GOING WITH THE FLOW: WHY THE URBAN GOVERNMENT AND NGOS OF

AHMEDABAD, GUJARAT BUILD SEWERAGE-CONNECTED, INDIVIDUAL TOILETS IN

SLUMS

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## **<u>Acknowledgements</u>**

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## I. Abstract

*Many slum occupants suffer from the effects of unhygienic sanitation, creating a public health concern and a moral duty to implement a system that ensures everyone lives in a healthy environment. Ahmedabad's large slum population, constituting 13% of the total urban population, and dismal sanitation facilities make Ahmedabad an ideal city in which to examine the top-down sanitation policy making in India. This exploratory study aims to fully understand why Ahmedabad's urban government (the AMC) and NGOs choose sewerage over alternative technologies and build individual toilets instead of community toilets using primary source data from interviews. It will examine slum communities' sanitation technology and method of access preferences to see if they align with government policies. Inertia drives the AMC's preferences for sewerage while the city's finances and water resources allow them to continue using sewerage. Government schemes and slum communities pressure NGOs to use sewerage. Slum communities do not care which sanitation technology they have, but simply want a properly maintained system. All stakeholders favored individual toilets over community toilets, suggesting that current government policies fit slum communities' preferences. Unless the AMC overcomes the inertia associated with sewerage, the AMC and NGOs will continue to build sewerage-connected, individual toilets.*

## II. Introduction

When Britain's Industrial Revolution took off in the 19th century, an unprecedented number of people crowded into cities. Migrants often lived in hastily constructed, small residences that lacked access to a method of hygienic disposal of human waste, also known as sanitation. The resulting overcrowding and unhygienic disposal of human waste created public health crises in the form of cholera outbreaks and chronic dysentery. Only after the British government enforced laws for providing tenants with sanitation did the deaths from these diseases fall, illustrating the powerful impact sanitation can have on individuals' health (Sretzer 1988). Urban overcrowding and poor sanitation has afflicted other countries the world over since that time, limiting people's long-term opportunities and quality of life. Today, about 35% of the global population still does not have access to a sanitation system and areas without effective sanitation systems continue to allow diseases such as cholera, malaria, dysentery, and diarrhea to flourish (Katukiza et. al 2012).

Lack of sanitation is not only a public health risk but also a moral concern that demands immediate attention. The burden of sickness is an infringement on an individual's right to a healthy life and significantly impacts the ability of that person to provide for his or her family. Furthermore, children who are exposed to human waste and contaminated water supplies are at risk of contracting chronic diarrhea and other intestinal diseases. These illnesses can prevent children from receiving adequate nutrition, regardless of their caloric intake, and can lead to stunting, which irreversibly limits physical and mental development (Gardiner 2014). Unsafe sanitation thus deprives both children and adults of their right and opportunities to be normal healthy persons over their lifetimes and reach their full potentials. It also poses a serious threat to community health.

In 1919, Gandhi noted, "The cause of many of our diseases is the condition of our lavatories and our bad habit of disposing of excreta anywhere and everywhere" (quoted in Gardiner 2014). India still struggles to curtail open defecation and to implement sanitation systems, with approximately 792 million Indians lacking access to safe sanitation (WHO 2014). For the purposes of this paper, "excreta" and "human waste" are defined as urine and fecal material. "Sanitation" refers to the safe management and disposal of human excreta (Government of India 2008). The dismal state of sanitation in India has not gone unnoticed, with the government rolling out several programs in the past 20 years to address this issue.  The largest program to date, the Total Sanitation Campaign (TSC), focused on eradicating open defecation in rural areas from 1999 to 2014 (Spears 2012). Under the Jawaharlal Nehru National Urban Renewal Mission from 2005-2014, the national government spent over $20 billion to provide the urban poor with access to basic services like sanitation and water and fulfill other key needs of urban communities (Government of India 2005). In 2008, the National Urban Sanitation Policy pledged to address the problems in underserved, poor urban communities (National Urban Sanitation Policy).

Sanitation issues remain for both rural and urban communities despite these government efforts and the $6.8 billion in international aid donated to help solve water and sanitation problems in India between 2005 and 2013 (OECD 2013). 65% of people in rural India and 12% of people in urban areas still practice open defecation (UNICEF 2014). As the number of people in Indian cities is projected to grow by 404 million by 2050, there is a pressing need to address lingering sanitation issues to ensure the health of India's burgeoning urban population (UN 2014). The new BJP government has signaled an interest in continuing the effort to improve urban services, as Narendra Modi, the current Prime Minister, reportedly "asked his team of over

100 qualified professionals to find out the financial implications of providing urban infrastructure like drinking water, gutter, solid waste management, storm water drainage, roads, transport and street light in 500 cities" (Venugopal 2014).

The lingering sanitation issues in the business capital of the state of Gujarat, Ahmedabad, prove particularly puzzling; the international development community regards Ahmedabad's development as a model for success, yet the city still falls short of providing necessary sanitation to slum communities. The government of India defines slums as "residential areas where dwellings are in any respect unfit for human habitation by reasons of dilapidation, overcrowding, faulty arrangements and designs of such buildings, narrowness or faulty arrangement of streets, lack of ventilation, light, sanitation facilities or any combination of these factors which are detrimental to safety, health and morals" (Census of India 2011). Ahmedabad received recognition for its "early success in implementing a comprehensive city development plan, which aims to transform India's seventh-largest city into a more livable, equitable metropolis" (Suzuki, Cervero, Iuchi 2013). Similarly, the Slum Networking Project, a collaboration between the Ahmedabad city government and NGOs that started in 1995, has gained international acclaim for its success in upgrading slums by linking them with city services like water and sewer connections (Davis 2002). Currently, the AMC is building permanent housing structures in slums and giving each household a water connection and individual, sewerage-connected toilet (Patel, R. personal interview, April 15, 2015). However, serious gaps in service delivery remain. 23% of slum households, or 38,272 households, in the urban area of Ahmedabad do not have access to an individual or shared toilet (Ahmedabad Municipal Corporation 2013). The ever-lingering problem of inadequate sanitation in slums indicates a need to critically examine the current approach to ameliorating this issue in order to better plan for future programs.

Though India has had a public discourse on the need to improve sanitation since its independence, the types of sanitation technologies used by all levels of government and NGOs, including those in Ahmedabad, have been largely unchanged. In this paper, "sanitation technology" or "technology" refers to the method of safely removing human excreta and consists of both the toilet superstructure, where people actually use the facility, and the system that holds and disposes of the waste. Before 1980, traditional sewerage was the preferred technology used to provide safe sanitation to the urban poor. According to the Government of India, sewerage is "the collective name for a system of sewers [and] consists of a network of buried pipes that convey wastewater from a house to the point of disposal. Sewerage relies upon a sufficient quantity of wastewater flow to convey solids along the pipe to a discharge point," typically a sewage treatment plant (Government of India 2008). Since 1980, many researchers have advocated for simplified sewer systems, which relax the engineering requirements for pipe diameters and gradients to make the system less costly to build, as the best way to provide sanitation to poor urban areas (World Bank 1995; Paterson, Mara, and Curtis 2007; Mara 2003; Mara and Alabaster 2008; Luthi, McConville, and Kvarnstrom 2010). The recent Mahatma Gandhi Swachhata Mission guidelines for "open defecation-free cities" discuss the potential of on-site sanitation systems, or systems in which waste is treated near the toilet itself as opposed to at a sewage treatment plant elsewhere. However, it still prioritizes sewage connections everywhere such a connection is feasible (when the toilet is 30 meters or fewer away from a city sewer).

There are several feasible alternatives to sewerage, such as septic tanks, twin pit latrines, and biogas toilets (collectively referred to as "alternative technologies" in this paper), that may be able to improve sanitation in the slums (see Appendix for extensive technical details). Septic

tanks are underground tanks that hold wastewater and must be cleaned out every 2-3 years for an individual toilet. They have often been the second choice for slum sanitation programs (Government of India 2008). Biogas toilets, or toilets that use bacteria to breakdown waste and neutralize the pathogens in the effluent, receive relatively little attention in the existing literature on sanitation in urban slums. Twin pit toilets consist of two pits, one of which holds waste until it is full, at which point waste is diverted to the second pit. Right before the second pit reaches capacity, the first pit is cleaned out. Like biogas toilets, twin pit toilets are not often considered a viable option for slum sanitation plans. Interestingly, Ahmedabad's urban government and NGO schemes do not justify advocating for expansion of the sewage network to slums, suggesting that planners may select sewage systems without considering these other technology options.

Previous research suggests that indeed governments do not readily integrate innovations into their plans. Governments tend to stick with old systems of water management to ensure reliability and stability (Lemos 2008). Decision-makers' aversion to new technologies in water management, a field related to sanitation, may also stem from "regulative, normative, and cognitive, structures" around accepted ideas that are difficult to change (Oberg et. al 2014). Governments may be especially reluctant to shift away from using sewage systems as sewers are "literally sunk into the ground" and are costs that cannot be recovered (Nilsson 2006). No research on whether or not inertia to change plays a role in the urban government of Ahmedabad's long-term commitment to sewerage as its sanitation technology of choice.

Discussions about the method of accessing urban sanitation have been separate from those about the sanitation technology. Here, "method of accessing" refers to the choice between individual/private and community toilet models.  Several different methods have been tried in the past few decades, including private toilets, free public toilets, and community block toilets.

NGOs and governments favor individual toilets because they do not suffer from long-queues or maintenance problems (Water Aid; Squatting Rights). However, the existing literature suggests that space constraints and the steep costs of installing the requisite infrastructure in each household sometimes render large-scale construction of private toilets ineffective in high-density, poor urban areas (World Bank 2006; Katukiza et. al, 2012). To some extent, NGOs still build community block toilets that require households to pay for services in order to give community members a "stake" in the maintenance of the facilities (SPARQ). Slum communities' views on the debate between public and community toilets do not factor into most of the research on which method works best for slum areas.

Though a wide variety of sanitation systems exist, Ahmedabad's city government, the Ahmedabad Municipal Corporation (AMC), and NGOs largely endorse one technology, sewage-connected toilets. Decision makers do not consider other technologies when devising sanitation schemes in slum areas, likely because sewerage is the unexamined "obvious" technology choice as it has been used for over 100 years. NGOs and the AMC consciously choose individual toilets because they have fewer maintenance issues than community toilets.

These theories serve as a framework for this research paper, with the paper's objectives oriented around the evaluation of the theories. The study will synthesize primary source data from different stakeholders, including researchers, NGOs, and government officials, to determine why the AMC and NGOs choose sewerage instead of alternative technologies and build individual toilets in Ahmedabad's slums. It will also use primary source data from focused group discussions with slum dwellers and unobtrusive observations to verify that slum dwellers' revealed preferences for sanitation technology and method of access align with those of the AMC and NGOs, as no research using primary source data currently investigates this question.

This study will end with a clear understanding of why the stakeholders involved in setting top-down sanitation policy continue to use sewerage and a discussion of its implications for adopting alternative technologies in the future and for eradicating unimproved sanitation in urban areas.

### III. Methods

I used qualitative primary source information from interviews to explore why the Ahmedabad Municipal Corporation constructs sewerage-connected, individual toilets in slums. I conducted semi-structured interviews with the AMC official (Rajesh Patel) who works on slum redevelopment and with two civil engineers who work in the drainage department and the sewage treatment department (Falgunkumar Mistry and Darshana Patel, respectively). I also interviewed members of the Performance Assessment System (PAS) project at CEPT University, which has advised the AMC and Gujarat state government on sanitation projects. I met Mr. Patel after asking AMC employees who was in charge of slum sanitation projects. Mr. Patel recommended I speak with Ms. Patel, who referred me to Mr. Mistry. I found out about the PAS project through my academic advisor, Trilochan Pandey. After securing each subject's written consent, I asked each person a series of questions about the AMC's decision to use sewerage-connected, individual toilets (see Appendix for interview questions).

To understand why NGOs in Ahmedabad support sewerage-connected, individual toilets, I gathered primary source data from interviews with representatives from organizations working on slum sanitation. From online research, I identified Mahila SEWA Housing Trust, the Urban Management Centre, Safai Vidyalaya, and SAATH as the organizations in Ahmedabad who have extensive experience working in slum sanitation. I arranged interviews with people from each NGO who were specifically involved in sanitation, as these organizations work to address

myriad issues in slums. I also spoke with Ashwani Kumar, a professor at CEPT University who has worked on green urban planning and in slums, whom I found by searching online for researchers with knowledge on slum sanitation systems. Once interviewees signed a consent form, I asked them what sanitation technologies and methods of access they have used in slums, why they chose those technologies and methods, and what they thought of alternative technologies and other access methods as jumping-off points for further discussion (see Appendix for NGO interview questions and note that questions were different for Mr. Kumar).

In order to get slum dwellers' preferences for sanitation technologies and method of access, I visited a total of four slums in Ahmedabad, including Vasant Rajab Nagar, Khodiyarnagar, Shankar Bhuvan Na Chapra, and Hanumanpura Ni Chali. I selected these slums by asking NGO representatives if they knew of any specific slums that do not have adequate sanitation, though each slum turned out to have some form of sanitation system.

I conducted focus groups in 3 slums with the help of three translators Shilpa Pandya (Vasant Rajab Nagar) Ankur Vijay (Khodiyarnagar) and Vishal Macwan (Shankar Bhuvan Na Chapra ) all of whom speak English, Gujarati, and Hindi. Vishal Macwan also assisted me in interviewing a resident of Hanumanpura Ni Chali. I began each discussion and interview by asking the participant(s) for their consent by having my translator read a consent form in Gujarati. As most members of the focus groups were illiterate, I secured each member's verbal consent. Gulab, the resident of Hanumanpura Ni Chali whom I interviewed, was literate, but I did not have a printed consent form for him to sign, so I secured his verbal consent by reading the consent form from the syllabus. Inquiries broadly covered the current method(s) of human excreta disposal in the slum, the participants' opinions of different sanitation technologies in terms of affordability, convenience, and maintenance, and their interactions (if any) with NGOs

or government organizations trying to improve sanitation in his/her community (see Appendix for interview questions).

With the communities' and households' consent in Shankar Bhuvan Na Chapra and Vasant Rajab Nagar, I also observed public facilities and individual toilets to evaluate how well these structures are maintained. In addition, I took photos of any infrastructure associated with sanitation in Khodiyarnagar, ensuring beforehand that the community was okay with photography of the area.

In order to protect the anonymity of respondents, I asked each person if I could explicitly use his or her name in my paper. I also assured every participant that the recordings of our conversation would stay in my possession alone and would be destroyed after this paper was completed.

There were several ethical considerations I had to keep in mind. As human waste is highly stigmatized in most cultures, questions about sanitation could make focus group participants uncomfortable. I ensured that respondents knew that they could leave the discussion at any time. I also consulted my translator about the best way to frame my questions so that they did not cause participants any sort of embarrassment or discomfort. In addition, women may face harassment in community toilets, so it was important to get women's opinions on sanitation in a setting that allows them to safely discuss these issues. Since I had limited time in the slums due to the brief research period and limited translator availability, most of my focus groups (2/3) were all women to make sure I heard any women-specific comments about sanitation systems.

## IV. Findings

### a. Government Technology Choice and Decision Process

**i) Government Sanitation Technology Decisions**

The Ahmedabad Municipal Corporation (AMC) area of Ahmedabad consists of 466 square kilometers divided into six administrative zones and 64 wards.  This territory encompasses the old city center, which contains high-density housing, the area east of the Sabarmati River, which primarily has low-income housing, and the area west of the river, where middle and upper-income housing dominates (see Appendix figure) (Ahmedabad Municipal Corporation 2013). Since the 1970s, the AMC resolved to provide every slum, regardless of its legality, with basic services such as water and sanitation (Ahmedabad Municipal Corporation 2013). The previously mentioned Slum Networking Program ran from 1995 to 2006 and provided slums with a package of services, including lighting, drainage connections, individual toilets, and storm water drainage (UN Habitat 2006).  In 2009, the Government of India announced Rajiv Awas Yojana (RAY), a plan to resolve the issues of slums by "bringing existing slums into the formal system and enabling them to avail the basic amenities as the rest of the town/city," addressing the causes of slum creation, and tackling the shortages of urban land and housing (Ahmedabad Municipal Corporation 2013). Under RAY, the AMC developed a plan to improve slums in its jurisdiction, which includes the objective to "ensure provision of piped water supply, a toilet, and a drainage connection to every slum house" (AMC). The plan does not include any option for other types of waste disposal system other than by sewer ("a drainage connection") (Ahmedabad Municipal Corporation 2013).

**ii) Factors in the AMC's Decision to Provide Sewerage**

     The AMC exclusively uses sewerage when improving slum sanitation in part because a

sewer system already exists, extinguishing any need for a decentralized system. One government

official, Rajesh Patel, the Deputy City Engineer and Executive Assistant to Municipal

Commissioner who is in charge of slum sanitation for the AMC, felt that extending sewerage to

the slum communities makes the most sense because the city drainage network already covers

95% of the AMC's land (Patel, R. personal Interview, April 15, 2016). With only a fraction of

the city unable to access the sewer system, the government regards other types of sanitation

technologies irrelevant: "Why do we need septic tanks if we have sewers?" (Patel, R. personal

interview, April 15, 2016; Bhavsar, personal interview). Dhruv Bhavsar, a member of the

Performance Assessment Project at CEPT University, which works closely with the Ahmedabad

Municipal Corporation and the Gujarat state government, agreed, saying, "[the sewer] network is

available everywhere. So there is no point in doing a decentralized system" (Bhavsar, personal

interview).

     The government believes sewerage fulfills its first priority with regards to sanitation,

which is to ensure that "nature does not suffer from giving any services" (Patel, R. personal

interview, April 23, 2015). Mr. Patel was unconcerned about the amount of water sewerage uses,

explaining, "Ahmedabad has no water scarcity" (Patel, R. personal interview, April 15, 2015). In

addition, the AMC recently proposed a plan to improve sewage treatment so that industries can

reuse treated wastewater; this plan intends to supply a service the city's industries have

demanded and reduce the amount of water used only for sewerage (Patel, R. personal interview,

April 23, 2015).

     According to the AMC, sewerage has an advantage over other technologies because it

can serve space-constrained slum areas where other technologies would not work. When pressed

on why alternative technologies do not figure into the AMC's policies at all, Mr. Patel pointed

out that in Ahmedabad's slums, the "land is very lesser" and cannot allow for septic tanks, bio

gas toilets, or soak pits (Patel, R. personal interview, April 23, 2015).  Mr. Bhavsar echoed this

statement, claiming, "In a highly dense city, sewerage is the only system that works" (Bhavsar,

personal interview).

  Mr. Patel also felt that one of sewerage's strengths was that it is "maintenance free"

(Patel, R. personal interview, April 15, 2015). The additional city engineer, Falgunkumar Mistry,

noted that the sewage lines require periodic maintenance in the form of "desilting," or removal of

the debris that naturally builds up over time in pipes carrying sewage (Mistry, personal

interview). This process is costly, as it requires expensive machines to suck the detritus out of the

network; desilting does not put a strain on the city's financial resources, especially as it is

necessary less than once every 50 years (Mistry, personal interview).

  According to some experts who have collaborated with the government on waste issues,

inertia plays a significant role in its decision not to use newer technologies. Mehgna Malhotra,

Deputy Director at the Urban Management Center, an NGO that created the Ahmedabad

Sanitation Action Lab, posited that the emphasis on sewerage as the best sanitation technology is

part of the shift towards centralized sewer systems that "has been there since the past 100 years"

(Malhotra, personal interview). Ravi Kalantri, an independent consultant who works on waste

management for the city and frequently collaborates with AMC, emphasized that there is general

aversion to moving away from traditional ways of doing things: "People want to go on the same

path… they do not want to try something new" (Kalantri, personal interview).

  Manvita Baradi, the director of the Urban Management Centre, thought the AMC's

current indifference towards alternative technologies stems from the AMC's desire for "proven

solutions" (Baradi, personal interview). She added that the merits of the alternative technologies have not been adequately "communicated and demonstrated" to the government. Ms. Malhotra confirmed this statement and added that, while the AMC engineers have in-depth knowledge about sewerage, they do not know that alternative systems are as effective as sewerage (Malhotra, personal interview).

**Comment [TC1]:** Topic sentence?

### ii) AMC's Preferred Method of Access

Rajesh Patel felt that community toilets were not a good option in slums because people often treat communal facilities quite poorly: "If it is a public toilet then they will not properly use it, damage the taps and windows…" (Patel, R. personal interview, April 15, 2015). Though he acknowledged that space constraints can make individual toilets difficult to construct, Mr. Patel still felt that individual toilets were superior to community toilets in slums (Patel, R. personal interview, April 15, 2015). Mr. Patel felt that any further discussion of why individual toilets were better than community toilets was superfluous (Patel, R. personal interview, April 23, 2015).

### b. NGOs' Technology Choice and Decision Process

### i) Current NGO Sanitation Technology Choices

NGOs primarily provide slum dwellers with access to sewerage as opposed to other technologies. SAATH, a youth-based organization that works to facilitate provision of services like water and electricity in slums, connected slums to the Ahmedabad sewer system under the Slum Networking Program discussed above (Jani, personal interview, April 28, 2015). More recently, SAATH has constructed urban resource centers that give slum dwellers resources about

government schemes for sewerage as well as other for other services (Jani, personal interview, April 28, 2015). Similarly, Mahila SEWA Housing Trust (MHT) participated in the SNP and helped build sewerage-connected toilets in slums. Currently, MHT helps slum dwellers secure a no objection certificate from the AMC, which allows the slum dwellers in illegal settlements to secure services despite the illegality of their residence (Bindiya, personal interview). MHT also works to build individual, sewerage-connected toilets under the Central government's Swachh Bharat mission, a scheme to give every Indian access to sanitation. Safai Vidyalaya, an NGO started in 1935 that focuses exclusively on sanitation, has built 10,000 individual toilets in urban Ahmedabad since 2009 (Patel, J. personal interview).  A majority of these toilets (percentage unavailable from organization and representative) were sewer-connected toilets while the remaining ones were either twin pit or single pit latrines (Patel, J. personal interview).

**ii) Factors in the NGO Decision to Provide Sewerage**

Despite NGOs' efforts to build sewerage-connected toilets in Ahmedabad, there is not a consensus that sewerage is the best technology. Bindya from Mahila SEWA Housing Trust saw no issue with building sewerage-connected toilets in slums and thought there was no need to explore other technologies because sewerage was "easiest" (Bindiya, personal interview). Others agreed that sewerage was generally easier relative to septic tanks and twin pit latrines because of the space constraints in many slums (Jani, personal interview, April 15, 2015; Mansuri, personal interview; Bhavsar, personal interview, May 5, 2015). However, the large majority of respondents did not think that sewerage was the absolute best choice for sanitation schemes (Malhotra, personal interview; Baradi, personal interview; Patel, J. personal interview).

Except for the representative from Mahila SEWA Housing Trust, all other respondents had misgivings about using sewerage to provide slums with sanitations. A common problem NGO representatives raised was the amount of water that sewerage requires (Patel, J. personal interview; Jani, personal interview, April 15, 2015; Malhotra, personal interview). A toilet connected to sewerage requires at least 5-7 liters to flush and up to 10 liters for models with automatic flushing systems (Patel, J. personal interview). Mr. Jani of SAATH was especially concerned with the large volume of wastewater created from using sewerage (5-7 liters plus the volume of human waste); as Ahmedabad becomes more densely populated, he believes that the load on the sewerage pipes may become unmanageable (Jani, personal interview, April 28, 2015). Some pointed to Gujarat's water scarcity as a reason to be skeptical about the long-term viability of sewerage (Malhotra, personal interview; Patel, J. personal interview). Yet one interviewee believed that water is not an issue, echoing the statement of Rajesh Patel in the AMC (Bindya, personal interview).

Three of four NGOs interviewed would prefer to use a variety of technologies to provide sanitation to slum communities (Patel, J. personal interview; Jani, personal interview, April 16, 2015; Mansuri, personal interview; Malhotra, personal interview). Mr. Patel of Safai Vidyalaya felt that anaerobic biogas toilets are the ideal technology to use because they generate gas that can be used for cooking and manure (Patel, J. personal interview). However, he allowed that, in places where space was limited and the gradient was steep enough, sewerage would be an acceptable second choice (Patel, J. personal interview). For slum areas with one-story buildings, Mr. Patel thought twin pit latrines would be preferable to sewerage  (Patel, J. personal interview). Similarly, Aasim Mansuri of PAS said, "the choice of technology depends on the slum context" (Mansuri, personal interview). Ms. Malhotra supported context specific

technology selection, emphasizing that a "range" of options should at least be considered for every slum sanitation project (Malhotra, personal interview).

NGOs use sewerage in slums partially because of community pressure. SAATH and Safai Vidyalaya consult with each community in which they facilitate access to sanitation before deciding which technology to use (Jani, personal interview, April 28, 2015; Patel, R. personal interview). The communities almost invariably choose to use sewerage (Jani, personal interview, April 28, 2015; Patel, R. personal interview). As these NGOs aim to serve the needs of the slum as expressed by the community members themselves, this pressure impacts their decision process (Jani, personal interview, April 28, 2015; Patel, R. personal interview).

Interview participants offered differing opinions on why slum dwellers want sewerage as opposed to other sanitation technologies. Niraj Jani, the Associate Director of SAATH, explained this strong preference one way: "When we are working with vulnerable communities who are availing services for the first time, they choose convention – they do not want to take a risk [by using a less common technology]" (Jani, personal interview, April 28, 2015). NGO representatives also believe sewerage seems safest to most slum dwellers because that is what the government constructs elsewhere (Jani, personal interview, April 15, 2015; Patel, J. personal interview). Mr. Jani elaborated, "What happens in a slum area is people aspire to grow in terms of better living conditions, better job, better growth. For them, the direction of growth is to mainstream" (Jani, personal interview, April 15, 2015). This desire to access the same services as the rest of the city manifests itself in a deep suspicion of trying out alternative sanitation technologies, which limits the reach of these technologies in slums (Kumar, personal interview; Jani, personal interview, April 15, 2015; Malhotra, personal interview). Ahswani Kumar, a professor of planning at CEPT University who has worked on developing environmentally

friendly urban spaces, thought alternative technologies would be more popular "if slum dwellers saw others of different income groups using [them]" (A. Kumar, personal interview, April 17, 2015).

Some claimed slum dwellers simply misunderstand the alternative technologies available, believing that these newer systems are not as effective and safe as sewerage (Patel, J. personal interview; Malhotra, personal interview). However, Manvita Baradi of the Urban Management Centre said, "People in the slums are not dumb. If you show them [alternative technologies], they will get it," agreeing with other interviewees who thought that slum dwellers may come to embrace alternatives if NGOs and researchers adequately explain it to them (Baradi, personal interview; Shaikh, personal interview). Mr. Patel of Safai Vidyalaya disagreed, claiming that though his NGO makes an effort to educate slum dwellers on alternative technologies, the slum dwellers in urban areas still tend to prefer sewerage because of its reputation as the best sanitation technology available (Patel, J. personal interview).

### iii) NGOs' Preferred Method of Access

NGOs construct individual toilets wherever there is space enough to accommodate the structures (Bindya, personal interview; Patel, J. personal interview; Jani, personal interview, April 16, 2015; Malhotra, personal interview; Mansuri). No respondent preferred community toilets to individual toilets as a means of providing a slum with sanitation (Bindya, personal interview; Patel, J. personal interview; Jani, personal interview, April 16, 2015; Malhotra, personal interview; Mansuri, personal interview).

As community toilets are not an individual's private property, slum dwellers often fail to keep up and even vandalize the structures (Mansuri, personal interview; Jani, personal interview,

April 16, 2015; Bindiya, personal interview). One respondent also pointed out that community

toilets are more hazardous to slum dwellers' health than individual toilets as they are not cleaned

regularly and do not have sinks for hand washing (Mansuri, personal interview).

**c. Slum Dwellers' Views of Sanitation Technologies and Methods of Access**

**i) Description of Slums' Current Sanitation Situations**

     Khodiyarnagar is an illegal settlement on the Ahmedabad Municipal Corporation's land

on the eastern bank of the Sabarmati river in the district of Behrampura (Ahmedabad Municipal

Corporation 2013). Though the AMC aims to build toilets with sewer connections in every slum,

the inhabitants of Khodiyarnagar did not receive the AMC's assistance in constructing toilets

hooked up to the sewer system (Focused group discussion of women, female Khodiyarnagar

residents). The residents used their own funds to build individual toilets that connect to one

septic tank shared by the community, which the AMC is responsible to maintain (Focused group

discussion of women, female Khodiyarnagar residents).

     Vasant Rajab Nagar is a low-income housing area containing 85 homes constructed by

the AMC in 1974 (Focused group discussion of women, female Vasant Rajab Nagar residents).

In 1974, the temporary slum houses that covered the area were burned down in riots and were

replaced with permanent housing for each family and a community toilet  (Focused group

discussion of women, female Vasant Rajab Nagar residents). Though the houses in Vasant Rajab

Nagar are permanent, it is considered a slum because of a lack of a hygienic sanitation system

(see next section).

     Hanumanpura Ni Chali is a slum of 75 households located in central Ahmedabad

(Ahmedabad Municipal Corporation 2008). The AMC built one community toilet with 8 unisex

stalls for the 1500 residents to share (Gulab, personal interview). It also brings portable toilets on

a truck to the area daily to provide more toilets for the community (Gulab, personal interview).

Currently, residents are building individual toilets with financial help from an AMC subsidy

(Gulab, personal interview).

Shankar Bhuvan Na Chapra is a slum of 2,175 households on the eastern bank of the

Sabarmati River. 2-3 years ago, the AMC built sewerage-connected individual toilets free of

charge for every household (Focused group discussion of men and women, Shankar Bhuvan Na

Chapra residents).

**ii) Factors in the AMC's Decision to Provide Sewerage**

No participants in areas with sewerage systems had any qualms about using sewerage

instead of alternative technologies (Focused group discussion of women, female Vasant Rajab

Nagar residents; Focused group discussion, male and female Shankar Bhuvan Na Chapra

residents). The women interviewed in Vasant Rajab were unaware of what septic tanks, biogas

toilets, or twin pit latrines were (Focused group discussion of women, female Vasant Rajab

Nagar residents). In Shankar Bhuvan Na Chapra, residents were aware of septic tanks (thought

not other technologies), but preferred sewerage because septic tanks require periodic cleaning,

which sewer systems theoretically do not (Focused group discussion, male and female Shnkar

Bhuvan Na Chapra residents). The amount of water sewerage requires to transport waste through

the pipes was not a concern for the residents with sewerage (Focused group discussion of

women, female Vasant Rajab Nagar residents). They explained that they have access to water

from the AMC for two hours per day, which allows them to store enough water to use the

bathroom whenever they need to (Focused group discussion of women, female Vasant Rajab

Nagar residents). The slum dwellers were not concerned with the possible environmental impact

of sewerage (Focused group discussion of women, female Vasant Rajab Nagar residents;

Focused group discussion, male and female Shnkar Bhuvan Na Chapra residents).

Residents of Khodiyarnagar use a septic tank to store the waste from toilet facilities in the

community, but showed no interest in sewerage or twin pit toilets (Focused group discussion of

women, female Khodiyarnagar residents). Focus group discussion participants did not recognize

what anaerobic or aerobic biogas toilets were and reported satisfaction with the septic tank itself

(Focused group discussion of women, female Khodiyarnagar residents).

**iii) Maintenance Issues with Sanitation Systems**

Regardless of the type of sanitation technology available to community members, many,

but not all, slum dwellers reported issues with blockages and AMC maintenance services. In

Khodiyarnagar, slum dwellers must deal with blockages in the pipes carrying waste from the

households to the community's septic tank every few days (Focused group discussion of women,

female Khodiyarnagar residents). In addition, community members in Khodiyarnagar must clean

out the septic tank manually, using long sticks to remove the waste (Focused group discussion of

women, female Khodiyarnagar residents). In Shankar Bhuvan Na Chapra and Vasant Rajab

Nagar, residents reported similar issues with the pipes carrying waste from the community toilet

(in Vasasnt Rajab Nagar) and individual toilets (in Shankar Bhuvan Na Chapra) to the larger

sewer system (Focused group discussion, female and male Shankar Bhuvan Na Chapra resident;

Focused group discussion of women, female Vasant Rajab Nagar residents). When a blockage

occurs, sewage consisting of a mix of water and human waste spills out onto the streets of the

slums (Focused group discussion of women, female Vasant Rajab Nagar residents; Focused

group discussion of women, female Khodiyarnagar residents). The residents file complaints about the blockages to the AMC, but the government often does not respond until two weeks later (Focused group discussion, female and male Shankar Bhuvan Na Chapra resident; Focused group discussion of women, female Vasant Rajab Nagar residents; Focused group discussion of women, female Khodiyarnagar residents). Gulab from Hanumanpura Ni Chali reported complete satisfaction with the efficiency of AMC's maintenance services on clearing blockages from the larger pipes (Gulab, personal interview). He added that the community clears blockages from the smaller pipes that connect individual toilets to the larger pipeline but did not believe this was an inconvenience (Gulab, personal interview).

There are several ways of dealing with the slow response time from the AMC. In some places, people often unblock the pipes themselves, clearing the waste that is causing the blockage (Focused group discussion of women, female Khodiyarnagar residents; Focused group discussion, female and male Shankar Bhuvan Na Chapra resident). Khodiyarnagar residents pile the removed waste next to the manholes on the street, where they remain until government workers come to remove them (see Appendix for photo) (Personal observation, Khodiyarngar; Focused group discussion of women, female Khodiyarnagar residents). Residents of Vasant Rajab Nagar do not clear the blockages but instead wait until the AMC clears it (Focused group discussion of women, female Vasant Rajab Nagar residents).

The slow government maintenance services cause problems that extend beyond simply keeping the toilets working. When sewage comes to the surface because of a blockage in the pipes connected to the community toilet in Vasant Rajab Nagar, it makes its way into homes adjacent to the manholes, creating unhygienic living conditions and attracting rats and flies to the area (Focused group discussion of women, female Vasant Rajab Nagar residents). As residents

of Khodiyarnagar clean out blockages from the pipes themselves and leave the piles of waste for government workers to remove, people come into direct contact with the slum's waste on the street (Personal observation, Khodiyarnagar). Women are especially concerned with the effects of this exposure to waste on the children, who are frequently sick (Focused group discussion of women, female Khodiyarnagar residents).

Khodiyarnagar suffers from additional problems due to the lack of AMC services. There is no separate storm drainage system in the slum, so water from rainfall runs into the underground pipe system connecting the slum's individual toilets to the community septic tank (Focused group discussion of women, female Khodiyarnagar residents). The water enters the pipes through holes in some of the manholes (Personal observation, Khodiyarnagar). As the slum does not have proper roads, which municipal officials promised to build before the 2014 election, storm water also runs into the drainage system via large, uncovered portions of the drainage network (Personal observation, Khodiyarnagar) (see Appendix for photo) (Focused group discussion of women, female Khodiyarnagar residents). When significant rainfall enters the system, the pipes cannot handle the combined volume from the rain and the wastewater from the toilets (Focused group discussion of women, female Khodiyarnagar residents). This results in overflowing that pushes water contaminated with human excreta to the surface of the slum (Personal observation, Khodiyarnagar).

**iv) Slum Dwellers' Preferred Method of Access**

Slum dwellers invariably preferred individual toilets over community toilets, though the specific reasons varied by area. Residents in all four slums reported no issues with affording or maintaining their individual toilets, nor did they have any other complaints about the structures (Focused group discussion of women, female Khodiyarnagar residents; Gulab, personal interview; Focused group discussion of women, female Vasant Rajab Nagar residents; Focused group discussion, female and male Shankar Bhuvan Na Chapra resident).

There are usually fewer seats in the community toilet than people living in the slum, so long lines to use the bathroom frequently form (Focused group discussion of women, female Vasant Rajab Nagar residents, April 19, 2015; Gulab, personal interview).  As people are rushing off to work, squabbles break out as people try to use the toilet as soon as possible and wish to forgo the wait (Focused group discussion of women, female Vasant Rajab Nagar residents, April 19th, 2015).

A common issue was the embarrassment women felt when they used the community toilet (Focused group discussion of women, female Vasant Rajab Nagar residents; Focused group discussion, female and male Shankar Bhuvan Na Chapra resident). The community toilet in Vasant Rajab Nagar has separate entrances for the men and women's sections, but the entryways are on the same side of the building (Personal observation, Vasant Rajab Nagar). This means women and men line up next to each other in the morning, creating "a very embarrassing situation" for women, who find the male attention uncomfortable (Focused group discussion of women, female Vasant Rajab Nagar residents). Before individual toilets were built in Shankar Bhuvan Na Chapra, using the community toilets was "embarrassing for women, for their families" (Focused group discussion, female and male Shankar Bhuvan Na Chapra resident).

Vasant Rajab Nagar's community toilet is often dirty and unhygienic (Focused group discussion of women, female Vasant Rajab Nagar residents).  People do not always flush their waste, leaving fecal material in the toilet and urine around the edges of the toilet (Personal observation, Vasant Rajab Nagar, April 19, 2015). In addition, the AMC, which is responsible for cleaning the facility, does not clean the facility regularly, so the toilets often stay dirty for long periods of time (Focused group discussion of women, female Vasant Rajab Nagar residents). Gulab reported no issues with maintaining the cleanliness of the community toilet in Hanumanpura Ni Chali, citing a sense of responsibility among residents that causes everyone to pitch in to keep the toilet tidy (Gulab, personal interview).

**V. Discussion**

**a) Sewerage vs. Alternative Technologies**

The AMC favors sewerage over alternative technologies not because sewerage is an "unexamined, obvious choice," as theorized, but because the AMC's history, finances, and knowledge base make sewerage a logical choice for sanitation technology. Inertia stemming from a colonial conception of sanitation influences the AMC's decision. The AMC has spent the last 25 years working to connect slums to the sewer system (Ahmedabad Municipal Corporation 2009). Ms. Malhotra from the Urban Management Centre pointed out that "The shift towards underground drainage happened with the whole colonial period. The whole emphasis towards centralized sewer systems has been there since the past 100 years" (Malhotra, personal interview). Indeed, the first municipal president of Ahmedabad, Ranchhodlal Chhotalal, advocated for a sewerage plan that followed "the rules of sanitary science" written by English public works engineer Colonel Walter Ducat (Tam 2012). So, from the beginning, the

Ahmedabad's government believed sewerage was a proven answer to the city's sanitation

problems. Rajesh Patel's conviction that no alternative technology is necessary if sewers exist

suggests that government attitudes towards sewerage as the best sanitation technology have

remained static (Patel, R. personal interview, April 28, 2015). Other researchers exploring the

adoption of alternative technologies in former British colonies reported similar findings (Chaplin

2011; van Vliet, Spaargaren, and Oosterveer 2009): as researchers explain, "the heritage of a

colonial sewer system is still limiting the innovation paths for wiser, more flexible sanitation

options for the urban poor" in Africa (van Vliet, Spaargaren, and Oosterveer 2009). The reliance

on the historic understanding that sewerage is an efficient way of delivering sanitation services to

citizens constrains the ability of the AMC to consider other technologies.

Another source of inertia is the existing infrastructure and knowledge of sewerage in the

government. According to Mr. Bhavsar, the AMC has no need to pilot alternative technologies

because its network covers the overwhelming majority of the city and its engineers understand

centralized sewerage thoroughly, making sewerage-connected toilets the easiest to build

(Bhavsar, personal interview). Implicitly, this means that the amount of knowledge of sewerage

already available to the AMC acts as a barrier to the adoption of other technologies, which would

require AMC personnel to learn new skills. This attitude reflects previous research in the field,

which found that "rigid" cognitive structures, defined as "dominant knowledge, thinking, and

skills," prevent the use of innovative sewage management (Oberg et. al 2014). In addition, the

AMC has already paid for and expanded the sewer system to 95% of its territory (Patel, R.

personal interview, April 15, 2015). It requires less effort to use the infrastructure already in

place than it does to invest in a completely new technology, which means there is a big incentive

to continue using current methods. Researchers find this specific kind of inertia to change is "an

inherent quality in large-scale technical systems" (Nilsson 2006). The knowledge of and

resources for sewerage available to the AMC act as a barrier to adopting a new system of

sanitation.

Ahmedabad's water security allows the AMC to indulge its tendency towards inertia.

One typical problem with sewerage raised by researchers is that it uses too much water (Katzukia

et. al 2007; van Vliet, Spaargaren, and Oosterveer 2009). Rajesh Patel was unconcerned about

the city's water current water supply and indicated that the future of the city's water supply was

not an issue either (Patel, R. personal interview, April 15, 2015). At last count, Ahmedabad's

residents currently use 187.33 liters of water per day for a total 1,190 million liters per day,

which is well under the 1,890 million liters per day capacity of drawl (Times of India 2013). If

Ahmedabad grows according to estimates, reaching a population of 7.4 million in 2025, the

city's current water capacity will still be enough to provide the population's needed 1,386

million liters of water daily, assuming no change in daily average water use. In addition, the

AMC has recently drawn up plans to construct a system to reuse water from sewage treatment

plans which addresses the issues of water demand from sewerage, according to the AMC

(Ahmedabad Municipal Corporation 2015). With treated sewage replacing fresh water in

industrial uses, more fresh water will be available for citizens' use in the future. Given this

project and the AMC's current water supply, there is little pressure on the AMC to try an

alternative sanitation technology in order to reduce water use.

Ahmedabad is similarly unaffected by financial constraints that may prompt other cities

to try newer, cheaper technologies. Multiple researchers have pointed out that sewerage costs

more relative to alternative technologies (Paterson, Mara, and Curtis, 2007; Katzukia et. al 2007;

Mara and Alabaster 2008). Indeed, sewerage can be extremely expensive, as evidenced by the

2.35 billion rupees spent on expanding and maintaining the AMC sewer system in the past four years (Ahmedabad Municipal Corporation 2015). Yet with a budget of 56.6 billion rupees, the expenditure per year on sewerage maintenance and expansion constitutes a mere 1.03% of the total annual budget (Times of India 2015). So, while on-site sanitation systems may or may not be cheaper than traditional sewerage once implemented, the AMC's treasure chest is large enough to outweigh any financial incentive to use alternative technologies for the time being.

Though Ahmedabad primarily connects slums to the sewer system due to inertia, sewerage is not an inappropriate choice according to central government guidelines on providing urban sanitation. The national government's "Technology Options for Urban Sanitation in India" suggests that off-site sanitation options like sewerage work best "where housing density is high (>40 houses per hectare), there is a reliable water supply on or close to the plot and sufficient fall is available to transport solids through the sewer without pumping" (Government of India 2008). There are 162,749 total huts in Ahmedabad's slums, covering 609 hectares of land (Ahmedabad Municipal Corporation 2013). This means that Ahmedabad's slums have an average housing density of 267.2 houses per hectare, which supports Mr. Patel's claim that sewerage is the best option for the slums under the AMC's jurisdiction. Though only 60% of slum dwellers have access to piped water as of 2013 (Performance Assessment System 2014), the AMC is currently working to extend piped water supply to all slums (Ahmedabad Municipal Corporation 2013). While slum dwellers lack a piped water supply, the AMC's subsidy for individual toilets is effectively useless, as you need water to flush a sewerage-connected toilet. Slums in low-lying areas do not have the appropriate fall (i.e. slope) to move sewage through the pipes, but the city already has 45 drainage pumping stations in place to overcome that issue (Ahmedabad Municipal Corporation 2015). Sewerage remains a viable long-term sanitation solution for the slums, so

necessity likely won't force the AMC to shift away from sewerage in the near future.

The NGOs receive pressure from two sides to provide slum communities with sewerage, making it difficult to implement alternative technologies. NGOs clearly don't believe that sewerage is a panacea for urban sanitation issues as they indicated concern about sewerage's water use and long-term ability to serve a growing population (Patel, J. personal interview; Jani, personal interview, April 15, 2015; Malhotra, personal interview). According to NGO representatives, slum communities often strongly prefer sewerage to alternative sanitation technologies because they do not understand the other options and want to use the same services that the average Ahmedabad resident uses (Jani, personal interview, April 15, 2015; Malhotra, personal interview; Patel, J. personal interview). NGOs aim to serve slum communities, so the slum dwellers' preferences factor into their decisions for how to implement sanitation programs. Additionally, NGOs often carry out their sanitation schemes in slums with financial support from the central, state, and urban government's subsidies, clearly working within the framework set up by the various levels of government. This indicates that the AMC's policies have enormous influence over the type of sanitation technology they choose to use. Researchers have found that government subsidies favor toilets with a sewerage connection even in areas where such a connection is not possible (PAS 2011). With the three levels of government providing more money for sewerage-connected toilets, NGOs have an incentive to promote sewerage rather than another technology in order to reduce costs for the community and themselves, if they are financing a percentage of the construction. If NGOs attempted to implement an alternative technology, they would have to first convince the slum communities to accept the technology and then determine how to finance those projects, which may be more difficult than affording sewerage-connected, subsidized toilets. Until one of the other stakeholders in the process shifts

its preferences towards alternative technologies, NGOs will likely continue promoting sewerage, as its actions are to some extent constrained by the wishes of the AMC and the slum dwellers.

The maintenance of a sanitation technology is much more important than the choice of the technology itself from a slum dweller's perspective. Slum community members did not indicate any interest in switching their current sanitation technology, whether they had a septic tank or a sewer connection (Focused group discussion, female and male Shankar Bhuvan Na Chapra residents; Focused group discussion of women, female Vasant Rajab Nagar residents; Focused group discussion of women, female Khodiyarnagar residents; Gulab, personal interview). However, residents of 3 out of the four slums reported issues with maintenance, which indicates that technology alone cannot fix sanitation problems in Ahmedabad's slums (Focused group discussion, female and male Shankar Bhuvan Na Chapra residents; Focused group discussion of women, female Vasant Rajab Nagar residents; Focused group discussion of women, female Khodiyarnagar residents). Failure to implement a sustainable, effective maintenance of sanitation systems is a recurring problem in attempts to provide improved sanitation to low-income areas (WHO 2000; Burra, Patel, and Kerr 2003; World Bank 2006; Government of India 2008). The frequency of this problem does not diminish the severity of its consequences for the urban poor. The AMC cannot claim to be solving the sanitation problems in slums if it forces slum dwellers to put their health at risk just to ensure their toilet works properly. The AMC must not only write its policies to provide slums with an appropriate technology but also include a way to effectively maintain the system to serve the needs of slum communities.

**b. Individual Toilets vs. Community Toilets**

As theorized, government and NGO decision-makers favored individual toilets because they are easier to maintain. Mr. Patel and NGO representatives reported issues with maintenance of and unhygienic conditions in community toilets due to a lack of cleaning (Patel, R. personal interview, April 15, 2015; Jani, personal interview, April 16, 2015; Mansuri, personal interview). The primary cause, according to respondents, is the lack of personal incentive to clean a toilet that you do not own (Patel, R. personal interview, April 15, 2015; Jani, personal interview, April 16, 2015). This reflects NGO and municipal government experiences with free community toilets in other densely populated, urban areas of India (UN Habitat 2003; World Bank 2006). Similarly, researchers posit that because slum dwellers are not involved in the development of community toilets, they do not have a sense of ownership over the facility, which limits their willingness to personally keep the facility properly maintained (World Bank 2006).

A secondary factor in NGOs' endorsement of individual toilets is the negative health effects of using a shared toilet facility. With no places for washing hands and the generally unhygienic condition of the facilities, shared facilities are a greater health risk for slum communities, according to Mr. Mansuri (Mansuri, personal interview). Research on shared conducted in other areas of India and in other developing countries also found that community toilets tended to be associated with more sickness than individual toilets (Heijnen et. al 2014; Burra, Patel, and Kerr 2003; World Bank 2006).

The inconvenience of community toilets played a significant role in slum dwellers' preference for individual toilets and a secondary role in NGOs' preference for individual toilets. The number of people in the slum dwarfs the number of toilet seats available, which forces slum dwellers to wait in long lines to use the facilities (Focused group discussion of women, female

Vasant Rajab Nagar residents; Gulab, personal interview). Waiting to use restroom for long

periods of time represents an unnecessary inconvenience and source of anxiety for families

(Bapat and Agarwal 2003), as well as a lost opportunity to spend that time on more productive

activities (WHO 2007).

Female slum dwellers felt that community toilets place an additional burden on women;

they create an "embarrassing situation" for women when men see them entering a shared toilet

(Focused group discussion of women, female Vasant Rajab Nagar residents; Shankar Bhuvan Na

Chapra). Women in slums across India face this stigma when using a community bathroom,

preventing them from comfortably and safely using toilet facilities where men can observe them

entering and exiting (Water Aid 2012; Dasra and Forbes Marsahll 2014; McFarlane 2008). While

in an ideal world people would not shame women for a natural bodily function, in reality the

most practical way to prevent women from experiencing this kind of embarrassment is to provide

them with a private toilet. In an individual toilet, women can comfortably relieve themselves and

forgo the unnecessary stress from the judgment of others in the community.

The respondents in the Khodiyarnagar focus group had no issues with the individual

toilet facilities in their homes, underscoring how private toilets satisfy this community's

sanitation needs (Focused group discussion of women, female Khodiyarnagar residents).

Furthermore, the fact that several Vasant Rajab Nagar residents built their own individual toilets

just to avoid the embarrassment and long lines highlights the extent to which people dislike

community toilets (Focused group discussion of women, female Vasant Rajab Nagar residents).

As one woman in Vasant Rajab Nagar put it, "it is better for everyone if everyone has an

individual toilet" (Focused group discussion of women, female Vasant Rajab Nagar residents).

Thus, the AMC's current policy of subsidizing individual toilets and the NGOs' efforts to build

individual toilets rather than constructing community toilets thus aligns with these slum communities' preferences. From the perspectives of health, convenience, women's safety, and maintenance, stakeholders believe individual toilets are an appropriate method of access for safe sanitation in urban slums.

## VI. Conclusion

Inertia from the colonial conception of sanitation combined with the AMC's existing knowledge, finances, and water resources limits the likelihood that the AMC will shift away from sewerage. The merits of sewerage relative to other technologies play a minor role in the government and NGOs decisions. Instead, NGOs reinforce the prevalence of sewerage by connecting slums to the city sewer network because they are under pressure from government schemes and slum community preferences. Without a significant change in the AMC's policies on slum sanitation, NGOs will remain unlikely to push alternative technologies themselves, as it would require additional resources from their organization or slum dwellers to do so. The choice of technology means little to slum dwellers while the maintenance of the system is crucial, as it is ultimately determines whether or not the sanitation system effectively serves the community. Without question, all stakeholders agree that individual toilets are easier to maintain and cleaner. The AMC and NGOs' scheme to build private toilets align with slum dwellers' preferences, as private toilets are much more convenient and safer for women than community toilets.

The AMC's commitment to sewerage illustrates rigidity in city governments that may be difficult to overcome if circumstances in the future require a new approach. As the government of India aims to eradicate open defecation, cities need to be more willing to test out new sanitation technologies, especially in areas without the existing infrastructure, water and

financial resources of Ahmedabad. The fact that all stakeholders supported individual toilets

suggests that efforts to address both rural and urban sanitation should continue to prioritize

individual toilets.

**VII. Further Research**

Further researchers could follow several different avenues to expand upon this study. A

detailed analysis of the various challenges that currently prevent slum dwellers without sanitation

from accessing improved sanitation would help determine if any of the alternative technologies

would suit these areas better than sewerage would. In addition, it would helpful to explore more

fully the genesis of slum dwellers' preference for sewerage to determine if the NGOs'

hypotheses detailed in the "findings" section hold true on the ground. Finally, this study drew

conclusions about slum dwellers' preferences based on only 3 focused group discussions and 1

personal interview. This research could benefit from more extensive interviews with slum

community members.

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## IX. Appendices

**Interview Questions for Rajesh Patel (semi-structured)**
Which sanitation technologies does the AMC currently use in slums?
Why did the AMC choose these technologies?
Who is responsible for maintenance?
How much do these technologies cost?
Why did you decide not to use other available options?
What are the AMC's priorities when choosing a sanitation system?

**Interview Questions for Darshana Patel and Falgunkumar Mistry (semi-structured)**
How much maintenance does the sewer system require?
What area of the city does the sewer system cover?
How much has the AMC spent on the sewer system in recent years?
Is this amount of money a strain on the AMC's resources?
How much water does the sewer system require to move sewage?
How many pumping stations does the system have?
Where does treated sewage go?
Are there any plans to reuse treated wastewater?

**Interview Questions for NGOs (semi-structured)**
How does your NGO help slums access improved sanitation?
Which sanitation technologies does your organization use?
Why those?
Why did you choose not to use the other technologies?
How do you finance these projects? How much do slum dwellers contribute?
What is the cost per toilet (if constructed toilets)?
How much water does the system you implemented use?
Who maintains the system?
How successful do you think your efforts have been so far?

**Interview Questions for Ashwani Kumar**
What are the challenges you have seen in connecting slums to a sanitation system?
NGOs have reported that slum dwellers are wary of alternative sanitation technologies. Have you seen this in your work on green technologies? If so, how do you explain this skepticism?
Do you think the government

**Focused group discussion and interview questions for slum dwellers***
Does this community have a sanitation system?
What type of toilet does this community currently have?
Who built the sanitation system?
How much did it cost? Was it affordable for the community?
Do you prefer to have individual or community toilets? Why?
Who is responsible for the maintenance of the toilet (both the superstructure and the disposal mechanism)
*Note that for these interviews, my incredibly helpful translators asked these questions in the most accessible way possible, using their judgment to modify questions if necessary

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**Slum Information**

| Zone | Ward Name | Slum Name | Ownership | Area In Sqm | No Of Huts |
|------|-----------|-----------|-----------|-------------|------------|
| South | Behrampura | Khodiyarnagar | AMC | 7434 | 277 |
| Central | Dudheshwar | Hanumanpura Ni Chali | Private | 2230 | 75 |
| Central | Shahpur | Shankar Bhuvan Na Chapra | Private | 57250 | 2175 |
| South | Behrampura | Vasant Rajab Nagar* | Private | n/a | 85 |

*Note that Vasant Rajab Nagar is not a slum as defined by the Ahmedabad Municipal Corporation because the houses are permanent. Its inadequate sanitation system, however, makes it a slum under the government of India's definition.
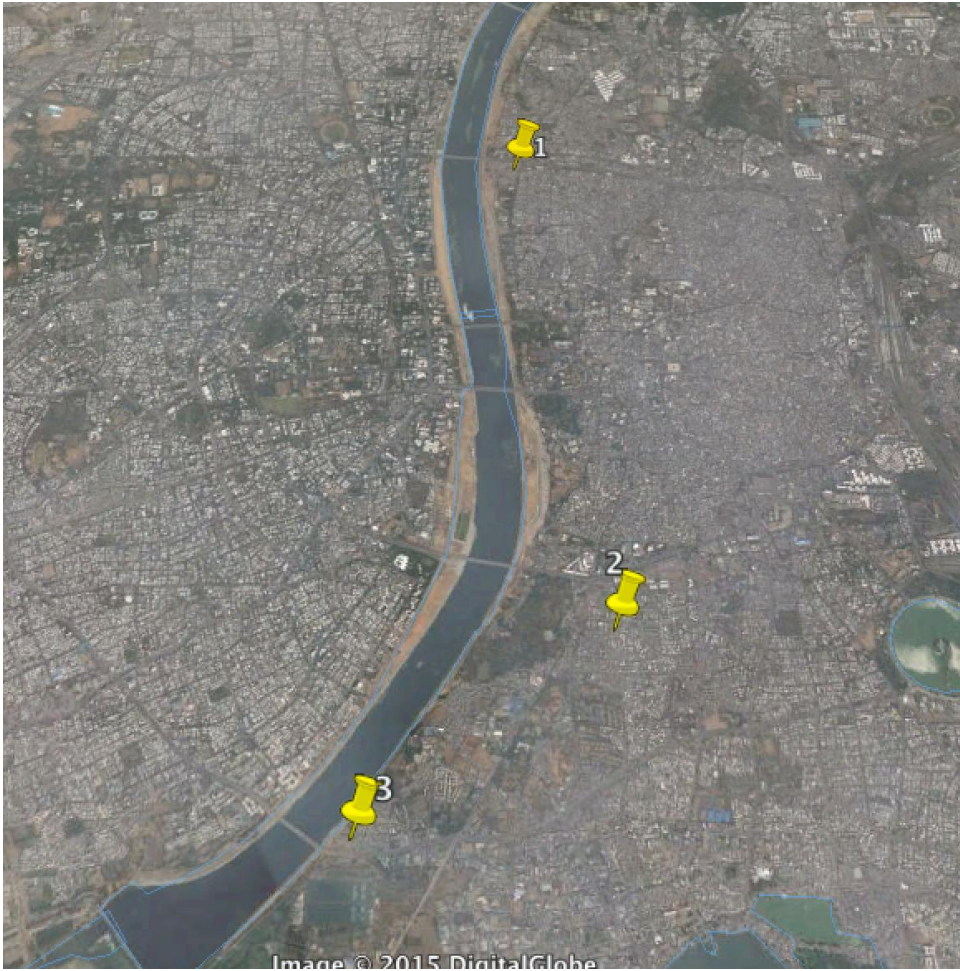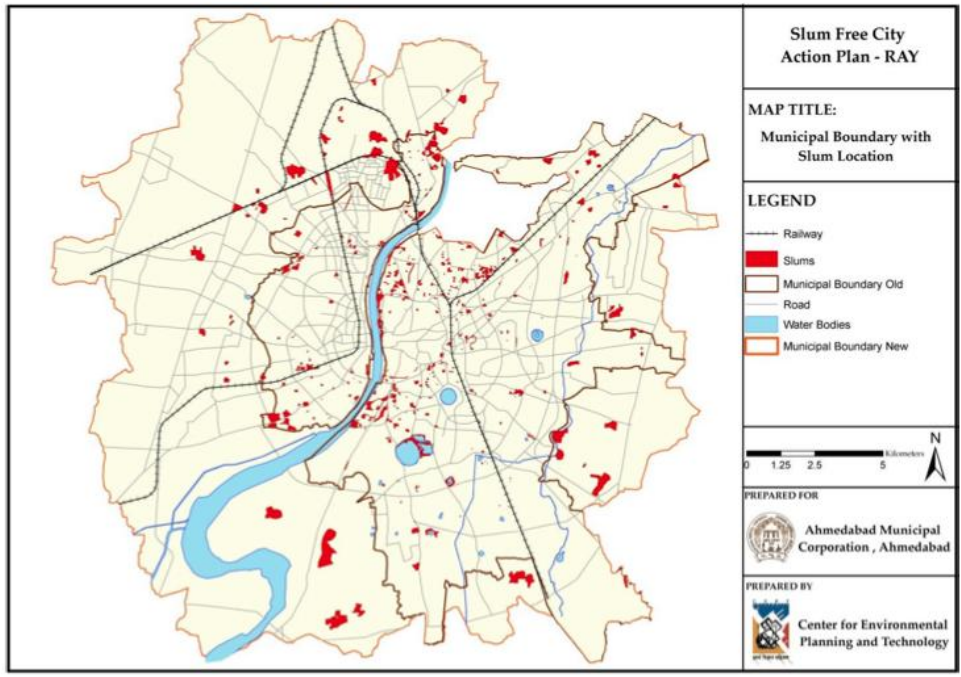
**Pictures**



Image from Google Earth
1 – Hanumanpura Ni Chali and Shankar Bhuvan Na Chapra
2 – Vasant Rajab Nagar
3 – Khodiyarnagar

A map of the Ahmedabad Municipal Corporation's territory and the location of
existing slums (Ahmedabad Municipal Corporation 2013)

Khodiyarnagar – Open stretch of pipe connecting toilets to the communal septic tank that allows storm water and trash to enter the pipe.

Khodiyarnagar – A pile of human excreta that a resident removed from the pipe connecting toilets to the communal septic tank.

Khodiyarnagar – A broken covering for a manhole, which allows storm water to entire the pipe system.

| Sanitation Technology | Description | Space Requirement | Benefits | Drawbacks | Cost (in rupees) for 5-user model |
|---|---|---|---|---|---|
| Twin-pit latrine | Two pits designed to hold at least a year's worth of waste are set at least one meter apart. A pipe from the toilet leads to a diversion chamber, from which the waste flows into one pit. Once the first pit is full, the waste goes into the second pit. When the second pit is almost full, the first pit must be cleaned out (by which time digestion will have ensured the waste sludge is pathogen and smell-free). | 40-60 sq. ft. | - Digested sludge can be used in agricultural purposes<br>- Can be used with either waterless or water using technologies | - Water from the pits may percolate into the soil and potentially contaminate the groundwater.<br>- Households must understand when and how to switch the flow of waste water from one pit to the other. | 15,000 - 20,000 |

| Sanitation Technology | Description | Space Requirement | Benefits | Drawbacks | Cost (in rupees) for 5-user model |
|---|---|---|---|---|---|
| **Septic tank** | A septic tank is a chamber beneath the ground that collects wastewater and allows it to decompose into effluent. The effluent must be cleaned out periodically and then be discharged into a reed pit or other soakaway away from human inhabitation in order to neutralize the threat of pathogens. | 40-50 sq. ft. | - Gets rid of 50-60% of biological load in the waste water | - Streets in the slums may not be wide enough to accommodate the size of the maintenance truck that must drain the tank every 2 or 3 years. | 25,000 - 30,000 |

| Sanitation Technology | Description | Space Requirement | Benefits | Drawbacks | Cost (in rupees) for 5-user model |
|---|---|---|---|---|---|
| **Bio-digester toilet** | Connected to a toilet or multiple toilets, a bio-digester toilet uses anaerobic microbial inoculum to convert fecal waste into usable water and gases. The digested product from the tank should be disposed into a soak pit or a reed bed in order to convert the product into water acceptable for reuse. | 29-35 sq. ft. (for superstructure above the tank and the reed bed) | - Claims that there is no sludge formation, so there is no need for de-sludging and treatment<br>- Bio-digester tank requires no maintenance<br>- Biogas can be used for cooking/lighting/etc. | - If the toilet is not used for >4 months continuously, a small amount of inoculum must be fed to reactivate the bacteria. | 67,000 – 72,000 |

| Sanitation Technology | Description | Space Requirement | Benefits | Drawbacks | Cost (in rupees) for 5-user model |
|---|---|---|---|---|---|
| Aerobic bio-tank/bio-toilet | The anaerobic bio-toilet is a multi-compartment tank that uses aerobic bacteria to break down waste into carbon dioxide ($CO_2$) and water ($H_2O$). The water must be treated with chlorine in a separate chamber in order to kill all of the pathogens in it. | 16 sq. ft. | - No need for periodic sludge removal<br>- Waste breaks down into carbon dioxide and water within 24 hours | - Needs bacteria inoculation at least every 3 months<br>- In dense areas where toilet blockages often occur, not inoculating the toilet on time can render the tank dysfunctional.<br>- Chlorine is required to make water usable. | 20,000 |

| Sanitation Technology | Description | Space Requirement | Benefits | Drawbacks | Cost (in rupees) for 5-user model |
|---|---|---|---|---|---|
| **Simplified Sewage** | Simplified sewage systems function much like traditional ones, carrying away the waste from a toilet to a centralized waste treatment plant. Simplified sewer lines have less strict construction requirements as the pipes can be smaller and at a lesser depth and gradient than traditional sewer lines. | Varies by slum | - Cheaper than traditional sewage<br>- Safely disposes of waste water with little upkeep | - Requires access to the main city sewage line, which may not be possible in illegal settlements | Varies by slum |

Note: Information for the table taken from the Government of India's "Technology Options for Urban Sanitation in India"