

THE AMERICAN UNIVERSITY OF PARIS
MASTER OF ARTS IN GLOBAL COMMUNICATIONS AND CIVIL SOCIETY

Diffusion and Adoption of Sustainable Sanitation Technology:
A Case Study of Ecological Sanitation in Tamil Nadu, India

A THESIS SUBMITTED IN PARTIAL FULLFILMENT OF THE REQUIREMENTS
FOR THE DEGREE OF MASTER OF ARTS IN GLOBAL COMMUNICATIONS
AND CIVIL SOCIETY

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Paris,
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ACKNOWLEDGEMENTS

I would like to thank Sumathy, Lucas and the staff at EcoPro for their time, kindness and hospitality in helping me with this project. I am incredibly grateful to all of your efforts and patience in working with me to understand the intricacies of this so often overlooked sector. Working with all of you in and around Auroville, Krishnagiri, Bootheri and Tamil Nadu has been an eye-opening and inspiring experience and I have taken with me an incalculable number of lessons.

Professor Talcott, thank you for the original introduction to Auroville, without which the seed for this thesis would not exist. As my final piece of research carried out at AUP (after a very long run), I offer my many thanks to all of the professors, staff and community for always nurturing my ideas and ambitions and providing me with the tools necessary to make any project a reality.

Mom and Umesh, thank you for introducing India to me many years ago and teaching me the patience necessary to love this very unpredictable country. Papa and Judy, you don't know how thankful I am for all of those Monday night phone calls- thank you for all of your love and support, no matter how far away I am.

Finally, my love and gratitude to Tom. I started this project on my own and finished it with you. Your patience and support has been my foundation throughout this adventure.

Diffusion and Adoption of Sustainable Sanitation Technology:
A Case Study of Ecological Sanitation in Tamil Nadu, India

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2013

The development and marketing of sustainable sanitation technology contributes significantly to improving human and environmental health and reducing economic poverty. Despite extensive studies indicating the positive role sanitation facilities and hygiene-related behavior provide in terms of health benefits and human dignity, diffusion of sustainable sanitation technology remains a low priority among governments, donors and the water, sanitation and hygiene sectors. Consumers are often resistant to sanitation innovations as the diffusion of technologies can confront long-held traditions and beliefs, particularly regarding the practice of open defecation. Few studies have analyzed how socio-cultural norms and behaviors influence sanitation decisions, especially in developing countries. This study aims to understand and empirically measure the processes that lead to Ecological Sanitation (EcoSan) adoption in rural Tamil Nadu, India. The factors that lead to EcoSan acceptance or resistance are surveyed and then Everett Rogers' diffusion of innovations theory is applied to the findings. Finally, the research identifies strategies and innovations used to develop successful sanitation interventions and devises a possible framework for them.

KEYWORDS: ECOSAN, ECOLOGICAL SANITATION, SUSTAINABLE SANITATION, INDIA, DIFFUSION OF INNOVATIONS

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KEY TO ABBREVIATIONS

ADB	Asian Development Bank
AREDS	Association for Rural Education and Development Services
BCs	Backward Classes
CLTS	Community-Led Total Sanitation
CRSP	Central Rural Sanitation Program
DRDA	District Rural Department Agency
EcoSan	Ecological Sanitation
EM	Effective Microorganisms
GDP	Gross Domestic Product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
INR	Indian Rupee
MDG	Millennium Development Goal
NGO	Non governmental organization
PRA	Participatory Rural Appraisal
SC	Scheduled Caste
SHG	Self Help Groups
SSHE	School Sanitation Hygiene Education
TSC	Total Sanitation Campaign
UDDT	Urine Dry Diverting Toilet
UN	United Nations
UNICEF	United Nations Children's Fund
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization
WSP	Water and Sanitation Program

INTRODUCTION

In the past two decades, the issues surrounding a healthy global environment have become a matter of general public concern and the concept of sustainability has assumed a central role in science, politics, and economics (UN, 1987, 1992; Cairncross, 1987; Kates, et al., 2001). The increase in emissions and waste due to rapid urbanization, population growth and poverty are overloading the intake capacity of the natural environment and the resulting environmental and health burdens due to lack of sanitation facilities and inadequate drinking water sources are most affecting the poor in developing countries, especially women and children (Langergraber, et al., 2005; WHO/UNICEF, 2003). According to the World Health Organization (WHO) more than 2.5 billion people- 40 percent of the world's citizens- lack access to any type of improved sanitation facility (2012). In developing countries over 90 percent of sewerage is discharged untreated into lakes, rivers and other water bodies, contaminating drinking water and food with fecal particles and pathogens (Langergraber, et al., 2005, p. 434). As a result, nearly 2 million people die each year due to diarrheal disease- the majority of them children under the age of five (WHO/UNICEF, 2012).

The diffusion of toilets and their significance to improved sanitation has been the study of several different areas of social and economic study. Toilets are a classic pro-poor innovation that empower users by contributing to their ability to move out of poverty and allowing them to benefit from economic growth while respecting their basic right to human dignity (OECD, 2012; IRC, 2006; Cairncross, 1993). Access to sanitation facilities also gives people the freedom and capabilities they need to engage in economic activities and participate in political and cultural life (Sen, 1999; Snell, 2006). Despite

extensive studies indicating the positive role sanitation facilities and hygiene-related behavior provide in terms of health benefits and human dignity, sanitation continues to be a low priority among governments, donors and the water, sanitation and hygiene (WASH) sectors (OECD, 2012).

Research exploring sanitation diffusion in developing countries has revealed a lack of demand, access, affordability, governance, and technical skills at the community and institutional levels (WSP, 2011, 2012; Ramani et al., 2012). In India, where community hygiene practices are deeply embedded in cultural and religious values providing environmentally safe sanitation presents multiple challenges. Diffusion of sanitation technologies confronts long-held traditions and beliefs, particularly regarding the practice of open defecation. Similarly, sanitation is not a socially or culturally appealing subject and rarely appears as a compelling political issue (IRC, 2006). Financially, sanitation projects are difficult to organize as they involve small, repeated expenditures to change individual behavior that are usually more costly than other health projects.

Few theoretical studies have examined how socio-cultural norms and behaviors influence sanitation diffusion in developing countries. In explaining how attempts to change defecation behavior in rural India have been met with limited success, this thesis frames the introduction of Ecological Sanitation (EcoSan) as the appropriate sanitation technology for rural Tamil Nadu, India using diffusion of innovations theory. The objective of this study is to understand the community processes that led to EcoSan toilet acceptance and their use in eight rural villages. Surveys were performed to determine the opinions of EcoSan users and those of their neighbors relating to their experience and

perception of EcoSan toilets. This thesis also assesses different institutional models that were involved in the implementation of EcoSan programs and considers the role of formal and informal institutional mechanisms in enabling sustained behavioral change in hygiene and sanitation.

This study finds that EcoSan technology is a suitable alternative to ‘conventional’ sanitation systems¹ given the appropriate advocacy, design, and education. A review of the literature reveals that optimal technology design makes use of local resources to develop appropriate technologies for the poor (Schumacher, 1973; Stewart, 1977; Rogers, 1995). For many decades, a ‘top-down’ approach to sanitation diffusion focused on giving away or subsidizing latrines without first creating demand, resulting in them being misused or abandoned by their intended beneficiaries (Mosse et al., 1998). It is now widely accepted that in addition to installing the appropriate toilet models, sanitation must involve the interaction between a complex range of institutions, processes and actors, both public and private (Alison, 2002; Iles, 1996). Innovations must also be distinguished from their mere provision and include a two-way process of communication convergence (Rogers, 1995; Ramani, 2012). This thesis finds that women and children play an important role in diffusion of sanitation innovations, and suggests the need for their inclusion in any grassroots or community-based sanitation programs. Finally, achieving lasting behavior change involves creating incentives for optimal adoption and effective utilization by intended beneficiaries (WSP, 2012; Avvannavar, 2008).

¹ In *Closing the Loop* (1998) Stephen Esrey describes two types of conventional sanitation systems: centralized waterborne, “flush and discharge” systems and on-site wastewater disposal systems, also referred to as “drop and store.”

² Pro-poor growth must directly reduce poverty and must be obviously in those sectors

Field Research

Case study research was carried out by the author during a four-month internship with EcoPro, an NGO based out of the Auroville township in the Villupuram district of Tamil Nadu, dedicated to the ecologically sound management of natural resources. EcoPro operates across a variety of waste and resource management projects. Information for this study was gathered through two separate case studies in the Krishnagiri and Villapuram districts and the collection of data from three separate surveys evaluating 50 EcoSan users, 18 neighbors of EcoSan users, and an independent assessment of 76 EcoSan toilets in eight villages. This thesis also employs the participant observation method and includes qualitative data documented in field notes and recordings gathered while the author attended focus groups, educational sessions, and other meetings throughout Tamil Nadu.

Research Problem and Goal

Despite the many benefits of sustainable sanitation for human health and the environment, diffusion of EcoSan technology and practices at both the community and institutional level have been limited. EcoSan application in India, even after many years of vigorous effort, has not been scaled-up, despite the presence of many small projects throughout the country. Building on relevant research carried out by other scholars of the subject, as well as the findings of this thesis, this study seeks to answer the following questions:

What sanitation behaviors are practiced in rural Tamil Nadu? What are the origins of these practices? How does EcoSan address the challenge of improving sanitation coverage in Tamil Nadu- and in rural India? What are the key factors in gaining

community acceptance of EcoSan? In particular, what are diffusion best practices when implementing EcoSan technology? What are the barriers to adoption that sanitation promoters face when scaling-up EcoSan programs? What inferences can be drawn from this study on sustainable technologies as pro-poor innovations?

Research Context

In seeking to understand how EcoSan projects can be scaled-up through community-led, demand-driven implementation plans, this thesis is driven by several assumptions.

The first of these assumptions is that practicing open defecation and the improper use of existing sanitation facilities contributes to a larger dynamic of poverty in India and that sanitation facilities and related hygiene behavior provide great dividends in terms of health benefits and human dignity, especially for women (IRC, 2006). In India, more than two thirds of the population (814 million) live without access to improved sanitation facilities and more than half of the population continues to defecate in the open (UNICEF/JMP, 2012). The annual estimated financial loss of poor sanitation is estimated to be US\$54 billion, or 6.4 percent of India's annual GDP (WSP, 2011, p. 53). Additionally, one in every ten deaths is related to inadequate sanitation or hygiene (2011, p. 36-37).

It is widely accepted that access to sanitation empowers users by contributing to their ability to move out of poverty, allows them to benefit from economic growth, and respects their basic human right to dignity (OECD, 2012; UNICEF, 2012). Toilets are

considered to be a classic pro-poor² 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” (Ramani, et al., 2011, p. 680). Recognizing the accepted definition of sanitation as the “the safe management of human excreta,” including the environmentally safe management of both the ‘hardware’ (latrines and sewers) and the ‘software’ (regulation, education and hygiene promotion) necessary to reduce fecal-oral transmission (IRC, 2006), this thesis posits that current sanitation systems diffused in developing countries are not sustainable. The latrine of choice for sanitation planners remains primarily the flush-based, single-pit latrines because they are less expensive and easier to construct than other toilet models. In India, where only 30 percent of rural households have access to improved water supply and an estimated 21 percent of sewage is effectively treated, flush-based sanitation systems are entirely unsustainable (WSP, 2008; CPCB, 2005).

In 1999, the Government of India launched the Total Sanitation Campaign (TSC) in an effort to improve rural sanitation using demand-driven implementation strategies carried out by government workers acting as change agents. This thesis finds that community-led initiatives, in contrast to the TSC, have been more successful in effecting behavior change throughout India (Chapin, 2011; WSP, 2010) Using a process of social persuasion, grassroots initiatives gradually effectuate normative change from within the community. A review of sanitation programs in India revealed one, the Community-Led

² Pro-poor growth must directly reduce poverty and must be obviously in those sectors where the poor are and must use the factors of production they possess (Klasen, 2003, p. 68).

Total Sanitation (CLTS) Campaign using participatory methods at the community level to trigger effective sanitation and hygiene behavioral change (Movik and Mehta, 2010).

Overview

Chapter One begins by surveying the challenges surrounding the adoption of EcoSan toilets in India in order to frame the issue of improved sanitation to sustainable development in rural Tamil Nadu. This chapter uses Everett Rogers' *Diffusion of Innovations* theory to explore the development of appropriate technologies and pro-poor sanitation technology in India. It concludes by examining the notion of "appropriateness" and how social norms affect delivery and adoption of innovations.

Chapter Two presents field data gathered through survey and participant observation while the author worked with EcoPro from October 2011 to February 2012. It begins by outlining the methodology and design of the study and introduces the work of EcoPro in Tamil Nadu. It then presents findings from both village case studies, *Naralapalli* and *Bootheri*. The three surveys are then presented: their questions, village and participant selection are discussed, and acknowledgments are made regarding the limitations and technical difficulties encountered by this study. Findings are presented according to categories in each survey: survey of EcoSan users, survey of neighbors of EcoSan users, and assessor checklist of EcoSan toilets.

Chapter Three synthesizes the research surveyed in Chapter One with findings presented in Chapter Two. This chapter begins by analyzing data sets presented in Chapter Two through the application of diffusion of innovations theory as articulated by Everett Rogers. It then focuses on communication channels used to deliver sanitation messages and suggests the use of EcoSan incentive and disincentive programs. Finally,

this chapter concludes by exploring a framework for EcoSan that includes technological and communication best practices to optimize the acceptance of EcoSan in rural Indian communities.

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This study is driven by the broader principle that the goal of any development policy and the diffusion of any technology should be sustainable. In order for sustainable sanitation and other development initiatives to be effectively implemented and adopted, environmentally sound management of the earth's natural resources must be a priority for all. Technology must move beyond the conventional 'Western' constructs of modernity and ensure sustainability. A new paradigm for development must emerge ensuring that "development meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland Report, 1987).

CHAPTER ONE: LITERATURE REVIEW

This chapter begins first by surveying the challenges surrounding the adoption of EcoSan toilets in India in order to frame the issue of improved sanitation to sustainable development in rural Tamil Nadu. The second section will examine Everett Rogers' *Diffusion of Innovations* (1995) theory and explore the development of appropriate technologies, specifically the introduction of pro-poor sanitation technology in India. The third section will examine 'appropriateness' of a new idea and the role of communication strategies in effecting the delivery and adoption of innovations.

Sanitation, the Environment and Remedial Efforts in India and Tamil Nadu

Globally, 2.5 billion people lack access to improved sanitation, including 1.1 billion who have no access to facilities and are practicing open defecation (WHO/UNICEF, 2012, p. 1). Poor sanitation comes at a significant global cost to human health and the environment. Nearly 85 percent of all surface water bodies in developing countries are polluted due to poor sanitation and waste disposal practices, causing a substantial health burden as a large number of communicable diseases are transmitted through water (WSP, 2011, p. 7) Most affected are the poor, caught in a "pathogen cycle" in which a contaminated environment places them at greater risk of infection and disease (Esrey, 2001, p. 8). As a result, an estimated 1.7 million people die each year because of unsafe water, sanitation and hygiene practices (WSP, 2012; UN, 2010). In developing countries, young children under the age of five disproportionately account for 90 percent of these deaths with nearly all deaths occurring in the poorest, rural regions. The resulting global economic burden of poor sanitation is significant, costing an estimated US\$260

billion per year, noticeably impacting the GDP of those countries (WHO, 2012, p. 5; WSP, 2011, p. 7)

The UN-WHO Joint Monitoring Program for Drinking Water Supply and Sanitation defines an “improved” sanitation facility as one that “hygienically separates human excreta from human contact” (JMPDWSS, 2006). These facilities include flush toilet models that are piped into sewer systems, septic tanks, or pit latrines, and latrines with slab or composting toilets (WSP, 2011, p. 8). A *sustainable* sanitation system comprises of a toilet, system for collection, treatment, and use of excreta that meets the needs of the user while being simple to use, maintain and repair (Ramani, et al., 2012, p. 680). This system must also address sanitation “from toilet to river,” meaning that pathogens and pollutants must not enter nearby water sources and contaminate the environment (ADB, 2009, p. 18).

At the United Nations Millennium Development Summit held in 2000, 189 countries signed the Millennium Development Goals (MDGs) with the aim of ending extreme poverty, hunger and disease by 2015 (UN, 2012, p. 4). Sanitation, a fundamental element for preventing disease and reducing poverty, was initially absent from the original eight goals (WSP, 2012, p. 3). It was only following evidence showcasing the positive impact of sanitation coverage on health conditions, environmental security and poverty reduction, that policy makers included the goal of halving the number of people without access to improved sanitation as part of the MDGs at the 2002 World Summit on Sustainable Development (Ramani, et al., 2012, p. 679).

Today, sanitation remains one of the developing world’s most intractable challenges. Despite expanded global awareness regarding the critical role sanitation plays

in improving health and overall well-being, it remains poorly resourced and understood (WSP, 2012, p. 3). At an international level, policy makers have affirmed that “the economic case for sanitation and drinking water is no longer in doubt,” and that they are “the key to development, human progress, and dignity” (Neira, WHO, 2010). However, at the current rate of progress, the world will miss the MDG for sanitation by 1 billion people in 2015, with the greatest sanitation shortfalls in South Asia, East Asia and Sub-Saharan Africa. (WHO/UNICEF, 2012).

The Challenge of Sustainable Sanitation

It has only been in the past two decades that issues surrounding a healthy global environment have become a matter of general public concern and the concept of sustainability has assumed a central role in science, politics, and economics (UN/GA, 1987). In 2010, over 90 percent of wastewater in developing countries was estimated to be discharged untreated in surface water bodies, negatively affecting public health, the environment, and the economy (UNEP, 2010, p. 5). The benefits of providing improved sanitation far outstrip costs and are reported to be as high as 7 to 1 for basic sanitation services in developing countries; similarly WASH interventions could help to relieve approximately ten percent of the global burden of disease (OECD, 2010, p. 15).

Providing affordable improved sanitation technology that is also safe for the environment is particularly challenging. The simplest and most affordable sanitation option- single pit latrines- must be covered, moved, and emptied regularly when full. Flush latrines require a readily available water supply, as well as adequate septic tanks and sewerage systems to remove wastewater that lead to a treatment facility (ADB, 2009,

p. 18). The Asian Development Bank recommends using models such as, composting, Urine Dry Diverting Toilets (UDDT) and Ecological Sanitation (EcoSan) systems which break down waste into organic compost as a soil conditioner, lessening the need for chemical fertilizers, reducing groundwater pollution, and diminishing dependence on water (ibid). However, because these models tend to require higher front-end costs for construction and education they are less popular than other less expensive options.

Sanitation in India

In India, sanitation remains a major concern where an estimated 814 million people (66 percent of the population) do not have access to improved facilities (UNICEF/JMP, 2012). The associated costs of inadequate sanitation in India amount to an annual estimated loss of US\$53.8 billion, or 6.4 percent of its GDP (WSP, 2011, p. 53).

The health-related impacts (death, disease, cost and time lost due to treatment) of inadequate sanitation have the most significant impact on the Indian economy. One in every ten deaths is related to inadequate sanitation and hygiene (WSP, 2011, p. 36-37). A lack of access to toilets results in a loss of time, comfort, convenience, dignity, and status, whose effects are most often felt by women and girls (2010, p. 50-51). An estimated 55 percent of the population defecates in the open; this includes 72 percent of rural residents. (ADB, 2010, p. 11; WSP, 2011, p. 20). The resulting 78.6 billion hours spent accessing open defecation sites and shared toilets contributed to a significant loss of time and productivity. The largest losses are experienced by girls at school and women in the workplace, resulting in economic losses totaling US\$10.5 billion (WSP, 2011, p. 52). The effect on drinking water is significant: more than three-fourths of India's surface

water resources are polluted and 40 percent of bacteriological water contamination is due to poor sanitation (2011, p. 18). More than 90 percent of rural households and 50 percent of urban households must treat their water by filtering, purifying, straining, boiling, or using chemicals before drinking it (2011, p. 43). The economic losses due to the cost of water treatment total US\$4.21 billion (ibid.). Finally, tourism related losses are estimated to represent US\$266 million.

Sanitation in India is a complicated process involving a large number of stakeholders that is greatly exacerbated by widespread poverty, social customs, and severe environmental degradation. A highly complex system of formal and informal institutions at the state and grassroots levels and a large number of civil society groups must work together to promote and achieve sanitation goals. Despite significant efforts to scale-up sanitation over the past two decades in India, the poorest majority continue to suffer without access. Most improvements have served the middle and upper classes, with sanitation services improving by less than 10 percent for India's poorest (ADB, 2009, p. 15; UNICEF, 2012, p. 44). Certain areas and population groups in India have a greater resistance to adopting household sanitation facilities than others and there is a lack of research exploring how socioeconomic background characteristics (e.g. residence, caste, education status, and religion) shape cultural attitudes towards using sanitation facilities (ADB, 2009, p. 15-16).

State governments, despite being empowered by the Indian constitution, have generally not taken the initiative in developing sanitation policies. The result has been a strong reliance on NGOs and the central government for policy initiatives and fiscal incentives (Burra et al., 2003, p. 43). The first public program that focused exclusively on

sanitation was the Central Rural Sanitation Program (CRSP) initiated in 1986 by the District Rural Department Agency (DRDA). Under this program, targets were set for toilet construction with the beneficiaries being totally absolved from having to bear the costs of installation, disincentivizing them from any prolonged interest in managing their new toilet system. The toilet model used was the single pit latrine, which overflowed during the rainy season and needed to be covered when not in use or when full. Once full, these toilets also needed to be dismantled and reconstructed over a new pit. For these reasons, the majority of these toilets were abandoned and the success of the CRSP was low, as evidenced by the mere seven percent increase in improved sanitation between 1990 and 2000 (UNICEF/JMP, 2012, p.44).

In an effort to restructure the outdated CRSP, the central government launched the Total Sanitation Campaign (TSC) in 1999, making the program more “demand driven” and “people centered,” with the goal of eliminating open defecation by 2017 (DRDA, 2004). Unlike the CRSP before it, the TSC offers little or no subsidies (between Rs. 1500 to 2500 per household) and uses poverty-based criteria for allocation. Despite significant investment in awareness and education to elicit behavior change, India has been making slow progress. In 1990, only 18 percent of the population had access to improved sanitation, by 2000 this figure had risen to 25 percent and by 2010 it was 34 percent (WSP, 2011, p. 36-37).

Sanitation in the state of Tamil Nadu, this thesis’s main area of focus, ranks among the highest average performers of Indian states (fourth) in terms of rural and urban sanitation coverage and performance (Census, 2011). In Tamil Nadu, 46 percent of households practice open defecation (compared to the national average of 49.8 percent)

and in rural areas open defecation is practiced by 73 percent of the population (ibid). In 2008, a state-wide education program was put in place to train teachers and students how to test water quality, dispose of liquid and solid wastes, the use and maintenance of toilets, and measures to prevent gastrointestinal disorders.

Pro-poor Sanitation Developments in India

Toilets are a classic pro-poor innovation that empowers users by contributing to their ability to move out of poverty, allows them to benefit from economic growth, and respects their basic human right to dignity (OECD, 2012, p. 21). Furthermore, access to safe sanitation facilities gives people the freedom and capabilities they need to engage in economic activities and participate in political and cultural life (Sen, 1999). The challenge of providing safe and sustainable sanitation to India's 814 million who lack improved sanitation facilities is daunting, especially in a country where the introduction of new technologies can confront people's traditions and beliefs (ADB, 2009, p. 7).

The first major innovations in composting toilet models for developing countries were designed by Dr. Bhindeshwar Pathak, founder of the NGO Sulabh, in India in the early 1970's. His original motivation was human rights-based, seeking to develop a toilet model that would allow for the emancipation of manual scavengers or '*Bhangis*,' who represented the lowest stratum of Indian social hierarchy and whose hereditary occupation was to collect and clear human excrement (Avvannavar, 2007, p. 7). In an effort to liberate this group, Dr. Pathak developed an alternative toilet model that could be autonomously maintained. The Sulabh toilet, as it popularly known, is an Indian-style squatting toilet with one hole for flushing, but instead of connecting to a sewage or septic system, the excreta is flushed into one of two deep leach pits. The pits are used

alternatively and the capacity of each is designed for three years of usage. Once full, a family switches to the second pit and the waste in the first pit is gradually and naturally transformed into a dry, pathogen-free, nutrient-rich material that can be used as a soil conditioner and fertilizer. The Sulabh toilet is currently being used in 1.2 million Indian homes and in over 54 million Government constructed toilets (Sulabh International, online). The “Sulabh Sanitation System” has also been declared a “Global Best Practice” by UN HABITAT and is being diffused by the UNDP all over the world (Ramani, et. al., 2011, p. 681).

The Sulabh toilet model, while being suitable for dry areas with a low water table, has proved unsuitable for coastal areas or those with high rainfall due to water logging of the pits. In these regions, a second major innovation emerged in the 1980’s by a British naval engineer, Paul Calvert, who re-invented a version of the existing urine diversion toilet, also know as an ecological sanitation ‘EcoSan’ toilet or UDDT, and added features that made it friendly to Indian users (Ramani, 2012, p. 681).

EcoSan Technology

EcoSan technology is based on a system of dehydration and decomposition of excreta and diversion of urine into a specialized collection device. The process of dehydration and decomposition removes moisture content and rapidly breaks down pathogens, allowing for use directly as a fertilizer and soil conditioner without the need of further processing (Esrey, 1998, p. 20). The toilets can be adapted to wet anal cleansing (“washers”) or dry anal cleansing (“wipers”) and use locally available ash, sand, or wood chips after defecation to absorb the moisture content in the collection chamber. Properly adapted, the toilets can work in either dry or humid climates and across a wide

range of temperatures. Generally, they require a higher initial investment than pit latrines but as a decentralized system there are significantly lower operational costs (Esrey, 2001, p. 4). Groundwater contamination is prevented because the toilets use little or no water and the feces are self-contained in alternating chambers.

EcoSan, through its innovative technological design, is an alternative approach to Western “flush and discharge” toilet systems that are designed on the basis of human excreta as waste only fit for disposal (2001, p. 10). EcoSan recognizes that human waste is a resource that can be recovered and recycled and, properly sanitized, this waste becomes valuable for farming. It is a sustainable sanitation system that effectively “closes the loop” by recovering nutrients from human excreta for food production (2001, p. 12). As a completely decentralized system, based on household or community management, it requires the user to actively participate and take the lead in improving their health, economic and social status. It also expands their horizons through education and strongly encourages a participatory learning approach to hygiene and sanitation practices (OECD, 2012, p. 32) The EcoSan model requires more effort on the part of the promoter and the user, however its significance in economic productivity and environmental sustainability make it an overall better option than traditional single pit latrines.

The first introduction of EcoSan technology into India was in the South Western state of Kerala in the late 1980’s (Esrey, 1998, p. 42). The emerging double-vault toilet was revolutionary because it was the first EcoSan toilet adapted to a population of washers- diverting not only the urine, but also the water used for anal cleansing, into reed beds next to the toilet. The squatting slab was adapted to have three holes: one for urine, feces, and for anal cleansing. A number of Indian social entrepreneurs, NGO’s,

environmental, and public health institutions began the process of advocating for and implementing small-scale EcoSan projects throughout India. In 2011, according to the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), there were approximately twenty-nine ongoing EcoSan projects and 90,000 estimated regular users in India.³ Most importantly, policy makers at the Indian Ministry of Rural Development amended the TSC Guidelines in May 2010 to include EcoSan as a component of its implementation plan. Following this, India became the most populous country in the world making explicit references to EcoSan and its promotion within its national sanitation policy (TSC, 2010; UNICEF, 2010). However, due to the higher costs associated with construction and accompanying educational campaigns compared to other forms of latrines, EcoSan is not a popular choice amongst sanitation planners, engineers, developers, and individual household buyers, as evidenced by the ratio of EcoSan to water-based, flush toilets (129:1,000,000).⁴

EcoSan and Normative Behavior in India

EcoSan toilets require significant handling by the user: when one vault is full and the composting process complete, it must be emptied and applied as a soil conditioner. In chapter four of *Ecological Sanitation*, “Making Ecological Sanitation Work,” Esrey discusses the acceptability of EcoSan toilet systems into different cultures by addressing two specific cultural issues: handling of excreta and proper use of toilets in societies

³ India ranks 7 out of 18 countries with the highest number of EcoSan users, behind Nepal (686,000), Ethiopia (269,000), Bolivia (200,000), South Africa (450,000), China (196,000), and Vietnam (108,000). (GTZ, 2011)

⁴ Based on approximately 90,000 total EcoSan users in India (GTZ, 2011) and a total population of approximately 700,000,000 traditional, flush-based toilet users (WSP, 2011, p. 1)

where washing after defecation is mandated by tradition and or religion (Esrey, et al., 1998, p. 44-45). He determines that some cultures do not mind handling human excreta- “feceophilic”- while others find it ritually polluting or abhorrent- “fecophobic” (ibid). Based on early findings and EcoSan trials, the author finds that most cultures lie somewhere in between these two extremes and reservations disappear with well-managed EcoSan systems.

The extent to which socio-cultural practices have an influence on attitudes towards excreta is a significant factor in the design and diffusion of sanitation technology. In India, sanitation systems must account for anal cleansing in toilet design and social constructs of ritual purity. Although this thesis will not explore the deeper socio-cultural analysis of the Hindu religion beyond what is necessary to understand its place in the sanitation context- it would be impossible to understand the Hindu conception of hygiene without an analysis of the cultural origins of ritual purity.

Hindu Culture and Religious Impurity

In India, hygiene is a normative construct associated with impurity. The Hindu concept of *dharma*, or religious law, has purification (*suddhi*) as one of its main themes. Historian Mark Muesse describes this concept as linked to “intense concern with cleanliness” as a means of “ritual purity,” a state of cleanness required to approach what is holy or sacred (2011, 18). According to Hindu doctrine, one may become polluted by coming into contact with someone or something that is impure. Activities considered to be ritually impure include the acts of: tanning and leatherwork, eating meat, contact with

dead bodies, menstruation, scavenging, childbirth, eating with the left hand, or eating food prepared by someone of a lower caste (2011, 20).

In Hindu culture, the left hand is used to wash after using the toilet and should not be used to eat or to touch and hand an object to another person. According to Manu, the progenitor of mankind who voices the “law of the social classes,” there are twelve bodily secretions considered impure, excrement being one of them- and the “lowly fate reserved for the left-hand,” known in Tamil as the “hand of filth” (Dumont, 1970, p. 49). The relationship of excrement to impurity has been further defined by the traditional practice of manual scavenging. Traditionally, it was the job of the *Dalits* (scheduled castes) to collect night soil- the excrement from dry latrines- as the act was considered to be unclean, impure, and the enormously ritually polluting. Despite the practice being banned in 1993, the act of cleaning a toilet has remained deeply linked to *Dalit* society, an acutely discriminated group in Indian society. There continues to exist some 13 million bucket latrines, requiring over 700,000 scavengers conducting house-to-house excreta collection (Duenas, 2009). Historian Sagarika Ghose explains how racism towards Dalits is deeply ingrained in Indian society: “Every child born into an upper-caste Hindu family grows up with a mind’s eye image of the *acchyut* [Untouchable]. The imagined Untouchable is squalid in appearance and it is the religious duty of a “pure” Hindu to consider him perpetually inferior” (2003, p. 87). Because the caste system remains an engine of Hindu society, and before the general public can be expected to make the transition towards new systems of sanitation that challenge traditional practices, a complete understanding of any cultural taboos and stigmas towards feces must be fully explored before adoption of EcoSan can take place.

Diffusion of Innovations in India

How innovations are designed and marketed to their intended beneficiaries is essential to their adoption. In *Diffusion of Innovations* (1995) Everett Rogers seeks to explain how new innovations are adopted by a population. He defines diffusion as “the process by which an innovation is communicated through certain channels over time among members of a social system” (1995, p. 5). The diffusion process Rogers refers to is mediated through a two-way process of communication convergence rather than a one-way linear act (Rogers and Kincaid, 1981). Taking a different turn from other theories of behavior change, which focus on persuading individuals towards change, *Diffusion of Innovations* sees change as the evolution or “reinvention” of products and behaviors so they become better fitted for the needs of individuals or groups. He discusses diffusion as a process with four key elements (Rogers, 1995, p. 11-13):

- 1 The innovation: an idea, practice or object that is perceived as new by individuals or a group of adopters.
- 2 Communication channels: the means by which innovations move from individual to individual or group to group.
- 3 Time: the non-spatial interval through which the diffusion events occur. The events include the innovation-decision process, the relative span of time for the individual or group to adopt the innovation and the innovations’ rate of adoption in a system.
- 4 Social system: a set of interrelated units that are engaged in a joint problem of solving activities to accomplish a goal or goals.

“Diffusion,” per Rogers, is a particular type of communication in which the content exchanged is concerned with a new idea (1995, p. 17). The concept of newness in the message content means that there is some degree of uncertainty involved in its adoption, especially relating to its ability to influence social change (1995, p. 6). How the innovation message is communicated refers to a specific communication channel and the conditions through which a message will be transmitted (Rogers, 1995, p. 6). Rogers describes two forms of communication channels: “mass media” and “interpersonal.” Mass media channels are the most rapid and efficient means of informing an audience of potential adopters by creating “awareness-knowledge,” however interpersonal communication- face to face exchange between two or more individuals- is more effective in persuading an individual to accept a new idea (1995, p. 18). This shows that diffusion is a social process, and adoption is based on the modeling and imitation by potential adopters of their peers who have adopted previously.

The introduction of any new sanitation innovation must be carried out with consideration and respect for the specific socio-cultural norms of the intended recipients. Successful diffusion of EcoSan is dependent on the platforms used to disperse the sanitation message and communication channels must take into account the resources and functions available to mobilize adoption and effective utilization of a technology (Ramani, 2012, p. 677). Participatory development communication methods are a powerful tool to disperse the intended message from the promoter to the beneficiary. As identified in the literature, communication should be mediated through a two-way process, actively involving community groups, stakeholders and development agents working within the community (Rogers, 1995; Bessette, 2004, p. 1). There are three elements that

must be established prior to the creation and execution of a communications strategy: (1) strong relationships must be developed between both the community and the change agent, (2) the community must be involved in identifying the problem, and (3) they must be involved in determining its solution (Bessette, 2004, p. 4). As will be explored further in this study, these steps are necessary to create lasting social change and shift community behavior.

Demand-Driven Innovations

Identifying the need and confirming the appropriateness of the innovation to serve that need is essential to creating demand for an innovation. A review of the literature reveals that optimal technology design makes use of local resources to develop appropriate technologies for the benefit of the poor (Schumacher, 1973; Stewart, 1977; Rogers, 1995). Appropriate 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. According to Rogers, the appropriateness of any technology is dependent on five characteristics (1995, p. 32):

- 1 Relative advantage: the degree to which an innovation is perceived as better than the idea it supersedes. This is often measured in economic terms, social prestige, convenience or satisfaction.
- 2 Compatibility: the degree to which an innovation is perceived as being consistent with existing values, past experiences, and the needs of potential adopters.
- 3 Complexity: the degree to which an innovation is perceived as difficult to understand and use.

- 4 Trialability: the degree to which an innovation may be experimented with on a limited basis; and,
- 5 Observability: the degree to which the results of an innovation are visible to others.

An innovation can be successfully adopted if it has a strong relative advantage over the existing technology already utilized by the intended beneficiaries. This relative advantage could exist as an economic advantage, simplicity of use, or a greater compatibility with user's norms and existing habits. Understanding and identifying the differentiating features of an innovation and how they are compatible with socio-cultural norms is essential when creating the marketing strategy for diffusion of an innovation (Ramani, 2011, p.681).

Diffusion and Social Systems

Diffusion occurs within a social system- a set of interrelated units that are engaged in joint problem solving to accomplish a common goal, in which the sharing of a common objective binds the system together (Rogers, 1995, p. 24). These networks are usually guided by opinion leaders who convey innovation information to individuals and decrease uncertainty about a new idea (1995, p. 300). Diffusion takes place within the context of structured social relationships- based upon power, norms, and public acceptability. By understanding the relationship between the innovation, the communication channels, and the time (or rate) of adoption, diffusion can be further defined as the cumulative increasing degree of influence upon an individual to adopt or reject an innovation, resulting from activation of peer networks about an innovation in a social system (1995, p. 300).

An adoption decision is, in the sociological sense, a change in normative expectations- the established behavior patterns for the members of a social system. These norms tell an individual what behavior is expected, and define a range of tolerable behaviors by serving as a guide or a standard for the members' behavior in a social system (1995, p. 26 & 218). Open-defecation has been a socially accepted behavior in India for generations and attempts by the Indian government and NGO's to change this behavior have had with limited success. Early sanitation initiatives by the CRSP were oriented towards sanitation coverage and aimed at construction of sanitation facilities, which remained unused and poorly maintained. It was only in 2004, with the revision of the TSC towards behavior change programs, that there was noticeable progress towards improved sanitation coverage.

How social norms and cultural beliefs mediate sanitation related behaviors has not been adequately explored in the Indian context. India is a culture in which the collective is emphasized over the individual and social influence exerts conscious and unconscious pressure on individuals and groups to conform to norms and existing practices.

Norms are a social phenomena which refer to a "variety of behaviors and accompanying expectations" that are propagated among group members through communication (Kincaid, 2004; Bichierri, 2006, p. 2-3). According to Christina Bichierri, norms are distinctive in that they are shaped by expectations of other people's behavior and that adherence to these norms is based on the "forgoing of some benefit" associated with heuristic behavior, rather than rational deliberation of costs and benefits (Bichierri, 2006, p. 2-3, 68). Social norms, per Bichierri, emerge and persist when individuals defer to predisposed social scripts and eventually, habit (ibid). In situations where individuals,

often children, lack the necessary information to make an informed decision on how to behave, “schemata,” defined as “cognitive structures that represent stored knowledge,” are used to make choices (2006, p. 93-94). In order to shift these habits, normative change can be effectively exerted through informal institutions, such as self-help groups, committees, cooperatives and clubs, interpersonal exchanges, and mass media (Bichierri, 2006, p. 170; Rogers, 1995, p. 207-208). These groups and institutions use trust and peer pressure to reshape scripts in support of new norms. When this occurs in larger groups, behavioral information is disseminated from a single original source through the triggering of commonly held scripts within groups of individuals, known as “informational cascades” (Bichierri, 2006, p. 17).

A study of sanitation programs currently in place in India revealed one program using social norms to convey a sanitation message. The Community-Led Total Sanitation (CLTS) approach was developed in Bangladesh in 2004 and has since spread throughout Asia and Africa. CLTS was introduced in India in 2002 and by 2006 had shown remarkable early results despite a low level of policy acknowledgement at the state and central government level (Mehta and Movik, 2011). CLTS recognizes that past sanitation efforts were unsuccessful because they assumed the provision of toilets would result in improved sanitation and hygiene. Instead, through the use of participatory methods, community members analyze their sanitation behavior and the extent to which open defecation affects individuals and the greater community. CLTS uses a behavior change communication strategy called “triggering” to establish a strong emotional appeal- shame, disgust, and embarrassment- that is then disseminated throughout the community (Movik, 2010; Dyalchand, et al., 2011). This is then used in conjunction with persuasive

communication techniques to change sanitation behavior norms at the collective level. Triggering results in a deep sense of embarrassment in the community, accompanied by feelings of disgust for the existing norm of open field defecation.

Though a wealth of literature exists documenting sanitation and its origins throughout the world and in India, little scholarship specifically examines the negative relationship of sanitation to existing Indian social norms. It has been generally assumed that the mere provision of sanitation facilities is enough to facilitate their use and maintenance. A review of existing sanitation programs and reports revealed that despite the presence of sanitation facilities, they often remain unused or abandoned by their intended beneficiaries. This thesis argues that poor sanitation habits must be understood as social norms for their negative affects to be efficiently addressed by grassroots initiatives that encourage sanitation and hygiene-related behavioral change. In order to later demonstrate how poor sanitation habits can be addressed through comprehensive communication strategies that create a demand for sanitation, this study will now present field data gathered while interning with EcoPro in Tamil Nadu.

Limitations of Diffusion of Innovations Theory

Diffusion of innovations theory is a popular method for predicting and explaining diffusion of new technology (Rogers, 1995). As shown through Rogers' research, the theory succinctly explains individuals' adoption decisions and intent to adopt. These decisions are relatively easy to define among homogenous populations with clear boundaries (Lyytinen et al., 2001, p. 174). Rogers explains the process of adoption through different implementation stages that are defined by characteristics of the innovation and the surrounding social system. However, complex technologies often

require a different set of factors that are not accounted for in diffusion of innovations. Rogers assumes that adoption decisions are framed as a rational choice decision between an old and new technology (Lyytinen et al., 2001, p. 178) and diffusion ideas as best communicated through interpersonal and mass media channels (Rogers, 1995). This does not take into account government, industry and other powerful actors who wield significant influence over a given population of adopters. The theory also assumes that interactions between change agents and adopters take place in a homogenous setting. Socio-cultural, economic and political differences among populations mean that diffusion strategies must be individually tailored to each new population.

CHAPTER TWO: METHODOLOGY, CASE STUDY AND FIELD DATA

Methodology

Qualitative and quantitative research methodologies were used to understand how to increase sustainable sanitation coverage in India. In particular, this thesis draws upon existing theory to frame defecation behavior in India to the diffusion of EcoSan toilets in rural Tamil Nadu.

The main objective of the field research was to analyze the introduction of EcoSan toilets at a community level into villages with no existing sanitation structures using the case study and participant observation method. The experience of EcoSan users in the Southern Indian state of Tamil Nadu over the last five years will also be assessed by reviewing existing EcoSan toilets from a technical, financial and social perspective.

Study Design

Factors in EcoSan adoption and diffusion in Tamil Nadu are explored by using case study and participant observer approaches with the household as the unit of analysis. The case study method was employed to achieve the depth required to understand the intricacies of adoption patterns. This thesis also draws on a second study conducted by the author which looked at eight different villages in Tamil Nadu where EcoSan toilets have been built in the last five years. A comparative study of the project outcomes in these villages was analyzed to understand how best to achieve full EcoSan coverage.

Villages were assessed on an individual basis for two reasons. First, the purpose of this paper is to understand the factors that lead to the widespread diffusion of EcoSan toilets. Project and village level details are the key to understanding the success of future

projects and the widespread diffusion on a state or national level. Second, it was clear that many EcoSan toilets built in Tamil Nadu immediately post-tsunami in 2004 were not being used, however, there was no in-depth research or reports outlining the outcomes of these EcoSan projects.

Case Study Selection

The specific case examined is the application of EcoSan into Naralapalli village, in the Krishnagiri District and Bootheri, in the Villupuram District of Tamil Nadu, India by EcoPro, a Tamil Nadu-based organization where the author participated as a research and communications assistant for the period of October 2011 to February 2012. The other six villages selected for EcoSan analysis were chosen under recommendations of EcoPro staff through their existing relationships with these villages.

Primary data for this research was collected during this period through survey administration and participatory research methods, including note-taking, interviews, and participant observation recordings throughout the selected villages.

EcoPro

EcoPro was founded in 2007 to promote the ecologically sound management of natural resources in Auroville, India and the surrounding local communities near Puducherry, Tamil Nadu. Using a multifaceted approach, EcoPro promotes integrated management of liquid and solid wastes, ecologically friendly approaches in environmental hygiene and sanitation, and sustainable methods and technologies in food production. EcoPro operates as both a business and not-for-profit unit in Auroville and classifies its programs into five main categories:

- The distribution and promotion of Effective Microorganisms (EM) technology;
- The construction and promotion of EcoSan technology;
- The construction of decentralized waste water treatment systems;
- The education and promotion of organic farming methods, in particular biodynamic farming and farming with EM solutions;
- Development of non-conventional and less standardized solutions in recycling and re-use of wastewater.

In 2008 EcoPro executed its first UNICEF-funded program, “Wise Water Management” in eight Government High Schools, and again in 2009 and 2010 in twelve girls’ hostels of Backward Classes (BCs) and Scheduled Caste (SC) communities⁵ in the Krishnagiri District of Northern Tamil Nadu. EcoPro has also completed construction of EcoSan toilets in two village households, and has commenced an ongoing EcoSan construction program in Bootheri, a rural community near Tindivanam. EcoPro has acted as a supervisor and partner across a number of EcoSan projects with NGOs Palmyra and UNICEF in rural and coastal villages throughout Southern Tamil Nadu following the 2004 tsunami that devastated the region.

Case Study, Field Observations and Surveys

Case Study One: Naralapalli

UNICEF has a long-standing commitment to improving water supply, hygiene and sanitation systems in Tamil Nadu and has supported the Indian national and state

⁵ According to the government of Tamil Nadu, Minister for Backward Classes and Minorities Welfare, Tamil Nadu’s BCs/MBCs/DNCs (Backward Classes, Most Backward Classes, and Denotified Communities) constitute approximately 67% of the total state population. See list of BCS/MBSc/DNCs in Tamil Nadu, accessed from <http://www.tn.gov.in/bcmw/bclist.htm>

governments by developing and implementing replicable WASH intervention models (UNICEF, 2013). In the latter half of 2011, following the successful execution of a number of WASH projects in partnership between EcoPro and UNICEF, EcoPro was approached to carry out a community level total village sanitation project in Krishnagiri district. EcoPro agreed on condition that the EcoSan system be used.

The 'Water, Sanitation and Health program at a Village Community Level' was launched in June 2011 in partnership between EcoPro and UNICEF with a long-term aim of "complete sanitation of the village in regard to human waste" (EcoPro, 2011). The project was expected to run for six months during which time three main activities were to be undertaken: (1) education, highlighting the links between hygiene and health and those between sanitation and agricultural productivity, (2) construction of 20 to 25 percent additional toilet coverage of the village, and (3) village-wide motivation to invest into toilet construction by means of micro-credits, and to use and maintain these toilets (EcoPro, 2011).

After careful consideration of fourteen villages for project implementation, Naralapalli village was chosen as the project site jointly by UNICEF and EcoPro with initial funding for the program provided by UNICEF. This site was chosen because of its lack of existing sanitation facilities at the village level and defective facilities in the local primary school. The village was also comprised of agricultural farmers with small plots of farmland who could benefit from the resulting compost. Crucial to the selection was the initial enthusiasm of the Naralapalli *panchayat* (district) president who expressed interest towards the construction of EcoSan toilets and demonstrated his support for the project by assuring his full cooperation.

Program Proposal: The proposed sanitation program by EcoPro to UNICEF aimed at improving sanitation, reducing open defecation, and improving drinking water hygiene for a water-poor village. EcoPro conducted several participatory surveys and programs, each of which was expected to increase the villagers' understanding and conviction to stop the practice of open defecation. Initial projections expected that 20 to 25 of the 98 village households would be ready to take micro-credit loans to build EcoSan toilets.

First, the decision to focus the majority of education initiatives on school-age children was crucial to the project's success. Using children as influencers and advocates for sustainable sanitation was a key characteristic of the project. The Narallapali school children would act as channels through which sanitation and hygiene messages would be successfully communicated and then integrated into the larger community. EcoPro recognized that children who use improved sanitation facilities in school, generally begin to require one in their home and reasoned that introducing sustainable sanitation systems would have a similar effect.

Second, the decision to introduce a complete WASH curriculum into the school and later into the village, was important. Conventional WASH programs are usually singular, focusing on only one element such as hygiene, sanitation or water management. EcoPro and UNICEF's approach was multilateral and used education to creatively fuse the three into one concept, effectively instilling the message that one is not without the other. The program design included three phases at the school, village and farming levels that integrated hygiene and sanitation messaging with EcoSan agricultural benefits at the village level.

Third, EcoPro recognized the opportunity to introduce EcoSan toilets into Narallapali- and ultimately into the UNICEF model. The successful outcome of this project would mean a willingness on the part of UNICEF to use the sustainable sanitation model in the future. EcoSan projects are often typically 50 percent more costly than traditional pit latrines so EcoPro was to introduce a financing scheme based on a micro-credit model that would allow for this more expensive sanitation option (Interview, Dengel, 2011). This would allow for the completion of the third phase of the project: 25 new EcoSan toilets to be built and managed.

Project Timeline and Activities: The pilot phase of the Narallapali Village project lasted from July 2011 through September 2011 and consisted of the implementation five different assessments: to review the village sanitation habits, toilet assessment, drinking water quality and supply, and health check-ups. During this phase EcoPro was able to develop a fuller understanding of the community and develop relationships with village stakeholders. It also allowed them to better understand current sanitation habits specific to the village. The relationship with the Panchayat president was also instrumental during this time as he came to visit the site twice during different assessments and publicly announced his support for the projects. The assessments were carried out exclusively by EcoPro staff members.

The second phase of the project began in October 2011 with the introduction of educational materials such as videos, puppet shows, and educational trips to support the program objectives and the construction of EcoSan-based projects in the local primary school. During the author's time with EcoPro, this phase was underway using WASH education sessions, the repair and replacement of the schools sanitation facilities in an

ecologically sound fashion, and finally the introduction of ecological landscaping for water and waste management through composting and drainage remodelling.

The final stage began in January 2012 and focused on introducing these practices into the wider community at the village level, culminating in the construction of 25 new toilets. It also included exposure visits to Auroville and other successful project sites to showcase positive examples of how EcoSan works on a long-term basis. Unfortunately, due to complications largely relating to political will, the final building stage was never carried out as will be discussed further in the analysis in chapter three.

Case Study Two: Bootheri

The village of Bootheri is located outside of Tindivanam, a city in the Villapuram District of Tamil Nadu. As the population of Tindivanam has grown, much of the land used by Bootheri residents for farming has been encroached upon, leaving little free space for open defecation and a lack of privacy when practicing open defecation.

Bootheri was chosen as an EcoSan project site because it was the birthplace of EcoPro's Senior Technical Officer, P. Sumathy. Sumathy's vested interest in her hometown and her strong contacts made her the most effective change agent in the village, and meant that the likelihood of success in implementing EcoSan toilets would be much greater than in other villages.

The original proposal focused only on the construction of EcoSan toilets with an emphasis on education and community-led management. Because the chief change agent was from the village and already widely respected in the community, there was already a strong level of trust and eagerness on behalf of many residents to build the toilets.

Initially, all material costs were borne by EcoPro with each family contributing the cost

of labor. EcoPro was testing the construction of a new, two-room EcoSan structure that had both toilet and shower and was subsequently more expensive. As the construction of the first round of toilets (eight) was complete, EcoPro realized that in order to completely sanitize the village, it would be necessary to also provide potable drinking water.

The pilot phase of the Bootheri project involved different assessments to review the village sanitation habits including existing toilet assessments, drinking water supply and quality, and health check-ups. The Participatory Rural Appraisal (PRA) was carried out over two days in a celebratory fashion with sweets and performances from a local dance group.

The secondary phase focused on choosing a core group of women to pilot the construction and management of EcoSan toilets. These women were chosen because of their enthusiasm for the projects and by their willingness to contribute financially through contributing to the labor costs of the build. A village-wide screening and discussion regarding sanitation was held, as well as several exposure visits to Auroville to showcase the positive effects of EcoSan on the environment and community.

The third phase was construction, which was carried out in an almost ritual-like fashion and finalized with a celebratory inauguration, as is normally carried out for the inauguration of a new house in India, with simple prayers and sweets. The final festivity was to be held when the first compost vault is opened and the fertilizer is spread in the fields approximately one year from the construction of the toilet. A skilled mason was brought in to instruct a local builder how to construct the toilet and it is hoped that this process can be continued autonomously within the village.

The fourth phase will include the construction of 80 additional toilets by 2014 and regular follow-up of existing toilets. The EcoPro team conducts monthly monitoring that ensures each toilet is being used and maintained. If one family appears to be lacking in either areas they are visited by an EcoPro staff member or a member of the community. The women also work together, suggesting new ways to improve the construction, design or maintenance of the toilets and focus groups are held to discuss these ideas and setbacks.

Village EcoSan User, Neighbor, and Toilet Assessments

During the research phase, the study team and author made household and site visits to different homes in Tamil Nadu. During these visits, EcoPro staff interviewed household members about their use of toilets, sanitation and hygiene habits, and observed existing EcoSan toilets. Based on practical experience and the literature study, two surveys and one checklist were developed for the field study:

- Survey of EcoSan users
- Survey of neighbors of EcoSan users
- Checklist to observe EcoSan toilets

Surveys were designed to be as user friendly as possible with input from EcoPro's Senior Technical Officer and an EcoPro Field Officer. The EcoSan User Survey consisted of 18 questions in four categories: (1) demographic information, (2) motivation for using an EcoSan toilet, (3) management of the EcoSan toilet, and (4) attitudes and perceptions towards EcoSan toilets. The EcoSan Neighbor Survey consisted of 17 questions in three categories: (1) demographic information, (2) knowledge and awareness

of EcoSan toilets, and (3) attitudes, perceptions and willingness to build an EcoSan toilet. The checklist consisted of four questions assessing: (1) years in place, (2) use, (3) cleanliness, and (4) structural integrity. These questions were located at the end of the EcoSan User Survey and were independently assessed by the study team while on location in different villages. Survey questions were phrased in either single answer format (“yes” or “no” or multiple choice), in multiple answer format (“check all that apply”), ranking (“Good” to “Hazardous”), and the option to elucidate all answers. Surveys were hand-written in Tamil and English and administered orally by three EcoPro staff members across seven villages between November 2011 and February 2012.

A total of 68 surveys were completed and 76 toilets were surveyed across villages in the Villupuram and Krishnagiri Districts of Tamil Nadu. Participants were categorized by household as EcoSan users and neighbors of EcoSan users. Each survey took approximately ten to fifteen minutes to answer and were conducted in succession while visiting each village. Households with EcoSan toilets were chosen in each village. Neighbors were defined as those living next to or around a home with an EcoSan toilet. Participants were not provided with answer choices before responding and were encouraged to share any relevant personal stories about open defecation, sanitation and EcoSan toilets.

Additional data during the field study includes: qualitative and quantitative data collected by EcoPro and their partner, UNICEF, during their initial base data collection phase; PRA assessments completed by EcoPro in Bootheri and Naralapalli; documents provided by EcoPro staff members for both internal use and external communications,

including reports, Power Point presentations, photographs, the author's note log, and recordings of staff-attended discussions and interviews.

Methodological Limitations and Technical Difficulties

Potential limitations of the methods employed in this study include the following:

Budgetary and Time Constraints – Due to both budgetary and time restraints the author was unable to conduct more than 68 surveys in three different districts, as such these results cannot be statistically indicative of the more than 90,000 EcoSan toilets constructed throughout India (GIZ, 2011). The author was also not present for the full project cycles of the EcoPro and UNICEF project in Narallapali or Bootheri and thus must rely on third party accounts or recordings of the actions taken.

Sample demographics: Survey administration was dependent on the EcoPro knowledge and proximity to past project sites. These sites are in the EcoPro and partner NGO networks and not representative of other NGO projects on a wider scale.

Language: The author does not speak the local language, Tamil, and therefore relied on third party translations for all qualitative data.

Influence: The presence of EcoPro and NGO staff, including the author, undoubtedly influenced participant behavior and the survey findings. The extent of this is evident in the results and the high discrepancy between EcoSan toilets purported to be “in-use” by survey participants and toilets independently assessed as “not in-use” by surveyors.

Findings

For the purpose of clarity, the findings will be divided into two parts: Case Study Findings and Survey Analysis.

Case Study Findings: The Narallapali project was unable to enter into phase three and complete construction of EcoSan toilets at the village level. Largely due to a lack of political will, EcoPro staff were unable to motivate villagers or the ruling political party to fund the toilets and there was a strong lack of motivational interest at the community level for WASH practices, sustainable or otherwise.

Phase 1: During the PRA carried out in early July 2011 the villagers were cooperative and interactive. Over 60 percent of community members attended the initial session and were enthusiastic about the possibility of building toilets and bettering their village. Throughout all of the assessments, the community remained positive and cooperative, working with EcoPro to carry out surveys and the testing of toilets, water supply and community health. A health and nutrition assessment in the primary school revealed that eight out of ten children were underweight, anemic and tested positive for hookworms and other parasites. It was decided to provide the 90 children at the primary school with a high-protein and carbohydrate snack of lentils to fill the gap in their daily diet. The Panchayat president declared his full cooperation for the project up to the elections to be held in October 2011.

Phase 2: During this phase the primary goal was education of the school children regarding WASH practices and community meetings to further discuss these concepts. A film screening was held first at the school and later in the evening at the community center, and a discussion followed with a question and answer session. In November 2011,

there was also a puppet show, with scripts written by the children, performed before the entire village. Representatives from the Panchayat office also came to this, as well as the Minister of Education for Krishnagiri district.

Phase 3: In December 2011, the Panchayat president expressed his interest in building flush toilets for Narallapali village, reversing his original support for EcoSan toilets. This led to a universal demand by the villagers for flush toilets, technology which could not be supported by the limited water and infrastructure of the village.

The original bid by EcoPro was to build 20 to 25 EcoSan toilets, testing a new model that would have two rooms, one for the double toilet vault and the other as a shower room.

The cost of these toilets was approximately 4,000 INR (USD\$73). The funds were to come from DRDA (Rs. 2,200) and UNICEF (Rs. 4,000) with the household asked to contribute at least Rs. 1,000 (with the option to use a micro-credit assisting NGO).

During this phase no households were willing to contribute to the cost of constructing an EcoSan toilet. UNICEF management then insisted on building flush toilets, to which EcoPro refused.

In Bootheri, the outcome was markedly different from the experience in Naralappalli. Over the course of thirteen months, eight two-room EcoSan toilets were constructed and were in-use, with the plan to construct some 80 more by 2014. At the time of the author's departure no toilet vault was full, however in one focus group some of the village women expressed their enthusiasm and excitement for the day they were to be opened. An experiment was underway in one plot of land to show the effects of urine

on marigold growth. The marigolds treated with urine collected from the EcoSan toilets were almost a foot higher than those without (see Appendix E for photo).

The most noticeable effect was the sense of pride of having a toilet and the privacy that it offered women and younger girls. The neighbors of these families were enthusiastic and also wanted an EcoSan toilet on their property. The construction of the EcoSan toilets had led to a greater general awareness of hygiene and sanitation and many of the villagers were now demanding a clean and potable water supply. Overall, the effect of regular post-construction follow-ups and a deep involvement on behalf of EcoPro led to sustained use and independent user-management of each toilet. For example, EcoPro realized that many women and girls were hesitant to use the toilet in the dark and installed solar-powered electric lighting systems with a single lamp for each of the toilets.

Survey Analysis

Upon completion of the surveys, the obtained data was tabulated and analyzed. Free form answers were translated with the help of a Tamil-speaking EcoPro staff member. The results are presented as outlined in the categories of the survey, focusing on the findings most pertinent to the study, complemented by observations and free response answers to questions posed.

EcoSan User Survey:

Demographic information

Of the fifty total respondents, 44 were women and 6 were men- with five of the men's surveys coming from the same household as the women. The low number of males is due to the fact that the majority of men in the coastal villages were working (fishing

and timber farming) during the daytime hours. The majority of respondents (76 percent) were between the ages of 22 and 50 years old. The surveys were equally divided between agricultural (46 percent) and fishing (54 percent) villages.

Motivation for using an EcoSan toilet

In all of the User Surveys across the eight villages, 94 percent of those interviewed had an EcoSan toilet in their home, with 28 percent also citing access to a community “pay and use” toilet and 18 percent noting that the toilet was in their home in a state of disrepair and unusable. Thirty-three percent of respondents claimed to always use their EcoSan toilet and only twelve percent stated that they never used it. Of the 54 percent who sometimes use their EcoSan toilet, they specified that they use it at night and during the monsoon. When not using their toilet this group practices open defecation and will use the community toilets⁶ in an emergency. When asked, “who in the family uses the toilet?” the majority of respondents answered “all family members” (62 percent). However, when asked to specify which family members, it was found that 33 percent of women and 27 percent of children use the toilet and only two percent of men in the village. Most women noted that their husbands defecate on the beach or in the fields on their way to work in the morning.

All respondents were asked to identify the “motivation to use your EcoSan toilet?” with possible answers outlined as “check all that apply” in the following five categories: fertilizer, privacy, monetary incentives, the “need to have a toilet”⁷, and none.

⁶ Community “pay-and-use” toilets were built in Amandaikuppam in 2010 (Authors notes, 2012)

⁷ The “need to have a toilet” was included in the survey to indicate a household’s overwhelming desire or feeling that they must own a toilet. Preliminary interviews

Seventy-eight percent of participants explained that privacy was the motivating factor for having a toilet, while 51 percent identified the use of fertilizer, 19 percent cited no motivation to using the toilet, seven percent cited monetary incentives, and a significant number (64 percent) of users responded with “need to have a toilet.” Respondents explained that they enjoyed having a toilet, citing privacy benefits and an elevation of status from owning a toilet.

Management of EcoSan toilets

Seventy percent of EcoSan users had their toilets for more than three years, indicative of the early EcoSan toilet models built in coastal villages following the tsunami of 2004. Respondents in Bootheri, Athiganur, Pattiparai, Soolegundah and M.C Palli, had their toilets for one to three years and for less than one year. An overwhelming majority (92 percent) stated that their EcoSan toilets were being used for urination and defecation and all respondents indicated that they use ashes to cover the feces after defecation. When interviewed regarding responsibilities surrounding the management of their toilet, the majority of household members (60 percent) believe that it is the women’s responsibility to clean the toilet, with twenty percent citing that it is everyone in the family’s responsibility to clean it after use and 19 percent indicating that no one cleans the toilet. Emptying the vault when full was cited as a “combined responsibility” of the males and females in the household by 31 percent of respondents, however, the majority (64 percent) cited that they rely on a third party to empty the vault. It was unclear according the study how often the vaults had been opened and used as most households could not clearly cite a date.

indicated that many households understood that they should not defecate in the open and associated this with a general need to own a toilet.

Attitudes and perceptions towards EcoSan toilets

According to the survey, most people (67 percent of surveyed users) are happy using their EcoSan toilet and have a positive view of it. When asked to explain any noticeable benefits of having an EcoSan toilet these respondents explained that they “enjoyed having their own toilet” and 78 percent also stated that privacy was the largest benefit. Only a small minority, eleven of the fifty respondents, reported making use of the urine and compost, and an even smaller group, three out of fifty respondents cited its benefits towards the environment.

Approximately one third (30 percent) of respondents said that they experienced some discomfort with the toilet model. The majority of complaints were management-related, regarding smell, cleaning, and construction of the toilets; or purity-related, with respondents citing that they were “uncomfortable” with the toilet model. Twenty-five percent reported problems cleaning the toilet, as water must be excluded from the feces chamber. Twenty-one percent stated they did not have enough ash to cover the feces, a further 27 percent noted that the building structure had fallen into disrepair, and 13 percent stated that they are unable to collect the compost. A large number of respondents explained that they were “uncomfortable with the toilet type.” When prompted to expand on this, these thirteen respondents cited purity related discomforts, explaining that they were uncomfortable “seeing” the feces in the vault as they went to the bathroom and with the concept of removing the feces to use as fertilizer.

Survey of Neighbors of EcoSan Users

Eighteen neighbors were surveyed while conducting the EcoSan surveys. These households had similar socio-economic backgrounds to the families interviewed during

the EcoSan surveys. Twelve of the eighteen interviewed were women whose main sources of income are derived from fishing or agricultural activities. These neighbors were interviewed regarding access to toilet facilities and sixteen of those interviewed did not currently have a toilet in their home. When asked, “where do you go to the bathroom” 93 percent responded that they or their family practiced open defecation, with only two using the available community toilet. Sixty-seven percent responded that having a toilet was a “high need” or “need” based addition to their home and for their family. When asked to clarify “why,” 93 percent of those interviewed explained that there was no land available for open defecation and the women needed privacy when defecating. A further 27 percent of the neighbors also explained that the water table was too low for a flush toilet (a common problem in fishing villages like Amandaikuppam).

When interviewed regarding their knowledge and attitude towards EcoSan toilets 100 percent of neighbors had heard of one before, with 83 percent citing their neighbors toilet; 50 percent had heard of one from EcoPro and 39 percent from another NGO. Only 28 percent of respondents had no knowledge regarding the use or purpose of an EcoSan toilet; 33 percent understood it’s uses for feces and urine, and 17 percent cited health benefits as a purpose of the toilet. Only three respondents cited the necessity of toilets to prevent groundwater contamination . Forty-four percent of respondents had used an EcoSan toilet in the past. None of the neighbors had ever experienced any discomfort with their neighbor’s EcoSan toilet and 82 percent would be willing to build one in their own home. The majority of these respondents cited privacy and the “enjoyment of having their own toilet” as the reason to have a toilet and only 47 percent cited that they would

make use of the urine and compost. This showed a greater need for education and awareness, as there was a clear lack of understanding of the EcoSan concept.

Assessor Checklist

At the end of each household User Survey the assessor was asked to independently assess the state of the EcoSan toilet in the home. The results were surprising as the assessment of the toilets was vastly different from what was reported by the respondents.

Time in place: Fifty-four of the toilets were located in the post-tsunami affected villages whose toilets were constructed by NGOs Palmyra, the Association for Rural Education and Development Services (AREDS) and UNICEF in 2005, 2006, and 2008. These toilets were between three to five years old at the time of assessment. Ten toilets were constructed by EcoPro beginning in 2009 through 2011 and twelve toilets had been demolished at an unknown time in Amandaikuppam and thus could not be included in the data findings of the study other than to note that they had originally been built.

Use, Structural Condition and Cleanliness: In the User Survey, 74 percent of respondents claimed to use their toilets on a regular basis (“sometimes” or “always”). However, the assessor findings showed that only 27 toilets of a total 64 were actually in-use. The strongest discrepancy came from Amandaikuppam, where it was clear that only three of the 32 constructed toilets were actually in-use. When inspected further, ten toilets were being used as a shower, eleven others were used as storage space and only three of 32 functioning EcoSan toilets in the village were being used for defecation and urination. Structurally, 32 of the 33 toilets were in need of varying degrees of repair- this ranged

from missing toilets caps, structural disrepair (e.g. missing doors or roofs), a lack of collection devices for urine, and cracked or broken pans. The majority (93 percent) were also assessed to be unclean- mud and dirt throughout the room, a lack of sufficient ash in the chamber, the compost was mixed, or the feces were visible on the pan. In contrast, 100 percent of the EcoSan toilets built by EcoPro in Bootheri, Athiganur, Pattiparai, and Soolegundah were assessed to be in-use with only one toilet in need of structural repair and only two deemed to be at a low level of cleanliness.

There were also problems related to collection in two of the five villages- Amandaikuppam and Vadagram. In these villages it was clear that some of the toilets had never been emptied or the vault was cracked and damaged in the back, rendering it unusable. The process for removing the compost in EcoSan toilets is to break open the sealed vault, remove the compost and then reseal it using thin layer of sand and cement. A vault that has been open and resealed is clearly visible and 25 of the vaults in Amandaikuppam had clearly never been opened. When prompted to explain, the respondents cited collection issues- explaining that they were unable or unwilling to do it themselves, or that the appointed person never came to open the vaults. It was unclear in nine toilets how often or when the vault was emptied.

This thesis will now draw upon literature surveyed in Chapter One to explain how sanitation habits can be mediated through participatory development, grassroots communication strategies. The following chapter will also explore how the data collected from these surveys suggests that community-led practices and an understanding of the technological appropriateness of an innovation by the sanitation promoter can mitigate inhibitions to adoption.

CHAPTER THREE: ACCEPTANCE OF ECOSAN

Having presented an outline of the case studies and field data, and established the role in which key stakeholders and local capacity affect perceptions and use of EcoSan, this thesis will now explain how technological appropriateness and communication channels are used in diffusion of innovations theory. The first section will analyze data sets presented in Chapter Two through the application of diffusion of innovations theory as articulated by Everett Rogers. The next section will then explore the communication channels used to distribute the sanitation message and the degree to which this influences adoption. The final section will look at market-based delivery platforms and the extent to which they can be beneficial in diffusing EcoSan systems.

Adoption of EcoSan

The results of this study prove that implementing a successful EcoSan project is dependent upon a number of factors and challenges. EcoSan requires acceptance of not only the technology, but also the associated practices required to use and maintain it. Without the appropriate education, training, and follow-up the results of EcoSan use in the household and at an agricultural level are low, as evidenced by the differences in usage between villages in this study. The villages- Amandaikuppam and Vadagram- that showed the lowest levels of use and maintenance were those which had the least involvement on the part of the promoter and whose beneficiaries were not required to contribute financially to the original construction of the toilet. Contrastingly, those villages in which there was a required household contribution for construction and in

which adequate training and education were provided, are using their toilets effectively and seeing benefits at the agricultural level.

This next section will analyze the technological appropriateness of EcoSan according to Rogers' five characteristics: (1) relative advantage, (2) compatibility, (3) complexity, (4) trialability, and (5) observability (1995, p.32). It will then look at the communication channels used by the sanitation providers of this thesis's intended area of study- the Government through the TSC, international organizations such as UNICEF, and local, community-based organizations such as EcoPro- analyzing the disparities between the perceived relative advantages of the promoter and those of the intended beneficiaries.

1. Relative advantage

In Tamil Nadu over 72 percent of rural communities are currently practicing open defecation, either by choice or due to lack of any suitable alternatives (Census, 2011). The challenge then of EcoSan as an innovation is to become the preferred sanitation system by both sanitation providers- the "promoters," and by their intended beneficiaries, the "users." Accordingly, in order for EcoSan to be better than other forms of sanitation systems it must demonstrate a relative advantage over these technologies, including the technology currently used for the task (in most circumstances, open defecation) (1995, p. 230). Rogers defines relative advantage as the degree to which an innovation is perceived to be better than the idea it supersedes (1995, p. 230). The following section will discuss the perceived relative advantages of EcoSan in terms of health advantages, economic profitability, environmental benefits, and social prestige.

In order to better understand the perceived benefits of EcoSan technology for the user, the EcoSan User Survey asked respondents what the primary “motivation was to use your EcoSan toilet?” Seventy-eight percent of survey respondents were motivated by privacy, and 64 percent also cited a general “need” to have a toilet in their homes, signifying that owning a toilet elevates social status in the community. Others did not feel compelled to use their toilet, as one woman in Amadaikuppam explained, going to the toilet was a social activity and that walking and sitting with her family and neighbors provided her with time away from the household duties (Field notes, 2012). Half of the respondents cited the use of fertilizer and 19 percent mentioned the monetary incentives of higher crop yields. None of the respondents cited health-related benefits to having the toilets. However, during a focus group in Bootheri one of the women mentioned that having access to clean and potable water is as important as having a toilet, with her motivations primarily health-related (Field notes, 2012).

This is significant as the most cited advantages of having an EcoSan toilet from the User Survey are similar to those that would come from having any kind of toilet model- privacy, social standing, and a feeling of general need. The benefits most associated specifically with EcoSan toilets- environmental, financial and health-related- were among the least cited. These benefits are the main point of differentiation between EcoSan and other toilet models and a lack of awareness suggests three possible explanations: the education and awareness has been inadequate, the toilets are being improperly used, and/or there is mismanagement of the system.

This thesis hypothesized that a large part of EcoSan misuse would be based on concepts of religious impurity and an inhibition towards the toilet model. In this study,

although negative normative perceptions towards excrement remain strong, evidence points to the fact that these are overcome through prolonged and proper use of the facilities. Only 19 percent of respondents cited purity-related discomforts with the toilet model, most often claiming that they did not want to “see”⁸ the feces. In these cases the respondents generally explained that they preferred water-based flush toilets because they no longer had to “see” or “think” about the excrement. Of note was the high level of misreporting in Amadaikuppam, where 67 percent of respondents claimed to enjoy their EcoSan toilet. However, a physical assessment of toilets in Amadaikuppam revealed that 91 percent of toilets were not being used. It was clear from physical examinations of the toilets sites that in those villages the majority of beneficiaries never adopted the practice of toilet use. In this village, where the toilets had been constructed post-tsunami in 2004 and were heavily subsidized, those who constructed EcoSan toilets on their property were offered loans for construction and maintenance. The leader of the local women’s self-help group (SHG) later explained that most will claim to use the toilet as they worry that if they admit that they do not it will preclude them from any benefits offered in the future. It is clear that this discrepancy is due to the poorly executed original communication strategies and construction. There was also little follow-up and maintenance of the toilets, and after five years they were in visible disrepair. In these cases, it is possible to conclude that sanitation behaviour had not changed and the practice of open defecation continued to be prevalent throughout the village.

⁸ The toilet model requires the user to pour sawdust (or other organic materials) into the collection chamber after using the toilet. During this time it is possible to “see” the excrement of others who have previously used the toilet.

Health advantages

EcoSan benefits can be grouped into two kinds of advantages: preventive and incremental. Rogers explains that health is a preventive advantage that has a “particularly slow rate of adoption” because beneficiaries have trouble perceiving its relative advantage (1995, p.217). Using the example of smoking, one study made the observation that, “the knowledge generation and knowledge use or application remains problematic” (Oldenburg, et al., 1999). Oldenburg’s study showed that despite a high level of diffusion regarding the negative effects of smoking on human health, only 16 percent of smokers considered quitting for health-related reasons (ibid). In contrast, an incremental advantage of an innovation provides a desired outcome that is visible to its beneficiaries in the near future. The health benefits of improved sanitation are clearly one of its most important user and societal benefits. However, as seen in the User Survey, it is often the least cited reason for one to adopt and use a toilet because the users do not get to see the beneficial results immediately. In Tamil Nadu, where the majority of rural sanitation programs are funded in part by the TSC and intergovernmental organizations like UNICEF, the percentage of toilets actually in use- EcoSan or other- is low and more than two thirds of rural inhabitants continue to practice open defecation (Census, 2011).

Economic Prosperity

The economic benefits of EcoSan technology are one of its most salient and differentiating features from other sanitation systems. EcoSan transforms waste into a nutrient rich fertilizer that has proven capabilities of increasing crop yields (Esrey, 2001; Field notes, 2011). In only four of the eight villages studied were the majority of EcoSan users effectively utilizing their compost and/or urine for agriculture. When interviewed,

these households cited noticeable benefits from urine and EcoSan compost. One education method used by EcoPro is to carry out exposure visits, bringing select members of one village to another to see the positive effects of the toilets in another village. In Bootheri, a marigold field was divided in half to show the effects of urine application. The marigolds with applied urine were approximately one foot taller and the flowers fuller compared to the plot without application. At the time of study, the first group selected by EcoPro for EcoSan construction in Bootheri, were using urine in their kitchen gardens, at the base of their palm trees, and in their fields. The increased marigold and crop yields are a clear incremental advantage, as larger, fuller crop yields mean a higher price and greater profits for these women at the local market.

Environmental Benefits

Similar to the advantages to human health, the benefits to the environment were among the least cited by respondents. Only three of the fifty user respondents cited EcoSan benefits to the environment and three of the neighbors surveyed cited that the toilets helped to prevent groundwater contamination. This can be attributed to the fact that environmental benefits, like health, are preventive advantages with few direct or immediate visible advantages. It is often more complex for intended beneficiaries to perceive the relative advantage of preventive innovations and thus it is understandable why they often do not adopt based on these characteristics alone (Rogers, 1995, p. 218). The environmental benefits are also largely based on the collective use of EcoSan over a long period of time and are thus more difficult to perceive at the individual household level.

At the institutional level, EcoPro's perceived relative advantage for constructing and promoting EcoSan toilets is based on its mission to promote the ecologically sound management of environmental resources (EcoPro, 2011). This does not mean that health and human dignity are not an important factor in their promotion of EcoSan toilets, merely that their primary motivation is ruled by environmental health. The significance of this was evident in Naralapalli, where the Panchayat President changed his mind regarding the construction of EcoSan toilets midway through the program, demanding flush toilets for the community. Despite insistence from the direction at UNICEF to shift the project design to flush toilets, EcoPro refused, as they do not believe in the ecological appropriateness of single-pit latrines. EcoPro's unwillingness to shift the project design to flush toilets became a major source of contention between the two organizations, resulting in UNICEF declaring the project a "failure" and no toilets being built in Naralapalli (Interview, Dengel, 2011).

A review of the participatory development literature suggests that a degree of flexibility is necessary when executing development projects. There are often shifts in community perceptions towards a project when an evaluation reveals other needs than the one initially planned. As was revealed in the Bootheri case with the provision of potable drinking water in addition to the provision of sanitation facilities. In the case of Naralapalli, the change agents had different objectives: UNICEF planned to "sanitize" the village, and EcoPro intended to construct EcoSan toilets. As a result both organizations were at odds when the Panchayat President requested flush toilets. This was also the result of an unrealistic timeline (12 months) where EcoPro could not effectively

implement the necessary behaviour change techniques necessary to create demand for more than just sanitation, but also for the EcoSan toilet model.

Social Prestige

One of the most interesting results of the survey was the perceived need by EcoSan users and of their neighbors of their “need” to have a toilet. When asked to explain any “noticeable benefits to having an EcoSan toilet” 67 percent of respondents claimed that they enjoyed having their own toilet and a further 78 percent cited privacy as the largest benefit. While the users were not prompted to further explain why they enjoyed having a toilet, a discussion of this with EcoPro staff revealed that having a toilet is important to the social status of a villager as many identify owning a toilet with Western concepts of prosperity (Field notes, 2012). There is a sense of pride associated with having a toilet and neighbors regarded their toilet-owning peers as superior for having one. However, the benefit of “having” a toilet does not mean that it will be used correctly, as was seen in Amandaikuppam where 67 percent of villagers claimed to enjoy their toilet despite the fact that 91 percent of them were not in-use or being misused. There is a clear contrast between demand for toilets and their consistent use. As seen throughout this study, the mere provision of toilets does not guarantee their use (Ramani, 2011, p. 680). EcoPro creates demand for the end product, the compost, ensuring the correct and consistent application of the toilets unlike those toilets constructed by UNCEF and Palymra.

2. Compatability

According to Rogers, compatibility is the degree to which an innovation is perceived as consistent with existing socio-cultural values and beliefs, past experiences or previously introduced ideas, and the needs of potential adopters (1995, p. 224). As seen in Chapter One, open defecation has been a socially accepted behavior in rural India for many generations and attempts to change defecation behavior have had limited success. Understanding the pathways that lead to changes in sanitation behaviors and how they are mediated through social relations, structural barriers, community norms and individual intent is imperative to planning locally relevant, culturally specific, and compatible behavior change programs (Dyalchand et al., 2011).

Both EcoPro and the TSC promote sanitation programs among children, as they are typically easier to influence and they bring this information home to their parents and families. As explained by an EcoPro staff member, the strongest sanitation results are from girls who use a toilet in their school and bring that need back to their household, demanding the same rights to privacy in the home. Since 2004, the largest education expenditure of the TSC has been towards School Sanitation Hygiene Education (SSHE) (WSP, 2010, p. 24).

EcoSan toilets are often not initially compatible with existing sanitation behavior and patterns. As explored in Chapter One, patterns of behavior in India are dictated by codes of conduct and structured, hierarchical rules, which serve the purpose of maintaining community order. Per Bichierri, in situations where individuals, often children, lack the necessary information to make an informed decision on how to behave, “schemata” or “cognitive structures that represent stored knowledge” are used to make

choices (Bichierri, 2006, p. 93-94). The act of open defecation is ingrained in childhood scripts of how to behave and, provided with the appropriate form of behaviour change communication, can be subject to change. In order to shift these habits, normative change can be effectively exerted through informal institutions, such as, self-help groups, committees, cooperatives and clubs, interpersonal exchanges, and mass media (Bichierri, 2006, p. 170; Rogers, 1995, p. 207-208). These groups and institutions use trust and peer pressure to reshape scripts in support of new norms. When this occurs in larger groups, behavioral information is disseminated from a single original source through the triggering of commonly held scripts within groups of individuals, known as “informational cascades” (Bichierri, 2006, p. 17).

In the Community Led Total Sanitation communication plan, different change agents are used to promote a sanitation message. Methods of communication include a walk through the village and an assessment of existing open defecation sites, this is known as the “walk of shame.” During the PRA sessions, facilitators use words such as “shit” and “shitting” to shift the discussion away from previously perceived taboo subjects. They use crude symbols, such as putting a hair in human feces and then swirling it in a glass of water to show the effects of open defecation on water contamination. The community imposes sanctions on those who continue to practice open defecation (Dyalchand, 2011, p. 5). Women representing self-help groups threaten to announce the names of non-conformists in the village and children blowing whistles are involved in “shaming” and embarrassing their peers. When these community sanctions do not work, the community can impose fines (ibid). The underlying assumption of CLTS messaging is that once people are convinced about the need for sanitation they endeavor to construct

toilets according to the resources available. The success of the CLTS is a clear indicator that behavioral associations with shame, disgust, and embarrassment are effective at inducing normative social change.

3. Complexity

EcoSan is a complex innovation, as evidenced by high mismanagement and lack of use of toilet facilities in some villages of this study. The apparent use of toilet facilities both as toilets and/or as storage closets for firewood (25 percent) or as shower rooms (30 percent), shows a clear lack of understanding by the user of the toilet model. In Bootheri, an EcoPro administered project, there is monthly follow-up and monitoring and all of the toilets are in-use. This is in contrast to Amadaikuppam, an earlier Palmyra site, where there is no monitoring or follow-up and the majority of toilets are abandoned or misused. In villages that had at least one year of regular monitoring by EcoPro (Soolegunda, Bootheri, Athiganur, and Pattiparai) all of the toilets are still in-use by the household and being used positively for agricultural benefits. Additionally, those villages with regular monitoring found that EcoSan, despite its initial complexity in terms of cleaning and emptying the vaults when full, is a system that becomes increasingly second-nature and viewed as essential by the household over time (Field Notes, 2012).

4. Trialability

Trialability refers to the degree in which an innovation may be experimented with on a limited basis (Rogers, 1995, 245). Once positively viewed by the innovations' early adopters, there is a strong precedent set and the innovation becomes important in the community, as seen in the CLTS implementation of positive sanitation behavior (1995, p.

243). Bootheri is EcoPro's first major EcoSan experiment on a large-scale. The decision to introduce EcoSan toilets slowly, over a three-year period was strategic to creating a demand for EcoSan at the entire village-level. During the author's time with EcoPro, the project was in its first year and the toilets were only eight months old. The decision to wait until after the first vaults were opened before constructing more was strategic to slowly introduce and create a strong demand for EcoPro in the community. There are a number of techniques employed by EcoPro to drive demand for EcoSan. One way was to remove the negative association of the compost by marking the opening of the vault with a small ceremony, during which the family, neighbors and EcoPro say prayers and perform a small religious ceremony. In Bootheri, this first group of women to use the toilets had positive reviews, and coupled with the increased yields due to the use of urine in the field, the first eight toilets were considered a success.

5. Observability

The degree to which the results of an innovation are visible to others, it's observability, is essential to any successful sanitation project. As evidenced by the results of the Neighbor Survey, 82 percent would be willing to build a toilet in their own home. In many cases, clear, observable and positive results are able to over-come a lack of compatibility. In the case of the EcoSan toilet, there are often initial apprehensions regarding the model. For this reason, EcoPro employs the idea of observability in both the pre and post construction periods. During the education and awareness phase, EcoPro uses exposure visits to showcase the positive effects that EcoSan can have at the household and village level. The chosen trial group, who become the early sanitation village leaders, are brought to either Auroville or Krishnagiri (depending on geographic

proximity) and exposed to long-standing EcoSan toilets that have been in-use successfully for more than three years. In the post-construction phase, the positive effects of compost and urine on crop yields is communicated as much as possible, for example in the marigold and kitchen garden experiments in Bootheri. As seen throughout the study, many of the neighbors of EcoSan users felt the desire to have the same incremental advantages as their peers, despite the fact that many of them did not fully understand the preventative benefits of an EcoSan toilet.

Driving Demand for EcoSan

EcoSan faces challenges on two-fronts: both a lack of promotion and supply from sanitation planners and a lack of demand from users. Making EcoSan projects compatible in a fecophobic society requires significantly more involvement on the part of the promoter and the communication methods used to promote EcoSan must be culturally aligned with the intended beneficiary. The misuse and continued practice of open defecation is not related to a certain toilet type. This is directly related to poor communication and failure to introduce behavior change. The act of open defecation, like any sanitation practice, is a habit, and until the need for and benefits of sanitation are realized and internalized in a community, the mere provision of toilet facilities will not achieve total sanitation (WSP, 2005, p. 1)

Market-based diffusion strategies

The trends in diffusion identified in the study from Chapter Two indicate that EcoSan is often being poorly marketed to intended users and that greater exposure to its points of differentiation from other toilets would have a positive impact on the rate of its

adoption. EcoSan projects are time and cost intensive and difficult to scale-up. This section argues that a scaling-up of EcoSan is possible through the promotion of a community led and ‘market-based approach. This method works on the premise that if facilities are to be used effectively, a real demand for their functionality must be created among users (Ramani, 2012, p. 682). This thesis suggests that the first step in introducing EcoSan toilets is to create a greater demand for sanitation in general. As seen in the literature, one of the strongest reactions to sanitation comes from using communication strategies that create a collective feeling of disgust for open defecation and shaming at the community level. Using these techniques at the onset of any sanitation project- EcoSan or other- can effectively introduce the need for sanitation into the village. Following this, the EcoSan toilet model and its relative advantage over other models can be presented to the community.

As recalled in the literature, a real need for the innovation must first be confirmed. Then the compatibility of the innovation to satisfy a given need must be verified, followed by an evaluation of demand and a formulation of the strategy for the innovation’s delivery (Ramani, 2012). Using the model for pro-poor innovation diffusion developed by Ramani, the following section will seek to move beyond the standard method of delivering sanitation technology to one that assures a good fit of the innovation to meet the demand (2012, p. 682).

Phase 1: Assessment of Needs

Understanding the needs of the intended beneficiary is a first and necessary step to developing a behavior change program. Ramani suggests a “socio-economic survey” to gather information on the distribution of ownership of assets and toilets, as well as the

availability of complementary infrastructure that is accessible in the community (2011, p. 682). Most organizations, including the two used in this thesis' case studies- EcoPro and UNICEF- conduct PRAs before the education and construction phase as an evaluation of the needs and willingness of the community. It also allows the organization to interact directly with the villagers, fostering a greater sense of trust between the sanitation promoter and the intended beneficiaries. Before choosing Naralapalli, EcoPro and UNICEF conducted studies on 14 different villages to assess which was most compatible. Once chosen, three separate community PRAs were carried out, involving chalk drawings of open defecation sites and personal, door-to-door interviews, and health checks by EcoPro staff (see photos in Appendix F).

Phase 2: Evaluation of demand

A necessary second step is to evaluate the demand for an innovation and how this is applicable in the community. In the case of sanitation, both the advantages and disadvantages of inadequate sanitation must be communicated in such a way that improved facilities are demanded by the community. EcoPro created a demand for urine in Bootheri by showcasing its effects on different crops, including marigolds and kitchen gardens. The result was a spike in demand by other women in the village to collect urine for use on the base of palm trees, in their fields and around the exterior of their homes- believing that the addition of urine would also bring good luck.

Creating a demand for the final product- compost- is an essential component of ensuring effective use of EcoSan toilets. In the same way that an entrepreneur is guided by a profit motive, and a social entrepreneur by a social mission, this thesis suggests that market-based approaches for the diffusion of an innovation are necessary to ensure

supply and demand of the product (Ramani, 2011, p. 682). Further research must be conducted to assess the feasibility of instituting a collection service strategy using profit-based motives. This could involve setting up networks of large-scale agricultural farms that can benefit from the compost end product of the EcoSan toilet. This works by creating a commodity that has monetary value for both the farmer and the EcoSan toilet owner. EcoPro, or other sanitation programs, could nominate a member of the village to act as a 'collector' of the village compost and operate as medium between the farm and the village. This person could negotiate the price of the compost and earn a commission-based salary from its sale. By treating the compost as a commodity, rather than waste, would ensure the regular and correct use of the EcoSan toilets.

Phase 3: Formulation of a delivery mechanism

Ramani explains the formulation of an effective delivery mechanism in three stages: education campaigns, pilot models that can be tested, and the scaling-up of the project into the community (2011, p. 683). Formulating an effective delivery mechanism and realizing the correct communication channels are critical to the successful adoption of the project by the community. Using a similar model to that of Everett Rogers, Ramani cites trialability and compatibility as key elements to determining how to choose the first sanitation leaders and what mechanisms to use to make the project visible to the rest of the community. In rural Tamil Nadu, sanitation programs must focus on the collective over the individual and use observable results to overcome the social taboos of feces and compost. Diffusion must take place at a level that creates a collective demand by the community for an innovation, similar to the program EcoPro has used in Bootheri.

The original phase of the project in Bootheri was based on a trial of eight households (less than 3 percent of the village population) to test the initial construction and implementation of the toilets. Those eight chosen households then became community leaders and advocates in regards to sanitation. They took pride in this status and used the opportunity to inform and drive demand among the other members of the community. This was different from the case of Naralapalli, where there was very little demand for EcoSan toilets as the majority of early education campaigns were focused on health-related benefits to improved sanitation in schools and there was a lack of political will at the institutional level. As a result, none of the villagers demanded the construction of EcoSan toilets after the Panchayat president declared his desire for the village to have flush toilets.

Phase 4: Post-construction monitoring and evaluation

Many projects do not include appropriate or adequate post-construction follow-through necessary to ensure sustained use of EcoSan (or other sanitation) projects. Given the large number of toilets not in-use in Amandaikuppam and Vadagram, at some stage during the implementation there was not enough need, demand, education or monitoring on behalf of the sanitation promoters and end-users. Rogers refers to incentives when describing the value-enhancement propositions that promoters can make when marketing and implementing an innovation. According to Rogers, “Incentives increase the rate of adoption of an innovation. Adopter incentives increase relative advantage, and diffuser incentives increase the observability with which an innovation is perceived” (Rogers, 1995, p. 221). Using incentive and disincentives is a key component of a sanitation communications plan. EcoSan promoters should explore the use of the marketing the

financial incentives gained by increased crop yields from composting and of sales from the compost end product.

As previously cited, one incentive method utilized frequently by sanitation planners, including EcoPro, is the celebration of the toilet once built and, in the case of EcoSan, another celebration once the first vault is opened and the compost used in the fields. This type of incentive has a strong effect on normative behavior- as users no longer equate compost with waste and feces, and view it instead as a resource that must be valued and used. While EcoPro has initiated small-scale incentive programs (primarily driving demand through the economic incentive of higher crop yields) further studies should be undertaken to determine what other incentive actions could be launched to increase demand for EcoSan toilets.

Finally, it is essential that any post-construction phase include a period of monitoring and evaluation of the toilets and a reassessment of the needs of the users. One of the clearest examples highlighting the need for this feedback mechanism is the use of EcoSan toilets as shower rooms. Over 25 percent of EcoSan users were using their toilet as a shower, a practice that is not compatible with the structure of the EcoSan toilet as the vaults must stay as free from as much moisture as possible. The use of the toilet as a shower is obviously due to a lack of understanding regarding the toilet model from the user, but also shows a clear need and a demand for private shower areas in the home. As a result, EcoPro is the only NGO in South India now committed to building EcoSan “bathrooms” that have two separate rooms: one for the toilet and one for the shower. While this model is more expensive, it reduces the possibility of contamination in the

vault and addresses an important demand by the user, making the toilet more acceptable and user-friendly.

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Keeping in mind the limitations of diffusion of innovations theory in the adoption of complex technologies, this study suggests the formation of a multifaceted approach that takes into account the varying factors involving the technology, adopters and change agents. Communication programs for EcoSan must be demand driven and focus on the differential benefits of EcoSan to overcome any hesitancy in design. Open defecation and a collective cultural aversion towards feces is ingrained in Indian normative culture. Communication channels must then focus on programs that change this perception by creating new injunctive norms that shift individual perceptions about what ought to be done. As long of matters of maintenance and collection are carried out in an efficient and culturally appropriate manner, then many of the issues relating to purity-related discomforts are circumvented.

CONCLUSION

This thesis confirms that a comprehensive approach, which includes several communications and institutional arrangements, is necessary for the effective implementation of a sanitation program. The failure over the past two decades to provide access to safe and improved sanitation facilities in India is due primarily to a resistance towards sanitation and a lack of culturally relevant and socially compatible behavior change programs. Having confirmed that open defecation is a socially accepted behavior, whose origins are defined in the purity regulations of sacred Hindu texts, this study has found that open defecation is not primarily motivated by religious obligation, but by normative expectations and habit.

In fecophobic societies reservations towards toilets disappear with effective behavior change communication strategies and well-managed sanitation systems. Conventional approaches have tackled the issue of poor sanitation by attempting to raise awareness and emphasize the benefits of toilet usage on human health. This marketing of sanitation in order to create individual demand has not resulted in significant progress. Instead, this study has found that in societies where the need for sanitation is not properly understood, a demand for sanitation must be generated at the village and community level. Diffusion of sanitation has been primarily government or state-led in India with sanitation targets defined by the number of people who have access to facilities. As a result, large-scale sanitation projects have not been adopted in communities where they are implemented.

Using diffusion of innovations theory, this thesis finds that EcoSan toilet models are an appropriate technology for rural Tamil Nadu. EcoSan technology- through a

system of dehydration and decomposition- allows for the safe management of human excreta and for its reuse as agricultural compost. The decentralized systems are an alternative to Western systems that use flush technology and water resources to dispose of waste. Although the EcoSan model requires significantly more effort on the part of the promoter and the user, its significance in economic productivity and sustainability make it a better option than traditional, single pit latrines currently being diffused throughout India.

This study suggests a market-based approach to sanitation- its technology and diffusion- should be employed to ensure the delivery of the innovation that satisfies the technical and social appropriateness of its intended beneficiaries. Through a detailed ethnographic study, this thesis identified the successes and failures of different EcoSan projects in rural Tamil Nadu. Successful sanitation projects begin by evaluating the perceived value of sanitation to the community through socio-economic surveying. They then employ the use of education and awareness campaigns to develop an understanding of both the need for sanitation and, more specifically, the benefits of EcoSan toilet models to the community. Incentive mechanisms are employed to improve understanding and use of the system. Following the provision of the innovation, a system of monitoring, evaluation and resolution is constructed to address any post-construction needs.

As seen throughout the research, issues with compatibility of EcoSan toilets were overcome through trialability and observability. It found that the social benefits of owning a toilet were immediately apparent- raised status in the community and privacy- however, the advantages unique to EcoSan were only understood once agricultural yields and increased monetary profits were realized. As determined in the research, eliminating

open defecation and imparting new, positive sanitation habits occurs only when social scripts are reshaped to form new collective norms. EcoPro employed the use of exposure visits to showcase the benefits of EcoSan use at the household and community level. It chose individuals who expressed interest in the program and who eventually became sanitation leaders in the community and representatives of the sanitation message. As communication patterns in India are largely dictated by hierarchical rules and codes of conduct based on the collective over the individual, their successful adoption of the technology was crucial to the diffusion of the EcoSan toilets throughout the community. Finally, incentive systems involving celebrations of the toilet structure and the compost are used to diminish any further negative associations with EcoSan.

Creating a demand for sanitation in the community is an essential first step to effecting successful sanitation projects. The sanitation messaging used by NGOs must engage individuals in the community to take action against harmful sanitation habits. Promotion of the negative aspects of poor sanitation works by evoking a deep emotional response- shame and disgust- and are important tools for creating a collective need for sanitation and driving demand for toilets. Furthermore, the challenges cited by individuals using EcoSan toilets- structural and logistic- need increased research and design to overcome any competency flaws. For example, more efficient systems for collection of compost should be employed in villages that are resistant to feces. Compost is valuable as a fertilizer and this should be capitalized on as an incentive for EcoSan users to use and maintain their toilet.

Future Research

This thesis has examined how successful diffusion of EcoSan is dependent on changing normative behavioural habits and creating a perceived need for sanitation in the community. Future research would benefit from a larger study sample and comprehensive assessment of other EcoSan programs throughout India. A more complete understanding and an aggregate study of past and existing EcoSan programs, as well as their sponsor organizations, would be beneficial to developing a greater understanding of why EcoSan has been unable to be scaled-up in India. The logistical and budgetary restraints in this study prevented further research of other existing EcoSan projects in Tamil Nadu, and an expanded study would be more indicative of Tamil Nadu's 72 million residents. This would allow for a greater understanding of the sanitation habits and adoption best practices to be used when promoting EcoSan.

Throughout this study, EcoSan is referred to as a rural, pro-poor innovation, which is not to discount its effectiveness in middle and upper class urban environments. As identified, there is a strong tendency towards the diffusion of 'Western' concepts and technologies. This can be seen in the upper and emerging middle classes in developing countries who are inclined towards adopting these Western versions of modern technology. Further research into the perceptions of this group towards sanitation, their habits, and their perceptions towards EcoSan as an appropriate sanitation technology would be instrumental to developing a communication framework across a wider scale. This framework would benefit from understanding how to shift the perception of EcoSan as a "poor and rural" sanitation technology to one that can be used across all societal classes.

Sanitation behaviour is largely based on social norms and habits. A greater understanding of how these negatively affect sanitation diffusion in India could provide important pathways identifying how to mitigate negative sanitation behaviour and create culturally and socially relevant communication strategies. While there exists numerous studies regarding the origins of sanitation in India and the existing (or lack thereof) sanitation infrastructure, few studies have related sanitation behaviour to concepts of ritual purity and other normative Hindu behavioral codes. A comparative study between different Indian states would provide deeper insight into the variations of sanitation habits and how this relates to existing socio-cultural normative behavior.

One of the main barriers to EcoSan diffusion is an initial negative opinion towards the toilet model because of the handling of the feces-compost. As identified throughout this thesis, negative perceptions tend to dissipate with well-managed systems. However, in order to diffuse EcoSan on a larger scale, more effective communication strategies must be in place. This study focuses primarily on the effectiveness of interpersonal relationships in diffusing sanitation messages. However, as mentioned in Chapter One, mass media can often be effective in dispelling myths and negative attitudes. Developing a media communications strategy for press would be an efficient way of marketing EcoSan to a wider audience- particularly if a well-known media personality agreed to figurehead the cause.

Developing a clearer framework for driving demand would provide a better understanding of the variations in toilet and excreta use. It is clear from this study that there are two important aspects to creating demand for EcoSan: first, a demand must exist for sanitation, and second, a demand must then be created for EcoSan toilets. A more

detailed study into each of the separate aspects of EcoSan systems, operation, maintenance, reuse, and design flaws would better explain why toilets are in danger of suffering from low utilization. In the case of Bootheri, adding a private room for showering significantly enhanced the appeal of the EcoSan toilet and resulted in a high-level of use and maintenance of the facility. Change agents must then develop follow-through plans and share this information with other NGOs and sanitation providers. The application of this study to a larger framework of sustainable innovations may also reveal other strategies that could be useful in diffusion of EcoSan toilets.

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The potential of EcoSan as a sustainable solution to the global sanitation crisis is impressive. Almost half of the global population- 2.5 billion people- lack access to any type of improved sanitation facility and a further 1.1 billion are practicing open defecation. EcoSan, and other sustainable sanitation systems, are a potential solution to this growing crisis.

Developing and marketing sustainable technologies to the poor in developing countries is an under-explored area of research. As a rapidly growing sector of the global economy, this group has remained largely unexposed to Western, societal constructs of modernity. Supplying “green” options and solutions to this population is an opportunity to meet a growing global demand across a range of sectors. The challenge now is to further develop appropriate technologies and marketing solutions that drive demand and ultimately their successful diffusion.

Appendix A
EcoSan User Survey

1. Village:

- Ammendaikuppam, Villupuram, Tamil Nadu
- Vadagram, Villupuram, Tamil Nadua
- Bootheri, Villupuram, Tamil Nadu
- Athiganur, Krishnagiri, Tamil Nadu
- Soolegunda, Krishnagiri, Tamil Nadu
- Naralapalli, Krishnagiri, Tamil Nadu

2. Gender:

- Male
- Female

3. Age Group?

- 10-15 years
- 15-22 years
- 22-30 years
- 30-50 years
- 50+ years

4. Household:

Adult Males:

Adult Females:

Children Male:

Children Female:

Total:

5. Main source of income?

- Agriculture
- Fishing
- Animal Husbandry
- Rickshaw or Taxi driver

- Shop owner
- Government
- Other

6. Do you currently have a toilet in your home?

- Yes
- No

7. If answered “yes” to the previous question, what kind of toilet do you have?

- Private flush toilet
- Private pit toilet
- Community “pay and use”
- EcoSan or UDDT
- Toilet is broken
- Other:

8. How often do you use your toilet (v. open defecation)?

- Always
- Sometimes
- Never
- At night
- During the monsoon
- Other:

9. If answered “yes” to using an EcoSan toilet, who use the toilet?

- All family members
- Women
- Men
- Children

10. How many years have you had your EcoSan toilet?

- Less than one year
- 1 to 3 years
- More than 3 years

11. How is your EcoSan toilet being used?

- For urination and defecation
- For urination only
- For defecation only
- Other:

12. What is the motivation to use your Ecosan toilet?

- Fertilizer
- Need to have a toilet
- Privacy
- Monetary incentives to build the toilet
- None

13. Whose job is it to clean the toilet?

- Women in the household
- Men in the household
- Children in the household
- All members of the household
- Other:

14. Which materials do you use to cover the feces?

- Ash
- Organic materials
- Sand
- Other:

15. How often have you emptied your ecosan toilet?

- When the next vault is full
- As needed
- Not emptied yet

16. Whose responsibility is it to empty the vault?

- Male family members
- Female family members
- Combined responsibility
- Rely on 3rd party to empty the vault

17. Do you experience any discomfort with your EcoSan toilet?

- Smell
- Problems cleaning
- Not enough ash
- Building is in disrepair
- Unable to collect the compost
- Uncomfortable with the toilet type
- No discomfort- like toilet

18. If you currently use an EcoSan toilet, have there been any noticeable benefits?

- Privacy
- Status
- Makes use of urine
- Makes use of compost
- Makes use of urine and compost
- Good for the environment
- None

Appendix B
Neighbor EcoSan Assessment Survey

1. Village:

- Ammendaikuppam, Villupuram, Tamil Nadu
- Vadagram, Villupuram, Tamil Nadua
- Bootheri, Villupuram, Tamil Nadu
- Athiganur, Krishnagiri, Tamil Nadu
- Soolegunda, Krishnagiri, Tamil Nadu
- Naralapalli, Krishnagiri, Tamil Nadu

2. Gender:

- Male
- Female

3. Age Group?

- 10-15 years
- 15-22 years
- 22-30 years
- 30-50 years
- 50+ years

4. Household:

Adult Males:

Adult Females:

Children Male:

Children Female:

Total:

5. Main source of income?

- Agriculture
- Fishing
- Animal Husbandry

- Rickshaw or Taxi driver
- Shop owner
- Government
- Other

6. Do you currently have a toilet in your home?

- Yes
- No

7. If answered “yes” to the previous question, what kind of toilet do you have?

- Private flush toilet
- Private pit toilet
- Community “pay and use”
- EcoSan or UDDT
- Toilet is broken
- Other:

8. If answered “no” to the previous question, where do you currently go to the bathroom?

- In the bush (open defecation)
- On the beach (open defecation)
- Use community toilet
- Use community toilet in an emergency
- Use toilet at school

9. If answered “no” do you feel that you need a toilet in your home?

- High need
- Need
- Low need
- Do not need

10. Have you ever heard of an EcoSan toilet before?

- Yes
- No

11. If answered “yes,” how?

- Neighbors
- EcoPro
- UNICEF
- Palmyra
- Indian Government
- Other:

12. Do you understand the use of the EcoSan toilet?

- Understands use of both urine and feces
- Understands use of feces as compost
- Understands use of urine
- Understands benefits for the environment
- Health benefits
- No knowledge of benefits

13. Do any of your neighbors have an EcoSan toilet?

- Yes
- No

- If “yes” how many neighbors?

14. Have you ever used an EcoSan toilet?

- Yes
- No

15. Have you ever experienced any discomfort with your neighbors EcoSan toilet?

- Yes
- No
- Comment:

16. Would you be willing to build an EcoSan toilet?

- Yes
- No

17. If selected “yes,” explain why.

- Privacy
- Enjoy having own toilet
- Makes use of urine
- Makes use of compost
- Makes use of urine and compost
- Good for the environment
- Other:

Appendix C: EcoSan User Survey Results

Village	Response Percent	Response Total
Ammandaikuppam, Villupuram, Tamil Nadu	53.06%	26
Vadagram, Villupuram, Tamil Nadu	20.41%	10
Boodheri, Villupuram, Tamil Nadu	16.33%	8
Athiganur, Krishnagiri, Tamil Nadu	4.08%	2
Pattiparai, Krishnagiri, Tamil Nadu	2.04%	1
Soolegunda, Krishnagiri, Tamil Nadu	4.08%	2

Total # of respondents 50.
Statistics based on 49 respondents; 0 filtered; 1 skipped.

Gender	Response Percent	Response Total
Male	12%	6
Female	88%	44



Total # of respondents 50.
Statistics based on 50 respondents; 0 filtered; 0 skipped.

Age Group?	Response Percent	Response Total
10- 15 years	0%	0
15-22 years	22%	11
22-30 years	32%	16
30-50 years	44%	22
50+ years	2%	1



Total # of respondents 50.
Statistics based on 50 respondents; 0 filtered; 0 skipped.

Household	Mean	Response Total
Adult Males	1.24	50
Adult Females	1.62	50
Children Male	1.46	46
Children Female	1.45	47

Total # of respondents 50.
Statistics based on 50 respondents; 0 filtered; 0 skipped.

Main source of income?		Response Percent	Response Total
Agriculture		46%	23
Fishing		54%	27
Animal Husbandry		0%	0
Rickshaw or taxi driver		0%	0
Shop Owner		0%	0
Government		0%	0





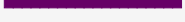
Total # of respondents 50.
Statistics based on 50 respondents; 0 filtered; 0 skipped.

Do you currently have a toilet in your home?		Response Percent	Response Total
Yes		94%	47
No		6%	3




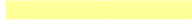
Total # of respondents 50.
Statistics based on 50 respondents; 0 filtered; 0 skipped.

In answered "yes" to the previous question, which kind of toilet do you have?		Response Percent	Response Total
Private flush toilet		0%	0
Private pit toilet		0%	0
Community "pay and use"		28%	14
Ecosan or UDDT toilet		94%	47
Toilet is broken		18%	9

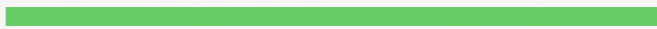


Total # of respondents 50.
Statistics based on 50 respondents; 0 filtered; 0 skipped.






How often do you use your toilet (v. OD)?		Response Percent	Response Total
Always		32.56%	14
Sometimes		53.49%	23
Never		11.63%	5
At night		25.58%	11
During the monsoon		25.58%	11


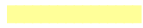

Total # of respondents 50.
Statistics based on 43 respondents; 0 filtered; 7 skipped.

If answered "yes" to using an ecosan toilet who uses the toilet?		Response Percent	Response Total
All family members		62.22%	28
Women		33.33%	15
Men		2.22%	1
Children		26.67%	12
Total # of respondents 50. Statistics based on 45 respondents; 0 filtered; 5 skipped.			


How many years have you had your ecosan toilet?		Response Percent	Response Total
Less than 1 year		14.89%	7
1 to 3 years		14.89%	7
More than 3 years		70.21%	33
Total # of respondents 50. Statistics based on 47 respondents; 0 filtered; 3 skipped.			

How is your ecosan toilet being used?		Response Percent	Response Total
For urination and defecation		92.11%	35
For urination only		2.63%	1
For defecation only		5.26%	2
7			
Total # of respondents 50. Statistics based on 45 respondents; 0 filtered; 5 skipped.			

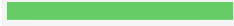


What is the motivation to use your ecosan toilet?		Response Percent	Response Total
Fertilizer		51.06%	24
Need to have a toilet		63.83%	30
Privacy		78.72%	37
Monetary incentives to build the toilet		6.38%	3
None		19.15%	9
Total # of respondents 50. Statistics based on 47 respondents; 0 filtered; 3 skipped.			

Whose job is it to clean the ecosan toilet?		Response Percent	Response Total
Women in the household		60.47%	26
Men in the household		0%	0
Children in the household		0%	0
All members of the household		20.93%	9
No one cleans it		18.61%	8
Comments			3



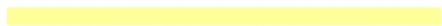
Total # of respondents 50.
Statistics based on 46 respondents; 0 filtered; 4 skipped.

Which materials do you use to cover the feces?		Response Percent	Response Total
Ash		100%	38
Organic materials		0%	0
Sand		0%	0
Comments			8







Total # of respondents 50.
Statistics based on 45 respondents; 0 filtered; 5 skipped.

How often have you emptied your ecosan toilet?		Response Percent	Response Total
When the next vault is full		34.21%	13
As needed		36.84%	14
Not emptied yet		28.95%	11
Comments			8





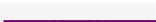

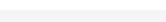
Total # of respondents 50.
Statistics based on 46 respondents; 0 filtered; 4 skipped.

Whose responsibility is it to empty the vault?		Response Percent	Response Total
Male family members		4.76%	2
Female family members		0%	0
Combined responsibility		30.95%	13
Rely on 3rd party to empty the vault		64.29%	27
Comments			3

Total # of respondents 50.
Statistics based on 45 respondents; 0 filtered; 5 skipped.







Do you experience any discomfort with your ecosan toilet?		Response Percent	Response Total
Smell		4.17%	2
Problems cleaning		25%	12
Not enough ash		20.83%	10
Building is in disrepair		27.08%	13
Unable to collect the compost		12.5%	6
Uncomfortable with toilet type		27.08%	13
No discomfort- like toilet.		31.25%	15
Other		4.17%	2



Total # of respondents 50.
Statistics based on 48 respondents; 0 filtered; 2 skipped.





If you currently use an ecosan toilet, have there been any noticeable benefits?		Response Percent	Response Total
Privacy		71.11%	32
Enjoys having own toilet		66.67%	30
Makes use of urine		6.67%	3
Makes use of compost		24.44%	11
Makes use of urine and compost		22.22%	10
Good for the environment		6.67%	3
None		24.44%	11
Other		0%	0

Total # of respondents 50.
Statistics based on 45 respondents; 0 filtered; 5 skipped.

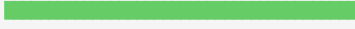



Appendix D: Neighbor of Ecosan User Survey Results

Village?	Response Percent	Response Total
Ammandaikuppam, Villupuram, Tamil Nadu 	38.89%	7
Vadagram, Villupuram, Tamil Nadu 	11.11%	2
Boodheri, Villupuram, Tamil Nadu 	33.33%	6
Kathikuppam, Villupuram, Tamil Nadu	0%	0
Athiganur, Krishnagiri, Tamil Nadu 	5.56%	1
Pattiparai, Krishnagiri, Tamil Nadu 	5.56%	1
Soolegunda, Krishnagiri, Tamil Nadu 	5.56%	1
Total # of respondents 18. Statistics based on 18 respondents; 0 filtered; 0 skipped.		

Gender?	Response Percent	Response Total
Male 	33.33%	6
Female 	66.67%	12
Total # of respondents 18. Statistics based on 18 respondents; 0 filtered; 0 skipped.		

Age group	Response Percent	Response Total
10-15 years	0%	0
15-20 years 	22.22%	4
20-30 years 	44.44%	8
30-50 years 	22.22%	4
50+ years 	11.11%	2
Total # of respondents 18. Statistics based on 18 respondents; 0 filtered; 0 skipped.		

Household?	Mean	Response Total
Adult Males 1.39	1.39	18
Adult Females 1.61	1.61	18
Children Male 1.18	1.18	17
Children Female 1.24	1.24	17
Total # of respondents 18. Statistics based on 18 respondents; 0 filtered; 0 skipped.		

Main source of income?		Response Percent	Response Total
Agriculture		50%	9
Fishing		38.89%	7
Animal Husbandry		5.56%	1
Rickshaw or taxi driver		0%	0
Shop owner		5.56%	1
Government		0%	0
Other		0%	0





Total # of respondents 18.
Statistics based on 18 respondents; 0 filtered; 0 skipped.

Do you currently have a toilet in your home?		Response Percent	Response Total
Yes		11.11%	2
No		88.89%	16
Community Toilet		0%	0

Total # of respondents 18.
Statistics based on 18 respondents; 0 filtered; 0 skipped.

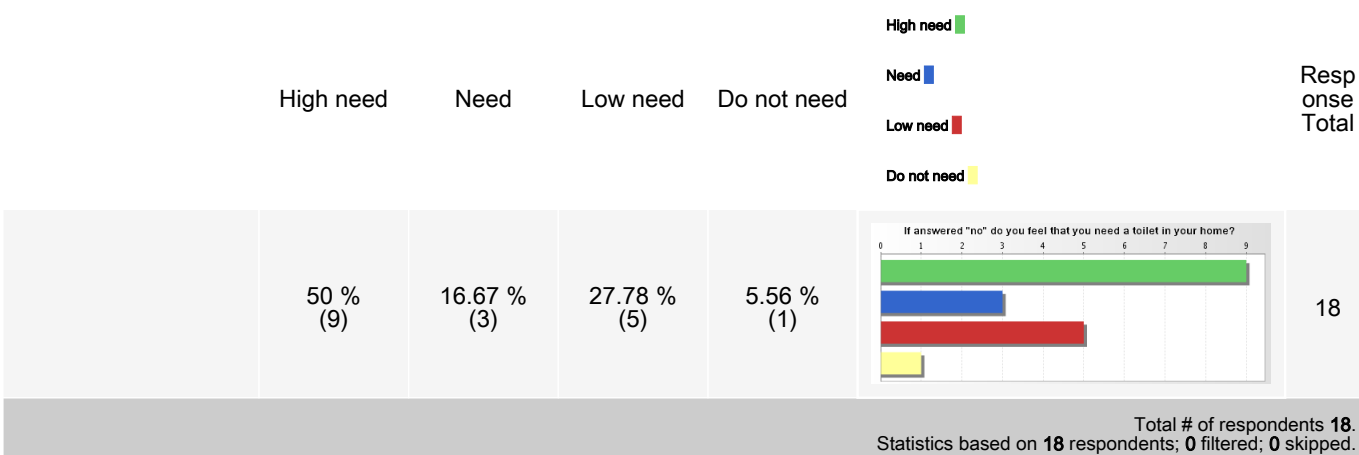
If answered "Yes" to the previous question, which kind of toilet do you have?		Response Percent	Response Total
Private flush toilet		100%	2
Private leach pit		0%	0
Community "pay and use"		0%	0
Ecosan or UDDT		0%	0
Toilet is broken		0%	0
Comments			0

Total # of respondents 18.
Statistics based on 2 respondents; 0 filtered; 16 skipped.

If answered "no" where do you currently go to the bathroom?		Response Percent	Response Total
In the bush (open defecation)		82.35%	14
On the beach (open defecation)		11.77%	2
Use community toilet		11.77%	2
Use community toilet in an emergency		23.53%	4
Use toilet at school		0%	0

Total # of respondents 18.
Statistics based on 17 respondents; 0 filtered; 1 skipped.

If answered "no" do you feel that you need a toilet in your home?



If answered "high need to need" please explain why?	Response Percent	Response Total
Privacy	93.33%	14
No land available for open defecation	93.33%	14
The water table is too low for a flush toilet	26.67%	4
Current toilet is broken or has never worked	0%	0

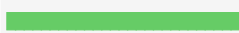

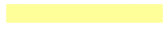
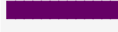

Total # of respondents 18.
Statistics based on 15 respondents; 0 filtered; 3 skipped.

Have you ever heard of an ecosan toilet before?	Response Percent	Response Total
Yes	100%	18
No	0%	0

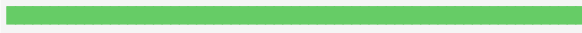

Total # of respondents 18.
Statistics based on 18 respondents; 0 filtered; 0 skipped.

If answered "yes" how?	Response Percent	Response Total
Neighbor(s)	83.33%	15
EcoPro	50%	9
UNICEF	0%	0
Other NGO	38.89%	7
Indian government	0%	0

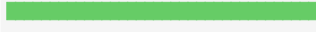

Total # of respondents 18.
Statistics based on 18 respondents; 0 filtered; 0 skipped.

Do you understand the use of the ecosan toilet?		Response Percent	Response Total
Understands use of both urine and feces		33.33%	6
Understands use of feces as compost		27.78%	5
Understands use of urine		0%	0
Understands benefits for the environment		22.22%	4
Health benefits		16.67%	3
No knowledge of benefits		27.78%	5


Total # of respondents 18.
Statistics based on 18 respondents; 0 filtered; 0 skipped.

Do any of your neighbors have an ecosan toilet?		Response Percent	Response Total
Yes		83.33%	15
No		16.67%	3
If "yes" how many of your neighbors have ecosan toilets.			0

Total # of respondents 18.
Statistics based on 18 respondents; 0 filtered; 0 skipped.

Have you ever used an ecosan toilet?		Response Percent	Response Total
Yes		44.44%	8
No		55.56%	10

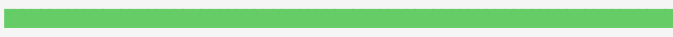




Total # of respondents 18.
Statistics based on 18 respondents; 0 filtered; 0 skipped.

Have you experienced any discomfort with your neighbors ecosan toilet?		Response Percent	Response Total
Yes		0%	0
No		100%	17
Comment:			1

Total # of respondents 18.
Statistics based on 18 respondents; 0 filtered; 0 skipped.

Would you be willing to build an ecosan toilet?		Response Percent	Response Total
Yes		82.35%	14
No		17.65%	3

Total # of respondents 18.
Statistics based on 17 respondents; 0 filtered; 1 skipped.

If selected "yes" explain why.		Response Percent	Response Total
Privacy		93.33%	14
Enjoy having own toilet		86.67%	13
Makes use of urine		0%	0
Makes use of compost		6.67%	1
Makes use of urine & compost		46.67%	7
Good for the environment		6.67%	1
Other		0%	0

Total # of respondents 18.
Statistics based on 15 respondents; 0 filtered; 3 skipped.

Assessor Survey of EcoSan Toilets (cont'd)

Surveyor Assessment of EcoSan Toilets in Rural Tamil Nadu October 2011 to February 2012																																			
Toilets	In-use?		Year Built	Organization	Structural Assessment					Cleanliness					Demolished	Other notes*																			
	Yes	No			1	2	3	4	5	1	2	3	4	5		Toilet used correctly?		Used as shower?		Storage?		Collection?		Unable to assess											
																Yes	No	Yes	No	Yes	No	Yes	No												
Athiganur																																			
1	1		2009	EcoPro	1							1					1		1	1															
2	1		2009	EcoPro	1								1					1		1	1														
Pattiparai																																			
1	1		2010	EcoPro	1								1					1		1	1														
Soolegundah																																			
1	1		2009	EcoPro	1								1					1		1	1														
Renganathapuram																																			
1	1		2008	AREDS	1								1					1	1			1	1												
2	1		2008	AREDS	1									1	1							1	1												
3	1		2008	AREDS		1								1	1							1	1												
4		1	2008	AREDS		1								1				1	1			1	1		1										
5	1		2008	AREDS		1								1						1		1	1												
6	1		2008	AREDS	1									1		1				1		1	1												
7	1		2008	AREDS	1									1						1	1	1	1												
8	1		2008	AREDS			1							1	1					1	1	1	1												
9	1		2008	AREDS	1									1						1	1	1	1												
10	1		2008	AREDS		1										1				1	1	1	1												
Narallapalli																																			
0																																			
	27	37				18	9	6	25	3		17	10	14	16	6			21	43	18	42	16	47	23	32	12								

Appendix F
Pertinent Photographs
(All photos by author)



Dysfunctional toilets in Soolegunda school, Krishnagiri



Unclean EcoSan toilets using tiles as covers in Amadaikuppam

EcoSan toilet without roof in Vadagram



EcoSan toilets being used as storage spaces in Amandaikuppam



PRA in Naralapalli, mapping of open defecation sites



Puppet show teaching the schoolchildren in Naralapalli positive WASH practices



Marigold field urine application experiment- left side has urine application, right side does not.



Double room EcoSan toilet in Bootheeri with light, shower and ventilation pipe



Urine diversion for crop application and anal cleansing water filtration system into reed bed.



EcoSan toilet in Pattiparai, 3 years old.



Composting in Naralapalli Primary School



Newly constructed EcoSan toilets in Bootheeri Village

BIBLIOGRAPHY

WORKS CITED

- A Decade of Total Sanitation: Rapid Assessment of Processes and Outcomes*. Report. New Delhi: Water and Sanitation Program- South Asia (World Bank), (2010). Web, 21 May 2011.
- Alison, Marisa. "Balancing Responsibility for Sanitation." *Social Science Medicine* 9.55 (2002): 1539-1551. Print.
- The Central Pollution Board. *Annual Report 2004-2005*. India. The Central Pollution Board, 2005. Web, 15 Sept. 2012.
- Avvannavar, Santosh and M. Mani. "A conceptual Model of People's Approach to Sanitation." *Scientific Total Environment* 1.390, (2008): 1-12, Web, 15 Sept. 2012.
- Bessette, Guy. *Involving the Community: A Guide to Participatory Development Communication*. Penang: Southbound and the International Development Research Centre, 2004. Print.
- Bichierri, Christina. *The Grammar of Society: The Nature and Dynamics of Social Norms*. New York: Cambridge University Press, 2006. Print.
- Burra, Sundar, Sheela Patel, and Thomas Kerr. "Community Designed, Built and Managed Toilet Blocks in Indian Cities." *Environment & Urbanization*, 15.2, (2003). Web, 20 Sept. 2012.
- Cairncross, Sandy. "Sanitation in the Developing World: Current Status and Future Solutions." *International Journal of Environmental Health Research* 13 (2003): 123-131. Web, 11 Dec. 2011.
- Chaplin, Susan. "Indian cities, sanitation and the state: the politics of the failure to provide" *Environment and Urbanization* 23.1 (2011): 57-70. Print.
- Corcoran, Emily, Christian Nelleman, Elaine Barker, Robert Bos, David Osborn, and Heidi Savelli (eds.) "Sick Water: The Central Role of Wastewater Management in Sustainable Development." A Rapid Response Assessment. Norway: United Nations Environmental Program and UN-HABITAT, 2010. Web, 18 Dec. 2012.
- Core Questions on Drinking Water and Sanitation for Household Surveys*. Report. Joint Monitoring Program for Drinking Water Supply and Sanitation (JMPDWSS), Geneva and New York: World Health Organization and United Nations Children Fund, 2006. Web, 21 Sept. 2012.

- District Rural Development Agency. Manual. Chapter 2: Particulars of Organisation Functions and Duties, 2004. Web, 15 Nov. 2011.
- Dueñas, Christina. *Country Water Action: India- Changing the Sanitation Landscape*. Report. Asian Development Bank, 2009. Web, 15 Jan. 2012.
- Dumont, Louis. *Homo Hierarchicus: The Caste System and Its Implications*. Chicago: George Weidenfeld and Nicolson, Ltd., 1970. Web, 15 Sept. 2011.
- Dose, Sagarika (2003) “The Dalit in India” *Social Research*, Vol. 70, No. 1, .83-94 (2003). Web, 15 Sept. 2011.
- Dyalchand, A., and M. Khale, et al. “What Communication and Institutional Arrangements Influence Sanitation Related Social Norms in Rural India?” in L. Mehta and S. Movik *Shit Matters: The Potential of Community Led Total Sanitation* London: Practical Action Press (2011). Print.
- Economic Impacts of Inadequate Sanitation in India*. Report. Water and Sanitation Program, 2011. Web, 15 April 2012.
- Esrey, Stephen, Ingvar Andersson, Astrid Hillers, and Ron Sawyer. *Closing the Loop: Ecological Sanitation for Food Security*. New York: United Nations Development Program (ESDG), 2001. Web, 29 Sept. 2011.
- Esrey, Stephen, Jean Gough, Dave Rapaport, Ron Sawyer, Hebert Simpson, Mayling, Vargas, Jorge, Winblad, Uno (ed). *Ecological Sanitation*. Stockholm: Department for Natural Resources and the Environment, SIDA (1998). Web, 21 May 2011.
- Global Costs and Benefits of Drinking Water Supply and Sanitation Interventions to Reach the MDG target and Universal Coverage*. Report. World Health Organization (2012). Web, 15 May 2012.
- Ghose, Sagrika. “The Dalit in India.” *Social Research*, 70, n. 1, (2003): 83-109. Web, 21 May 2011
- Harnessing Market Power for Rural Sanitation*. Report. Jakarta: Water and Sanitation Program (WSP), 2005. Web, 21 May 2011.
- Hutton, Guy and Laurence Haller. “Evaluation of the Costs and Benefits of Water and Sanitation Improvements at the Global Level.” Report. World Health Organization, 2004. Web, 15 April 2012.
- India -Tamil Nadu Rural Water Supply and Sanitation Project*. Washington D.C. - The Worldbank (2003), Web, 18 Nov. 2012.

India's Sanitation For All: How to Make it Happen. Report. Manila: Asian Development Bank, 2009. Web, 21 May 2011.

Kincaid, Lawrence. "From Innovation to Social Norms: Bounded Normative Influence." *Journal of Health Communication*, 9, n. 1, (2004): 37-57. Web, 21 May 2011.

Klasen, Stephen. "In Search of the Holy Grail: How to Achieve Pro-Poor Growth?" In, *Toward Pro Poor Policies: Aid, Institution and Globalization*. The International Bank for Reconstruction and Development- The World Bank. Washington DC: Oxford University Press, 2004: 63-93. Web, 15 April 2012.

Langergraber, G. and Muellegger, E. "Ecological Sanitation- A Way to Solve Global Problems?" *Environment International*, no. 31 (2005): 434-444. Web, 29 Sept. 2011.

Lyytinen, K. and Damsgaard, J. "What's Wrong With the Diffusion of Innovations Theory? The Case for Complex and Networked Technology." In, *Diffusing Software Innovations*. Ed. Mark Ardia and Barbara Marcolin. Norwell: Kluwer Academic Publishers (2001). Web, 15 April 2013.

Mehta, L. and S. Movik. *Shit Matters: The Potential of Community Led Total Sanitation* London: Practical Action Press (2011). Web, 18 Dec. 2012.

Mendoza, R., N. Thelen. "Innovations to Make Markets More Inclusive to the Poor." *Development Policy Review*, no. 26 (2008): 427-458. Web, 11 Feb. 2012.

Mosse, David, John Farrington, and Alan Rew. *Development as Process: Concepts and Methods for Working with Complexity*. New York: Routledge (1998). Print.

Movik, Synne and Lyla Mehta. "The Dynamics and Sustainability of Community Led Total Sanitation (CLTS): Mapping Challenges and Pathways." *Step Centre* (2010). Web, 15 Feb. 2012.

Muesse, Mark. *The Hindu Traditions: The Concise Introduction*. Minneapolis: Fortress Press, 2011. Web, 21 May 2011.

Neira, Maria. Speaking at the "First Annual High Level Meeting of Sanitation and Water for All." April 2010 at the World Bank in Washington, D.C., Dr. Maria Neira, Director of the Department of Public Health and Environment at the World Health Organization. Presentation.

Oldenburg, Brian, Gavin Turrell, Ingrid McGuffog, and Rebekah Dent. *Socioeconomic Determinants of Health: Towards a National Research Program and a Policy and Intervention Agenda*. Queensland University of Technology, School of Public Health, Ausinfo, Canberra (1999). Web, 15 April 2012.

- Our Common Future*. Report. World Commission on Environment and Development, 1987, Doc A/42/427. Web, 21 May 2011.
- Prahalad, C.K. and S. Hart. "The Fortune at the Bottom of the Pyramid." *Strategy+Business* no. 26 (2002): 54-67. Web, 29 Sept. 2011.
- Progress on Drinking Water and Sanitation*. Report. WHO/UNICEF Joint Monitoring Program, 2012. Web, 15 April 2012.
- Promoting Pro-Poor Growth*. Report. OECD, 2009, Web, 30 March 2012.
- Ramani, Shyama, Shaun SadreGhazi, and Geert Duysters. "On the Diffusion of Toilets as Bottom of the Pyramid Innovation: Lessons from Sanitation Entrepreneurs." *Technological Forecasting & Social Change*, n. 79 (2012): 676-687. Web, 12 Nov. 2011.
- Review of Sewerage and Sanitation Intervention in Urban India*. Final Report. Vol. 1. New Delhi: Water and Sanitation Program- South Asia (World Bank), 2008. Web, 12 Nov. 2011.
- Rogers, Everett and Lawrence Kincaid. *Communication Networks: Toward a New Paradigm for Research*. New York and London: Free Press, 1981. Print.
- Rogers, Everett. *Diffusion of Innovations*. 4th Ed. New York: Free Press (1995). Print.
- Schumacher, E.F. *Small is Beautiful*. New York: Harper & Row, 1973. Print.
- Sen, Amartya. *Development as Freedom*. New York: Knopf, 1999. Print.
- Snell, Marielle and Jo Smet. "The Value of Environmental Sanitation- Case Studies." Report. International Water and Sanitation Centre, 2006. Web, 13 March 2013.
- Stewart, Frances. *Technology and Underdevelopment*. London: Macmillian, 1977. Print.
- What Does It Take to Scale Up Rural Sanitation?* Report. Water and Sanitation Program (World Bank), 2012. Web, 13 March 2013.
- Worldwide List of 324 Documented EcoSan Projects by Various Organizations*. Report. Germany: Gesellschaft für internationale Zusammenarbeit (GIZ), 2012. Web, 29 Sept. 2011.

Works Referenced

- Beder, Susan. "The Role of Technology in Sustainable Development" *Technology and Society*. 13, n. 4 (1994): 14-19. Web, 15 March 2013.

- Bellu, Lorenzo. *Development and Development Paradigms: A Reasoned Review of Prevailing Visions*. Food and Agricultural Organization and EASYPOL, Module 12, 2011. Web, 15 April 2012.
- Carpenter, Stanley. "When Are Technologies Sustainable?" *Phil and Tech*, 1, no. 1&2 (1995). Web, 12 Nov. 2012.
- Daly, H.E., Cobb, J.B. *For the Common Good*. Boston: Beacon Books (1994)
- Dumont, Louis. *Homo-Hierarchicus: The Caste Sytem and Its Implications*. Chicago: The University of Chicago (1970). Print.
- Feenberg, Andrew. "Critical Theory of Technology: An Overview" *Tailoring Biotechnologies*, 1, n. 1, (2005): p. 47-64. Web, 15 May 2013.
- From Promise to Performance, Ecological Sanitation as a Step Towards the Elimination of Manual Scavenging in India* Report. Mass. Institute of Technology (2006). Web, 21 May 2011.
- Hawken, P., Loving, A., Hunter-Lovins, L. *Natural Capitalism: creating the next industrial revolution*. USA: Little, Brown and Company (1999). Print.
- Jones, Sir William (ed.) *Institutes of Hindu Law: or, the Ordinances of Menu, according to Gloss of Culluca Comprising the Indian System of Duties, Religious and Civil*. Calcutta: Printed by order of the Government (1796). Web, 29 Sept. 2011
- Kurzban, Robert and Leary, Mark. "Evolutionary Orgins of Stigmatization: The Functions of Social Exclusion" *Pyschological Bulletin*, 127, n. 2. (2001): p.187-208. Web. 18 Dec. 2012.
- Michael, S. *Untouchable, Dalits in Modern India*. Boulder: Lynne Rienner Publishers, Inc. (1999). Web, 14 Sept. 2011.
- Qureshi, H. and Moyhuddin, H. "Health Status, Diseases, and Economic Development: A Cross-Country Analysis." *The Journal of Developing Areas* 39, no. 2 (2006). Web, 14 April 2012.
- "Promoting Pro-Poor Growth." OECD. Web, 30 March 2012.
- Rees, W.E. "An Ecological Economics Perspective on Sustainability and Prospects for Ending Poverty." *Population and Environment*, 24. (2002) p. 15- 46. Web, 14 Sept. 2011.
- Rees, William E. and Wackernagel, Mathis. "Perceptual and structural barriers to investing in natural capital: Economics from and ecological footprint perspective" *Ecological Economics*, vol. 20, (1997): 3-24. Web, 14 Sept. 2011.

- Rees, W.E. Socially Just Eco-Integrity: Getting clear on the concept. In *Just Integrity*, Peter Miller and Lara Westra (Eds.) Lanham, MD: Rowman and Littlefield. (2002a). Web, 14 Sept. 2011
- Romer, Paul. "The Origins of Endogenous Growth." *American Economic Association* 8, no. 1 (1994). Web, 14 Sept. 2011.
- Smith, J.W. *Economic Democracy: The Political Struggle of the 21st Century*. Armonk, NY: M.E. Sharpe (2000). Print.
- Stiglitz J., Edlin A., DeLong, J. *The Economists Voice*. New York: Columbia University Press (2008). Web, 18 Dec. 2012.
- Stiglitz, J. *Globalization and its Discontents*. New York: Norton & Company (2002). Print.
- Stiglitz, J. *Making Globalization Work*. New York: Norton & Company (2006). Print.
- Vallee, Gerard (ed). *Florence Nightingale on Health in India*. Ontario: Wilfrid Laurier University Press (2006). Print.

