

Please cite this article as: S.V. Ramani, et al., On the diffusion of toilets as bottom of the pyramid innovation: Lessons from sanitation entrepreneurs, Technol. Forecast. Soc. Change (2011), doi:10.1016/j.techfore.2011.06.007

Forthcoming in the journal:
Technological Forecasting and Social Change

**On the Diffusion of Toilets as Bottom of the Pyramid Innovation:
Lessons from Sanitation Entrepreneurs**

Shyama V. Ramani*, Shuan SadreGhazi and Geert Duysters+**

*United Nations
University-MERIT
Keizer Karelplein 19
6211 TC Maastricht
The Netherlands
ramani@merit.unu.edu

** United Nations
University-MERIT
Keizer Karelplein 19
6211 TC Maastricht
The Netherlands
ghazi@merit.unu.edu

+ Eindhoven
University of
Technology and
Tilburg University
The Netherlands
g.m.duysters@tue.nl

(Running Title: "Lessons from Sanitation Entrepreneurs")

Please address correspondence to: Shyama V. Ramani, UNU-MERIT, Keizer Karelplein 19, 6211 TC Maastricht, The Netherlands. ramani@merit.unu.edu Tel: +31 43 350 5300 Fax: +31 43 350 6399

On the Diffusion of Toilets as Bottom of Pyramid Innovation:

Lessons from Sanitation Entrepreneurs

Abstract

There is an emerging body of literature on product innovations for the poor at the bottom of the income pyramid. However, there is little on why delivery systems succeed or fail in this context and the present paper attempts to fill this void by examining why and how sanitation entrepreneurs are succeeding in India to diffuse toilets – an innovation for rural households, which never had access to one before. The literature is analyzed and confronted with the actual field practises. We demonstrate that the common thread that unifies progressive sanitation entrepreneurs is their adoption of a ‘market based approach’. There are market failures stemming from the demand side due to problems in expression of demand and its mismatch with the perceived value of the innovation. In response, sanitation entrepreneurs go beyond the standard linear model of assessing need and appropriateness of technology. They create innovations in ‘technological design’ as well as in the ‘delivery platforms’ to include practises for ‘accompaniment’, ‘sustainable maintenance’ and ‘generation of knowledge’. Thus, they make-up for sluggish or missing markets and informational asymmetries to ensure sustained use of toilets.

Keywords: Pro-Poor Innovation, Rural Sanitation, Bottom of the Pyramid, Diffusion, Delivery Platform

On the Diffusion of Toilets as Bottom of the Pyramid Innovation: Lessons from Sanitation Entrepreneurs

1. Introduction

In India, even as of 2005, only one third of the population had access to any form of a functioning toilet [1] and though the situation is improving slowly, the lack of sanitation coverage remains a major problem. But this is not just an Indian dilemma. Every day over 1.1 billion people around the world respond to the call of nature in the open because of a lack of access to improved sanitation. Improved sanitation refers to a toilet that is connected either to a public sewer, or a septic tank or some pit in such a way that the air, water and soil in and around the pit are not contaminated. The open mounds of untreated and exposed human waste, resulting from open defecation, are a leading cause of the spread of diseases [2]. Despite all the technological progress that has taken place in the world, including in sanitation, nearly 40% of the world population continues to suffer without access to appropriate sanitation systems (<http://earthtrends.wri.org/updates/node/359>). The problem lies not only in provision of *appropriate* toilets but also in inducing a *behavioral change* among the target beneficiaries. Therefore, innovations for social change in this sector have to focus not only on appropriate technological models, but also on their delivery platforms, to induce the required behavioural changes. The present work can also serve to aid such prospection.

It is common knowledge that the successful diffusion of toilets in India is due to the activities of non-profit organizations (or NPOs) working in partnership with the Indian Government and international aid agencies. A handful of social entrepreneurs from such NPOs are in particular highly acclaimed for their role in promoting and diffusing toilets among the poor. Social entrepreneurs are individuals who create efficient models – technologically and socially- to cater to basic human needs not addressed by existing markets and institutions [3]. They are distinct from commercial entrepreneurs in that their efforts are not guided by the prospects of direct financial gains. By the poor, we refer to the 'Bottom/Base Of the income Pyramid' (or BoP from now on), i.e. the largest, but poorest socio-economic groups in the global income pyramid living on a few dollars a day [4]. An examination of the strategies used by the leading social entrepreneurs to increase sanitation coverage in India makes a worthwhile study to gain insight on the diffusion of innovations in BoP contexts.

Diffusion of toilets as a pro-poor innovation is a challenge because their successful adoption calls for a change in individual behavior, daily routines and perhaps even social norms. In order to succeed, social entrepreneurs not only introduced innovations in the 'technological design' but also in the 'delivery platform' of toilets. By delivery platforms, we refer to a set of resources (knowledge, skills, financial resources, social networks etc.) and functions mobilized to ensure adoption and effective utilization of toilets. While, our awareness of the existence and impact of social entrepreneurs in many fields is increasing, there is little knowledge about the processes developed by social entrepreneurs to catalyze social change and meet the needs of the poor. To fill this lacuna, the present article aims to focus on the following questions: How do social entrepreneurs address the challenge of improving sanitation coverage in rural India? In particular how do they ensure effective adoption and sustained use of toilets? What inferences can be drawn from such a study on the optimal features of a delivery platform of pro-poor innovations?

In the above context, our study contributes to two streams in the economics and management of innovation literature: 'social entrepreneurship' and 'diffusion of pro-poor innovations' in terms of success factors for technology and delivery design. In the post-production phase or the diffusion phase of pro-poor innovations, firms, social entrepreneurs and public agencies face the same challenge: How to get the intended

beneficiaries to adopt the innovation and use it in an effective and sustained manner? Examining the strategies of social entrepreneurs to diffuse and ensure sustained use of a much needed innovation like toilets, is of pertinence to all actors engaged in serving the poor such as planners, public agencies, NPOs and firms.

The nature of the findings of the paper and its organization can be understood as follows. We start by explaining the research approach and methodology in section 2. Then, in sections 3.1 and 3.2, we analyze the existing literature related to the diffusion of pro-poor innovations to identify the main recommendations highlighted in the literature. We confront the model so derived with other case studies on the failure of diffusion of BoP innovation in section 3.3, to draw some inferences on why there is such a large gap between the 'optimal delivery model' and delivery platforms in reality.

Then in section 4, we briefly present the salient features of the innovations in the 'technological design' of the pro-poor toilets and follow it up with an analysis of why the first attempts of the Indian Government to diffuse toilets failed. We show that practically none of the requirements proposed by the literature were satisfied in the diffusion process.

In section 5, we examine the central features of the delivery platform of the sanitation entrepreneurs. We show that they go beyond the standard linear model of assessing need and appropriateness of technology to include practises for 'accompaniment', 'sustainable maintenance' and 'generation of knowledge' in order to make-up for sluggish or missing markets and informational asymmetries.

Finally, in section 6, based on the above findings, we propose a checklist for delivery platforms to diffuse pro-poor innovations. We reiterate throughout the article in different ways that for successful adoption of BoP innovations, it is necessary to embed routines in the delivery platform that ensure sustained use. Rather than being a one-shot linear process, success may come only after several iterations to fine-tune the delivery platform.

2. Methodology

Methods of qualitative research were used to unravel the process of increasing sanitation coverage, the focus being on the 'how' rather than the 'why' – assuming it was an objective to which the studied stakeholders were committed. In particular, the objective was to build a grounded theory based on facts compiled from the case study [5, 6]. The case study, involved an embedded design with a two-level analysis: at the sectoral level and at the organizational level. It was constructed following a three stage procedure, using multiple data sources (archives, ethnographic notes and interviews).

In the first stage, the existing literature on the diffusion of pro-poor innovations was compiled to unfold the main findings. These consisted of academic articles, government documents as well as the annual reports of international agencies and NPOs engaged in sanitation promotion.

In the second stage, the data accumulated by the first author on the process of sanitation coverage in rural India over a period of five years (2005-2010) was analyzed. This data consisted of extensive memos taken and emails exchanged as participant-observer on the general features of public and private sanitation drives. The notes had been taken during interactive sessions (informal get-togethers, strategic discussions, public meetings etc.) with different stakeholders in sanitation projects, such as rural households, NPOs and local government representatives.

Out of the literature survey and data analysis emerged the first version of our grounded theory on: (i) the processes recommended by the existing literature on how pro-poor innovations ought to be diffused, (ii) the refinement of these processes by

successful sanitation activists; and (iii) the checklist for the diffusion of BoP innovations in other sectors based on lessons from failed and successful sanitation drives.

In the third stage of the research process, this theoretical construct was validated and refined at an organizational level in a series of in-depth, semi-structured, open-ended interviews conducted with the founders of three leading NPOs in sanitation: Sulabh, EcoSolutions and SCOPE. The interview approach is a useful method to gain information on the dynamics of general processes to seek exceptions to the grounded theory initially conceived and to identify explanations for any contradictory opinions received from others on the theory, based on the respondent's personal opinion and experience [7]. The three NPOs were particularly chosen because they have introduced the most significant design innovations in the sanitation systems being diffused in India to the BoP. M. Subburaman, the founder director of SCOPE was involved in discussions throughout, as he is strongly committed to the dissemination of knowledge and awareness on the crucial problem of sanitation in India. The interviews with the founders of Sulabh and EcoSolutions, Bhindeshwar Pathak and Paul Calvert respectively, started with questions on how they emerged as sanitation activists, what challenges they were currently facing and how they were tackling these problems. Each interview lasted between 3 to 5 hours. Relevant points were then integrated into our grounded theory. In order to minimize subjectivity and cross-validate, the revised theoretical construct was again presented to them for comments and our email exchanges continued for little over a year. The final version of our grounded theory thus emerged as described by Eisenhardt [8], as an outcome of an iterative process, whereby through constant comparison of theory with data, the final theory was constructed so as to most closely fit the data.

3. Pro-poor Bottom of the Pyramid Innovations

Generally speaking, any new commodity made available or accessible to the BoP can be considered as an innovation with respect to the BoP consumers – even though it may be a commonly used product for higher-income consumers. Furthermore, not all BoP products have the same developmental impact in terms of improving the lives of the poor. For instance, the long term impact of the consumption of shampoo in sachets – designed specifically to be accessible to the poor will not be the same as clean water. Therefore, in line with Mendoza and Thelen [9] we distinguish pro-poor BoP innovations as those that cater to the essential needs of the poor such as healthcare, housing, food, water and sanitation or enhance productivity and income-generation capacity. Mendoza and Thelen [9] also reiterate that to be viable, the delivery system of pro-poor innovations must ensure accessibility to the targeted consumers as well as positive financial or reputational returns to the suppliers.

In addition, the diffusion of innovations must be distinguished from their mere provision, for the former also involves creating incentives for optimal adoption and effective utilization by the intended beneficiaries. Indeed, though there is an extensive literature on the processes of innovation diffusion, not much is applicable to the BoP contexts outside of agriculture. Therefore, in order to have a conceptual framework to understand the nature of BoP innovations, we first begin by exploring the demand side, then we turn to the delivery procedures, highlighting the main recommendations of the literature, and finally, we examine some case studies of BoP innovation failures.

3.1 Factors influencing the demand for BoP innovations

The decision to adopt an innovation is influenced by the same factors that usually affect any conventional investment, such as benefits, costs, risks in a specific institutional/social environment. BoP users are similar to those in higher-income tiers in that they make investment decisions to maximize their expected utility. However, the

perceived value of the product and the expected utility obtained are likely to be different given the constraints surrounding them, which can be one or more of the following broad types:

Financial constraints: A high percentage of BoP workers are unemployed, self-employed or employed in the informal sector. Indeed, in developing countries, informal employment comprises one half to three-quarters of non-agricultural employment [10]. Therefore, unlike mainstream workers employed in formal sectors, the income of BoP households is subject to greater seasonal, temporal and regional variance. In addition, and because of low/fluctuating income access to credit or other types of financial services are limited or unavailable for them, which further affects their consumption choices [11].

Lesser knowledge, information and skills base: Individuals of the BoP communities are likely to have less education, skill and awareness about the possibilities of innovation [12]. They might be unfamiliar with certain goods and services, such as new technologies or financial services. As a result they might not have accurate information about the advantages (or disadvantages) of new products or might perceive their use as being complicated, which in turn can deter them from using these products. For example, individuals in rural areas are less likely to have knowledge about the benefits of IT services and their demand for them will be low, unless they learn how to utilize them.

Limited access to complementary infrastructure: BoP communities are likely to have less access to complementary infrastructure that creates an enabling environment for effective use of certain products or services. They may have limited access to electricity, water connections and complementary products needed to install and use certain products and service properly.

The above mentioned constraints affect the level of demand at BoP. The constraints are likely to translate into a no-demand or lower demand for certain products and services. Nevertheless, it should not be assumed that those at BoP use only low quality commodities and services in keeping with their financial endowments. In addition to being 'consumers', BoP individuals are very careful 'money managers' and planning often goes into saving for the purchase of goods and services that constitute a luxury for them, such as movies and high quality rice for special occasions, which yield high directly utility or enhance their status and social standing [11].

3.2 On optimal characteristics of BoP innovations and their diffusion: Need, Technology and the Socio-Economic Context

Many pro-poor BoP innovations emerge from the identification of a need. The 'need' for any innovation is generated by socio-economic structures and cultural norms. Therefore, the first step is to examine the nature of needs. As Katz [13] explains, "it is as unthinkable to study diffusion without some knowledge of the social structures in which potential adopters are located as to study blood circulation without adequate knowledge of the veins and arteries." The second natural step is to confirm the appropriability of innovation to serve the need. These have to be along different dimensions: technological and socio-economic contexts.

There exists an extensive literature on the optimal technology design to cater the BoP needs. Following the 'small is beautiful' concept a la Schumacher [14], the

'appropriate technology' works advocate making optimal use of local resources to develop technologies for the benefit of the poor. Early work in the area focused on 'technology or product innovation design' to fit the constraints of the context and the resource base of the final user. By default, it led to the reigning explanation that if an innovation is unsuccessful with the poor, it is because the technology is not designed appropriately.

Other scholars have called for a broadening of the notion of 'appropriateness'. Stewart [15] pointed out that the new technology must be compatible with the income levels, resource availability, existing modes of production, existing technologies and costs in the society for which it is designed. It has also been noted that an innovation could be successfully adopted if it has a relative advantage over the solutions already utilized by the users over and above notions of 'appropriate technology'. Such a relative advantage could be lent by factors such as simplicity of use or compatibility with user's norms and existing ways of doing things [16].

Although the above factors are relevant for diffusion of a BoP innovation, it is accepted that in order to ensure a positive development impact, there is a need to take a holistic approach starting from conception of the innovation to its final delivery. This premise has given rise to a vibrant and growing literature, mainly in the form of case studies on different aspects of the diffusion of pro-poor BoP innovations and its main recommendations can be summarized as follows:

- Confirm that there is an unmet or underserved need for which a technological solution can help [17, 18]
- Verify that the product characteristics are compatible with the socio-economic context. Favourable characteristics are a proper price/performance ratio, robustness of product for harsh conditions of BoP environment and de-skilling of product for easy use [19].
- Build a delivery model that is compatible with the socio-economic context. Beyond fixing of price, the marketing strategy should take into account socio-cultural norms and power [20, 21].
- Identify and use appropriate 'change agents' to adopt and convince others to do the same [16].
- Ensure that that the complementary institutions or assets needed for sustained functioning of the innovation are available [22].
- Confirm the adsorptive capacity of targeted consumers both as individuals and as members of social groups [23].
- Make sure that the business and delivery model generate positive returns to the suppliers. For this application private sector management principles could be useful [24].
- 'Co-create' value with all stakeholders including the user community, firms, public agencies and NPO through non-traditional forms of partnership [25-27].

Though the above literature is very useful – two shortcomings can be pointed out. From a theoretical perspective the steps to diffuse an innovation are rather clear, nevertheless, the protocols for actual implementation are not evident. It is obvious that every BoP context will be different and possibly require a different solution. Then the question becomes – how the theory can be applied in practice? Moreover, it would seem that by following this set of practically common-sense rules all practitioners can be successful. Reality reveals that this is not the case and we turn now to some of these failures.

3.3 Reasons for the failure of product innovations in BoP

A principal reason for the failure of BoP product innovation seems to be linked to the implicit belief of both technology-oriented and market-oriented scholars and practitioners that affordable and appropriate product innovations that enhance the welfare of the BoP communities will be adopted widely after being introduced to the community. This is simply not the case.

Many well-intentioned technologies and innovations targeting the poor can fail because the ways in which the poor make decisions are much more influenced by their social and cultural environments, as compared to mainstream consumers [28]. For instance, in India, despite the water crises in the country, water-efficient ecological toilets are not popular with consumers because they call for a greater effort for usage [29]. Low-cost efficient cook stoves failed in Asia because they could not produce the high levels of heat required by the local cuisine [30]. A majority of the failures in diffusion of BoP innovation rise from an inadequate understanding of these social and environmental factors. Frequently, there is a mismatch between the way providers see the value of the innovation for the poor and the way the community perceives it. One way to tackle this, especially in the case of sanitation, could be to separate out the organizations in charge of manufacturing from those in charge of marketing – as these two operations in the context of BoP markets face very different challenges and require different skills [31].

In addition, different perceptions about new technologies and bias towards traditional solutions can lead to users' 'resistance' to innovation [32]. Examples include water purification devices in Africa that were in the form of a straw. The users did not feel comfortable to change their habit of drinking water through a straw. Moreover, since the health benefit of drinking purified water was not immediately visible, its value as advertised by the providers, was not clear to the community. Another example of a well-intentioned but failed innovation is the wheeled multi-purpose tool-carrier in Africa. It was aimed to increase farmers' productivity and enhance income generation, but it got flatly rejected by the farmers [33]. On the technological side it relied on advanced engineering design, focusing on simplicity of use and ease of manufacturing, based on the experience gained from agricultural research stations in various developing countries. However, the farmers argued that the tool carrier was too expensive for them and single-purpose implements suited their needs better. Problems can also arise from an imperfect understanding and knowledge base of the BoP consumers. For instance, a dial ambulance service in India, despite the real need for such a service, initially failed because the urgency and importance of the service were not evident for the targeted beneficiaries [34]. Unaware of the advantages offered by the ambulance, many people preferred to take public transportation like taxis or rickshaws to the hospital. Many of them had never used an ambulance before and the advantages of the new, improved service had not been communicated to them effectively.

To summarize, most of the existing literature on the diffusion of innovations in the BoP context has focused unduly on the supply side of the markets. On the other hand, given the nature of BoP consumers' demand, failure can stem from problems related to one or more of the following:

- Technology design.
- Product design.
- Delivery design.
- Missing institutions or capabilities or linkages.

For all these various reasons a BoP market exhibiting effective demand might simply be non-existent or sluggish requiring steps to be taken to create or activate the market.

4. Diffusion of Sanitation Systems in India's BoP

Although the term “sustainable development” is increasingly used in national plans of many developing countries, there are systemic obstacles to “enable” the plans [35]. Sanitation is one of the areas that still faces a challenge in diffusion, especially in rural areas being one of the most neglected issues in the BoP context. Even at the level of policy makers, despite the fact that about 2.4 billion in the world do not have access to proper sanitation facilities, the problem of sanitation coverage did not figure in the ‘Millennium Development Goals’ signed by 181 countries in 2000 [36]. It took mounting evidence and arguments on the positive impact of sanitation coverage on hygiene, health conditions, environmental security and ultimately poverty reduction, to include sanitation coverage targets as part of the ‘Millennium Development Goals’ in the 2002 ‘World Summit on Sustainable Development’. Toilets are a classic pro-poor innovation, because they empower through imparting ‘social dignity’ which is as important, or even more important, than augmentation of income-generation capabilities – and help to change social values at the core. In the long run, universal sanitation coverage also boosts economic growth by improving the health status of citizens.

For communities which have never used a toilet before, it may not be easy to make the switch. The barriers to adoption of sanitation are still not well understood. A review of the sanitation reports [37] mentions diverse factors such as lack of demand, access, affordability or technical skills. Avvannavar and Mani [38] point out the hygiene practices of communities are deeply embedded in cultural and religious values and therefore convincing the poor to use a toilet instead of the outdoors and to make them pay for the construction of a toilet, are a great challenge. It is fully recognized that achieving sanitation targets involves the interaction between a complex and diverse range of institutions, processes and actors (both public and private) – in addition to installing the appropriate toilet models [39].

A sustainable sanitation system comprises a toilet, and systems for collection, transport, treatment, and use of excreta that meet the needs of the user, while being simple to use, maintain and repair. Additionally, a sustainable sanitation system must be affordable, not cause any form of environmental contamination and must be safe for humans [40]. Presently, four types of decentralized sanitation technologies are being diffused in India for the BoP. They are the single-pit latrine, double-pit latrine, the urine diversion toilet (Ecosan) and the toilet with an attached septic tank (septic tank model). Of these, the double-pit latrine and the Ecosan are the new product innovations that have been introduced for their sustainability and safety. The two traditional models, the single pit latrine and the septic tank are more popular but they add to soil and water contamination in India, because their technology design is such that if they are not constructed properly (and mostly they are not), contaminated water containing faecal matter leaches out to the surrounding soil [29].

4.1 Innovation in Technology Design: Double pit and Ecosan

The first major innovation in pro-poor toilet models was created by Dr. Bhindeshwar Pathak, the founder of the NGO ‘Sulabh’ during the 1970’s. His primary motivation was not to create an innovation in itself, but to improve the lot of millions of manual scavengers in India involved in the daily emptying of traditional toilets. But manual scavenging could not be eliminated without offering consumers an alternative toilet model that could be autonomously maintained. Therefore, the Sulabh toilet model was developed to empower a community and not to maximize profits.

From the outside, the Sulabh toilet model for individual households looks just like the standard Indian squatting style toilet slab with one hole for flushing, but, instead of the flushed waste going directly into the ground or a septic tank or to a central sewer canal, it falls into one of two deep pits that are outside the toilet. When the first pit is full, the family can switch to the second pit, while the waste in the first pit is gradually

and naturally transformed into a rich material that can be removed and used as dry, powdery fertilizer. When the second pit is nearly full, the first pit can be emptied and its contents can be used as compost and the two pits can be used alternatively and continuously. Currently the Sulabh toilet is being used in about 1.2 million poor households and has been declared a 'Global Best Practice by United Nations HABITAT and Centre for Human Settlements'. It is being diffused by the UNDP all over the world.

The Sulabh toilet model, while being suitable for dry areas was found to be unsuitable for those with a high water table such as coastal zones or those receiving high degree of rainfall, because of water logging of the pits. Hence, the Sulabh model was never adopted widely in such regions. For these regions, a second major toilet innovation in the form of a urine diversion toilet was created during the late 1980's by a British naval engineer named Paul Calvert on deputation to India. While there is evidence of experimentation with urine diversion toilets during the 1970's in many parts of the world, and especially in Nordic countries, its virtues were practically unknown outside of the circle of its devout practitioners. Thus, Calvert had to re-invent a version himself and his contribution to the basic model is to have added features that made it user friendly under Indian conditions.

The urine diversion toilet developed by Paul Calvert, also popularly called an ecological-toilet or 'Ecosan', involves the separation of urine from faeces, thereby accelerating the process of compost formation. The toilet squatting slab has three holes, one behind the other, with different slopes. The user urinates first and shifts slightly back to defecate permitting the faeces to fall into a compost pit. A mug of ash or saw dust is then thrown into this hole facilitating dehydration of the faeces. Then the user moves back further to wash the behind. The urine goes out through a bamboo pipe to irrigate a garden planted around the toilet. The wash water is filtered through layers of gravel so that the water that leeches out into the soil is harmless. Thus, urine, faeces and wash water are completely separated and recycled.

The 'Sulabh' and the 'Ecosan' toilet model demand more effort both on the part of the end-user and the promoter. They are technological innovations that require a basic understanding for their proper use, and furthermore in the case of the ecological toilet, users need to make more efforts than in other types of toilets to maintain them properly. However, these two models represent 'totally decentralized' and 'sustainable sanitation systems that close the loop – completely recycling the waste without any risk of environmental contamination.

4.2 Failure of State efforts to diffuse single pit latrines

For forty years after attainment of national independence in 1947, there was no public investment in sanitation coverage because open defecation was not perceived as a major social problem or health hazard. The vegetal coverage was sufficient to ensure privacy and safe recycling of waste into the soil. But a high population growth coupled with steady destruction of vegetal coverage led to open defecation without privacy and this started posing problems to health and human dignity even in rural areas.

The first public program to focus exclusively on sanitation was the Central Rural Sanitation Program (CRSP) initiated in 1986 by the Ministry of Rural Development. Under this scheme, at the district level, the Offices of the District Rural Development Agency (DRDA) financed the construction of toilets to meet set targets with the beneficiaries being partially or near-totally absolved (depending on their income level) from having to bear the costs of installation. At the district level, officers were given a target number of toilets to be constructed for beneficiaries and these were simply built. Appropriateness was not clear either in terms of technology or the socio-economic context.

The model diffused under the government program was the 'single pit latrine' which overflows during the rainy season and which has to be covered or dislodged when full. In the case of the latter, the entire superstructure has to be dismantled and put again over the new pit. Thus, it is not surprising that most of these single pit latrines were abandoned when they began to dysfunction or when they got full.

A former Secretary of the Planning Commission notes [41] that the other causes for the abandoning of the toilets provided by the State were a "lack of demand from people who did not see the need or feel the desire for sanitation; lack of adequate water sources; lack of space; absence of choice on cost or technology; total absence of people's participation – construction of the latrines was done centrally; hygiene promotion and marketing of the products were lacking; and lack of supply chain – materials and skills were not locally available".

A UN report also confirms that the CRSP failed to be effective for several reasons. For instance, only the toilet slab was provided and the households were required to build the superstructure by themselves. However, the cost of the superstructure was out of reach for many rural households. Moreover, the public sector employees were not very motivated, and other actors like NPOs and firms were not involved in the sanitation drive [42]. Indeed, the failure of the CRSP lay in the fact that in practice, the delivery platform was sub-optimal, skipping many of the steps proposed in the literature discussed in the preceding sections (3.1 and 3.2). There was no reflection about whether needs were supported by effective demand, or whether all the institutions and capabilities necessary for adoption and sustained use were present. The adoption failed because the reality on the ground did not match the requirements for success.

In the light of the above experience, the strategy of the Indian Government was completely restructured in 1999 and a new 'Total Sanitation Campaign' was launched. As the Department of Water and Sanitation announces on its website (http://india.gov.in/sectors/rural/central_rural.php): "The restructured programme moves away from the principle of state-wise allocation of funds, primarily based on poverty criteria, to a demand driven approach in a phased manner". The State programme moved from a high subsidy to a low subsidy regime, with investment of funds in building awareness and increasing sanitation coverage through public-private partnerships with NPOs. Progress has been steady. In 1990, only 26% of the population in India had access to improved sanitation, but by 2000 this figure had risen to 37% and by 2008 it was 46% [2].

5. Diffusion strategies of sanitation entrepreneurs

For the purposes of this paper, we refer to sanitation social entrepreneurs as workers in NPOs promoting the diffusion of sustainable sanitation systems, namely the two pit latrine and the Ecosan toilet among the BoP communities. While the vision of a conventional entrepreneur is guided by the profit motive, a social entrepreneur's efforts are to accomplish a social mission. Thus, the ultimate goal of sanitation social entrepreneurs is ensure access to a functioning toilet for all.

Besides the two techno-social entrepreneurs presented earlier, Bhindeshwar Pathak of Sulabh and Paul Calvert of Ecosolutions, a number of NPOs and their leaders are active in diffusing toilets to BoP households in India. Some of them have also introduced several incremental innovations in the technology design and refinements in the delivery platform. Of this set of second-generation sanitation entrepreneurs, M.Subburaman (founder of SCOPE) is renowned for his innovations in sanitation delivery and is a recipient of the Government of India 'Nirmal Gram Puraskar Award' (National award for promoting hygiene). In the coming section we present the diffusion strategies developed by these three sanitation entrepreneurs.

5.1 On implementation of the standard BoP diffusion model

The common thread that unifies progressive sanitation entrepreneurs is their adoption of the 'market-based approach', which works from the premise that if the facilities constructed are to be used efficiently, first a real demand must be created among end-users. A sanitation program can have a perceptible impact only if a certain critical mass of neighboring households also adopts toilets. Therefore, the end-user cannot be merely taken at the individual level but must be considered at a collective level in terms of a set of adjacent households, indicating the existence of minimum scale constraints.

As may be recalled, the literature suggests that a real need must be confirmed first. Thereafter the compatibility of the innovation to satisfy that need in the given context must be verified. This should be followed by an evaluation of demand and the formulation of a strategy for innovation delivery. How do the sanitation entrepreneurs do this? We now answer this question through a presentation of the strategies used by the leading entrepreneurs mentioned above: Sulabh, Ecosolutions and SCOPE.

5.1.1 Assessment of needs before construction

The most widely used method to assess the needs of the area is to conduct a 'socio-economic survey'. Such a survey is usually conducted even if secondary data is available at a more aggregated level in order to understand the distribution of revenue, employment, demographic features and religious affiliations of the population concerned. The survey also gathers information on the distribution ownership of assets including toilets, as well as the availability of complementary infrastructure accessible to all, local markets for the materials required, local prices etc.

The survey has a threefold objective that goes much beyond a simple gathering of information. First, a survey permits a direct interaction in an impersonal setting with targeted recipients to assess a real need and interest in adoption of the innovation. Second, in casual conversation, the willingness to pay for the innovation can be gauged. For instance, in the case of sanitation such an assessment helps to decide whether toilets must be freely provided or whether end-users can partially finance the cost of the toilet. Third, the sample selection of target households and identification of the prices of materials and costs of transport to the locality, gives an estimate of the costs of diffusion.

5.1.2 Evaluation of demand before construction

When demand is not explicitly expressed, it could be because of a lack of awareness and knowledge of the recipient of not only the benefits of the innovation, but also the disadvantages and risks of using alternatives or not adopting the innovation. Therefore effective demand cannot be gauged before educating the target population.

For instance, in the case of sanitation, as Calvert succinctly put it, "The need for interactive training and awareness-raising is to unravel and dispel the misunderstandings and confusion that often surrounds sanitation, health, hygiene, water and the environment." Indeed, sanitation entrepreneurs agree that education is an essential ingredient for success. Not only do potential investors have to be educated on the advantages of having a toilet, but they must also be made aware of the disadvantages of open defecation. Furthermore, consumers are rarely aware that toilet use can improve health conditions only if all their neighbors also have and use toilets. The benefit of a toilet in terms of hygiene is not immediately visible to them. Therefore, awareness building is absolutely necessary to create an endogenous demand by which potential investor-households convince their neighbors and a group of households comes forward to experiment with the introduction of toilets.

Attracting members of the target community to an educational workshop is not easy. There is intense competition from television and other work of the families. Therefore, in order to gather an audience, education has to be theatrical, entertaining and interactive. The most widely used methods for education are: street dramas, leaflets, jokes, quizzes, songs, films to pass the message. Children and the elderly should not be taken lightly as they can also influence family decision making even if they are not earning members of the household. Furthermore, in order to motivate consumers to leave their work and come to a meeting, refreshments need to be provided.

The next step after education is house to house visits, with inter-personal discussions so that the family can ask questions or discuss details of the points raised during the workshop within the intimacy of their homes. If there is still doubt about the nature of demand, after the educational workshop and house-to-house visit, additional 'focussed group discussions' may be organized with various groups in the villages to make a final evaluation of the nature of effective demand.

A major difficulty is that most financiers do not see the importance of this step and consider 'entertaining education' combined with fun and refreshments as an unnecessary waste of funds. They also see this as an effort that should be given freely by NGOs as they are interacting with BoP consumers without realizing that imparting entertaining education is not costless. Financiers do not understand that unless a real demand is created through interactive education over an initial period of time, the program cannot be a success.

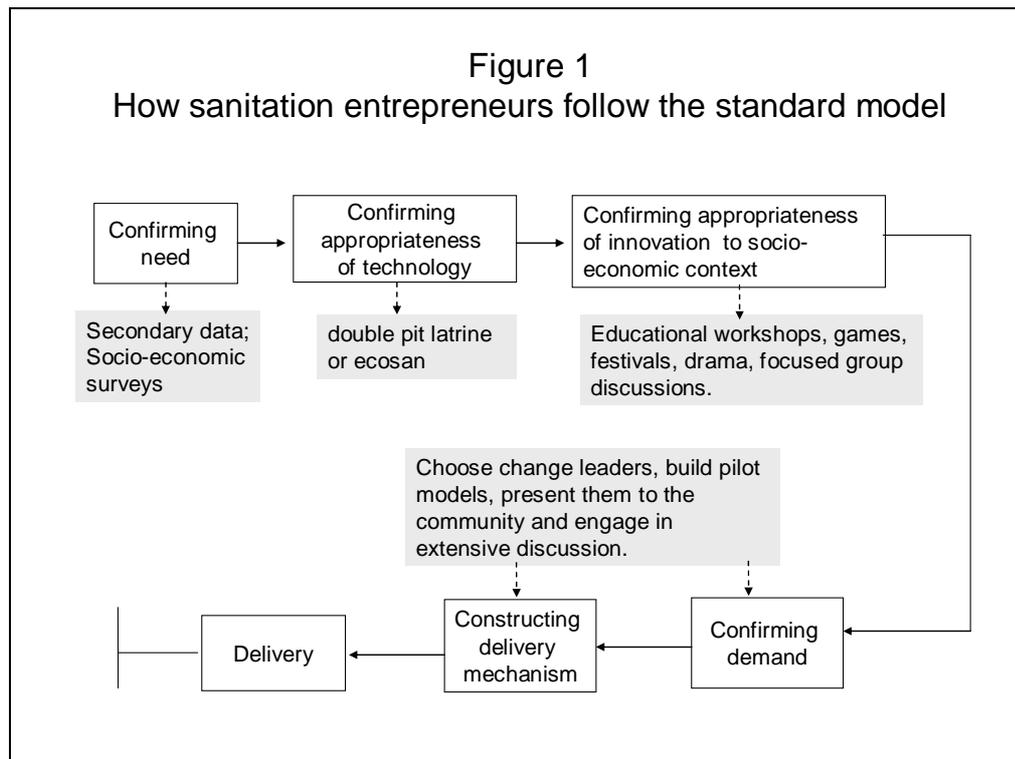
5.1.3 Formulation of a delivery mechanism

A delivery mechanism proceeds in three stages. It starts with the education discussed above, then it continues with the building of some pilot models that all can use and test, and finally, ends with the scaling up and diffusion of the innovation to the entire target community. In other words it starts with a test drive.

The choice of participants for the first two steps is very important. Indeed, an interesting strategy that is evoked is that the 'change leaders' must be selected so that they have something to gain also by being a 'change leader'. Unlike what conventional wisdom indicates, often the change leaders are not the power brokers of the community, for the latter may not have much to gain from being a 'change leader'. The 'change leaders' in sanitation are usually those who are trying to climb up the ladder of power, so that trying out the innovation increases their visibility and their networks within the target community, thereby benefiting them as well. For instance, candidates can be chosen among those trying to improve their position in the local government, religious body, school, hospital or firm etc.

A pilot project consists of three steps: construction of a few models (for the chosen 'change leaders' if this step is followed), testing and discussion followed by visits by other members of the community and wider discussion. Building a set of models is a necessary step, but its usefulness is maximized only if it is accompanied by discussion with the target community. Special efforts must be made to make them feel comfortable so that they are able to voice drawbacks freely or suggest possible improvements. Informal rather than formal meetings serve the purpose best. Once all issues are attended to, slowly visits can be arranged for a larger set of target users.

Thus, the sanitation activists assiduously follow the steps necessary to assure a good fit of innovation to need and demand. This notion is captured in figure 1.



5.2 Going beyond the standard model of delivery – Accompaniment for sustained use in post-construction period

While many management theories stop with the design of indicators for an optimal mode of delivery, on the presumption that the innovation will be used efficiently once obtained, sanitation entrepreneurs are more realistic. Given the large number of abandoned toilets in India, they adopt a variety of practises during the post-delivery period to accompany the end-users during the initial phase of adoption to ensure effective utilization. Some even go so far as to create feedback loops through promoting further innovations on the technology and improving the design using ideas from the end-users themselves. We summarize these practices below.

5.2.1 Value enhancement through involvement of end-users

Involvement of end-users in product development has been advocated as a way for more efficient innovations [43, 44]. When end-users are involved in the design of an innovation they are empowered with a greater sense of 'proprietorship' and therefore are more likely to maintain the product well. For instance, in the case of toilets, if at least some features of a toilet are decided by the family, then there is a family-specific, personal touch to the design of each toilet that integrates a toilet to the rest of the residence. The value of such a toilet is much higher than that of a carbon copy of a set of identical toilets installed in a locality. Families can also be involved through requesting them to participate in the construction of a toilet along with the professional masons. This usually increases the feeling of ownership and the commitment to use the toilet.

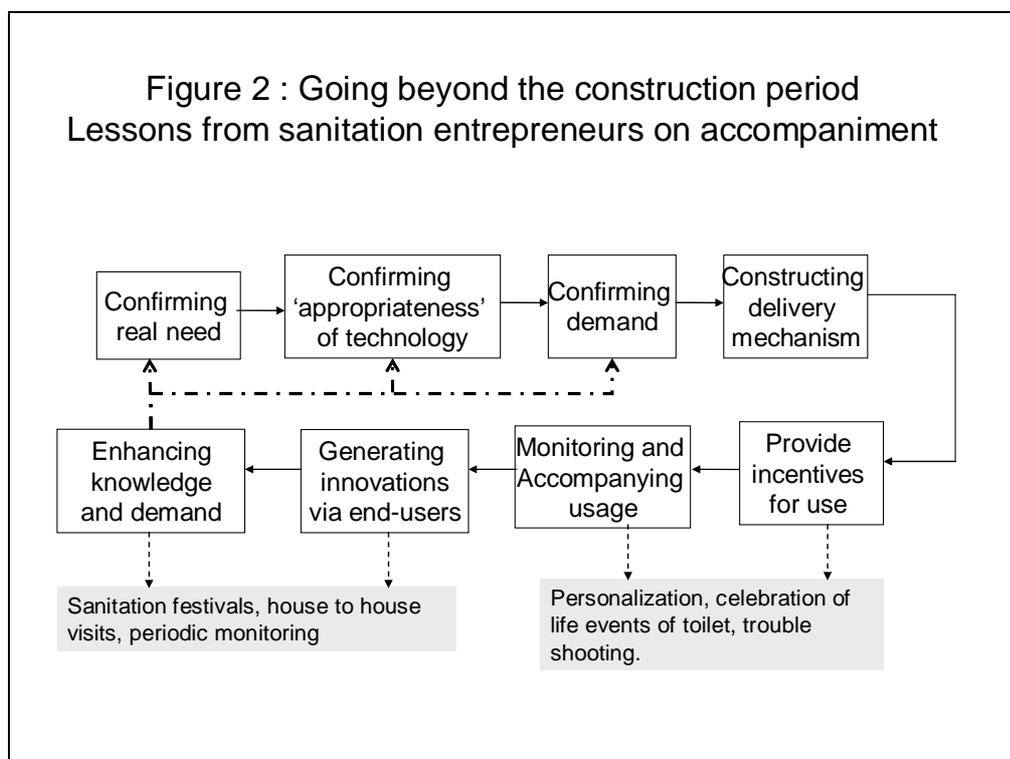
5.2.2 Celebrations for the acquisition of the innovation

The value of rituals involving the celebration of life with loved ones cannot be underestimated in any society. Anytime a toilet is perceived as a room that is impure,

smelly and dirty because of being used by others, it is rejected. In order to inculcate pride in owning such a room, sanitation entrepreneurs introduce rituals, to mark the acquisition and evolution of the life of a toilet, as it is normally done for the inauguration of a new house in India. For instance, the blessings of the Earth Goddess are invoked as the site of the toilet is chosen in a simple ceremony with prayers and partaking of sweets. Then its construction is celebrated, followed by a final festivity as the first compost pit is opened and the compost is used on new saplings.

5.2.3 Accompanying the initial phase of adoption and trouble-shooting

All NPOs unanimously insist that monitoring of use after construction is necessary for two reasons. If there are any problems of maintenance, and if the users cannot approach anyone to correct them, slowly such toilets fall into disuse. This is indeed the main reason for the thousands of 'unused toilet fossils' marking the landscape of India in an ugly fashion. Second, toilets could be diverted to other use, if the women are not very empowered in the family. Usually this occurs by closing the toilet and using it or renting it out as a storeroom for keeping animals. Normally, a good education and awareness creation prior to construction of toilets ensures proper use of the toilets. However, a period of three months of monitoring is recommended in the case of even conventional toilet models, and in the case of Ecosan, monitoring is necessary for the first 18 months with special attention being paid during the closure of the first chamber and the subsequent removal of compost, under the guidance of qualified personnel. So sanitation entrepreneurs make regular visits to households and train members of the self-help groups of that area to monitor use.



To conclude, while the sanitation entrepreneurs validate the four-step methodology of confirming need, appropriateness of technology, demand, and formulating a delivery mechanism, the above brief presentation reveals that they also accompany the beneficiaries in the post-construction period. They use the first round of

accompaniment as a means to generate knowledge from the construction workers and from the beneficiaries. This enables them to fine tune further the technological design as well as the different components of the delivery platform in non-linear feedback loops as shown in figure 2.

Indeed, sanitation entrepreneurs go beyond the standard model to create feedback loops through steps that accompany the end-user, monitor use and provide incentives for maintenance. Accompaniment and monitoring are necessary to ensure solutions to problems encountered and effectuate required repairs as well as to prevent diversion of innovation to other uses or even abandoning of the innovation in the medium term. Poor quality of construction and workmanship characterize pro-poor installations and a variety of measures can be used promote innovation and upgrade quality by motivating the workers and the recipient families. These in turn generate knowledge and demand spillovers beyond the targeted community.

6. Discussion

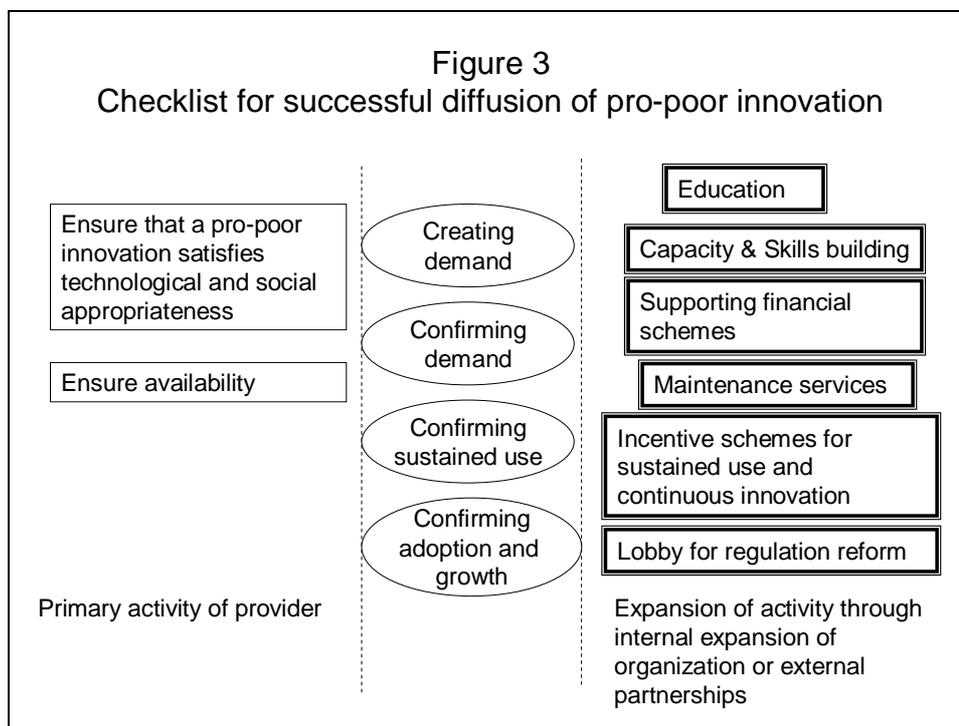
The actual field practices of sanitation entrepreneurs in India hold promising venues for improving our current understanding of pro-poor innovation diffusion. Such understanding can be seen as an important step towards the formulation of more effective delivery platforms. It can be noted that 'market oriented' or 'market delivered' innovation does not mean that the end-user effectuates all transactions associated with the diffusion through markets. Behind a market delivery, there is a complex network of actors, comprising financiers, facilitators, service providers and field staff, the last interacting most closely with the target community.

There is no magic formula for successful co-creation and diffusion of pro-poor innovations. Three points distinguish the nature of efforts required to diffuse pro-poor innovations as compared to mainstream ones. First, an iterative process might be necessary to activate a BoP market – to ensure through trial and error a good fit between 'supply' and 'demand'. This is because BoP markets tend to be zone and sector specific. Second, such an iterative process might require an accompaniment with the targeted consumer that goes far beyond mere transactions, both within and outside the market. Third, such an accompaniment might require either an expansion of the capabilities and activities of the provider, or partnerships with other organizations. This means that in addition to scale capabilities, BoP suppliers might have to develop scope capabilities or else initiate partnerships with suitable organizations specialized in the required areas.

On the supply side, even with a BoP innovation that is appropriate from the technological and socio-economic points of view, i.e. safe, acceptable and affordable, diffusion could still be limited if there are not enough local organizations for maintenance.

On the demand side, the provider's value proposition must match the BoP consumer's perception of need for such added value. For households living in poverty, the most valued innovations are those that give instant gratification or increase their income generating capacity directly. Indeed, there might be no perception of need or want for a pro-poor innovation. In this case, a market would have to be created from scratch. Investment will be needed to transform needs into wants and ultimately trigger effective demand. On the other hand, if the problem is simply one of 'technological inappropriateness' then a better design could solve the problem. Finally, if the lacuna is one of lack of skills to use the innovation or lack of paying capacity – then a solution would have to be designed in terms of education and/or financial schemes that make consumption possible. Thus, adoption failures stemming from the demand side could be

due to problems of expressions of demand and their mismatch with perceptions of the value of the innovation. These points are summarized in figure 3.



The challenges faced by sanitation entrepreneurs can now be better understood. There are pro-poor innovations for which there is no problem of demand except affordability and accessibility. For instance, mobile telephones became popular once an appropriate platform comprising affordable handsets, pay-as-you-go tariff, network coverage and complementary services was created. Then they were perceived as giving instant gratification, adding to social status and increasing productivity. If tomorrow, good quality fridges are created so as to be affordable and accessible, there would be no consumer resistance. On the other hand, there are pro-poor innovations like toilets, which face great challenges, because intended beneficiaries perceive neither a need nor a want for them. In response, social entrepreneurs catalyze demand for such pro-poor innovations through a variety of schemes, before and after provision of the new product.

7. Conclusion

Considering that about two thirds of the world population resides at the bottom of the income pyramid, sustainable development cannot be promoted on an international scale without finding new solutions for the problems faced by these communities. However, pro-poor innovations – their creation and diffusion – have simply not received the kind of attention given to mainstream innovations by economists and management science experts. Indeed, an examination of the emerging stream of management literature related to diffusion of pro-poor innovations revealed that there is little on actual implementation practises (sections 3.1 and 3.2).

In the above context, the main objective of the present paper was to provide more insight on strategies for the diffusion of pro-poor innovations. Presently, market-based delivery systems are also not perfect as there are a number of needs of the poor, for which technological solutions exist, but without any market or non-market system to deliver them effectively (section 3.3). Thus, we attempted to add some insight on

delivery of pro-poor innovations by identifying and analyzing the actual field practises of sanitation entrepreneurs in India.

Through a detailed ethnographic analysis (sections 4-5), we showed that sanitation entrepreneurs start by ascertaining the community's perceived value of the innovation through multi-purpose socio-economic surveys, which serve to initiate relations with the target community. Then they confirm the appropriateness of technology and demand through entertaining-educational workshops, house-to-house visits and focus group discussions. Finally, they construct a closed-loop delivery mechanism that involves 'monitoring', 'accompaniment' and 'resolution of problems' after provision of the innovation. Incentive mechanisms are also employed to elicit user-feedback in order to improve the product and delivery design. The standard delivery models consist of two phases before delivery – pre-construction and construction. However sanitation entrepreneurs follow their target beneficiaries through three phases: pre-construction, construction and post-construction activities. The last activity of accompaniment is most crucial for the success of sanitation diffusion and therein lies the most valuable lessons (section 6).

Our study suggests two main avenues for further research. First, it would be worthwhile to refine and illustrate the checklist developed in this paper (figure 3) with the diffusion experiences of other pro-poor products and services. Some typical examples are water harvesting installations, solar energy panels and health insurance packages.

Second, in the present global economic situation, complete sanitation coverage cannot be achieved by the allocation of public funds alone. Private and social funds have to be mobilized as well. The greater challenge will be to persuade BoP households to take out loans for building proper toilets on the basis that they will improve their health and hence income generation capacity in the medium run. Innovative financial schemes involving credit-bundles for different final uses may be necessary (e.g. combining loans for life insurance with loans for building toilets). A variety of such schemes are in use today in different parts of the world. An evaluation of their efficiency would make a useful contribution.

References

- [1] UNDP, Beyond scarcity: Power, poverty and the global water crisis, in: Human Development Report, United Nations Development Programme, New York, 2006.
- [2] WHO/UNICEF, Progress on sanitation and drinking water in: , WHO/UNICEF Joint Monitoring Programme, 2010, pp. 60.
- [3] J. Mair, I. Marti, Social entrepreneurship research: A source of explanation, prediction, and delight, *Journal of World Business*, 4 (2006) 36-44.
- [4] C.K. Prahalad, S. Hart, The fortune at the bottom of the pyramid *Strategy+Business*, (2002) 54-67.
- [5] B.G. Glaser, A.L. Strauss, *The discovery of grounded theory: Strategies for qualitative research*, AldineTransaction, 1967.
- [6] R.K. Yin, *Case Study Research: Design and Methods*, Third ed., Sage Publications, Thousand Oaks, 2002.
- [7] S. Kvale, *Interviews: An introduction to qualitative research interviewing*, Sage Publications, Inc, Thousand Oaks, 1996.

- [8] K.M. Eisenhardt, Building theories from case study research, in, JSTOR, 1989, pp. 532-550.
- [9] R. Mendoza, N. Thelen, Innovations to Make Markets More Inclusive for the Poor, *Development Policy Review*, 26 (2008) 427-458.
- [10] ILO, Women and men in the informal economy: A statistical picture, in: L.L. Lim (Ed.), *International Labor Organization Geneva*, 2002.
- [11] A.V. Banerjee, E. Duflo, The Economic Lives of the Poor, *Journal of Economic Perspectives*, 21 (2007) 141-167.
- [12] UNDP, *Creating Value for All: Strategies for Doing Business with the Poor*, in, United Nations Development Programme, New York, 2008.
- [13] E. Katz, The Social Itinerary of Technical Change: Two Studies on the Diffusion of Innovation *Human Organization*, 20 (1961) 70-82.
- [14] E.F. Schumacher, *Small is beautiful : a study of economics as if people mattered*, Blond and Briggs, London, 1973.
- [15] F. Stewart, *Technology and underdevelopment*, Macmillan, London, 1977.
- [16] E.M. Rogers, *Diffusion of innovations*, 5th ed., Free Press, New York, 2003.
- [17] C.M. Christensen, H. Baumann, R. Ruggles, T.M. Sadtler, Disruptive innovation for social change, *Harvard Business Review*, 84 (2006) 94.
- [18] S. Hart, *Capitalism at the crossroads: The unlimited business opportunities in solving the world's most difficult problems*, Wharton School Publishing, 2005.
- [19] C.K. Prahalad, *The fortune at the bottom of the pyramid : [eradicating poverty through profits : enabling dignity and choice through markets]*, Wharton School Publications, Upper Saddle River, NJ, 2005.
- [20] P. Kotler, N. Roberto, T. Leisner, Alleviating Poverty: A Macro/Micro Marketing Perspective, *Journal of Macromarketing*, 26 (2006) 233-239.
- [21] M.F. Letelier, F. Flores, C. Spinosa, Developing Productive Customers in Emerging Markets, *California Management Review*, 45 (2003) 77-103.
- [22] N.M. Reddy, J.D. Aram, L.H. Lynn, The Institutional Domain of Technology Diffusion, *Journal of Product Innovation Management*, 8 (1991) 295-304.
- [23] P. Jeffrey, R.A.F. Seaton, A Conceptual Model of Receptivity Applied to the Design and Deployment of Water Policy Mechanisms, *Environmental Sciences*, 1 (2004) 277 - 300.
- [24] A. Ghobadian, *Public-private partnerships: policy and experience*, Palgrave Macmillan, Basingstoke, Hampshire; New York, 2004.
- [25] J. Brugmann, C.K. Prahalad, Cocreating Business's New Social Compact, *Harvard Business Review*, 85 (2007) 80-90.
- [26] R. Franceys, A. Weitz, Public-private community partnerships in infrastructure for the poor, *Journal of International Development* 15 (2003) 1083-1098.
- [27] T. London, D.A. Rondinelli, H. O'Neill, Strange bedfellows: Alliances between corporations and nonprofits, in: O. Shenkar, J.J. Reuer (Eds.) *Handbook of strategic alliances*, SAGE Publications, Thousand Oaks, 2006, pp. 479

- [28] M.B. Bertrand, S. Mullainathan, E. Shafir, Behavioral Economics and Marketing in Aid of Decision Making Among the Poor, *Journal of Public Policy & Marketing*, 25 (2006) 8-23.
- [29] S.V. Ramani, Playing in Invisible Markets: The Market for toilets and empowerment, in: Charles Cooper Annual Memorial Lecture, Maastricht, The Netherlands, 2008.
- [30] F.R. Manibog, Improved Cooking Stoves in Developing Countries: Problems and Opportunities., *Annual Review of Energy* 9(1984) 199-227.
- [31] S. Cairncross, Sanitation in the developing world: current status and future solutions, *International Journal of Environmental Health Research*, 13 (2003) 123-131.
- [32] R. Garcia, F. Bardhi, C. Friedrich, Overcoming consumer resistance to innovation, *MIT Sloan Management Review*, 48 (2007) 82-88.
- [33] E. Simanis, S. Hart, Expanding Possibilities at the Base of the Pyramid, *Innovations*, 1 (2006) 43-51.
- [34] J. Novogratz, Meeting Urgent Needs with Patient Capital, *Innovations*, 2 (2007) 19-30.
- [35] X. Bai, A.J. Wieczorek, S. Kaneko, S. Lisson, A. Contreras, Enabling sustainability transitions in Asia: The importance of vertical and horizontal linkages, in, Elsevier, 2009, pp. 255-266.
- [36] G. de Bruijne, M. Geurts, B. Appleton, Sanitation for all?, in, IRC International Water and Sanitation Centre, Delft, The Netherlands, 2007, pp. 56.
- [37] WELL, Guidance manual on water supply and sanitation programmes, Department for International Development (DFID), London, 1998.
- [38] S.M. Avvannavar, M. Monto, A conceptual model of people's approach to sanitation, *Science of the Total Environment*, 390 (2008) 1-12.
- [39] A.T. Iles, Health and the environment: A human rights agenda for the future, *Health and Human Rights*, 2 (1996) 46-60.
- [40] E. Tilley, C. Lüthi, A. Morel, C. Zurbrügg, R. Schertenleib, *Compendium of Sanitation Systems and Technologies*, Swiss Federal Institute of Aquatic Science and Technology, Dübendorf and Geneva, Switzerland, 2008, pp. 157
- [41] N.C. Saxena, Bridging Research and Policy in India, *Journal of International Development*, 17 (2005) 737-746.
- [42] UN-DESA, India: A Case Study - Related Best Practice or Lessons Learned in Water & Sanitation, 2003, <http://www.un.org/esa/sustdev/csd/csd13/casestudies/case/CaseStudyIndiaws1.pdf>, last accessed 12 Jan 2010
- [43] E. von Hippel, *The sources of innovation*, Oxford University Press, New York, 1988.
- [44] E. von Hippel, *Democratizing innovation*, MIT Press, Cambridge, 2005.

Acknowledgements

We are extremely grateful to Dr. Bhindeshwar Pathak of Sulabh, M.Subburaman of SCOPE and Paul Calvert of Eco-solutions for the extensive and repeated interviews accorded to us. The first author also gratefully acknowledges support from UNU-MERIT under the FINISH programme.