Challenges to the Commercial Viability of Point-of-Use (POU) Water Treatment Systems in Low-Income Settings

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Abstract

Point-of-use (POU) water treatment systems have been put forward in recent years as low-cost, scalable, and effective solutions to the significant challenge of providing potable drinking water in lower income settings. In spite of their usefulness, however, levels of adoption and continued use remain low. Recently, several projects have turned to a commercial approach in order to make the products more widely available. This trend seeks to position POU products alongside other health-related products which have been delivered in part by a commercial approach, such as condoms or bed-nets. Drawing upon semi-structured interviews with key industry experts, this research argues that these initial projects have failed to boost significantly adoption rates. Reasons for this failure are explored. Nevertheless, the pursuit of commercial viability presents a promising strategy by which to promote POU products' adoption and sustained use. Strategies that have helped POU projects achieve partial commercial viability thus far, and may be useful in formulating strategies for POU projects seeking commercial viability in the future, are developed and explored. While projects promoting POU products have to date been unsuccessful in achieving commercial viability, should they do so in the future, these products, in conjunction with a commercial approach, have the opportunity to change the paradigm for the provision of potable water in lower income settings.

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Tables:

List of Acronyms

ABF	Arsenic Biosand Filter
BOP	Bottom of the Pyramid
CAWST	Center for Affordable Water and Sanitation Technology
CDC	Centers for Disease Control and Prevention
DALY	Disability Adjusted Life Years
FfDI	Financing for Development Initiative
G-LAB	Global Entrepreneur Lab
HIV-AIDS	Human Immunodeficiency Virus-Acquired Immune Deficiency Syndrome
HLL	Hindustan Lever Limited
IADB	Inter-American Development Bank
LSHTM	London School of Hygiene and Tropical Medicine
MDG	Millennium Development Goal
MIT	Massachusetts Institute of Technology
NGO	Non-Governmental Organization
P&G	Proctor & Gamble
POU	Point-of-Use
PSI	Population Services International
SODIS	Solar Water Disinfection
SWS	Safe Water System
UN	United Nations
USAID	United States Agency for International Development
UV	Ultra-Violet
WBCSD	World Business Council for Sustainable Development
WHO	World Health Organization

1. INTRODUCTION

This dissertation will investigate the commercial viability of point-of-use (POU) water treatment systems in lower income settings. POU systems refer to the range of water treatment methods—including filters, chemicals, and others—which treat water at the point of consumption rather than at the source, as is the case for many centralized water treatment and distribution systems. The range of POU technologies available will be discussed in greater detail in Section 1.3. The effectiveness and affordability of these systems have made distinct progress in recent years; they have proven themselves to be effective on highly contaminated input water, and to be affordable in certain lower income settings. These systems allow for the regulation of water quality at the household level, and as a result have the potential to alter dramatically the dominant paradigm by which certain households obtain their drinking water supply.

With a range of POU products readily available, the attention of researchers is now turning away from the research and development, and toward their diffusion. The term 'diffusion' refers to the process by which the usage of a certain product is initiated, spread, and sustained, made common in Rogers' (1995) *The Diffusion of Innovations* and its earlier editions. In spite of their promise, these products have so far failed to attain widespread adoption within the communities in which they would be the most effective. Adoption models led by government agencies and development organizations have so far failed to promote widespread adoption. The commercial approach—whereby some or all of the costs of producing, marketing, and distributing the products are covered by the purchase price paid for the product by the consumer—provides a promising new

approach by which these products can be diffused. While initial cases in which the commercial approach has been used to promote the adoption of POU services have met with mixed success, the strategy nevertheless shows promise. If successful, the commercial approach could be useful in getting these products into the hands of those who need them most, and could play a role in meeting international development targets such as the Millennium Development Goals (MDGs).

This research will investigate challenges encountered by POU products as they have sought to establish commercial viability. Section 1 will review the important links between water and health, discuss some of the challenges encountered in attaining goals for water supply, and introduce the concept of POU water treatment methods.

1.1. Water and Health

Water has long been understood as a significant pathway for disease (Snow 1855, Kfir *et al* 1989, White *et al* 2002). Globally, 1.1 billion people lack access to what the World Health Organization (WHO) considers to be an adequate water source (see Table 1). Unsafe water and sanitation causes 1.6 million deaths annually, mainly from diarrheal disease (WHO 2004). Diarrheal disease alone claims the lives of 5000 children every day (WHO 2005). Water causes four billion cases of diarrhea per year (WHO 2002), placing diarrheal disease globally as the third highest cause of morbidity and the sixth highest cause of mortality, accounting for 5.7% of the global disease burden measured in

DALYs[1] (Prüss *et al* 2002). This health impact is borne in particular by residents of the developing world, especially children (Parashar Bresee and Glass 2003, WHO 2004). Ninety percent of deaths from diarrheal diseases in the developing world occur in children under the age of five (WHO 2005). Women and children, particularly girls, bear an additional burden related to an inadequate water supply: time spent collecting and transporting water diminishes time available for other productive applications, especially school (WHO 2005, Guarcello *et al* 2004). Lack of access to safe water is strongly correlated with poverty, and the provision of safe drinking water is considered to be a fundamental step in a community's transition out of poverty (Sachs *et al* 2005).

The international commitment to alleviating the global burden associated with inadequate drinking water was affirmed during the recent Millennium Development Goal (MDG) process. One of these goals tackles water supply and sanitation directly, aiming to: "Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation" based on baseline data from 1990. Measuring progress in fulfilling this target is, accordingly, dependent on the definition used for 'safe drinking water.' The WHO differentiates between the concepts of 'safe' and 'improved,' which leads to some confusing results (WHO 2005). Table 1 compares sources considered improved and unimproved within the WHO framework.

[1] Disability Adjusted Life Year (DALY) measures the aggregate global healthy life lost, in years, due to mortality (death) and morbidity (disease) over a certain period of time (definition adapted from that used by the World Bank).

Table 1: Improved vs. Unimproved water source

Improved sources of drinking water	Unimproved sources of drinking water
Piped water into dwelling, yard or plot	Unprotected dug well
Public tap/standpipe	Unprotected spring
Tubewell/borehole	Vendor-provided water
Protected dug well	Tanker truck water
Protected spring	Surface water
Rainwater collection	
Bottled water (with conditions)	**Source: WHO 2005**

Under the current classification, a standpipe providing contaminated water up to one kilometer away from a residence may count as 'improved' but may not be 'safe.' Similarly, water supplied by a vendor may be 'safe' but not 'improved' as adequate supplies may be unaffordable to the user. For the purposes of this paper, it is significant to note that populations using POU treatment 'in principle' count as having access to 'safe drinking water' based on the MDG described above. However, due to gaps in the survey methodology used to gather WHO data, the statistics may not reflect this compliance until mid-2006 (WHO 2005). It should also be noted that improvements in water and sanitation have a relevance in the MDG process beyond their own MDG area; they are considered to be indispensable in fulfilling the goals of other MDG areas, such as eradicating extreme hunger and poverty, and achieving universal primary education (UN 2005, WHO 2005).

A considerable body of literature examines the effectiveness of various water-related interventions in severing the connection between water and disease. Cairncross and Valdmanis (2004) stress the importance of increasing the quantity of available water. Esrey and Habicht (1986) emphasize the importance of improving sanitation facilities

and modifying hygiene practices. Vanderslice and Briscoe (1993) emphasize the importance of ensuring water quality at the source point. In the past, several studies specifically downplayed the importance of water quality at the point of use (Esrey *et al* 1991, Vanderslice and Briscoe 1993). Spurred in part by the recognition of the importance of post-source contamination (Gundry, Wright and Conroy 2004), recent studies have emphasized the importance of ensuring water quality at the point of use, and have demonstrated the health impact of water interventions targeting household treatment and safe storage (Clasen and Cairncross 2004).

1.2. Goals for Water Supply

In order to meet the water supply ambitions of the MDGs, it is estimated that the current spending on global water interventions will need to increase considerably (Brown and Holcombe 2004)[2]. Table 2 summarizes Hutton and Haller's (2004) recent estimates of the costs of a variety of water related health interventions.

[2] Baletti and Raymond (2005) estimate that existing annual global investment in the water supply and sanitation sectors in developing countries amounts to US$15 billion.

Table 2: Costs of varying levels of water intervention

Intervention	Cost (USD billion/year)
#1: Halving the proportion of people without sustainable access to improved water supply	**$1.78**
#2: Halving the proportion of people without sustainable access to both improved water supply and improved sanitation	**$11.30**
#3: Access for all to improved water and sanitation services	**$22.60**
#4: Intervention #3 PLUS a POU system (chlorine and safe storage)	**$24.60**
#5: Access for all to regulated in-house piped water supply with quality monitoring and in-house sewerage connection with partial treatment of sewage	**$136.50**
Source: Hutton and Haller (2004)	

Several points are worth highlighting in these data. First, even if the MDG in water and sanitation is achieved, up to a half of the percentage of those unserved in 1990 will remain unserved by an improved water supply. Second, the water accessible to many of those whose water source now counts as improved will remain unsafe (R6[3], WHO 2005). Third, adding access for all to household water treatment using a POU system would add US$2 billion to the cost of providing access to all to improved water and sanitation services, a budget increase of approximately 9%.

While the responsibility for providing water services globally remains largely with the public sector, it has been accused of underperformance, neglect of infrastructure, and an inability to build out and maintain water infrastructure (e.g. Economist (2003), an argument challenged by Swyngedouw (2005a)). Many have called on the private sector to share the burden of fulfilling water objectives, noting in particular the private sector's

[3] Evidence provided by stakeholders interviewed during the course of this research is referenced R1-R10. To whom these designations refer can be determined by consulting Table 3 in Section 3.1.

advantage in raising capital (Sachs *et al* 2005, Financing for Development Initiative (FfDI) 2005, World Economic Forum[4]). This enters into a contentious debate. Many argue that the task of providing safe drinking water is sufficiently large and complex that the greatest number of stakeholders must be involved for results to be obtained; furthermore, the private sector's efficiency and ability to mobilize capital allow it to make unique and valuable contribution (e.g. World Bank 1997, Lee and Floris 2003). Others make the case that the risks of private sector participation outweigh the potential benefits, that the private sector fails to take into account water's unique and social roles (Gleick *et al* 2002), and that private sector involvement is rarely as beneficial as touted (Hall 2001).

Public or private, a key question is how water infrastructure will be financed. While safe water supplied by piped infrastructure is a noble goal, and while the WHO (2005) argues that investments in developing country water infrastructure will pay back an eight-fold return, willingness-to-pay surveys have demonstrated that the amount consumers are willing to pay in lower income settings is not sufficient to cover the capital costs of improved service delivery to the point of individual house connections (Goldblatt 1999, Merrett 2002). Considerable attention has been focused on how the international community can help bridge this funding gap, including the International Drinking Water Supply and Sanitation Decade (1981-90) and more recent initiatives such as the World Water Forums and MDG process. These, however, have been responsible for only modest progress (UN 2005, Ahammed and Chaudhuri 1999). Consumers and

[4] www.weforum.org/water. Accessed 8/23/05

governments in lower income settings appear unable to shoulder themselves the investments required of installing piped water infrastructure for all. Nor does the international community appear willing to finance the shortfall. Thus, the field appears ripe for innovative solutions (Lantagne *et al* 2005).

1.3. Point-of-Use Technologies

One such innovative solution, put forward with increased enthusiasm recently, is POU treatment systems, often referred to as household water treatment (Sobsey 2002). The technologies are not new (the Doulton filter was being used in the early 19th century) and their potential impact has been long understood (Wagner and Lanoix 1959, Inter-American Development Bank (IADB) 1980, Mann 1983). A renewed awareness of their potential application from a public health perspective came out of the cholera outbreak in Latin America in the early 1990s (R2), sparked considerable recent research (Ahammed and Chaudhuri 1999), and has led to their establishment within the international community as a valuable policy option (WHO 2005). The potential impact of POU systems was reinforced during the recent South Asia tsunami, where the WHO (2005) estimates that they provided potable water to 3-5 million survivors of that disaster.

Three main categories of POU product can be identified (Sobsey 2002):

1) **Solar treatment:** using heat or ultra-violet (UV) radiation (exposing water to sunlight) to neutralize contaminants;
2) **Physical treatment:** using sedimentation or filtration to physically remove contaminants;

3) **Chemical treatment:** using chemical coagulation, flocculation and precipitation, adsorption, ion exchange, or chemical disinfection to neutralize and/or remove contaminants; and
4) **Combined treatment:** systems using more than one of the above processes.

A range of studies have proven POU systems' effectiveness in removing particles (turbidity), and in neutralizing microbiological contaminants, including bacteria, viruses and in some cases protozoa (Sobsey 2002, Kfir *et al* 1989, Ahammed and Chaudhuri 1999, Quick *et al* 1997, Rangel *et al* 2003, Quick *et al* 1999, Crump *et al* 2004, Souter *et al* 2003, Fewtrell *et al* 2005), delivering potable water consistently from heavily contaminated input water. Furthermore, the low price of emerging POU interventions puts them within reach of low income consumers (Sobsey 2002, Hutton and Haller 2004), thus raising the potential for the products' commercially driven diffusion. Recognizing their potential public health impact, POU products have been frequently included as part of development based health programs and government initiatives, frequently appearing as one component of a multi-pronged strategy including hygiene behavior modification, and improved sanitation facilities.

The profile of POU products was boosted by the recent formation of the WHO sponsored International Network to Promote Household Water Treatment and Safe Storage ('the Network'), whose third annual meeting was recently held in Bangkok, Thailand (WHO 2004). The Network emphasizes the importance of safe storage of water alongside appropriate treatment, recognizing the potential for infection arising during transport and

storage (Clasen and Bastable 2003, Trevett 2002, Wright *et al* 2004, Mintz *et al* 1995). The potential for contamination during transport and storage makes the challenge of providing safe drinking water even greater. Assuming that water drawn, for example, from a communal standpipe is safe to drink at collection, significant opportunity for infection still exists during the process of transporting the water to the home (transport over a distance of up to one kilometer still counts as 'improved' according to WHO definitions), and during the storage of water prior to consumption (usually from contaminated hands or vessels dipped into stored water—Trevett 2002).

POU systems have not been universally embraced as a panacea. A variety of challenges have been posed to their effectiveness. Health benefits of POU practices are often lost due to improper use (Luby *et al* 1999); the unattractive taste or smell of water purified chemically impedes adoption (Kirchhoff and McClelland 1984), and the inability of clean drinking water alone, without concomitant progress in other critical areas such as personal hygiene and sanitation, drinking water sources outside the home, and food storage practices, to result in a reduction of morbidity (Kirchhoff and McClelland 1984).

Cairncross and Valdmanis (2004) argue that POU solutions cannot be considered as an alternative to centralized piped water supply because of the insufficient evidence of long term efficacy, and the greater cost effectiveness of improving a centralized source compared with distribution of POU capacity to every household. POU proponents, however, make clear that the products are intended to accelerate the health gains associated with improved water until the longer term goal of universal access to piped,

treated water can be attained (Lantagne *et al* 2005), and that large-scale, centralized water treatment facilities remain critical components of water supply initiatives (Mintz *et al* 2001, Brown and Holcombe 2004, Murcott 2001, Quick *et al* 2002). POU products can also be questioned on ethical grounds should financing be diverted toward POU solutions, with a short-term impact, and away from long-term piped water infrastructure (Swyngedouw 2005b).

But the most potent criticism of POU products to date is the failure of the projects which support their use to scale up beyond a limited or project-based application, to achieve long-term adoption beyond the life of the public health initiative that promotes their use, or to generate significant levels of use in a non-subsidized environment. Too often, the use of promising technologies that achieve significant penetration rates within a community is discontinued once the project or subsidy supporting their use withdraws (R1, R6). In light of the failure of POU projects to achieve widespread adoption, the role of market based approaches, and private sector involvement is attracting increased research interest (Lantagne *et al* 2005).

There is a need for improved drinking water supply in lower income settings. Many of these areas appear unlikely to receive potable piped water supply in the near future. POU systems have proven their effectiveness in delivering potable water from contaminated supply at a price affordable to many consumers. Existing diffusion models, primarily subsidized development or government initiatives, have failed to bring about widespread

usage. This paper will investigate the role that the commercial approach can play in bringing about more widespread and long-term adoption.

1.4. Dissertation Outline

Drawing mainly on the testimony of a range of key experts from within the POU industry, this paper examines the experience of a selection of POU systems whose diffusion has taken place in part through a commercial approach. ***Section Two*** reviews some promising areas of the academic literature for informing an examination of the commercial diffusion of these products. ***Section Three*** reviews issues arising in other academic research which have called upon similar techniques. ***Section Four*** presents the analysis of the data gathered, presented in three main sections. The first demonstrates the difficulties encountered by POU systems as they have sought commercial viability; the second reviews some of the obstacles that have caused this difficulty; and the third reviews some lessons learned, and promising practices through which POU systems may succeed in attaining commercial viability in the future. Finally, ***Section Five*** draws together the findings of the research, by examining whether or not commercial applications can play a beneficial role in the diffusion of POU products, dwelling on some of the strengths and limitations of the current research, summarizing areas for future research, and dwelling on the impact that POU products, should they become commercially diffused, could have on the drinking water supply of lower income consumers.

2. COMMERCIAL ASPECTS OF POU RESEARCH

In cases where POU interventions find themselves to be higher in appropriateness than in adoption, the commercial approach is increasingly being considered as a means of promoting their diffusion. This section reviews emerging areas of POU research in which commercial issues play a role, and describes the role that the study of commercial opportunities in lower income settings and innovation adoption can play in better understanding the commercial aspects of POU diffusion.

2.1. Emerging POU Research and the Commercial Approach

A fresh range of issues confronts POU research as the products begin to move from pilot projects to more well-established national and regional policy initiatives. Financial analyses are playing an increasing role, including cost recovery and financial sustainability (Lukacs 2003), economic feasibility (Brown 2003)[5], and cost effectiveness (Clasen 2005). The WHO followed up its key technical background contribution to the POU literature (Sobsey 2002) with Hutton and Haller's study (2004) employing a cost-benefit analysis framework to examine the costs and benefits of POU interventions compared with other water supply interventions. The Network's[6] research agenda is turning increasingly to questions related to scalability and long-term adoption. Promising lines of enquiry concerning commercial aspects of POU product diffusion are being pursued through the recent collaboration between Massachusetts Institute of Technology's (MIT) Department of Civil and Environmental Engineering and Sloan

[5] Lukacs' financial sustainability refers to the sustainability of projects promoting POU systems; Brown's economic feasibility refers to a consumer population's ability to support a product's cost.
[6] As discussed in Section 1.3, references to 'the Network' refer to the WHO-led International Network to Promote Household Water Treatment and Safe Storage.

School of Management's Global Entrepreneur Lab (G-LAB) at MIT[7] (R7). However, this side of POU research is still in its infancy, and many studies are still being carried out by public health officials without specialist expertise in the emerging fields (R6, R8).

2.2. Commercial Opportunities in Low Income Settings

A growing literature describes the opportunity for commercial operations in lower-income settings, tapping into Prahalad's "Fortune at the Bottom of the Pyramid" (2005). While lacking the disposable income of higher income consumers, Prahalad argues that the high potential sales volume in lower income markets provides opportunities for robust profits for those organizations nimble enough to capture them. Low income consumers clearly have some ability to pay for clean drinking water. Producing safe drinking water by boiling, a standard practice in much of the developing world, has a significant financial cost (on account of the costs of gathering and transporting fuel, and the time investment of boiling—Gilman and Skillcorn 1985), not to mention the environmental and health costs of biomass fuel combustion required of boiling (De Koning *et al* 1985). Similarly, Carpenter (2003) and Swyngedouw (1997) have demonstrated that poor consumers, served by private water vendors, frequently pay significantly more for water than their middle class peers provided by municipal infrastructure in the same area. Prahalad and Hammond (2002) found that the poor in Mumbai's Dharavi slum pay a "poverty premium" for water from a water vendor of 37 times the municipal price charged in a neighboring middle-class area for piped water supply, though some of this may be attributable to the added expense of serving the remote locations in which poorer

[7] Project documents, and other relevant materials, available via MIT's website: http://mit.edu/watsan/. Accessed 8/23/05.

consumers tend to reside (R6). Lower income markets provide a challenge to commercial operations honed in developed country contexts; an opportunity nonetheless exists.

Succeeding in lower income settings requires a fundamental rethink of commercial operations. Conditions in lower income markets can be challenging, and consumers can be difficult to reach via conventional business practices (Prahalad and Hart 2002). Products need to be re-invented, with a radical rethink of cost structures, packaging, serving size, and robustness of design (Hill and Still 1984, Hammond and Prahalad 2004, Prahalad 2005). Companies seeking to replicate the success of a product sold in other markets need to decide whether to invest in adapting that product to local preferences, entailing a high cost for an uncertain return, or to market that product in its existing form to a potentially limited market (Dawar and Chattopadhyay 2002). Some have argued that making these adjustments, tailoring products and operations to the tastes of lower income markets, derives benefits to a company beyond the possibility of profit. Succeeding in lower income markets, for example, requires a process of innovation, the fruits of which can subsequently benefit a firm elsewhere (Hart and Christensen 2002, Prahalad 2005).

Some question the ethics of deriving profits from low income consumers. Multi-national corporations with operations in lower income areas, for example, have been accused of threatening local cultures and the survival of local companies (Dawar and Frost 1999, Witkowski 2005). Others would argue that the private sector is well placed to leverage requisite levels of investment (World Business Council for Sustainable Development

(WBCSD) 2002, Witkowski 2005), and that its involvement benefits the poor by giving them the dignity of consumer choice (Hammond and Prahalad 2004). Furthermore, Prahalad (2005) contends that while the private sector does derive profits from low income consumers, these profits are a fraction of those exacted by the informal sector through which these consumers currently access required products and services.

When markets succeed in lower income settings, they provide the opportunity for a radical re-think of the development paradigm. Development projects driven by a funding donor organization tend to end, or become less effective, once the funding period ends. However, development projects can generate greater effectiveness and sustainability through the adoption of a commercial approach, leveraging private retail and distribution channels, and harnessing donor funding to stimulate initial uptake (Heireli 2000, Lukacs 2003). The treadle pump, for example, has had a major impact on a variety of developing country irrigation economies. Its adoption has been leveraged by development funds, but has been driven by a commercial apparatus (Armstrong and Karmali 2005).

2.3. Innovation Adoption

In contrast with the rudimentary nature of existing water treatment practices in many lower income households, POU systems often appear as innovations, as either a new product entirely, or as a radical upgrade of prior practice, such as purifying water by boiling, or allowing it to settle. Thus research into the adoption of innovations—"the diffusion of innovations" (Rogers 1995)—is relevant. Diffusion, according to Rogers, "is the process by which an innovation is communicated through certain channels over time

among the members of a social system." The rate of adoption of an innovation is determined by various characteristics of the innovation, including its relative advantage, compatibility, complexity, trialability and observability. The rate of adoption of innovations can be described with an S curve, whereby an innovation is slowly adopted by innovators and early adopters, quickly adopted by the majority, until the rate of adoption slows over time as the market approaches saturation.

The theory of innovation diffusion has been modified and added to extensively (Bucklin and Sengupta 1993, Fichman and Kemerer 1999). A considerable literature uses diffusion studies to examine the adoption of health care innovations (Fitzgerald *et al* 2002). Areas which have received particular attention include the diffusion of: HIV prevention strategies (Dearing *et al* 1996), condoms (Eloundou-Enyegue 2005), and treadle pumps and cook stoves in lower income settings (Lukacs 2003).

3. METHODOLOGY

This section provides an overview of the products which are reviewed in this research, and the industry experts upon whose testimony this research draws. The techniques employed to gather and analyze data are reviewed, as are issues arising from other academic research that have called upon similar techniques.

3.1. Data Sources

Data were gathered through semi-structured interviews with key POU industry experts. Data were gathered from two types of expert: 1) experts with a primary affiliation with a

specific product; and 2) general industry experts, without a specific product affiliation. These distinctions are not clear in all cases. Some product-specific respondents promote more than their own product[8]; furthermore, some industry experts have an affiliation with specific products[9].

Products and Product Experts Reviewed:

Interviews were conducted with representatives of seven different products. Additional information, including the name and title of the individual/s interviewed for each product, is provided in Table 3 below. Website links for each of these products is provided in Appendix 1. The products reviewed are:

- **Biosand Filter**: Center for Affordable Water and Sanitation Technology (CAWST). Gravity fed, slow sand filter.
- **Ceramic Filter Technology**: Potters for Peace. Table top colloidal silver-enhanced ceramic filtration system.
- **Fairey Ceramics:** gravity fed unit comprising two or more candle filters.
- **PuR**: Procter & Gamble (P&G). A single use sachet combining chlorination with a chemical flocculent to purify and clarify water.
- **Pureit:** Hindustan Lever (HLL). A table-top, three stage combined water purification system, employing filtration and chemical treatment.
- **Safe Water System (SWS)**: Center for Disease Control (CDC). Chlorine based water treatment combined with safe storage and education.

[8] CAWST, for example, promotes its own product, the Biosand Filter, as well as other POU products.
[9] PSI, for example, promotes primarily SWS and PuR.

- **SODIS** (SOlar water DISinfection): The Swiss Federal Institute for Environmental Science and Technology. Employs solar radiation in destroying water borne pathogens in water stored in clear plastic bottles.

Product and Product Expert Selection:

A variety of factors guided the researcher's selection of the above-mentioned products. They represent an array of product technologies, including filter, chemical disinfectant, ultra-violet, and combination treatments. Each has been marketed in low-income settings. They have adopted a range of commercial implementation strategies, ranging from fully commercial (Pureit) to fully non-commercial (SODIS), and several points in between. Lastly, each of the experts affiliated with the products listed above and mentioned in Table 3 below was willing to field the researcher's questions.

Expert Selection:

Three industry experts were interviewed:

- **Chuck Szymanski**: Senior Manager, Maternal and Child Health, Population Services International (PSI). Washington DC, USA
- **Susan Murcott**: Professor, Department of Civil and Environmental Engineering, Massachusetts Institute of Technology (MIT). Massachusetts USA
- **Tom Clasen**: Professor, Department of Infectious and Tropical Diseases, London School of Hygiene and Tropical Medicine (LSHTM). London, UK

The industry experts were selected based on their capacity to inform the research on commercial aspects of POU systems. Industry experts, while intimately familiar with the diffusion of these products, do not have a specific affiliation with a particular product. Their input, therefore, provides a useful counterweight to the inputs of the experts whose viewpoints are guided by an affiliation with a specific product. All three are well-respected experts in the field, and have each acquired hands-on experience in diffusing a range of POU products.

Table 3 summarizes the interviews conducted for this research. The designation P or I refers to whether the interviewee provides input concerning a particular Product or the Industry in general. Dissertation code is the reference by which a particular interview is referred to in the text. One interview (CDC) collected information from two respondents. Their combined input will be referenced as R2. Another respondent spoke to the researcher on two occasions (Clasen). Information from both of these interviews will be considered collectively and referenced as R6.

Table 3: Interviews conducted

Name	Title	Product (P) or Industry (I) Expert	Organization	Date of Interview	Method of Interview	Dissertation code
Greg Allgood	Director, Children's Safe Water Drinking Program	P	Procter & Gamble (P&G)	7/25/2005	Phone	R1
Rob Quick Daniele Lantagne	Foodborne and Diarrheal Diseases Branch	P	Center for Disease Control (CDC)	7/28/2005	Phone	R2
Ron Rivera	International Coordinator	P	Potters for Peace	7/30/2005	Phone	R3
Martin Wegelin	Program Manager	P	SODIS	8/3/2005	Phone	R4
Simeon Gabriel	Sales & Marketing Manager	P	Fairey Ceramics	8/15/2005	Phone	R5
Tom Clasen	Professor, Department of Infectious and Tropical Diseases	I	London School of Hygiene and Tropical Medicine	5/10/2005 8/19/2005	Person Phone	R6
Susan Murcott	Professor, Department of Civil and Environmental Engineering	I	Massachusetts Institute of Technology (MIT)	8/16/2005	Phone	R7
Ronald Lentz	Technology Director	P	Center for Affordable Water and Sanitation Technology (CAWST)	8/22/2005	Phone	R8
Suresh Nadakatti	Senior Research Scientist	P	Hindustan Lever (HLL)	8/24/2005	Phone	R9
Chuck Szymanski	Senior Manager, Maternal and Child Health	I	Population Services International (PSI)	8/25/2005	Phone	R10

3.2. Data Gathering

Research for this dissertation was carried out through semi-structured interviews with the key experts discussed above. Interviews were carried out by the researcher between May and August 2005. Four primary areas of research were determined to be necessary to address the current research question. These were identified out of an extensive literature review, in addition to preliminary discussions with key experts. The four areas were:

1. Demand creation and education

2. Advertising and promotion
3. Access
4. Cost and use

These four topics served as the foundation for an interview guide and checklist (Patton 2002), attached as Appendix 2, which provided the basic structure for the interviews conducted. Within these boundaries, however, respondents were encouraged to digress and interrupt, as they considered appropriate. One interview took place in person; the rest by telephone. All but one respondent agreed that the interview could be recorded (the other respondent was not asked), that quotes from the interviews could be used in the dissertation, and that quotes could be attributed. Some asked for the opportunity to approve their input prior to inclusion in the paper. No interviewee was compensated for participating in an interview. Every effort was made to ensure that questions were open-ended, neutral, singular and clear (Patton 2002). A practice interview was conducted before actual interviews were undertaken (Bernard 1995).

While the categories described here bear a strong resemblance to the four areas identified during the initial literature review described in Section 3.2, their development into the five areas listed below reflects the developing focus of the research.

3.3. Data Analysis

All interviews were recorded using a digital recorder. Most files were subsequently transcribed by the researcher as word processor files. When the intention of the

interviewee was clear, the grammatical errors of speech were 'fixed up a bit' (Bernard 1995) by eliminating filler phrases such as 'you know' or 'umm.' Transcribed documents (in addition to audio files of the un-transcribed interviews) were analyzed, and themes were extracted by coding (Ryan and Bernard 2000, Bernard 1995). These codes—and the process of coding—provided the foundation for analysis presented in the subsequent section. Ryan and Bernard (2000) point out that "coding is analysis." While interview text, the raw data emerging from this project's research, provided the foundation for this paper's analysis, other relevant sources were woven into the Results and Discussion section, where appropriate. While the four research areas developed during the literature review provided the starting point for the research, these themes were continuously modified and adjusted as research developed, and lessons from previous interviews informed subsequent interviews. In places in this paper, where sensitive issues or controversial opinions were discussed, attribution for the comment is omitted. No respondents requested this; this was done at the discretion of the researcher.

3.4. Methodology Discussion

Methodological strengths:

The semi-structured interview was selected on account of its suitability to the types of data that needed to be gathered (comparing the experiences of diverse products in diverse contexts), and the generally elite position of interviewees (Bernard 1995). The semi-structured interview format allows for the sympathetic collection of data, enabling respondents to speak in their own words, in rich detail (Herod 1993). The format

furthermore elicits in-depth responses, allowing the interviewee to bring in a breadth of information which could inform the research (Fontana and Frey 2000), and enabling a fuller understanding of the decision environment behind complex commercial practice than would a survey or questionnaire (Mullings 1999). Finally, the semi-structured interview can be used to deliver subtle results, capturing many of the subtle complexities underlying decision making processes which are frequently missed out by other research techniques (Herod 1993).

Methodological challenges:

At the same time, a range of complexities associated with the semi-structured interview technique needed to be considered. Issues related to the interview process related to positionality, elite interviewing, interviewing ethics, and reliability and validation are reviewed below.

Positionality:

Positionality refers to the role that the interviewer and interviewee play in determining the outcome of an interview: the "conscious analysis of the situatedness" of research (Rose 1997). It arises because "interviews are not neutral tools of data gathering but active interactions between two (or more) people leading to negotiated, contextually based results" (Fontana and Frey 2000). Mullings (1999) argues that:

> *[A researcher's] unique mix of race, class, gender, nationality, sexuality and other identifiers... will influence how the world is viewed and interpreted... [therefore] knowledge*

> *is never pure but is situated in the complex and sometimes contradictory social locations of producers and audiences*

While rigorous interview objectivity could provide an antidote to positionality, some argue that reflexivity provides a better approach. Instead of eliminating the role of interviewer and interviewee, reflexivity acknowledges clearly these positions, and includes these in the factors under investigation. The technique, frequently cited within the feminist geography literature, accomplishes this objective through a full understanding of the researcher, the researched and the research context (Rose 1997).

Positionality informs this study in several key ways. Many of the data derived for this analysis arose through the interaction of a Master's candidate researcher with corporate or organizational executives, with each party bringing their own biases, interests, and perspectives to the discussions. Significantly, all data were gathered from a corporate/organizational perspective, and therefore the myriad of insights that could have been derived from consumers into the questions at hand were necessarily ignored. Had more time and resources been available, the research could have been improved by weaving in the perspectives of product users and retailers.

The political and temporal context of the research's timing is another factor of positionality (Visser 2003). Thus, results may have been affected by the timing of the research within the promotion cycle of the products in question. Timing of the research early in the cycle could result in a hesitancy to divulge critical marketing or positioning

information, timing later in the cycle could involve a willingness to share practices and experience.

Elite interviewing:

Another factor affecting the positionality of the research was the generally elite status of interviewees. Positionality investigations have tended to focus upon situations where the interviewer is in an elite position; the implications of the interviewee being in an elite position have attracted less attention (Mullings 1999, Visser 2003). Access to elites is restricted, and they are likely to operate under significant time constraints (Mullings 1999). While all interviews sought were eventually undertaken, difficulties in coordinating with certain interviewees meant that several interviews took place while the writing process was in an advanced stage. While the input of these late informants still informed the research, it did not have the impact that it could have had otherwise. Furthermore, interviews conducted earlier in the process could have had a disproportionate impact on the results of the research than did interviews conducted later.

Interviewing ethics:

Fontana and Frey (2000) identify three areas of ethical concern while interviewing: informed consent, rights to privacy, and protection from harm. All respondents were given an interview statement, explaining the purpose of the research, and the proposed use for the information gathered, before the interview began (Patton 2002). Voice recorders were not used unless permission was explicitly requested and given.

Reliability and validation:

The reliability of the information gathered during the research process could be questioned in several ways. First, data were collected during the semi-structured interviews only on topics about which the researcher posed questions. Thus, a great deal of relevant information may have been excluded. Patton's (1990) inductive analysis, where conclusions are formed out of an inclusive set of data gathered, could have been used to form more reliable conclusions. Second, the story being investigated was in many ways a story about failure—the failure of POU products to be widely adopted. Thus the reliability of individual interviewees, invested to some degree in the success of their product, must be questioned. Third, few interviews were carried out in person, thus important non-verbal clues, such as facial inflections, were lost (Fontana and Frey 2000, Herod 1993). In order validate data derived from interviews, efforts were made to triangulate answers, considering interviews in light of the existing academic literature and the insights of independent industry experts (Bernard 1995, Ryan and Bernard 2000). With greater time and resources, data received could have been further validated by comparing them with responses derived from consumers and product retailers.

4. COMMERCIAL VIABILITY AND POU SYSTEMS

The results of the research will be presented in three main sections. Section 4.1 will detail the difficultly that projects promoting POU products have encountered in attaining commercial viability; Section 4.2 will examine some of the obstacles that have been encountered in the pursuit of commercial viability; and Section 4.3 will highlight

techniques that have been successful in cases where these projects have approached commercial viability.

4.1. Achieving Commercial Viability

This section will examine the profitability of POU projects, the reliance of these projects upon subsidies, and the difficulties that these projects have encountered in bringing about sustained use. By doing so, it will make the case that POU systems have to date failed to achieve commercial viability.

4.1.1. Elusive Profits

Using an analysis similar to Prahalad's (2005), the commercial opportunity for POU products in lower income settings appears to be substantial, and has been recognized (e.g. Carpenter 2003). Deriving actual profits from POU sales in lower income settings, however, has proved difficult (R2, R3, R6). While the health benefits were clear, the commercial viability was not. In the case of P&G:

> *Contrary to what you might think, that we could create a business opportunity but that it would have a small public health impact, we saw the reverse. We could create a huge public health impact but it wasn't at a high enough level to be an attractive ongoing business proposition for us (R1).*

A Wall Street analyst confirmed that "the PuR business is very small, isn't a core business to P&G, and isn't moving the needle over on the commercial front.[10]" None of the projects reviewed had achieved full cost recovery. Some had attained partial cost recovery. Nearly half of the CDC's projects had been able to recover the costs of production and distribution; none had been able to cover the costs of marketing (R2).

4.1.2. Necessity of Subsidies

For all of the products reviewed, some level of subsidy was received. These subsidies occur as internal subsidies (such as the corporate subsidy given to PuR by P&G in exchange for other benefits. See Section 4.3.6 for fuller discussion), or external subsidies (CDC is a US federal agency, and is consequently supported by US taxpayers; Potters for Peace and SODIS received programmatic support from individual donations or as part of a funded development project). They can be provided to the consumer (coupons with which to purchase a POU product), or to the organization which supplies the system. In some cases, subsidies were targeted specifically at certain aspects of a project's operations, subsidizing, for example, marketing expenditures, while demanding full cost recovery from production and distribution (R2).

This reliance upon subsidies is reflected in the wider literature. One recent study in Nepal, for example, concluded that:

[10] The analyst interviewed covers Procter & Gamble for a Wall Street financial institution, and spoke to the researcher by phone on August 19, 2005. The analyst elected to make comments anonymously.

> *We believe that ABF (arsenic biosand filters) cannot be distributed sustainably without subsidy support… the full cost of these filters cannot be recovered from villagers in the near to medium-term (Yildizbayrak et al 2004).*

This study concluded that a subsidy amounting to nearly one-third of the product's purchase price would be required for the filters to be adopted within a community. The sustained uptake of POU products is thought to be dependent on the continuation of the subsidies received (R6).

> *If the funding [programmatic funding received] was to dry up, SODIS would not be there anymore (R4).*

> *What happens if the subsidies dry up? The same as with condoms. There'll be condom companies that will close down and they'll have to close the factories... if the government doesn't keep subsidizing your potable water systems, you won't have them (R3).*

While helping to promote a product's initial adoption, subsidies can also threaten a product's continued use. Targeted subsidies, whereby use among certain communities is subsidized in order to foster use, can undercut the market elsewhere (R2). Misdirected subsidies can be ineffective: "there is overwhelming evidence.... that large and untargeted subsides are captured not by the necessarily poor segment, but by the "relatively" poor one that is financially stable and not in need of financial support" (Serafini 2005). PSI found price discrimination, whereby the cost of a product is determined by the consumer's ability to pay, difficult to implement (R10). Designing subsidies to have the desired impact is difficult: determining the proper amount of subsidy is a data intensive

process, requiring expensive data, little of which exists at this time for many of the communities in which POU systems are relevant (Serafini 2005, Yildizbayrak *et al* 2004).

Products provided at no cost are rarely valued equally as products which have been purchased. Even if the product is valued, those to whom a product is given initially may not be able to afford its subsequent purchase (R3). A consensus of respondents (R2, R3, R8, R10) thought that if consumers pay a certain amount for a product, even when that amount represents a fraction of the real value of the product, it increases the chance that the product will be valued, that required upkeep and maintenance will be carried out, and that usage will be sustained. Furthermore, deriving some income from a product's sale allows for a commercial distribution structure, which is an effective mechanism by which to distribute POU products in far-flung or marginal areas (R10). Similarly, evidence suggests that consumers who have purchased a product once have a greater chance of continuing to purchase the product in the future (R3).

4.1.3. Sustained Use

In spite of their demonstrated effectiveness, achieving sustained use—and ensuring that POU products receive required upkeep and maintenance—has been a great challenge for POU products and the projects which promote them. POU products are frequently distributed as a part of corporate philanthropy programs, or disaster relief and development projects. Achieving sustained use, however, is a challenge for each. While PuR failed to achieve commercial success, it is currently being supplied in various

markets as part of P&G's corporate philanthropy program (see Section 4.3.6 for a fuller discussion). However, this requires the continued support and goodwill of senior management, and a measurement of viability that values contributions other than profit (R1). Disaster relief and development based projects encounter similar problems in promoting sustained use:

> *The role of [disaster relief organizations] is to go in, do the band-aid work and get out. So they go in, distribute filters and then leave. I can't ask [them] to go back to see how many people are still using them, ask if they did any promotion, or follow up to see if the filter is still being used. That wouldn't be their objective (R3).*

Similarly, development-based projects are dependent upon continued funding; consequently, the threat exists that POU use generated by these programs will not be sustained once the program ends. A further difficultly is presented by development projects which budget for the initial purchase of a POU device, but not for the support required to perform required upkeep and maintenance, such as the purchase of a replacement filter. Re-purchase rates and upkeep levels of products originally secured via a development project are low (R3, R2, R6). These failures to achieve sustained use have proved frustrating for industry professionals.

> *[Once program funding ended,] the whole project went down the drain. About five years ago, I began to hit with my head against the wall and said "I just can't think—we have a great technology, the filter works, why is it always failing once it goes into the hands of the NGOs?" (R3).*

Promoting continued use of POU projects is providing challenging to policy makers; a range of World Bank grants and projects have been developed in recent years with the aim of promoting sustained use of POU systems (Serafini 2005, Yildizbayrak *et al* 2004). With consumers responsible for the purchase and continued use of POU products, commercial viability provides a new opportunity for enabling the sustained use of POU products. While PuR was being promoted through a purely commercial approach;

> *Many of us watched what P&G were doing with great interest. While they were taking a different approach than what public health professionals had tried in the past, many of us hoped they would succeed. Because what happens with other projects is that they run out of funding, and then the project stops (R6).*

4.2. Obstacles to achieving commercial viability

The previous sections discuss the difficulties that a selection of POU products has encountered in reaching commercial viability. The following section will highlight five key areas in which obstacles have been encountered.

4.2.1. Access and Usage

Accessing potential customers for POU products presents numerous challenges. The most easily accessible customer groups—"the low hanging fruit"—have already been targeted, leaving much of the remaining potential market in commercially marginal or difficult to access areas (R2). These communities are frequently hard—and expensive—to reach. Basic failures of logistical and road networks frequently hamper distribution. In areas with irregular rain patterns, areas frequently in need of POU solutions, distribution challenges can become insurmountable. In some areas during the rainy

season, large portions of the population can be cut off for a period of months. War and civil unrest occasionally provide more extreme, though less regular, obstacles to distribution networks (R2).

Accessing remote populations forces producers either into expensive investments in their own distribution networks (a prohibitive expense in the short term—R5), or partnerships with organizations that may not share the same organizational motivations, mainly NGOs. Accessing rural communities, particularly those outside the cash economy, usually requires the assistance of a well-connected local NGO (R2). The time required of building working relationships with NGOs and other local organizations can be frustrating to POU producers (R1).

Challenges are also encountered in ensuring POU products' effectiveness. In order to deal with the robust challenges of the areas in which they are used, the design requirements for successful POU products can be demanding. There is the need for POU products to be, among others, affordable, robust, simple to use, require no power, and to be effective with highly polluted input water. Failure in any of these areas can lead to non-use. Excessive product complexity, for example, leads to a decline in adoption rates (R7, R8). Fulfilling all these objectives is difficult, and can involve tradeoffs (R2). Certain products emphasize some aspects at the expense of others. Occasionally, expectations for a product's performance exceed its capabilities (R3).

Table 4 summarizes some of the perceived advantages and disadvantages of the products reviewed based on the input of interviewees.

Table 4: Perceived advantages and disadvantages of products reviewed

Product	Advantages	Disadvantages
Biosand Filter	• Local production • Fast treatment rate • Long life span	• Takes time before effective filtration is achieved • Heavy, difficult to move
Ceramic Filter: Potters for Peace	• Low per unit cost of water filtered • Long life span	• Fragile • Burdensome initial expense • Slow treatment rate • Unattractive design
Fairey Ceramics	• Simple: use requires no expert knowledge	• Slow treatment rate
PuR	• Low up-front cost • Single sachet design: no long-term purchase commitment	• Preparation process perceived as complex • High per unit cost
Pureit	• Per unit price comparable with boiling • Attractive design	• Burdensome initial expense
Safe Water System	• Produced with locally available supplies • High levels of adoption[11]	• Chemical taste and smell of treated water
SODIS	• Uses locally available bottles and sunlight • Inexpensive	• Many bottles required • Bottles can be hard to find • Time consuming • Ineffective on turbid or heavily contaminated water

[11] 12 million units sold in over 13 countries. Source: http://www.cdc.gov/safewater/about_pages/about_know.htm. Accessed 8.30.2005.

Furthermore, the usage of POU products depends upon a range of factors not related to the products themselves. In one case, the plastic receptacle required of the product made up the majority of the product's price, and has been responsible for all of the product's recent price increases (R3). It can be difficult to pinpoint the path of transmission for disease, where, for example, poor sanitation practices are responsible for infection rather than the consumed water supply. In these cases, measuring the effectiveness of a POU intervention is difficult. Furthermore, the effectiveness of POU products is dependent to varying degrees on proper usage.

> *The main problem with the filter is not with the filter itself, it's re-contamination. The filter is working in the field but if the users do not wash up the plastic receptacle correctly, then it can start with contaminated water. Of course, even if you filter the water more, the contaminated water will have a residual effect, causing water tests to come back contaminated (R3).*

4.2.2. Awareness and Promotion

One of the fundamental factors impeding the uptake of POU systems is the lack of awareness within low-income households about contaminated water and its health impact.

> *To make the filters, the technical part, is relatively easy. To get the awareness and promotion side right, to get people to buy them is, very expensive and makes us beat our heads against the wall once more (R3).*

> *I've interviewed women in Latin America, Asia and Africa, very young women with young children, and I ask them if their babies have diarrhea. They just look*

> *at me weird and say "Of course they have diarrhea." And I say "do your babies always have diarrhea?" and they say "Yeah, well babies are babies and babies are supposed to have diarrhea." So the concept of babies having a hard bowel movement just doesn't go into the head. It's normal that babies have diarrhea, it's normal that babies have fever (R3).*

Designing promotion campaigns to build awareness within these communities is challenging. Respondents referred to two stages of the promotion process: generic and branded messages. Generic messages indicate the importance of safe water; branded messages promote a specific product or system (R2, R10). While issues related to generic messages will form the basis of this section, some issues can also be applied to branded messages. Even in areas where there is a basic awareness of the importance of water quality,

> *It is rare to be able to connect the dots all the way to "I understand that my drinking water is making my child sick, and therefore I have taken an action to treat my water." So even though there is a huge public health need of people who need to treat their water, their understanding of that, and translating it into an action by people, is pretty small. It gets even smaller when you say "of the actions they're taking, are they effective from a public health standpoint?" (R1).*

Many products are being marketed in communities which have never encountered a water treatment practice before; in these situations, marketing efforts cannot build on what has gone before, they need to build awareness from scratch (R5). Building awareness is hard, expensive, and requires a sustained message (R4). Many programs seeking to change water habits have targeted women as the caretakers of household water supply (e.g.

Serafini 2005). However, when it comes to spending decisions, frequently men carry a veto. Thus these programs, the main targets of which were women, may have been effective at generating awareness, but have been less effective at generating a purchase of POU products (R2, R7).

The levels of existing awareness encountered within a community can exert significant influence on the outcome of a project.

> *Demand generation is much easier because the population is primed, and that's really the issue. If there is awareness in the population, they recognize the need a lot sooner (R2).*

These challenges are exacerbated when the awareness campaigns promoting POU systems contradict traditional knowledge and perceptions. In some areas, POU systems are thought to be too simple to be effective; in other areas, uptake is impeded by traditional assumptions. In Bolivia, for example, some perceive diarrhea to be caused if a dead dog is seen by the side of the road (R4). A frequent response provided by skeptical users is summarized thus:

> *"Yes, I understand that kids get sick with diarrhea. Well, that's a part of life, you know, that's what kids are supposed to do" (R1).*

> *"We have drunk this water for generations and we're still alive" (R3).*

Often communities perceive treated water to be bad. In one case, chlorine has a perceived association with cancer, and in Kenya, it was thought to cause sterility (R2).

Other communities perceive untreated water to be good. In one area, water available at certain times of the year was perceived to be safe; in Kenya rain water is thought to be blessed by God, and therefore, treatment during the rainy season is resisted (R2). Another perception is that clear water is safe. This is a particular problem in urban areas where water may be clear, but contains increasing levels of harmful contaminants (R1).

Overcoming perceptions can be particularly difficult when opposing messages were—and sometimes still are—promoted by government. In order to promote groundwater usage in the past, for example, some governments promoted it as a contamination free resource. In places where groundwater quality levels have deteriorated, it now poses a health threat. While POU systems could be useful in alleviating health impacts from compromised groundwater resources, some governments have resisted revising their message (R4).

Compounding these challenges is the fact that developing effective promotion campaigns has proved difficult. While community based efforts—led by local people with a sustained presence—have proven effective in promoting use in limited regions, such strategies are difficult to roll out on a national or regional level. Furthermore, calling upon mass channels, such as television, has been ineffective at replicating the success of intensive person-to-person community based efforts (R1). Furthermore, the costs of large-scale promotion campaigns often make a mockery of POU program budgets (R3, R5).

4.2.3. Cost and Customer Base

In spite of Prahalad's optimism, marketing to consumers at the bottom of the pyramid remains a difficult proposition. Unlike wealthier consumers, who are able to "inventory convenience" (Prahalad 2005) by purchasing goods needed over a period of time at once, lower income consumers are often forced to purchase items as they need them, with the money available at that time. Thus, POU products are competing against, and often losing out to, other items of household necessity or convenience (R3).

> *People are making this decision between food, soap, point of use water treatments and cigarettes. And they're going to make those decisions based on their family income, and there's never going to be enough income at the bottom level to buy all the necessary products (R2).*

Repeat customers are rare, regular customers even rarer (R1), particularly if their introduction to POU systems came through a development project or other subsidized environment. POU consumers tend to be highly price elastic. Willingness to pay studies undertaken by PSI have indicated that demand rates drop quickly once the price of a POU system exceeds 1% of annual income (R2). Another recent study (Yildizbayrak *et al* 2004) found demand dropped when expenditures approached 0.3-0.4% of income, and that only wealthy households were willing to spend up to 1% of annual income. As a result, maintaining demand while maintaining a commercial approach in places where the cost of a product exceeds these willingness to pay levels is an ambitious goal.

> *If you're raising the price in pursuit of cost recovery, you may never reach maximum capacity because customers are going to drop like flies, you're not going to have the same demand (R2).*

This elasticity of demand limits the scope for product improvements, and curtails investments in design enhancements.

> *When engineers and universities want to help us, the first thing I say, 'Yes. Come help us. But if you are going to increase the price of the product, stay home, don't help us. We don't need your help. I can increase the price of the product by myself' (R3).*

Compounding these difficulties, global estimates of per capital daily water usage serve as poor predictors of actual demand and therefore potential sales volumes. POU products tend only to be used for "high quality uses," uses related to consumption and hygiene (R2). According to P&G:

> *[Of those using PuR] demand levels amounted only 10 to 20 liters per household per week. We worried how is that possible? Don't people drink the recommended two liters per day per person, and a household is from five to six people and therefore shouldn't they be using more? What we found is that this product and others like it are intended to prevent diarrhea and people who've become regular users figure that out that's why they're using the products... So they segment the use of the product that they're purchasing on a regular basis to people who are prone to getting diarrhea. For the young kids or people who have been sickly or perhaps people that they know have HIV AIDS, the vulnerables in the household. You expect people to use 20 liters per person per day. Well they don't. They only need two liters for drinking and that's if they're an adult (R1).*

Ensuring that POU products are affordable within low income communities also presents a challenge. Table 5 summarizes the cost of each of the products reviewed in this paper. In order to stimulate demand, some products seek to peg their price against a common everyday product. Potters for Peace, for example, sought to peg their product's price with that of a machete, used daily in the fields; P&G sought to peg PuR at the price of an egg; Pureit was priced similarly to the cost of boiling water (R3, R1, R9). Aspirational purchasing was also exhibited. Pureit, for example, found an unexpected following among lower income consumers, in spite of the product's US$30 initial purchase price, on account of the product's good looks and social cachet: "we found the product was moving out of the kitchen and into the hall, where a glass of water purified with it could greet visitors" (R9). However, these characteristics were not universally encountered. For the typical POU consumer, the CDC (R2) argues that having any price makes the product aspirational.

Table 5: Per liter cost of water for products reviewed

Product	Cost per liter in US cents	Cost notes
Biosand Filter	0.0018	Sells for between $10-30, flow rate 60 liters/hour. No replacement required. Assume 2 years of use. Assume $20 purchase price.
Ceramic Filter: Potters for Peace	0.0376	Filter costs $12, it can work continuously for 2 years, at a through-flow rate of 1.75 liters per hour.
Fairey Ceramics	n/a	n/a
Pureit	0.8000	$30 initial purchase cost, filtering unit costs $6 which treats 1500 liters. Assume unit used for 5 years.
PuR	0.8000	One sachet, costing between 3.5 and 10 US cents, treats 10 liters of water. Assume 8 cent purchase price.
Safe Water System	0.0030	1000 liters for 30 US cents
SODIS	Free	Depending on availability of requisite plastic bottles

An obstacle faced by POU systems as they have sought commercial viability is that the potential customer base is squeezed at either end by groups who will not use the product: at one end, the cashless; and at the other, the better off, who prefer to trade-up for the convenience of bottled water (R1, R2). For those at the cashless end, many projects have investigated the role of micro-finance in seeking to defray the purchase price of POU systems. But getting microfinance right is difficult and expensive (Serafini 2005). Coupons and other forms of targeted subsidies for high risk populations have also been pursued.

> *You've got to really stretch yourself with people who are outside or just outside the cash economy or they're not going to use this stuff. And we haven't really figured that out yet (R2).*

At the other end of the spectrum, global bottled water sales—or sachet water sold in a single-serving plastic bag as is more commonly found in certain lower income markets—are robust (Gleick 2004, R7), and major bottled water suppliers have been very effective at expanding their distribution networks into relatively cash poor markets (R6). POU suppliers are very interested in building a customer base in this more lucrative section of the lower income market, but so is Coca-Cola, against which POU producers cannot compete in marketing and promotion (R3).

Not all producers, however, consider the bottled water market as a threat. First, bottled water remains orders of magnitude more expensive than most of the products examined during this research (R9). Second, purchasing bottled water as a 'luxury' purchase need not indicate a consumer preference with regard to water used for ordinary drinking and cooking uses in the household (R7). Third, the drinking water sector is large enough to accommodate numerous purification approaches, including POU products, bottled water, as well as others (R9).

While a fortune may exist at the BOP in the POU sector, at the moment the expenditures required to tap it appear to exceed the value of the theoretical fortune.

> *Our investment to create that public health awareness was higher than the commercial return of the amount of product we're selling (R1).*
>
> *I think there may be a fortune in the market, but I think you might lose that fortune trying to get that product into every household (R2).*

4.2.4. Business Impediments

The characteristics encountered in many lower income markets in which POU products are marketed present a range of commercial challenges. Varying local tastes and customs prevent marketing and branding from being standardized across markets, thus impeding an organization's ability to capture production and distribution efficiencies (R2). Furthermore, changes in use patters prevent a POU producer from being able to rely upon a consistent income stream throughout the year. In one case, for example, high salve volume occurred during the rainy season, and much lower levels during the dry season, according to the consumers' perceived risk (R2).

Local production of POU systems or components, another potential area in which to trim business expenditures, also presents a range of challenges. Serious questions can be raised about the quality of locally produced goods, and the ability for quality to be monitored and standardized, especially for such a health sensitive intervention. Furthermore, ensuring quality may cause the costs associated with local production to become prohibitive (R1, R2). For some manufacturers, local production represents a Catch-22 situation: the product generates insufficient demand to warrant local production, but it is difficult to bring down the product's cost to affordable levels, which may be a prerequisite of sparking demand, without local production (R5).

Finally, the timeframes associated with investments in POU markets are not conducive to a commercial approach. On account of their "commercial approach, and the need to quickly show a payout" (R1), P&G found that fitting in the time required for "obtaining

government approvals, gaining the trust of the local NGOs, and fitting in with their priorities" proved difficult.

> *The issue of time frames and a multi-national rollout time frame and investment pattern to get adequate return on investments versus the way the governments and the public health sector thinks are vastly different [to that of a corporation] and it creates a real challenge (R1).*

4.2.5. Political and Administrative Obstacles

A final area impeding the commercialization of POU systems involves political and administrative obstacles. Water issues are at times managed by numerous government agencies, with responsibility spread between units associated with health, public works, and water itself. Therefore, decision making can be fragmented and inefficient (R10). In spite of the high health impact of waterborne diseases, other more high-profile diseases and like HIV and cancer often receive greater attention and support (R3). Furthermore, the selection of POU interventions can become influenced by political and financial considerations. One respondent found that, in one case, the decision process for the selection of a POU product in a health intervention was influenced by a cash donation. In other cases, institutional biases, rather than an objective examination of the suitability of products, are perceived to have influenced product selection:

> *[Organization X] is focused on chlorine and they won't budge; they don't want to know about filters, they don't want to know about solar disinfection, they don't want to know about any other product. But of course if you have a lot of money to promote the filter, then they'll do it... the money is oriented toward chlorine. The first world*

solution to contaminated water is chlorine and that's what they want. And this won't change until the big funding can come along to change it (quote unattributed).

4.3. Emerging Solutions

The previous sections demonstrated the failure of a purely commercial approach to diffuse certain POU systems, and reviewed some of the obstacles faced by these products as they have sought commercial sustainability, based on interviews with key industry experts. These interviews, however, also identified factors that have helped these products become commercially sustainable to some degree, as well as best practices and emerging solutions that can assist as products seek to establish a commercial foundation in the future. These factors are summarized below.

4.3.1. Refine and improve product positioning

In order for POU products to achieve commercial viability, both the generic and branded messages which promote them must continue to reach the right audience in an effective manner. An effective, well understood, and sustained health message is an important determinant of use (R1). Product demonstrations to potential users, where possible by a trusted member of the community, are critical to the effective diffusion of health messages. The visual clue provided by on the spot demonstrations, where POU systems visually improve the quality of source water, is important to building awareness (R1, R3, R4).

However, promotion campaigns "can't be all about the magic show. They also need to be backed up by an understanding about the health of the children" (R1). New pathways

for the dissemination of key health messages need to be investigated and tried. Quick and Lantagne (R2) suggest working with umbrella NGOs as a means to broadcasting health messages as widely as possible.

Another key area in which POU products need to refine the focus of their health message concerns the traditional marketing to women. A substantial literature establishes women as the caretakers of domestic water supply in developing countries (e.g. Serafini 2005). Evidence gathered during this research backs up this conclusion (R1, R2, R4, R7). Women clearly play an important role ensuring safe water practices, and efforts should continue to effectively disseminate messages among them. Women's organizations, for example, should continue to be a key target for health messages (R4).

> *I think the worst marketing I have ever seen for our product is at a soccer game with teenage boys and little kids running around, and no women in the entire group. Some of the best marketing I've seen is the wraps that women wear around their waist with chlorine product branding on it, and baby clothes with the chlorine product branding on it (R2).*

However, while women are almost exclusively the collectors and managers household water, they are not exclusively the deciders of who spends the income in the household (R2, R7).

> *So we reach out to the men as well, but more often in the decision making capacity on the purchase of the product. That's becoming a general factor in many public health programs now, that you have to get the buy-in from the men,*

> *because they often are the ones who have to be convinced about purchasing the product (R2).*

As POU products continue to seek out a commercial foothold in communities, an approach which targets both men and women will be essential. In many cases, these initiatives will be targeting male members of the household for the first time.

4.3.2. Leverage existing health awareness

One of the major obstacles impeding the adoption of POU systems is the difficulty and expense associated with generating awareness. Awareness and promotional campaigns are critical to the success of projects with a POU component (Serafini 2005). However, leaving the costs of such campaigns up to an individual product, and wrapping these costs into the budget of a POU promotion project, eliminates the potential for commercial sustainability. Existing health awareness should therefore be leveraged, and to the extent possible, government should be persuaded to support awareness creation. It needs to be kept in mind, however, that governments often lack the financial capabilities to generate this kind of message effectively (R6). While blurring the line between commercial and developmental goals, harnessing the government as a promoter of health messages makes intuitive sense.

> *[Given the health outcomes of POU projects], it's only right that the public sector also contributes, as well as other types of donors... Furthermore, the private sector's not going to be that great at promotion because they don't have the public health competency to provide those messages at a local level in a sustained manner (R1).*

Rivera (R3) argues that the diffusion of HIV medication and condoms is benefited by such a government-led promotion campaign, and that the public health outcome of the adoption of POU systems justifies a similar government involvement. Quick and Lantagne (R2) use the example of soap. Soap no longer needs to be marketed. People understand that they need it, and purchase it accordingly. While promotion may still take place at the branded level, it no longer needs to take place at the generic level (Section 4.2.2).

A promising strategy, therefore, is to leverage existing health messages—position POU products to capitalize on health messages which a third party, usually government, already supports. In India, for example, boiling is a widespread technique used to purify tap water. There is a general cultural awareness of the need for boiling drinking water (R6), a message which is reinforced by disasters such as the recent tsunami and floods in Mumbai (R9). Hindustan Lever, therefore, has positioned Pureit to be "as safe as boiled water," providing water as safely and as inexpensively as does boiling. Boiling, however, has disadvantages which the product does not: it is perceived as time-consuming and as an inconvenience. Therefore, as the government has already made the case that water needs to be treated, Pureit leverages this by positioning itself as an improvement on a process which many households already undertake. Pureit's marketing is still in a trial stage, and it is therefore too early to draw conclusions on its commercial performance, but such a strategy could be useful for POU systems in the future (R6, R9, Nadakatti 2005).

4.3.3. Offer a smorgasbord of options

Promotion and demand generation are critical components of successful POU campaigns. They are also expensive, and constitute an area in which POU projects have traditionally underperformed. Successful promotion campaigns need to be sufficiently well supported that an adequate message can be diffused effectively over a sustained period, usually through expensive community based promotion methods. Furthermore, an array of concurrent individual product promotion campaigns, each trying to alter behavior and demonstrate the importance of safe drinking water, would appear to be inefficient.

With this in mind, a recent recommendation emerging from the Network is to consolidate promotion efforts for several products behind a single initiative, and allow consumers to choose between the various interventions according to their needs (R7).

> *The final goal is not to have many households using SODIS, but households with safe drinking water and hygiene. That's the ultimate issue. In Bangkok, I was comparing the strategy we have used so far with the sandwich. We were sandwich providers; some of us were providing bread, others ham, others salads or cheese, all over in Asia, Africa and Latin America. But it doesn't make much sense if you have only ham and you have vegetarians as a target population. So the aim is to have all the methods presented to the target population, and the population can then choose which of the point-of-use water treatment methods they would like to apply to use. And that's now the new strategy (R4).*

Such an approach could realize efficiencies of marketing and promotion, involve the public more closely in their own health decisions, thereby increasing their participation

and consequently chances for continued use. It would emphasize a target population's control and responsibility for the quality of their own drinking water, and remove the perception of a salesman peddling his wares, replacing it with the disinterested message of a health professional. This approach is currently moving ahead on a trial basis in Ghana (R7, R3), and in Ecuador (R4, R7).

However, such an approach has disadvantages, one of which is the excessive expense of promoting too broad a smorgasbord or products. A more suitable approach, therefore, could be to offer the two to three best products to consumers rather than a more expanded selection (R10). Offering a wider selection may furthermore overwhelm a consumer's ability to make an informed decision.

4.3.4. Adapt business practices

Neither the fully commercial nor the fully subsidized model has been successful at achieving widespread adoption of POU systems. In order for POU products to be successfully diffused, lessons must be drawn from both the subsidized and the commercial ends of the spectrum.

A hybrid approach shows some promise. PSI has spearheaded such an approach, promoting CDC's Safe Water System (SWS), and more recently PuR, in a variety of low income settings. Using an approach which they label 'social marketing,' a component of the cost of a POU product is recovered from the consumer. The gap between actual costs and recovered costs is made up for through donor funds, either from PSI itself, or from an

outside donor like the US Agency for International Development (USAID). Frequently, costs associated with production are recoverable. However, costs associated with marketing and promotion are rarely recoverable. A recent preliminary study has indicated that PSI projects around the world are currently able to recover 40-150% of the production costs associated with the SWS system. Should donor funds be found to consistently support costs which consumers appear unable to bear, such an approach shows tremendous promise. In Zambia, for example, a recent survey demonstrated that 40% of respondents have used SWS at some point. However, though 'the whole world right now seems to be emphasizing safe water,' donor funds have yet to be attracted at a level commensurate with the potential impact of POU interventions (R10).

First, NGOs and other organizations which promote the use of POU systems in a subsidized environment must internalize commercial strategies and planning procedures (Chasse *et al* 2005). While many of the more promising markets have already been tapped, the selection process by which potential markets are chosen and prioritized could be improved considerably. Three main factors which could pre-determine the success of POU interventions emerged from the interviews.

1) **Extent to which awareness of product already exists**: for example, HLL marketing Pureit in India, where the government already promotes water boiling, will have more success than a product promoted in a region with no pre-existing awareness (R6, R9). Inhabitants of areas susceptible to floods, hurricanes, or other natural disasters which affect the quality of the available

drinking water also tend to have higher levels of awareness of the need to treat water (R10).

2) **Extent to which society is culturally used to treating household water**: candle filters have a long history of use in India. POU products able to capitalize on this familiarity will have a better chance of success than in areas with no history of water treatment (R3).
3) **Extent to which conditions are suitable for treatment**: SODIS, for example, requires plastic bottles and sunlight, and has the greatest impact where water quality is poor, and diarrhea incidences are high. Its use, therefore, has a greater chance of success in areas with these characteristics (R4). POU products have greater levels of adoption when the quality of water available is perceived to be worse, one of the reasons behind HLL's decision to launch Pureit in Chennai (R9).

Strategies to systematize and prioritize market selection should be embraced. Yildizbayrak *et al* (2004) propose a four-factor set of criteria by which markets could be prioritized, based on market size, disposable income per household, awareness, and impact. Nor do only the NGOs need to improve performance here. P&G selected their initial markets for PuR based not on facilitating market conditions, but on where P&G had existing distribution infrastructure (R1). Its commercial prospects could have been improved in different markets.

Second, corporations and other organizations using a purely commercial approach should modify their activities to suit the complexities of the markets in which POU products are sold. Successful diffusion of POU products in lower income settings involves a range of stakeholders with which developed world corporations are unaccustomed to cooperating. Corporations need to grow accustomed to moving on NGO timescales, "building trust and taking the time to develop local relationships" (R1). Replicating the reach of schools, health workers, and NGOs would be difficult and costly for a corporation. Corporations must learn to work seamlessly with these stakeholder groups.

The timescale on which commercial success is expected must also be rationalized.

> *You just can't spend yourself into such a hole in the first year or two, you have to have funds available to slowly build a commercial foundation (R1).*

Some of the approaches developed in higher income settings need to be set aside. Mass media channels, such as television, may prove ineffective at promoting more widespread adoption. A profusion of smaller, community-driven promotion campaigns may prove more effective. Longer investments need to be made into POU product campaigns, with lower rates of return demanded from these investments. Corporations need to "spend behind" an initiative instead of "in front": making modest investments up front, and spending more as the project grows. Perhaps these criteria make it difficult for major corporations—with their emphasis on growth—to succeed in this market. Instead, smaller, more nimble corporations, having absorbed the lessons provided by the non-

commercial market participants, may be the ones to succeed in achieving commercial viability for POU products in low income settings (R1).

4.3.5. Find alternative models of viability

In order for the commercial approach to succeed, it may be necessary—at least initially—to lessen the requirement that all costs be recovered from consumers for the entire product cycle (including production, promotion, and distribution) in order for commercial viability to be achieved. Even if commercial viability remains elusive for certain aspects of the product cycle, including promotion and production, the commercial approach may nevertheless still play a role in the retail and distribution phases of the product's diffusion (R1, R4). Other promising strategies for investigating commercial viability without a rigid emphasis on full cost recovery include models in which subsidies are acknowledged, allowed for, and woven into an otherwise commercial approach (Yildizbayrak *et al* 2004), or models in which viability is more clearly understood by a more accurate assessment of the costs and benefits of a POU intervention (Serafini 2005).

Another promising model for measuring the viability of POU interventions involves what Allgood (R1) terms "non-traditional commercial viability." Organizations, including corporations, may derive value from the production of POU products beyond mere profitability. PuR, for example, serves as P&G's "focal corporate philanthropy program," leading to corporate reputation building.

> *But even more important than that is the engagement we're having with our employees on [the PuR program]. It's phenomenal, and it's providing greater*

> *dividends than we had imagined in that regard... We're going to send employees out in the future to work on the ground and on sabbaticals or before they join P&G to participate in the program directly. And we've already seen that some people are going to be joining P&G in Western Europe and they've said, "You know a qualified person wouldn't have looked at P&G if it wasn't for this program. But, now I'm going to do this program and then I'm going to join P&G. Because I see that you guys are walking the talk when it comes to improving people's lives" (R1).*

Indeed, Allgood argues that transforming PuR into a profit-generating product at this point could be counterproductive: "the payoff may be bigger for us in not converting; it might get in the way, for it to make money." The sustainability of these practices, however, can be called into question by the anecdotal methods by which they are measured and assessed, lacking therefore quantifiable measures by which to back up their impact (R1). Other benefits can be derived for a corporation by continuing with a loss-making product. The process of innovating for BOP markets may stir up a system of innovation whose benefits will be felt throughout the company (Prahalad 2005). Furthermore, these products may help corporations develop a foothold in strategic markets: "developing world markets is a growth strategy for P&G, and PuR helps them to establish a foothold in these markets[12]."

4.3.6. Focus on key product improvements

As POU products are refined and improved, the example of a range of comparable products—products with a public health impact whose diffusion may have been benefited

[12] The analyst whose opinion this is covers Procter & Gamble for a Wall Street financial institution, and spoke to the researcher by phone on August 19, 2005. The analyst elected to make comments anonymously.

by a commercial apparatus—will prove useful. The example of HIV medication and condoms were frequently cited by respondents (R3, R2). In these cases, the social marketing approach has encountered some success; government and/or development organizations have helped to create awareness and demand, and private producers and suppliers have diffused the product. Another example cited was bed-nets.

> *There's huge debate within the bed-net community on how to better diffuse the product. They get distributed for free, they get distributed at incredibly low costs like 5 cents in Maternal and Child Health clinics, they get distributed with coupons, they get distributed for more cost recovery in the market, like for a dollar a piece, and they get distributed for full cost. And often there's double, even triplicate branding where you end up with an unbranded product that gets distributed through the Maternal and Child Health Clinics, and then a branded product that gets distributed through the supermarkets and stores. There's a lot of market and product differentiation within the bed-net community. And I think that we haven't done that as much with water yet. There are a lot of places we could go with that (R2).*

Product differentiation was frequently cited as a promising strategy to diffuse the products among varying social groups without altering the microbiological effectiveness of the products. CDC (R2) envisions having a generic product for the lowest income groups, and a fancier, branded product, with a higher aspirational price, for groups with more disposable income. Potters for Peace has also tried three different outer casings, each carrying an identical filter, to appeal to three different price groups. The cheapest one is housed in plastic; the most expensive is housed in clay and painted glaze. However, demand for the upper-end product has to date been insignificant (R3).

The design of POU products should continue to evolve to overcome flaws that have and will be discovered in existing POU systems, and to meet the emerging needs of consumer. A range of product flaws among the seven products reviewed, and solutions proposed to ameliorate them, is described in Table 6.

Table 6: Perceived flaws and proposed mitigations

Perceived flaw	Proposed mitigation	Source
Chemical taste and smell	Flavor and fragrance company developing flavor masking technology.	R2
Detritus of plastic bottles	Develop and distribute reusable plastic bottles.	R4
Unappealing appearance: "the only bad thing about appropriate technology is that it's ugly" (R3)	Bring in craft designer to increase visual appeal.	R3
Inability to track and follow up on product use	Provide each filter with a unique serial tracking number.	R3
Cost and adoption	Adapt POU technologies to work with locally available and produced, widely used storage vessels. POU systems could be mounted at the spigot, thus filtering water as it is poured, or be designed to purify the capacity of these vessels.	R7, R3

However, other respondents believe that a continued emphasis upon product research and development deflects precious resources away from the most pressing challenge facing POU operations: product diffusion. This line of argument contends that a sufficient range of products already exists to suit most market conditions that will be encountered. The finite amount of resources available to POU products, therefore, could be better spent tackling demand creation and promoting sustainable micro-business distribution models rather continued new product development and product improvement (R8, R10).

5. CONCLUSION

Ensuring potable water supply has proved a significant challenge in many parts of the world. This challenge is sharpened by the large health consequences implicit of a failure to address the challenge. Lower income areas bear the greatest share of the health consequences of inadequate water supply. POU systems are being put forward as a useful strategy in providing potable water supply in these areas. Furthermore, the commercial approach is being used to promote these products' dissemination and adoption there.

In spite of the promise for these systems, and the promise of commercial viability in aiding their diffusion, this paper has found that the seven POU systems reviewed have thus far failed to achieve commercial viability. In places, partial cost recovery has been achieved; nowhere have POU systems presented a viable business opportunity in a non-subsidized environment. Five key reasons for this failure were identified: first, access and usage—getting a useful product to consumers and ensuring its correct usage; second, awareness and promotion—developing awareness of the products' usefulness and making the case for their purchase; third, cost and consumer base—ensuring that the products are affordable, especially in light of the spending habits of the target population; fourth, business impediments—characteristics of the products and the markets in which they are sold which prevent normal business efficiencies from being realized; and fifth, political and administrative obstacles—difficulties in organizing the political will and administrative focus to support their adoption.

In light of the products' attempts to achieve more widespread rates of adoption using a commercial approach, two schools of thought were reviewed: the commercial opportunity of a lower income setting embodied by Prahalad's conception of the Fortune at the Bottom of the Pyramid (BOP), and the process of innovation adoption embodied by Rogers' model for the Diffusion of Innovations (DOI). These models emphasize the potential for the uptake of a useful innovation by a target population, and for a commercial approach in driving their adoption. Each highlights the particular challenges of succeeding in lower income environments, and lays out product and process criteria which may benefit, or may be essential for, the products' uptake and continued use.

The examination of POU systems in light of the more general literature of innovation adoption and commercial opportunities in lower income settings, and the testimony of interviewees, raises several interesting areas for further research. The willingness to pay of, and price elasticity of demand for, target populations needs to be better understood. The cost-effectiveness of POU interventions needs to be more clearly demonstrated, and barriers to long term adoption more robustly investigated and understood. Furthermore, a comprehensive assessment of the experiences of POU projects seeking commercial viability needs to be undertaken so that common experiences can be pooled, and best practices emerge. Many of these topics are currently being taken up by a broad cross-section of interested researchers. The field, however, is still in its infancy, and much remains to be done.

The commercial approach is not a panacea. First, given the failure of the POU products reviewed here to achieve commercial viability in the past, it is speculative to think that they will do so in the future. Second, requiring a commercial return from these products can distract from the overriding public health goals of their use.

> *We're in this sector for public health reasons—we're trying to prevent disease and death. Unfortunately, the people who tend to be affected by disease and death are the ones with the least money. One of the annoying things about people demanding full cost recovery of these projects is that they're doing it on the backs of the very poor (R2).*

Third, commercial and public health ambitions can be contradictory. One organization reviewed had to be separated from its parent company in order to pursue its current humanitarian approach by which its POU product is offered; another organization suggests that its POU product be replaced once every two years in order to generate additional revenue for the manufacturer, in spite of empirical evidence that the product provides safe water for considerably longer (sources unattributed).

However, while this research went in search of obstacles, much of what it found was opportunities. Six factors that have helped POU projects approach commercial viability were highlighted, including refining and improving product positioning, leveraging existing health awareness, offering a smorgasbord of POU options, adapting business practices, finding alternative models of viability, and focusing on key product improvements. These factors may provide a useful list of emerging best practices against which POU projects seeking commercial viability in the future may consider their own

approach. Many of these factors had been discovered in the examination of BOP and DOI literature mentioned above. A more thorough review of these fields in light of POU projects' pursuit of commercial viability would therefore be useful.

The urgency of the water supply challenge facing lower income consumers presents the need for real, implementable, scalable, sustainable, high-impact interventions that can be rolled out in the near term. POU systems provide the opportunity for such an impact, an impact that can be felt using existing water supply, without waiting for the arrival of piped, potable water infrastructure. Many respondents asserted their belief that commercial viability is not only possible, it is essential to successful diffusion of POU systems (R6, R7).

> *For health interventions to be sustainable on a large scale, they need to be financially viable (R10).*

They believe that the appropriateness of POU solutions to the global drinking water challenge has been realized by policy makers, and that this will soon be reflected in their widespread promotion and adoption. As with any young market, the early commercial entrants have paved the way for an improved, more successful, second generation (R7). A 'tipping point' is envisioned: with demand created, and viable distribution channels established, the diffusion of POU products could become self-executing, similar to mobile phones, televisions, cooking stove oil, sachet shampoo, or other commercial products which have made an impact in lower income markets (R6). POU products have not yet achieved these lofty ambitions. Should they do so, however, they have the

opportunity to radically change the paradigm for the provision of potable water in lower income settings.

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7. BIBLIOGRAPHY

Ahammed MM and Chaudhuri M (1999). A low-cost home water filter. *J Water SRT—Aqua*. Vol 48 No 6 pp 263-267.

Armstrong D and Karmali N (2005). Trickle-Up Economics. *Forbes*. June 20, 2005.

Baletti A and Raymond P (2005). *Financing Water Supply and Sanitation Investments: Utilizing Risk Mitigation Instruments to Bridge the Financing Gap*. The World Bank, Washington DC.

Bernard HR (1995). *Research methods in anthropology: qualitative and quantitative approaches*, AltaMira Press, Walnut Creek, CA.

Brown C and Holcombe A (2004). In pursuit of the millennium development goals in water and sanitation. *Water Policy*. Vol 6 pp 263-266.

Brown, J (2003). *Evaluation of point-of-use microfiltration for drinking water treatment in rural Bolivia.* Master of Philosophy in Environment and Development. Department of Geography, University of Cambridge.

Bucklin LP and Sengupta S (1993). The Co-Diffusion of Complementary Innovations: Supermarket Scanners and UPC Symbols. *Journal of Product Innovation Management*. Vol 10 (2), 148-160.

Cairncross S and Valdmanis V (2004). *Water Supply, Sanitation, and Hygiene Promotion*. Disease Control Priorities Project. Working Paper No. 28, July 2004.

Camdessus M and Winpenny J (2003). *Financing Water For All. Report of the World Panel on Financing Water Infrastructure*. World Water Council.

Carpenter, G. (2003). Making markets work for clean water. *Water Science and Technology*. Vol 47 No 6 pp 97-102.

Chasse M, Gibney J, Greenblatt R and Sluder E (2005). *Kenya G-LAB team final project: Developing a sales and training plan in Nyanza Province, Kenya*. March 11, 2005. http://mit.edu/watsan/Docs/Student%20Reports/Kenya/GLAB%20Final%20Reports%20&%20Presentations.zip Accessed August 19, 2005.

Clasen T (2005). *Cost-effectiveness analysis of POU products*. WHO. Forthcoming.

Clasen TF and Bastable A (2003). Faecal contamination of drinking water during collection and household storage: the need to extend protection to the point of use. *Journal of Water and Health*. 01.3.

Clasen TF and Cairncross S (2004). Household water management: refining the dominant paradigm. *Tropical Medicine and International Health*. Vol 9 No 2 pp 187-191. February 2004.

Crump JA, Okoth GO, Slutsker L, Ogoja DO, Keswick BH and Luby SP (2004). Effect of point-of-use disinfection, flocculation and combined flocculation—disinfection on

drinking water quality in western Kenya. *Journal of Applied Microbiology*. Vol 97 pp225-231.

Dawar N and Chattopadhyay A (2002). Rethinking marketing programs for emerging markets. *Long Range Planning*. 35 pp 457-474.

Dawar N and Frost T (1999). Competing with giants: Survival strategies for local companies in emerging markets. *Harvard Business Review*, pp119-129. March-April 1999.

De Koning HW, Smith KR and Last JM (1985). Biomass fuel combustion and health. *Bulletin of the World Health Organization*. 63 (1): 11-26.

Dearing JW, Rogers EM, Meyer G, Casey MK, Rao N, Campo S and Henderson GM (1996). Social marketing and diffusion-based strategies for communicating with unique populations: HIV prevention in San Francisco. *Health Communication International*. Vol 1 No 4 pp 343-363.

Economist, The (2003). Private passions. 7/19/2003, Vol. 368 Issue 8333, p5.

Ellison S and Bellman E (2005). Clean Water, No Profit. *Wall Street Journal*. February 23, 2005.

Eloundou-Enyegue PM, Meekers D, Calves AE (2005). From awareness to adoption: The effect of aids education and condom social marketing on condom use in Tanzania (1993-1996). *Official Journal of the Biosocial Society*. 37, pp 257-268.

Esrey SA and Habicht JP (1986). Epidemiologic evidence for health benefits from improved water and sanitation in developing countries. *Epidemiol Rev.* Vol 8 pp 117-28.

Fewtrell L, Kaufmann RB, Kay D, Enanoria W, Haller L and Colford JM (2005). Water, sanitation, and hygiene interventions to reduce diarrhoea in less developed countries: a systematic review and meta-analysis. *The Lancet Infectious Diseases*, Vol 5, Issue 1, January 2005, pp 42-45.

Fichman RG and Kemerer CF (1999). The illusory diffusion of innovation: an examination of assimilation gaps. *Information Systems Research*, Vol. 10, Issue 3, pp. 255-275

Financing for Development Initiative (FfDI) (2005). *Financing for Development Initiative*; World Economic Forum. Development-driven public-private partnerships in water and sanitation: Practitioners' solutions. Second Roundtable, London, 10-11 May 2005.

Fitzgerald L, Ferlie E, Wood M and Hawkins C (2002). *'The Diffusion of Innovations in Health Care; the science in medicine'*, Occasional Paper 69, February 2002.

Fontana A and Frey JH (2000). *The interview: From structured questions to negotiated text*. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research (2nd ed.)*, pp. 645-672. Thousand Oaks, CA: Sage.

Gilman RH and Skillcorn P (1985). Boiling of drinking water: can a fuel-scarce community afford it? *Bulletin of the World Health Organization*. Vol 63 pp157-163.

Gleick PH, Wolff G, Chalecki EL, and Reyes R (2002). *The New Economy of Water: The Risks and Benefits of Globalization and Privatization of Fresh Water*. Pacific Institute, Oakland CA, February 2002.

Gleick, PH (2004). *The Myth and Reality of Bottled Water*. In *The World's Water: 2004-2005: The Biennial Report on Freshwater Resources*. Chicago, Island Press.

Goldblatt M (1999). Assessing the effective demand for improved water supplies in informal settlements: a willingness to pay survey in Vlakfontein and Finetown, Johannesburg. *Geoforum*. Vol 30, pp27-41.

Gonzalez ME, Quesada G and Bahill AT (2003). Improving product design using quality function deployment: The school furniture case in developing countries. *Quality Engineering*. Vol 16, No 1, pp 45-56.

Guarcello L, Lyon S and Rosati FC (2004). *Child labour and access to basic services: Evidence from fie countries. Understanding Children's Work Project (UCW)*. ILO-UNICEF. Draft: January 2004.

Gundry S, Wright J, and Conroy R (2004). A systematic review of the health outcomes related to household water quality in developing countries. *Journal of Water and Health*. Vol 02.01.

Hall D (2001). *Water in public hands: public sector water management—a necessary option.* Public Services International Research Unit (PSIRU), University of Greenwich. June 2001.

Hammond AL and Prahalad CK (2004). Selling to the poor. *Foreign Policy*. May-June 2004 pp 30-37.

Hart SL and Christensen CM (2002). The great leap: Driving innovation from the base of the pyramid. *MIT Sloan Management Review*. Fall 2002.

Heireli U (2000). *The market approach to development*. Swiss Centre for Development Co-operation in Technology and Management. Berne.

Herod A (1993) Gender issues in the use of interviewing as a research method. in a post apartheid research environment. *Research papers in Environmental and Spatial Analysis* No. 59, London School of Economics.

Hill JS and Still RR (1984). Adapting products to LDC tastes. *Harvard Business Review*. March-April 1984, pp 92-101.

Hutton G and Haller L (2004). *Evaluation of the Costs and Benefits of Water and Sanitation Improvements at the Global Level*. WHO, Geneva.

Inter-American Development Bank (IADB) (1980). *Identification And Evaluation Of Design Alternatives For A Low Cost Domestic Filter For Drinking Water: Evaluation of 10 filters worldwide*. Prepared by the Central American Institute of Industrial Technology, Guatemala. Study financed by The Inter-American Development Bank.

International Development Enterprises (IDE) Working Paper No. 1. *Ceramic Water Purifier Cambodia Field Tests*. October 2003.

International Water and Sanitation Centre (IRC) (2004). *FAQ sheet on household water treatment, prepared by IRC International Water and Sanitation Centre*, The Netherlands. www.irc.nl/page/8028. Accessed 8.29.05.

Jalan J and Ravallion M (2001). *Does piped water reduce diarrhea for children in rural India?* Policy Research Working Paper No. 2664. World Bank, Washington DC.

Kaplinsky R (2004). Spreading the gains of globalization: What can be learned from value-chain analysis? *Problems of Economic Transition*. June 2004 Vol 47 No 2 pp 74-115.

Kfir R, Bateman BW, Pitout A and Coubrough P (1989). Disinfection of polluted water by chlorine-flocculant tablet. *Water Science Technology*. Vol 21 No 3 pp207-213.

Kirchhoff LV and McClelland KE (1984). Feasibility and efficacy of in-home water chlorination in rural North-eastern Brazil. *J. Hyg. Camb*. Vol 94, pp 173-180.

Lantagne DS, Quick R and Mintz ED (2005). Household water treatment and safe storage options in developing countries: A review of current implementation practices. *Wilson Quarterly Review* (forthcoming).

Lee T, and Floris V (2003). Universal access to water and sanitation: Why the private sector must participate. *Natural Resources Forum*. Vol 27 pp 279-290.

Luby SP, Syed AH, Atiullah N, Faizan MK and Fisher-Hoch S (1999). Limited effectiveness of home drinking water purification efforts in Karachi, Pakistan. *International Journal of Infectious Diseases*. Vol 4 No 1 pp 3-7.

Lukacs H (2003). *From appropriate to sustainable: Can we identify traits that promote a technology's diffusion?* Presentation at Department of Civil and Environmental Engineering CAWST Seminar, Toronto, October 30, 2003. http://mit.edu/watsan/Docs/Other%20Documents/Lukacs-%20CAWST%20PresentationToronto2003.pdf. Accessed 8.29.2005.

Mann HT (1983). Water disinfection practice and its effect on public health standards in developing countries. *Water Supply*. Vol 1 pp 231-240.

Merrett S (2002). Willingness to pay—A review: Deconstructing households' willingness-to-pay for water in low-income countries. *Water Policy*. Vol 4 pp 157-172.

Mintz E, Bartram J, Lochery P, and Wegelin M (2001). Not just a drop in the bucket: Expanding access to point-of-use water treatment systems. *American Journal of Public Health*. Vol 91 No 10. October 2001.

Mintz ED, Reiff FM and Tauxe RV (1995). Safe water treatment and storage in the home: A practical new strategy to prevent waterborne disease. *Journal of the American Medical Association.* Vol 273 No 12 March 22/29, 1995.

Mullings B (1999). Insider or outsider, both or neither: some dilemmas of interviewing in a cross-cultural setting. *Geoforum* 30: 337-350

Murcott S (2001). *Clean water for 1.7 billion people?* Paper submission for "Development by Design Workshop." July 22, 2001. http://www.thinkcycle.org/tc-

filesystem/download/development_by_design_2001/clean_water_for_1.7_billion_people/Murcott-dyd.pdf?version_id=13004. Accessed 8.29.2005.

Mustonen-Ollila E and Lyytinen K (2003). Why organizations adopt information system process innovations: a longitudinal study using diffusion of innovation theory. *Info Systems J.* 13, pp 275-297.

Nadakatti S (2005). *Hindustan Lever's "Pureit" Water Purifier.* Presentation to the 3rd Annual Meeting of the International Network to Promote Household Water Treatment and Safe Storage, June 1-2, 2005, Bangkok. http://www.who.int/entity/household_water/resources/Nadakatti.pdf. Accessed 8.29.2005.

Parashar UD, Bresee JS and Glass RI (2003). The global burden of diarrheal disease in children. *Bulletin of the World Health Organization*. Vol 81 (4).

Patton MQ (2002). Qualitative Evaluation and Research Methods, Sage Publications, Newbury Park, CA. *Professional Geographer* Vol 45 pp 305-317 .

Prahalad CK (2005). *The Fortune at the Bottom of the Pyramid: Eradicating Poverty through Profits*. Wharton School Publishing, New Jersey.

Prahalad CK and Hammond A (2002). Serving the world's poor, profitably. *Harvard Business Review.* September 2002.

Prahalad CK and Hart SL (2002). The fortune at the bottom of the pyramid. *Strategy and Business.* 26, First Quarter 2002. http://www.strategy-business.com/press/article/11518?pg=0. Accessed 8.2.05.

Prüss A, Kay D, Fewtrell L and Bartram J (2002). Estimating the burden of disease from water, sanitation and hygiene at the global level. *Environmental Health Perspectives* Vol 110 No 5, pp 537-542.

Quick RE, Kimura A, Thevos A, Tembo M, Shamputa I, Hutwagner L and Mintz E (2002). Diarrhea prevention through household-level water disinfection and safe storage in Zambia. *American Journal of Tropical Medicine and Hygiene*. Vol 66 (5) pp 584-589.

Quick RE, Mintz ED, Sobel J, Mead PS, Reiff FM and Tauxe RV (1997). *A new strategy for waterborne disease prevention.* Presented at 23rd WEDC Conference. Water and Sanitation For All: Partnerships and Innovations. Durban, South Africa, 1997.

Quick RE, Venczel LV, Mintz ED, Soleto L, Aparicio J, Gironaz M, Hutwagner L, Greene K, Bopp C, Maloney K, Chavez D, Sobsey M and Tauxe RV (1999). Diarrhoea prevention in Bolivia through point-of-use water treatment and safe storage: a promising new strategy. *Epidemiol. Infect*. Vol 122, pp 83-90.

Rangel JM, Lopez B, Mejia MA, Mendoza C and Luby S (2003). *Journal of Water and Health*. Vol 01.1.

Robinson GM (1998). *Methods & Techniques in Human Geography*. John Wiley, Chichester.

Rogers EM (1995). *Diffusion of Innovation, 4th Edition*. Simon & Schuster, New York.

Rose, G. (1997) Situated knowledges: positionalities, reflexivities and other tactics. *Progress in Human Geography* Vol 21 pp 305-320 .

Ryan GW and Bernard RB (2000). *Data Management and Analysis Methods*. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (2nd ed., pp. 645-672). Thousand Oaks, CA: Sage.

Sachs J, Lenton R, Wright AM, Lewis K (2005). *Health, dignity and development: What will it take?* UN Millennium Project. Task Force on Water and Sanitation. London.

Serafini M (2005). *Promotion and microfinance of Kanchan Arsenic Filter in rural Terai region of Nepal. Project Final Report (Draft).* July 2005. Provided by email from Susan Murcott. August 16, 2005.

Snow J (1855). *On the mode of communication of cholera*. Churchill, London.

Sobsey M (2002). *Managing Water in the Home: Accelerated Health Gains from Improved Water Supply*. WHO, Geneva.

Souter PF, Cruickshank GD, Tankerville MZ, Keswick BH, Ellis BD, Langworthy DE, Metz KA, Appleby MR, Hamilton N, Jones AL and Perry JD (2003). Evaluation of a new water treatment for point-of-use household applications to remove microorganisms and arsenic from drinking water. *Journal of Water and Health*. 01.2.

Swyngedouw E (1997) "Power, Nature and the City. The Conquest of Water and The Political Ecology of Urbanization in Guayaquil, Ecuador: 1880-1980", *Environment and Planning A,* Vol 29 (2) pp 311-332.

Swyngedouw E (2005a). Dispossessing H_2O: the contested terrain of water privatization. *Capitalism Nature Socialism*. Vol 16 No 1 pp 81-98.

Swyngedouw E (2005b). Personal Communication. School of Geography and the Environment, Oxford University, May 2005.

Trevett A (2002). Household water security—the quality component. *Waterlines*. Vol 21 No 4 April 2002, pp 2-4.

UN (2005). *UN Millennium Project Task Force on Water and Sanitation, Final Report*, Abridged Edition. Health, Dignity and Development: What Will It Take? Achieving the Millennium Development Goals. UN, New York. http://www.unmillenniumproject.org/reports/tf_watersanitation.htm. Accessed 8.29.05.

VanDerslice J and Briscoe J (1993). All coliforms are not created equal: A comparison of the effects of water source and in-house water contamination on infantile diarrheal disease. *Water Resources Research*. Vol 29 No 7 pp1983-1995.

Varghese A (2004). A comparative risk approach to assessing point-of-use water treatment systems in developing countries. *Earth and Environmental Sciences*. Vol 38 pp 99-112.

Visser G. (2003) *Researcher positionality and political-temporal contingency*. London School of Economics, London.

Wagner EG and Lanoix JN (1959). *Water supply for rural areas and small communities*. WHO, Geneva.

White GF, Bradley DJ and White, AU (2002). Drawers of Water: Domestic Water Use in East Africa. *Bull World Health Organ*, vol.80, no.1, p.63-73.

WHO (2000). *Global Water Supply and Sanitation Assessment 2000 Report*. World Health Organization and United Nations Children's Fund.

WHO (2002). *The World Health Report 2002*. World Health Organization, Geneva. http://www.who.int/whr/2002/en/index.html. Accessed 8.2.05.

WHO (2004). The Second Annual Meeting of the International Network to Promote Household Water Treatment and Safe Storage, Nairobi, Kenya, Meeting Notes, 14-15 June 2004.

WHO (2005). *Water for Life: Making it Happen*. World Health Organization and UNICEF, Geneva, Switzerland.

Witkowski TH (2005). Antiglobal challenges to marketing in developing countries: Exploring the ideological divide. *Journal of Public Policy & Marketing*. Vol 24 (1) pp 7-23. Spring 2005.

World Bank (1997). *Toolkits for private participation in water and sanitation*. World Bank, Washington DC http://www.worldbank.org/html/fpd/water/wstoolkits/index.html. Accessed 8.2.05.

World Business Council for Sustainable Development (WBCSD) (2002). *Water for the poor*. EarthPrint, Hertfordshire.

Wright J, Gundry S and Conroy R (2004). Household drinking water in developing countries: a systematic review of microbiological contamination between source and point-of-use. *Tropical Medicine and International Health*. Vol 9 No 1 pp 106-117 January 2004.

Yildizbayrak B, Moschos N, Tamar T and LeTallec Y (2004). Distribution of arsenic and biosand filers in rural Nepal. G-LAB Project Report. April 2004. http://mit.edu/watsan/Docs/Student%20Reports/Nepal/NepalSloanABFReport2004.pdf. Accessed 8.19.05.

8. APPENDICES

Appendix 1: Product Websites

For additional background on the seven products reviewed during this reasearch, readers are referred to the following websites:

Biosand Filter: Center for Affordable Water and Sanitation Technology (CAWST).
http://www.cawst.org/technology/watertreatment/filtration-biosand.php

Ceramic Filter Technology: Potters for Peace.
http://www.potpaz.org/

Fairey Ceramics:
http://www.faireyceramics.co.uk/drink.htm

PuR: Procter & Gamble (P&G).
http://www.pghsi.com/safewater/

Pureit: Hindustan Lever (HLL).
http://www.hllpureit.com/

Safe Water System (SWS): Center for Disease Control (CDC).
http://www.cdc.gov/safewater/

SODIS (SOlar water DISinfection): The Swiss Federal Institute for Environmental Science and Technology.
http://www.sodis.ch/

Appendix 2: Interview Checklist

Commercial viability of POU technologies

(bracketed questions) signify ask only if time permits

1. **Overview:**

Background information:

- Name, title and organization
- Date of interview
- What location are we discussing?
- When was your product sold there? Is it still being sold there?

Product Overview: (will be filled in to the greatest degree possible pre-interview, certain pieces may need to be confirmed):

- Describe your product: chemical, filter, parts, etc.
- What product upkeep is required?: type and frequency of maintenance and product upkeep in order to maintain desired performance.
- What service, support and training is available for the product? (training, spare parts, etc.)
- To what extent is or can your product be locally produced?
- Where and when has the product been sold?

2. **Specific areas of challenge:**

Demand Creation: Education**:** Making the case that your product is needed

- Was the target market aware of the need for the product before it was introduced?
- If so, how was this done? How did you leverage awareness?
- What efforts did you undertake to create demand for POU technologies?
- Were these useful? What evidence do you have to support this?
- What resistance to uptake did your product encounter?
- How did the product design reflect the characteristics of your target market?
- Did women play a central role in the diffusion of your product?
- (What efforts did you make in educating consumers on appropriate behavior and practices?)

Awareness and Promotion: Advertising**:** Getting your product known

- Why did you choose this market?
- Target market: demographic profile? (age, male/female, urban/rural, location). Social status or income profile?
- What marketing channels were used to promote the product?
- What other methods were used to raise awareness of your product?
- Which were most successful?

- Please describe any marketing strategies and slogans that were used, and why did you use these?

Access: Getting your product to your customer

- Where can customers get your product from? Are these reliable suppliers? Can customers get any required spares from the same source?
- To what extent are retailers knowledgeable in the product's use?
- Did you encounter challenges with existing distribution channels? If so, how did you get around these?
- Have you partnered with NGOs and other community based organizations in selling the product? If so, describe the role these groups played.

Use/Cost: Getting your customer to buy and to continue buying your product

- Cost of use: how much for how long for how many?
- How is your product priced: Affordable to the greatest number? Subsidized at first then moving to cost recovery? Aspirationally?
- Obstacles encountered in scaling up?
- Obstacles in longer term adoption??
- Hs the product been subsidized in the past? If so, internal (corporate) or external (funder)?
- How much was the subsidy, and what was the impact of the subsidy on sales?
- What would be the effect of removing the subsidy?

3. General Thoughts:

- What other obstacles were encountered in selling your product?
- What is your vision for the commercial future of your product?
- Can POU products be commercially viable in a lower income setting? Why? How can commercial viability be achieved?
- Will you be modifying your product in any way?
- If your product is not commercially viable, why does your company still produce it? OR Are there other ways beyond commercial viability in which your product can be considered successful?