacts in the BOP water space may lie in improving the enabling environment that is essential for overall sector development. These include: 1) gaining local government policy and regulatory support for household water treatment technologies (such as supporting development of local water technologies or technology components and entrepreneurs, reducing or eliminating tariffs and import duties on household water products and components that cannot be produced locally, and developing or endorsing certification standards for product quality and safety); 2) working with local financial institutions to increase consumer finance availability; and 3) promoting consumer awareness of safe-water products and their benefits.

International agencies should promote the enabling environment by:

- **gaining local policy and regulatory support**
- **increasing availability of consumer finance**
- **promoting consumer awareness**

Investment can follow the creation of an enabling environment. However, changing policies is often tedious, expensive, and time-consuming, and investments should not wait for this to take place. Strategic partnerships should be formed with institutions that can help develop the sector as a whole, such as WHO's *International Network to Promote Household Water Treatment and Safe Storage* to develop POU product-certification and -evaluation guidelines.

2. STRENGTHEN COMMERCIAL FINANCIAL INTERMEDIARIES.

Development agencies and international financial institutions can create a more robust investment climate for safe-water products and services by strengthening local financial markets in developing countries. For instance, they might provide targeted loans, guarantees, and advisory services, to local commercial banks, or co-investment to local or international private equity funds who need partners to enter riskier developing markets. Such support can build the capacity of these financial intermediaries to manage both perceived and real risks inherent in early entry into new products and market segments (such as financing capital expenditures and working capital requirements for distributed water models appropriate for BOP consumers). Many commercial financing institutions in the survey's targeted countries are either unaware of the market for safe-water products or perceive such investments, especially end-user financing, as too risky.[65]

Investing in this sector is deemed risky for two reasons: 1) the market economics are such that the risks are high and the returns uncertain; and 2) many household water-treatment companies are SMEs, which lending institutions are reluctant to finance. Local or international development institutions might provide to local commercial financial institutions the risk-sharing and risk-management vehicles that can be used to support commercial financial institutions to finance safe-water products and services for BOP markets. IFC has significant experience in working with financial intermediaries, most notably relating to energy efficiency projects. It will be valuable to transfer the lessons learned from that experience to the safe-water sector. (See Box 8.)

65. Dondo, Aleke, K-Rep, and Vipin Sharma, ACCESS India, personal communications.

When commercial lending from local banks is required for larger safe-water products (such as community water systems), development agencies, international financial institutions, and their partners can help entrepreneurs develop a business case for profitability to show the banks, and offer co-financing as appropriate.

lice Lin Demas

3. INCREASE BOP CONSUMER DEMAND FOR SAFE-WATER TECHNOLOGIES

Creating awareness through consumer education or social marketing can, over time, increase consumer demand for safe-water products and services, and stimulate private sector participation. Since such programs are expensive and have long time horizons for generating results,[66] companies are often unwilling or unable to invest the time and resources needed to create sustained behavior change among BOP consumers. Public-private partnerships can leverage public resources to create social awareness of the need to treat water, and use private sector advertising to inform consumers that such products are available in the marketplace.

To this end, demand-generation activities that leverage consumers' existing desire for aspirational products and services can have more impact than traditional behavior-change programs that rely on health-related messages. These activities have very different implications with regard to the messages they deliver to consumers. Often, they have nothing to do with the health benefits of treating water, but everything to do with satisfying the

66. Kashyap, Pradeep, MART. Personal communication.

human desire for social acceptance, status, and upward mobility. This principle has been well-known and successfully practiced for decades by the private sector. And although such approaches have traditionally been anathema to many in the public health community, a growing body of social science research indicates that focusing product design and marketing efforts on behavioral drivers can generate demand relatively quickly and sustainably[67] Development agencies can use advisory services funds to support in-depth market research to identify these drivers to feed into private sector/NGO marketing strategies.

4. INCREASE BOP CONSUMERS' ACCESS TO CREDIT FOR WATER-RELATED BORROWING

Microfinance institutions have a useful role in making middle-market POU devices / technologies accessible to the poor though targeted micro-lending from funds that are set up specifically to finance the purchase of water-treatment devices. These funds will likely need to be in local currencies and can take the form of revolving funds.

Development agencies and the private sector can accelerate the development of appropriate microfinance initiatives by developing a structured approach catering to the needs of the MFIs, identifying the size of the opportunity and market, structuring risk-sharing guarantees or credit lines with them if needed, and providing advisory services for MFI capacity building and market research. MFIs should design creative market data-based microfinance product offerings that benefit entire communities (such as village-level lending for water services), or combine water-related loans with other financial products (such as health insurance). Two pilot microfinance projects in India—conducted by the NGOs ACCESS and AED (as described in this report)—have reported nearly 100 percent repayment on targeted loans for middle-market water filters in BOP markets.

5. PROVIDE SOFT AND FLEXIBLE FUNDING TO SAFE-WATER ENTREPRENEURS.

The BOP household water-treatment market is evolving at different speeds and in different ways within the developing world. In these high-risk environments, successful investing requires a great deal of flexibility, both in the array of funding options offered and in investors' ability to adapt the terms of their deals to mitigate implementation risks. Funding options can include equity and quasi-equity, working-capital loans, concessional loans, and guarantees, as well as smaller grants or in-kind contributions for advisory services and program design. This flexibility would allow investors to tailor their assistance, where legally possible, to suit local conditions, while enabling mitigation of systemic shocks or localized risks.

A key challenge for social enterprises straddling the line between strictly for-profit and strictly for-social-benefit models is finding ways to generate support from investors *and* donors, and to do it in a way that facilitates their long-term transition to sustainability in the marketplace. Development finance institutions (DFIs), which have an obligation to generate returns but also a mandate to promote sustainable BOP enterprises, should consider how they can leverage their substantial financial and technical resources. For social-enterprise investments in water, for example, soft debt financing can be considered as a means of providing investment capital to enable entrepreneurs to transition away from subsidized models. For NGOs experimenting with more market-oriented approaches, DFIs can also add value by providing advisory services in the form of business-skills training and helping entrepreneurs strengthen their value propositions in the safe-water supply chain.

67. Jenkins, M.W., and V. Curtis. 2005. "Achieving the 'good life': Why some people want latrines in rural Benin." *Social Science and Medicine* 61: 2446–59. And Jenkins, M.W., and B. Scott. 2007. "Behavioral indicators of household decision-making and demand for sanitation and potential gains from social marketing in Ghana." *Social Science & Medicine* 64: 2427–42.

Success often requires concessional financing with flexible terms, extended payback periods, long-term funding commitments, low collateral requirements, and moderate expectations for financial return.

Success in these operating environments often requires concessional financing with flexible terms, extended payback periods, long-term funding commitments, low collateral requirements, and moderate expectations for financial return. (See Box 7.) Flexible financing mechanisms may prove more effective in enabling high-risk projects to reach financial viability. Where local or national governments are supportive, investors can also consider a public-private partnership structure to effectively support entrepreneurs.

Curt Carnemark

BOX 7

PROVIDING FLEXIBLE FUNDING: SWAP AND K-REP DEVELOPMENT AGENCY IN KENYA

K-Rep Development Agency—the nonprofit arm of K-Rep Bank—is partnering with the NGO Safe Water and AIDS Project (SWAP) in Kenya. SWAP provides microcredit loans for HIV+ women to purchase and sell a variety of household water-treatment products using an "Avon lady" direct-sales model. Since the program's inception, repayment rates have consistently exceeded 95 percent. The one notable exception occurred during the political unrest that struck Kenya in December 2007. The most severe instances of rioting, looting, and tribal killings occurred in the Kisumu region where SWAP's operations were based. Understandably, repayment rates suffered dramatic declines during this period, because the female sales force was unable to make sales calls, collect payments, or obtain new supplies of inventory from the city, since transport routes were cut off. Fortunately, K-Rep was able to readjust its repayment schedule, providing an extended grace period that enabled its borrowers to avoid defaulting, thereby allowing the program to endure this harsh but temporary shock. Eventually, repayment rates returned to their pre-conflict high levels, and the program is currently expanding its lending operations throughout the province.[68]

Tom Outlaw

68. Eleveld, Alie, Aleke Dondo, K-Rep, and Vipin Sharma, ACCESS India, personal communications.

BOX 8

CAPTURING TRANSFERABLE LESSONS – IFC'S SUPPORT OF GRAMEEN SHAKTI IN BANGLADESH

One example of how working with local financing institutions can spur investment in new products in risky markets is IFC's support of the Grameen Shakti program, which promotes the commercialization of household solar-energy systems in rural Bangladesh.[69] An offshoot of the Grameen Bank, Grameen Shakti ("Village Power" in Bengali) received a loan from IFC to purchase solar equipment inventory, freeing capital to provide end-user financing. This arrangement enabled Grameen Shakti to overcome two major barriers to consumer uptake: high upfront purchase costs and lack of consumer credit.

An important additional advantage of this partnership was Shakti's ability to leverage the Grameen Bank's existing network of branch offices, allowing it to benefit from consumer recognition and trust of the Grameen brand, while also enabling it to quickly establish and begin scaling up its operations in the 36,000 villages where Grameen Bank operates.

A similar partnership in the water sector was launched in 2008 by Grameen Healthcare and the multinational NGO, Veolia Water. Though specific details are still being worked out, the venture's concept is for the two organizations to collaboratively install, operate, and maintain water- and sewage-treatment plants in Bangladesh's poorest villages.[70]

Dominic Sansoni

69. IFC (International Finance Corporation). 2007. *Selling Solar: Lessons from More Than a Decade of IFC's Experience*. Washington, DC: World Bank Group. 32. Available online at http://www.ifc.org.
70. Foundation of Grameen-Veolia Water Ltd. in Bangladesh. 2008. Press release (March 31). Available online at: http://www.veoliawaterst.co.uk.

6. INVEST IN A PORTFOLIO OF TECHNOLOGIES AND BUSINESS MODELS.

The variety of safe-water products, services, and business models referred to in this report underscores the absence of any "one size fits all" solution to providing safe water to BOP consumers. Instead, the need is for water solutions tailored to local-market economic, demographic, socio-economic, political, and hydrological conditions. A forthcoming WHO report on scaling up access to household water treatment,[71] recent systematic reviews,[72] and summary documents on available technologies[73] describe in detail possible interventions and their supporting scientific evidence. Emerging technologies may be an adaptation of existing technology (for example, the CrystalPur siphon filter, Aquatabs), a multibarrier technology that uses several mechanisms to produce potable water (such as Hindustan Unilever's Pureit device), or a novel or unproven mechanism (such as OneDrop).

Instead of focusing on picking individual winners and losers, investors should consider multiple technologies and business models that meet basic public health standards and take into account the need for affordability, durability, ease of distribution, and other relevant factors. Such broad support for the sector would help individual companies to better identify those market segments where their technology or service can provide the most affordable alternative to consumers' current water-treatment practices. For investors, building a portfolio—rather than promoting a single technology or class of technologies—provides better overall risk management; and it promotes competition in the marketplace, thus reducing prices, and increasing product options available to BOP consumers.

7. INVEST AS MUCH IN THE ENTREPRENEUR AS IN THE TECHNOLOGY.

Successful penetration of BOP markets depends as much—if not more—on the entrepreneur as on the product or service itself. Indigenous entrepreneurs often have a better understanding of BOP markets, which can be complex and highly volatile —and may represent unfamiliar territory to large multinational corporations more experienced with higher-income markets in more developed economies. In addition to the drive, enthusiasm, and creativity that characterize most entrepreneurs, indigenous entrepreneurs also often possess excellent knowledge of local customs, buying habits, and language dialects, as well as ethnic, religious, and gender-based differences that significantly influence consumer preferences. For example, David Kuria, a Kenyan entrepreneur, has achieved endorsements for his IKOtoilet business—from government officials in Nairobi, local corporations, and community leaders in urban slums—that have helped with market expansion and sparked interest from external investors.

71. Clasen, T. 2008. *Scaling Up Household Water Treatment: Looking Back, Seeing Forward*. Geneva: WHO. In press.
72. Clasen, T., W.P. Schmidt, T. Rabie, I. Roberts, and S. Cairncross. 2007. "Interventions to improve water quality for preventing diarrhoea: systematic review and meta-analysis." *British Medical Journal* 334 (7597): 755–56. Clasen, T., I. Roberts, T. Rabie, W. Schmidt, and S. Cairncross. 2006a. "Interventions to improve water quality for preventing diarrhoea." Cochrane Database of Systematic Reviews 19 (3): CD004794. Fewtrell, L., R.B. Kaufmann, D. Kay, W. Enanoria, L. Haller, and J.M. Colford. 2005. "Water, sanitation, and hygiene interventions to reduce diarrhea in less developed countries: a systematic review and meta-analysis." *Lancet Infectious Diseases* 5: 42–52.
73. Sobsey, M.D. 2002. "Managing water in the home: accelerated health gains from improved water supply." Geneva: WHO/SDE/WSH/02.07 (Limited Distr.). Available online at www.who.int. And Lantagne, D., R. Quick, and E. Mintz. 2006. *Household water treatment and safe storage options in developing countries: a review of current implementation practices*. Washington, DC: Woodrow Wilson International Center. And IRC (International Water and Sanitation Centre, Delft). 2005. "Household water treatment FAQs." Delft: IRC. And Hygiene Improvement Project (HIP). 2006. *Summary of Household Water Treatment and Storage E-Conference Proceedings*. Washington, DC: HIP.

Indigenous entrepreneurs often have a better understanding of BOP markets, which can be complex and highly volatile.

In evaluating water-sector investment opportunities, metrics should be considered for assessing the intangible but critical skills that entrepreneurs can contribute to a business model's viability. Investors also should find creative ways to build the financial and management capacity of entrepreneurs—either through direct advisory support or through strategic partnerships. They should require entrepreneurs to install strong monitoring and evaluation systems of safe-water products and services, once they have been introduced to the market, to ensure quality and sustainability.

Entrepreneurs typically lack the technical skills or the time to provide the extensive documentation required to obtain commercial financing. Simplification of investment requirements may not be possible due to the fiduciary responsibilities of financial institutions, but development agencies and investors could consider grants to entrepreneurs. These could cover advisory services and training on financial management skills that will last well beyond the due diligence period and the life of the investment.

8. IDENTIFY AND SUPPORT ENTERPRISES THAT MATCH PRODUCTS AND STRATEGIES TO THE RIGHT MARKET SEGMENTS.

Companies in the safe-water space must accurately segment the market to ensure that they are offering the products and services that are most appropriate to their target customers. In shopping for safe-water solutions, lower-income consumers are often driven mainly (or solely) by product affordability and, therefore, might desire products focused only on drinking water. Higher-income consumers, on the other hand, may desire products that produce higher volumes of water (for example, for dishwashing and bathing), are more convenient (such as bottled water), have additional features (such as hot and cold water, "vitamin" water), reflect social status or brand consciousness, or are part of a system serving other needs (for example, rainwater-harvesting tanks to supplement piped water supplies).

Various market segments also exist among lower-income consumers—some of whom are driven exclusively by price, others by aspirational features. The needs and desires these market segments represent can vary widely. Investors must assess how well the companies have matched their product and service offerings—as well as their marketing, pricing, and distribution strategies—to the characteristics of the consumers they are trying to reach.

9. IMPROVE TECHNOLOGIES AND BUSINESS MODELS THROUGH ADVISORY SERVICES.

Advisory services are useful in vetting and improving proposed safe-water technologies seeking private sector investment. For example, many technologies may be improved by adding a safe-storage component, or through comprehensive laboratory or field testing. Entrepreneurs can be advised to develop and document more effective technologies, with the goal of maximizing the impact of safe-water technologies and business models globally. Incubation of enterprises—through funding of consumer research, and field testing of new products and product design improvements—can also help increase consumer demand for the product, and thereby strengthen the business' product marketability. Finally, impact assessments will also help businesses monitor the quality and uptake of their technologies, providing input for future product innovations.

10. INCENTIVIZE PRODUCERS OF HIGH-END TECHNOLOGIES TO TARGET BOP MARKETS.

There is a real need for development of low-cost water-treatment devices. When producers of middle-market technologies show an interest in targeting the BOP, and the ability to do so, investors can encourage them through strategic investment in those product lines or business models that are most promising. Producers may also need co-funding from investors or donors to conduct the market research necessary to prove their business case and potential returns.

Edwin Huffman

APPENDIX I:

COUNTRY REPORT: Kenya & Uganda

KEY FINDINGS: EAST AFRICA

- The market for safe-water technology in Kenya and Uganda is small, but growing. Policy attention and investment resources remain focused on improving access to water supply—especially in rural areas—rather than on water quality. Little indigenous capacity for product innovation or manufacturing is available in this sector. Most safe-water technologies are imported from North America, Europe, or China, with multinational manufacturers relying on local partners for marketing and distribution.
- Disparities in access to safe drinking water between urban and rural areas remain high, despite significant public investment in water-supply development over the past two decades. Rural consumers, however, possess both the income and the demand for safe-water technologies that are appropriately priced, durable, and reliably available.
- Soft debt is a preferred financing instrument, given the multiple challenges of developing sustainable businesses focused on lower-income markets in East Africa.
- Microcredit is growing in popularity among East African consumers, including BOP consumers, in both urban and rural areas. Providing access to microcredit could help remove a major barrier to purchase of POU technologies at all price points.
- Business models integrating water, sanitation, and hygiene services (for instance, integrating pay toilets with drinking water and shower facilities) are a promising way to aggregate customers for vended safe water and create sustainable revenue streams, especially in densely populated, peri-urban areas.
- Distribution is perhaps *the* greatest challenge to businesses interested in profitably accessing BOP market segments. Successful business models for scaling up access to safe water will likely be those that best address the severe logistical challenges of delivering goods and services in East Africa, particularly in rural areas.
- Almost all of the businesses interviewed had a portfolio of products and services, both to create multiple revenue streams and to reduce their exposure from variable consumer demand patterns. Business models with a single intervention, service, or product were viewed as high-risk, especially in markets with limited access to working capital.

SAFE-WATER SECTOR OVERVIEW

Sub-Saharan Africa has made modest progress over the past decade in improving access to safe water supplies. For example, 62 million more people gained access to water supply in rural settings between 1990 and 2004, a gain of 6 percent per year. However, the portion of the population served by a household connection remains very low, in both urban and rural areas.[74] The safe-water sector (household water treatment and vended safe water) is growing in Kenya and Uganda[75], though not nearly as fast as in more rapidly developing countries such as India. (See Table 2 and Table 3.)

74. WHO and UNICEF. Joint Monitoring Programme data online at www.wssinfo.org. 2008.
75. Since 1990, Uganda has made significant progress in the proportion of the population that uses improved drinking water and is on track to meet the MDG goal for water. From WHO and UNICEF Joint Monitoring Programme, 2008.

Curt Carnemark

Table 2 Kenya's water sector by the numbers

KENYA [a]	
Total population	36,553,000
Total population, urban	21%
Total population living on < $1 per day	23% - 26.5%
Income	$580 GNI per capita
Regulatory climate	No regulation on safe-water products, but importation may be difficult
Entrepreneurial climate	Emerging but not healthy, access to credit may not be widespread
Percentage population without access to improved water	39% (17% urban, 54% rural)
Estimate percentage population with reliable household connection to treated water	36% urban, 14% rural[b]
Industry standards exist and are enforced for drinking water quality:	Yes, not widely enforced
Industry standards exist and are enforced for safe water products and services	No
Microcredit market	Weak, but improving. Lender fraud still widespread. MFI lending for POU products very limited.[c] Four MFI loan or savings accounts exist for every 100 people in Sub-Saharan Africa.[d]
Access to microcredit in rural areas	Very limited
Access to microcredit in urban areas	Limited
Description of middle market products and services:	Some effective high end technologies available (e.g., UV, reverse osmosis)
Description of BOP market products and services	Few beyond subsidized NGO products, but several promising technologies are emerging , as are water-vending entrepreneurs
US$ per m^3 for vended water	$1.46 urban, $0.93 rural (estimate)
US$ per m^3 for piped water[e]	$0.44 urban, $0.19 rural (estimate)
% of population boiling water	50% (estimated from data in nearby countries)
Subsidies in the water sector	Heavily donor subsidized across the sector for piped water. Vended water is private sector and not subsidized.
Prospective partners: marketing	Population Services International; Kentainers
Prospective partners: sales	Population Services International; Kentainers
Prospective partners: distribution	Population Services International; Kentainers

a Population, income, and water access data from UNICEF.

b http://www.afro.who.int.

c Dondo, Aleke, K-Rep Development Agency. Personal communication.

d Four MFI loan or savings accounts exist for every 100 people in Sub-Saharan Africa.

e All east Africa water-pricing data are from Porras, T., Thompson, et al. 2001. "The Cost of Water for Domestic Use in East Africa: Thirty Years of Change." Presented at AWRA/IWLRI International Specialty Conference. Accessed at: http://www.awra.org/proceedings/dundee01/Documents/.

Table 3 Uganda's water sector by the numbers

UGANDA[g]	
Total population	29,899,000
Total population, urban	13% urban
Total population living on < $1 per day	85%
Income	$300 GNI per capita
Regulatory climate	Importation of safe water products may be difficult; no regulation on POU water systems
Entrepreneurial climate	"young and weak" [h]
Percentage population without access to improved water	40% (13% urban, 44% rural)
Estimate percentage population with reliable household connection to treated water:	6.2% urban, 1.2% rural [i]
Industry standards exist and are enforced for drinking water quality:	Yes, not widely enforced
Industry standards exist and are enforced for safe water products and services	No
Microcredit market	Weak, but improving. Lender fraud widespread. Very limited lending for POU products. [j] Four MFI loan or savings accounts exist for every 100 people in Sub-Saharan Africa [k]
Access to microcredit in rural areas:	Very limited
Access to microcredit in urban areas:	Limited
Description of middle market products and services	Few, mostly available in Kampala
Description of BOP market products and services	Few
US$ per m3 for vended water (estimate), urban	$0.00403
US$ per m3 for vended water (estimate), rural	$0.00644
US$ per m3 for piped water	$0.80 [l] urban, $0.56 rural [m]
% of population boiling water	50% (estimated)
Subsidies in the water sector	Heavily donor subsidized across the sector for piped water. Vended water is private sector and not subsidized.
Prospective partners: marketing	BRAC, Crestanks, Population Services International
Prospective partners: sales	BRAC, Crestanks, Population Services International
Prospective partners: distribution	BRAC, Crestanks, Population Services International
Prospective partners: public education/labeling	Ministry of Health, WHO, WSP

g Population, income, and water access data from UNICEF.

h Mutahunga, E. 2007. "Uganda's Private Sector as the Proclaimed Engine of Economic Growth; Limitations, Policy Challenges and Role of Civil Society." Monograph. Paper Prepared for Presentation at the Launch of the CONSENT-DENIVA Trade and Socio-Economic Policy Dialogue Series, Kampala.

i http://www.afro.who.int.

j Islam, Arif. BRAC. Personal communication.

k Christen, R.P., R. Rosenberg, and V. Jayadeva. 2004. "Financial institutions with a double-bottom line: implications for the future of microfinance." CGAP Occasional Paper 08.

l Porras T., Thompson, et al. 2001. "The Cost of Water for Domestic Use in East Africa: Thirty Years of Change." Presented at AWRA/IWLRI International Specialty Conference. Accessed at: http://www.awra.org/proceedings/dundee01/Documents/.

m http://www.afro.who.int.

CASE STUDY: ECOTACT LTD.—KENYA

Providing integrated water, sanitation, and hygiene services to urban and low-income communities

Overview

Ecotact Ltd., a Kenya-based company, uses an innovative approach to marketing water, sanitation, and hygiene services to low- and middle-income consumers through a public-private partnership model of integrated service delivery. Founded by entrepreneur David Kuria, Ecotact Ltd. owns and operates its branded IKOtoilet sanitation facilities in urban Nairobi and the peri-urban slums of Kibera, as well as in 10 more municipalities across Kenya. The name IKOtoilet employs a bilingual double entendre—"Iko" suggests *ecological* in English, while, in Kiswahili, "IKOtoilet" means "there is a toilet here." The company's slogan—*thinking beyond a toilet*—is meant to encourage consumers to see toilet facilities as more than unpleasant places to deposit human waste, but as a "clean, well-lighted place" that serves as an economic and social aggregating point, as well as a safe, hygienic, and convenient place to relieve oneself and take showers. In addition, the company partners with Trojan UV to provide clean drinking water, and with other companies to provide advertising space, cell phone talk time, some grocery items, rainwater conservation, urine harvesting, and some other services, such as shoe shines, in a component called "toilet mall."

Background

Sanitation remains a critical health and development challenge that often takes a backseat to public demand for safe water supplies. Most areas of urban Kenya suffer from failures in the ability of city, town, and municipal agencies to provide adequate public sanitation facilities, despite high levels of public demand for these services. The IKOtoilet model attempts to leverage the Kenyan government's ongoing reforms favoring private sector provision of sanitation service delivery, with government authorities functioning as regulators and standard setters. Ecotact plans to construct and manage 200 pay-per-use public toilets and shower facilities in Kenya's urban centers over the next five years. Ecotact will enter into contracts with Kenyan municipal authorities on a five-year, no-cost lease to build the facilities.

Business model

The idea of privately operated pay toilets is not new, and in many cases such enterprises have been utter failures, both as businesses and as public health interventions.[76] However, Ecotact has leveraged lessons learned to build a self-sustaining business model. Ecotact's business approach promotes private sector involvement in delivering basic municipal sanitation services, while also generating employment opportunities by creating multiple revenue-generating opportunities beyond the simple "pay-to-pee" model to promote a public good.

Using his training as an architect, Ecotact founder David Kuria is building sanitation facilities that employ innovative architectural imagery within a human scale. The goal is to create a McDonald's-type brand recognition, so the public can easily recognize, identify, and patronize carefully selected locations in various municipalities throughout Nairobi and other Kenyan cities. The model's diverse revenue streams (from sale of products and services, and leasing of retail space) support the core sanitation and hygiene business and help increase and stabilize the business' cash flows. It also helps subsidize toilet and shower user fees, thereby providing more equitable access to proper hygiene and sanitation across socio-economic strata. Finally, if human-waste harvesting and selling prove profitable, this busi-

76. Colin, J., and S. Nijssen. 2007. *Public Toilets in Urban India: Doing Business Differently*. WSP Field Note (December).

ness model will have achieved a true triple-bottom-line return: financial returns in the form of sustainable profits; social returns from increasing access to basic water, sanitation, and hygiene for the poor; and environmental returns from the safe removal of human excreta from densely populated urban areas. This model also has applications in rural areas, where school toilet facilities serve as aggregation points for collecting human waste.

More promising from a development and health perspective is Ecotact's plans to replicate the urban toilet model in peri-urban slum areas. Construction of the facilities in a Kibera slum was funded through a foundation grant that enabled user fees to be subsidized at Ksh 3 per use for both toilet and shower services (compared to Ksh 20 for shower services and Ksh 5 for toilet services in non-subsidized models). The most compelling aspect of the IKOtoilet business model, especially in densely populated areas such as Kibera, is that these facilities lend themselves to serving as community water-vending areas, given that the facility already has an onsite water supply. Having a "one-stop shopping" facility—where residents can use the bathroom, shower, and purchase clean drinking water—provides an attractivemeans of aggregating customers, while also providing direct and indirect health benefits from offering water supply, sanitation, and hygiene services.

Tom Outlaw

APPENDIX II:

COUNTRY REPORT: India

KEY FINDINGS: INDIA

- The market for safe-water technology in India is strong and growing, with a number of promising technologies and delivery models. There is high and growing demand in middle- and upper-income market segments for safe-water products.
- A number of products now on the market intend to reach the BOP. However, producers experience problems with lower demand, market access, and the perception that cost is always correlated with effectiveness (that is, BOP consumers perceive that inexpensive solutions such as chlorine are less effective than more costly options).
- Microcredit access is a limiting factor in scaling up mid-range filters, for which there is strong demand in both urban and rural areas. Consumer uptake among rural and urban poor can be improved by providing access to microcredit for product purchase.
- Vended safe-water treatment technologies and delivery models (or community-level vended water of improved quality) are gaining ground and play a crucial role in safe-water access, especially in rural markets.

SAFE-WATER SECTOR OVERVIEW

India has made considerable progress in recent years in improving water supplies in both rural and urban settings.[77] Despite this advancement, only 24 percent of the total population is served by a household connection. The remaining 76 percent rely on surface water, private or public dug wells or boreholes, rainwater harvesting, or other sources. Although water supplies may be safe at the point of treatment or distribution, the water is subject to frequent and substantial microbial contamination by the time it is ultimately consumed.[78] Surveys of microbial water quality throughout India have shown extensive fecal contamination.[79] For example, in Chennai and Hyderabad, 56 percent and 50 percent, respectively, of water samples drawn from pre-monsoon, monsoon, and post-monsoon periods were positive for fecal coliforms. A recent report by the Government of India Planning Commission estimated that, each year, between 400,000 and 500,000 Indian children under age five die of diarrheal disease.[80] Figures from India's Central Bureau of Health Intelligence show that the incidence of diarrhea, enteric fever, viral hepatitis, and cholera has not decreased over the past decade.[81]

During 2003–2006, the Indian economy grew at an average annual rate of 8.5 percent,[82] with the overall growth in the water sector (industrial, agricultural, commercial, residential) at 15–20 percent annually. Estimates from 2006 put the municipal water-treatment sector market at more than $300 million and the bottled-water sector at $200 million, with the bottled- and packaged-water segment growing at 40 percent per year.[83] Although India

77. WHO and UNICEF. Joint Monitoring Program data online at www.wssinfo.org.
78. Wright, J., S. Gundry, and R. Conroy. 2004. "Household drinking water in developing countries: a systematic review of microbiological contamination between source and point-of-use." *Tropical Medicine and International Health* 9 (1): 106–17.
79. NEERI. 2004. "Potable water quality assessment in some major cities in India." JIPHE, India (4): 65.
80. Water Resources Division. 2002. *India Assessment 2002: Water Supply and Sanitation*. New Delhi: Water Resources Division, Government of India Planning Commission.
81. Mudur, G. 2003. "India's burden of waterborne diseases is underestimated." *British Medical Journal* 326: 1284.
82. Royal Danish Assembly, New Delhi, Trade Commission of Denmark. 2006. *The Water Sector in India*. Report available online at www.eksporttilindien.um.dk.
83. Chittora, M. 2006. Interview: Khan, M.R. "Water treatment sector needs more experience." Project Monitor online edition: www.projectsmonitor.com. Accessed October 1, 2008. The size of the market according to this estimate was $190 million–$240 million.


Dominic Sansoni

leads developing countries in private sector infrastructure investment, the water sector has not kept pace with the telecommunications and power sectors.[84] Water scarcity and degraded water quality for drinking have driven development in decentralized safe-water technologies and business models.

A recent report by Frost & Sullivan (2009) estimates the market potential for residential water systems in India to be INR 15 billion ($333 million), with growth originating mainly from the urban middle- to upper-income markets. The report specifically cites reverse osmosis (RO) systems as becoming the dominant technology (over ultraviolet and ceramic filters), concluding that the "market for traditional candle filters was already hit by the ultraviolet-based systems and now, the new RO-based system is expected to snuff out whatever remains of the candle filter market," citing poor quality and unreliability of the smaller or regional producers of lower-cost technologies. What is missing from this analysis is a focus on the need and latent demand for lower-cost but effective systems, since reverse osmosis requires both power and water pressure, and units start at well above $100—preventing RO from being a viable option for the many millions of BOP consumers in India without access to safe drinking water. (See Table 4.)

Urban versus rural markets

Rural markets—often with poor infrastructure, low population densities, and potentially less developed distribution systems for non-local goods—present challenges to companies trying to access rural populations.

Seventy-one percent of India's population, or 700–750 million people, live in rural areas in an estimated 600,000 villages[85]. Rural incomes in 2002 were $42 per month[86] on average, leading to a short time horizon for purchasing decisions.[87] Rural markets may also exhibit strong seasonal fluctuations with the ebb and flow of the local agricultural economy, and such variability is highly location-specific. In 2001, rural markets in India were estimated to be growing at twice the rate of urban markets.[88] Non-traditional approaches, such as the Shakti model[89] used by Hindustan Unilever, can help private sector companies access rural markets. The vended-water plans by WHI, Odanthurai, and others in India represent a viable model in peri-urban and rural markets where at least intermittent electricity is available.

84. Harris, C. 2008. "India leads developing nations in private sector investment." *Gridlines* 30: 1–4.
85. Census of India. 2001
86. Kripalani, M. 2002. "Rural India, have a Coke." *Business Week*, No. 24.
87. Dawar, N., and A. Chattopadhyay. 2002. "Rethinking marketing programs for emerging markets." *Long Range Planning* (35): 457. Quoted by Huhmann, S. 2004. "Tapping India's Rural Market." *Journal of Student Research*. UW-Stout.
88. Kannan, S. 2001. "Rural market—a world of opportunity." *The Hindu*.
89. Balu, R. 2001. "Strategic innovation: Hindustan Lever." *Fast Company* 120. Merchant, K. 2003. "A sales force for Indian villages: Marketing: Women are poised to run an online direct selling portal that promises to reach the smallest communities." *Financial Times* (9).

Table 4 India's water sector by the numbers

INDIA [o]	
Total population	1,151,751,000
Total population, urban	29% urban. Note that 750 million people in India live in 6 million villages
Total population living on < $1 per day	34%
Income	$820 GNI per capita
Water sector description	Varies greatly. Piped water supplies are inadequate. Of the 35 Indian cities with a population of greater than one million, none delivers water consistently.
Regulatory climate	Moderate. Small water-treatment units are not regulated.
Entrepreneurial climate	Among the healthiest in the world
Percentage of population without access to improved water	14% (5% urban, 17% rural)
Industry standards exist and are enforced for drinking-water quality	Yes, though enforcement is not common.
Industry standards exist and are enforced for safe-water products and services	No
Microcredit market	Strong and growing. 188 million accounts representing 18% of the total national population;[p] 3,961 MFIs, large number of other banks providing some microcredit service
Access to microcredit in rural areas	Good, increasingly common
Access to microcredit in urban areas:	Good, but less common, owing to wider availability of standard commercial financing, bias against debt
Description of middle-market products and services	Wide and growing range of highly effective technologies at high cost. Effective filters start in the $40 range.
Description of BOP-market products and services	Many options, most subsidized. India represents an excellent BOP market for innovative, effective, low-cost technology.
$ per m^3 for vended water	$.25–$55 (estimate)
$ per m^3 for piped water, urban	$0.03[q]
$ per m^3 for piped water, rural	$0.03
Percentage of population boiling water	10.6%:[r] 16.0% urban, 7.7% rural
Subsidies in the water sector	Piped water is heavily subsidized, and most systems do not function well. All vended water is unsubsidized.
Prospective partners: marketing	Many, including Hindustan Lever, MART
Prospective partners: sales	Many, including Hindustan Lever
Prospective partners: distribution	Many, including Hindustan Lever
Prospective partners: public education/labeling	Ministry of Health, WSP, WHO

o Population, income, and water access data from UNICEF.

p Christen, R.P., R. Rosenberg, and V. Jayadeva. 2004. "Financial institutions with a double-bottom line: implications for the future of microfinance." CGAP Occasional Paper 08.

q ADB (Asian Development Bank).

r DHS. 2006. "Demographic and Health Survey, India 2005–2006." Available at: http://www.measuredhs.com/pubs/pdf/FRIND3/02Chapter02.pdf.

CASE STUDY: HINDUSTAN UNILEVER (HUL) AND ACCESS

Bringing MFIs to the table to scale up access to safe water

Hindustan Unilever's Pureit

In 2005, HUL entered into the household water-treatment sector, introducing its Pureit water treatment system. Pureit is a fully integrated, gravity-fed, microbial water purifier designed for use at the household level with water of unknown microbiological quality. To meet the particular challenges of India and other developing countries, the unit was specifically designed to operate without electricity and without a piped-in water supply. The unit was also designed to address the physical and bacterial challenges presented by Indian source water as established by a survey conducted by the National Environmental Engineering Research Institute.[90] Laboratory testing demonstrated the device to meet the highest international standards for reducing microbial pathogens.[91] It has also been shown to reduce harmful chemical contaminants such as pesticides and herbicides.[92] A recent health impact study by the Indian National Institute of Epidemiology reported that the device was associated with a 49.4 percent reduction in the longitudinal prevalence of diarrheal disease[93] in children who are less than five years of age. The Pureit filter is well-characterized for its effectiveness against waterborne microbes[94] and has been marketed throughout India to primarily urban, middle-class populations. The unit now retails for INR 2,000 ($40). It requires a replacement consumable set, called *Germkill* battery, at INR 350 ($7) for each 1,500 liters treated. Users can call a national hotline or regional call center numbers to have replacement batteries delivered directly to the household, or to find the address of Pureit Safe Water Zone where they can pick up the consumable set.

Overview of pilots

There is strong and growing demand for mid-range water filtration devices in India, and pilot projects conducted by HUL, AED/POUZN, and ACCESS have shown that once users are provided with access to credit, they prefer Pureit and similar aspirational technologies. Purchases of these filters increase exponentially after access to microcredit is introduced. Support for MFIs may take the form of providing capital to specific MFIs, with earmarks for water filters, or providing a macrolevel credit facility or guarantee to financial institutions that lend to MFIs, to cover perceived credit risk from entering the water market. In India, microcredit historically has been limited to income-generating activities and products (such as farm equipment, looms, sewing machines). Despite this history, the pilot projects have demonstrated almost 100 percent repayment on loans for the Pureit devices, at interest rates ranging from 12–18 percent with a 3–12-month loan term.

CARE, ACCESS, and HUL

CARE, an international relief and development organization, has been working in India for more than 50 years in programs designed to reduce poverty, improve health and nutrition, empower women, educate youth, and promote community organization.[95] As part of its Livelihoods mission, and with funding from the U.K. Department for International Development (DFID), CARE established a microfinance program in 1999 known as the Credit and Savings

90. NEERI. 2004. "Potable water quality assessment in some major cities in India." *Journal of the Institution of Public Health Engineers, India*. (4): 65.
91. Clasen, T., S. Nadakatti, and S. Menon. 2006. "Microbiological performance of a water treatment unit designed for household use in developing countries.". *Tropical Medicine and International Health* 11 (9): 1399–1405.
92. CFRTU. 2004. "Evaluation of Pureit™ Technology by DFTRI, Mysore." Report of the Central Food Research Technology Unit, Mysore, India.
93. NIE. 2006. Data available by request.
94. Clasen, T., S. Nadakatti, and S. Menon. 2006. "Microbiological performance of a water treatment unit designed for household use in developing countries." *Tropical Medicine and International Health* 11 (9): 1399–1405.
95. www.careindia.org.

for Household Enterprise (CASHE). The program encourages poor women to pool their savings and work with partner organizations to bring more poor women into the fold. It also trained federations of women's groups to become more creditworthy, thereby ensuring that poor women would have access to mainstream finance. The program thrived, and by 2006 was reaching over half a million clients in Andhra Pradesh, Madhya Pradesh, Orissa, and West Bengal, with total client savings of INR 943 million and client loans of INR 1,219 million.

In 2007, CARE transferred its microfinance activities into a separate non-governmental organization, ACCESS Development Services,[96] to provide more focused attention and assistance to its non-profit MFI partners and the self-help groups they support. Since then, ACCESS has established the ACCESS Microfinance Alliance (AMA), creating a network of more than 110 MFIs and providing them with training, favorable start-up funding at below-market rates as low as 11.5 percent, and other support, such as fee waivers and accelerated loan processing (typically 30 days). These loans are made from a $3 million Livelihood Innovation Investment Fund originally established by DFID for CARE's CASHE Revolving Loan Facility program.

HUL, the Indian subsidiary of U.K./Dutch-based Unilever Limited, is India's largest producer and seller of fast moving consumer goods.[97] It has more than 15,000 Indian employees and annual sales in its home/personal care and food/beverage units in excess of INR 100 billion ($2.5 billion). In addition to its commercial distribution activities, HUL has pursued a number of strategies designed to improve the health and well-being of lower-income populations throughout the country. Its rural health program—Lifebuoy Swasthya Chetana—seeks to induce adoption of hygienic practices among rural Indians to reduce the incidence of diarrhea, and has thus far reached 70 million people in approximately 15,000 villages of 8 states. In 2001, it initiated its Shakti program,[98] which creates microenterprise opportunities for rural women, provides health and hygiene education, and creates access to relevant information through the iShakti community Internet portal. The program now covers more than 31,000 women entrepreneurs in 100,000 villages across India, directly reaching 150 million rural consumers. By the end of 2010, Shakti aims to have 100,000 entrepreneurs covering 600 million people in 500,000 villages.

MFIs and SHGs in India[99]

Microfinance institutions are organized as non-profit companies, often operating within several districts, and regulated by the Non-Banking Financial Institutions Act rather than by conventional banking law. Most new MFIs are unable to secure commercial loans, because they are time-consuming (three months or more processing time) and expensive (0.5–1.0 percent of principal in fees, and annual interest rates of 14–15 percent). Other than partnering with ACCESS, MFIs can obtain credit from a variety of private and state banks and lenders in India, including HDFC, ICICI, State Bank of India, Development Credit Bank, Axis Bank, and the Small Industry Development Bank of India.

Self-help groups were originally formed in the 1980s as a means of providing economic empowerment to women. SHGs typically consist of 15–20 women living in the same neighborhood. The ability to use SHGs to raise cash and facilitate the securing of external loans is fundamental to the organization and sustainability of SHGs, which have proven to be more sustainable than feeding and maternal-health programs. In the southern states of India, an estimated 70 percent of the adult female population belongs to SHGs. Elected leaders of SHGs join larger federations that deal directly with the MFIs.

Tom Outlaw

96. www.accessdevelopment.org.
97. www.hll.com.
98. www.hllshakti.com.
99. Interviews with ACCESS, 2008.

SHGs are initially capitalized by a small agreed amount (usually INR 20–50) per month from its members. That capital is used for small "internal" loans (usually INR 5,000–10,000) of 10–12 months at preset interest rates of about 1.5–2.0 percent per month. Continued contributions by SHG members and interest payments provide a "perpetual" and growing capital base. Once the SHG has a capital base and an operational track record, it can apply for "external" loans from an MFI. These loans are made to the SHG, and all SHG members generally ensure that the loans are repaid on a timely basis. Under applicable laws governing SHGs, 70 percent of MFI loans to SHGs must be for income-generating activities; the balance can be used to pay off other debt, for home improvements and items such as the Pureit filter. MFIs typically charge about 3 percent over their cost of funds on these loans to SHGs to cover their operational costs.

Results to date from ACCESS/HUL partnership for the sale of HUL Pureit

In December 2007 and January 2008, ACCESS developed a plan for the activation of its 27 MFI partners in Andra Pradesh, Tamil Nadu, and Karnataka. It anticipated that to participate in the program, MFIs would need dedicated loans to SHGs, varying by the client outreach of the MFI. In addition, interested MFI partners received a rebate (depending on volume of units sold) for each Pureit sold, to cover MFI marketing and distribution expenses. In the initial pilot project, all sales of Pureit to date have been financed with MFI loans, with none sold for cash. Loan terms and interest rates vary among MFIs.

Between October 2007 and March 2008, 11 MFIs were activated in southern India. Collectively, 1,500 homes were protected in the initial pilot with these 11 MFIs. The initial pilot program for marketing Pureit through ACCESS has been successful; the Pureit device is purchased on 3–12 monthly installments, and repayment to date has been at 100 percent. The income profile of the consumers who have bought via microfinance in ACCESS, as well as other microfinance partnerships, shows that the percentage of consumers with a household income of less than $1 per day was 22 percent; $1–2 per day, 36 percent; $2–3 per day, 25 percent; and the remaining 17 percent had household incomes of more than $3 per day.[100] This data suggest that targeted investment in partnership with local MFIs could present a viable option for bringing safe water to even the poorest of households in India.

100. Jain, Y. Personal communication.

APPENDIX III:

COUNTRY REPORT: China

KEY FINDINGS: CHINA

- There are many producers of technologies, mostly for export, all aimed at middle- or upper-income markets, with prices in the range of $100–$300 per unit ($200–$800 for reverse-osmosis and ultra-filtration technologies).
- Boiling remains a widespread intervention used for household water treatment, especially in rural areas; one recent estimate from a Chinese government report suggested that over 85 percent of Chinese households (approximately 1.1 billion people) boil some or all drinking water.
- Water-treatment technologies (other than boiling) used in rural China include chlorine tablets, activated carbon sachets, and intermittently operated slow sand filters, which are locally produced and distributed by local entrepreneurs. Solar cookers are also a promising emerging technology.
- Our survey yielded a number of promising possibilities using proven technologies and methods for water treatment, but all were relatively high-tech and aimed at upper- and middle-income markets. China may produce the largest number of water-treatment devices for export in the world, but these generally do not penetrate locally.
- Collectivization and government regulation in rural areas limit the possibility for market penetration outside urban areas. Water supply and treatment remains very much under government control.
- The microcredit sector in China is weak but growing slowly, and access to credit in rural areas is very limited.

SAFE-WATER SECTOR OVERVIEW

The latest UNICEF and WHO statistics from the Joint Monitoring Programme put the number of Chinese who drink unimproved water at 300 million (with 77 percent of the total population having access to "improved water," and 69 percent having access to a household connection). More than 70 percent of China's rivers and lakes—common drinking-water sources, especially in rural areas—are listed as "seriously degraded," with few options for treatment except in cities. Despite a large scale effort ($2.17 billion) by the government since 2000 to build more than 800,000 drinking-water projects in rural areas, many Chinese live without any improved water source and with very few options for treating water. In rural areas, more than 40 percent of families do not have access to treated tap water—and over 60 percent of Chinese people live in rural areas. Even piped water supplies are plagued by inefficient and unreliable operation and inadequate maintenance, and treatment is often lacking. All waters in rural areas are considered suspect.

Sales of barreled drinking water have increased sharply in recent years, rising to 18.36 million tons in 2007 from 3.39 million tons in 1999. It is forecast that China's sales of drinking water will exceed 30 million tons in 2010, and China's vended drinking-water market will continue to grow at a rate of over 10 percent annually in the following five to ten years.[101]

Barreled vended water has developed rapidly due to its advantages in purity, hygiene, and convenience, with a number of companies focusing on urban markets. The brands MasterKong, Nongfu Spring, Wahaha, and Robust are the leaders in the sector in China. Small companies Runtian, Maling, and C'estbon have entered the market in recent years.

101. China Drinking Water Market Report. 2008–2009.

Curt Carnemark

All these companies serve middle- to upper-income urban markets. A significant barrier to growth of the sector is quality control; according to media reports, testing suggests that the water may be untreated. As a result, the market for POU filter systems is growing, although these products are not regulated either. By current estimates, POU devices are used in approximately 5 percent of households in China, almost exclusively in urban middle- and upper-income households. Most of these upper-end technologies are out of reach of poor Chinese. A survey of the sector revealed few opportunities for microcredit lending outside urban areas.[102]

Drinking-water quality: rural China

From August 2006 to November 2007, China launched its first national investigation on drinking-water safety and environmental health status in rural areas. This investigation covered 6,948 water samples, 65,839 families, and 6,590 counties. The results show groundwater to be the major source of drinking water in rural areas, supplied as drinking water to 74.9 percent of the population; the balance of drinking water comes from surface water. Centralized systems supply drinking water for 55.1 percent of the population; supply for the other 44.9 percent is off-grid. According to the Water Quality Standard for Drinking Water in Rural Areas (2006), 44.4 percent of water samples did not meet the minimal requirement for drinking. Individually, 40.4 percent of surface water samples were not safe for drinking, and 45.9 percent of groundwater samples were not safe. The major contaminant in these drinking-water samples was microorganisms—25.9 percent of water samples did not meet the requirements due to abnormally high concentrations of total bacteria and total coliforms. Only 29.2 percent of grid-based water-delivery systems used a disinfection process. The investigation also found that 5.1 percent of families treat their water (other than boiling) before drinking; 85.2 percent of families drink boiled water. (See Table 5.)

In 2008, the central government of China declared that RMB 360 million ($52 million) would be appropriated to improve drinking-water quality and environmental health status in rural areas. In the last three years, the central government invested RMB 483 million ($70 million) to build latrines and monitor water quality in rural areas.[103]

Major problems identified in rural sites visited were:

- Low access to piped water connections
- Low water-treatment and -distribution capacity
- Inappropriate management and insufficient financial support for existing systems
- Poor water quality, not meeting national or international standards
- Lack of safe storage practices

Joe Brown

102. Zhiwen, G. 2008. "China Microcredit Development and Opportunities." Presentation at World Microfinance Forum, Geneva. The microfinance portfolio for one Chinese regional bank, Harbin Bank, currently totals $1.35 billion, accounting for 40 percent of the bank's total loans. According to this source,18 percent APR is typical.
103. Ministry of Health, People's Republic of China. 2008. "Large scale investigation on drinking water and sanitation in rural areas." Government report (in Chinese).

Table 5 The China water sector by the numbers

CHINA[t]	
Total population	1,330,044,544
Percent urbanized	41% urban
Total population living on < $1 per day	10.0%–18.8%; [u] 35% live on <$2 per day.
Income	$2,010 GNI per capita. The average annual income per capita differs enormously between urban and rural areas. For 2003, the urban figure was RMB 8,472 ($1,058) and for rural areas RMB 2,622 ($328), according to national data.
Regulatory climate	Heavy government bureaucracy
Entrepreneurial climate	Among the healthiest in the world [v]
Percentage of population without access to improved water, total	23% (7% urban, 33% rural)
Industry standards exist and are enforced for drinking-water quality	Yes, enforcement varies.
Industry standards exist and are enforced for safe-water products and services	No, but government ministries do vet technologies.
Microcredit market	157 million accounts representing 12% of the population; 153 MFIs (46,570 state banks that provide some services that would fall under the term "microcredit"),[w] although it is unknown whether loans are available for non-revenue-generating purchases.
Access to microcredit in rural areas	Very limited
Access to microcredit in urban areas	Limited
Description of middle-market products and services	Wide range of products for export and middle markets
Description of BOP-market products and services	Relatively few and not widespread; boiling is very common.
$ per m^3 for piped water, urban	$0.15–$0.28 (estimate)
$ per m^3 for piped water, rural	$0.15–$0.46 (estimate)
% of population boiling water	85%+ (estimate)
Subsidies in the water sector	Varies widely; piped systems generally are subsidized. All vended water is unsubsidized.

t Population, income, and water access data from UNICEF.

u PRB www.prb.org figure is 18.8 percent. UNICEF estimated 10 percent, based on data from 1995–2005.

v 2008 Global Entrepreneurship Monitor.

w Christen, R.P., R. Rosenberg, and V. Jayadeva. 2004. "Financial institutions with a double-bottom line: implications for the future of microfinance." CGAP Occasional Paper 08.

CASE STUDY: SHANGLI SOLAR COOKERS

Diversifying use of a widespread technology in China

Overview

Solar cookers are gaining widespread use in China,[104] where the technology has a long (30-year) history and the support of NGOs and government. According to one estimate,[105] more than 700,000 solar cookers were sold in China by 2005, with broad scale-up now being undertaken by NGOs and producers; but subsidies are still needed to reach the poorest areas.[106] Solar cookers have the advantage of using a method for water treatment that is already well known and practiced by many in rural areas. Although the locally produced and locally distributed solar paraboloid concentrator (a type of solar cooker) is widespread, the company with the largest market share currently is Yancheng Sangli Solar Energy, Ltd.

Description of the technology

Sangli's solar cookers are composed of two cast-iron, aluminum-coated reflectors with a total collection area of 1.5 square meters; these reflectors concentrate the solar energy into an area 5 centimeters in diameter under the cooking pot. The 800-watt cooker is designed with a low center of gravity, to be more stable in high-wind conditions (a problem with some other designs). The cookers are deployed in Tibet (through government assistance) and in western provinces of China. Yancheng Sangli Solar Energy Co., Ltd. also produces a parabolic cooker that weighs 20 kilograms (44 pounds) instead of 50 kilograms (110 pounds),[107] which is easier to ship and rapidly deployable. The export unit price is $105, if delivered to Shanghai for shipping; shipping costs vary by destination, and sales are largely to NGOs. Costs are lower within China.

Water can be pasteurized by putting blackened containers of water in a solar cooker. However, the amount of water that can be pasteurized at a time is limited, and it is dependent on having the right climate. In addition, the user needs to have a clear indicator of when the water has reached the correct pasteurization temperature.[108]

Solar cooker advantages and business models

Solar cookers have many advantages and contribute to substantial reductions in firewood-fuel needs locally. According to one estimate, each solar cooker saves 750–1,000 kilograms of firewood per year (cost of firewood in 2005 estimated to be RMB 10 or $1.50 per 100 kilograms in Hebei province, and much higher in other areas such as Tibet)[109]—providing the added benefit of saving of labor to collect firewood, as well as the ecological benefits of solar energy. Three models of solar cookers are distributed in China:

104. Chen, X., and T. Han. 2006. "The solar cooker development and application in China." Monograph. China Association of Rural Energy Industry (CAREI).
105. Ibid.
106. Ibid.
107. http://solarcooking.wikia.com/wiki/Yancheng_Sangli_Solar_Energy.
108. http://solarcooking.org.
109. Ibid.

Subsidized programs

During 1979–1986, the number of solar cookers in China grew from 2,000 to 10,000, with many of them being financially supported by the central and local governments and used as demonstration units. Concrete solar cookers were available for $2–4 to users, while the cost of production was $7–9.50. In 1985, the government began scaling back subsidies, and commercial sales are now predominant. However, some solar cookers are still distributed through NGOs.

Commercial production in centralized factories for private sector distribution

Commercial production of solar cookers is widespread in Jiangsu, Hebei, Henan, Gansu, and Beijing. The units are of many different designs and materials, with a wide range in cost. The largest producer is Yancheng Sangli Solar Energy with 1.84 million units sold since 1983; according to the company, it produces 80,000 solar cookers per year, selling 50,000 in China and exporting 30,000 more to countries such as Pakistan, India, the United States, and Brazil. Most units are sold through distributors to end users.

Microentrepreneurs

Microentrepreneurs also make and distribute solar cookers as a cottage industry, especially in Gansu and Hubei provinces. Often, cookers are made from waste glass materials and are sold at low cost, making them an affordable option for the rural poor.[110]

110. Chen, X., and T. Han. 2006. "The solar cooker development and application in China." Monograph. China Association of Rural Energy Industry (CAREI).

Suggested further reading

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