Building Stability Through Decentralization:
The Environmental, Economic, and Ethical Argument for
Informal Sector Collection and Decentralized Waste Processing in Urban India

By

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ABSTRACT

Rapid population growth, urbanization and increasing affluence have led to increases in consumption and waste generation in all Indian cities. The current system, a mix of informal recyclables collection and centralized waste collection by the formal sector with much garbage still disposed of in unlined landfills, is at a point of crisis. With waste generation far outpacing processing capacity, cities know they must invest in "improving" waste management systems, yet a key question is whether to invest in centralized or decentralized, formal or informal waste systems, or combine the strengths of both.

This research asks what approach to waste management in India will increase stability, economic and environmental sustainability, and social benefit. To answer those questions, I conducted a case study of Pune, since the city has implemented centralized waste processing, followed by supporting informal sector collection and instituting decentralized collection. The diversity of its methods and the many challenges Pune has faced have allowed me to analyze the benefits, impacts and limitations of each of these approaches. For the case study, I conducted more than 50 interviews of city staff, waste pickers, waste picker cooperative staff, restaurant managers, and citizens.

Based on this analysis, and comparison to other Indian cities, including Delhi and Bangalore, I have concluded that the best solution for most Indian cities is to build the capacity of the informal sector while also creating decentralized processing infrastructure to handle organics and non-recyclable waste. While this approach is challenging, it is possible, and I have created a set of recommendations in order to implement this effectively. These guidelines include the following: 1) conduct long-term planning across city departments to have proactive approach to waste generation; 2) focus on waste reduction and eliminate most non-recyclable and non-biodegradable waste streams; 3) invest in the capacities of the informal sector, including giving waste pickers space for sorting, more information on their rights, and support; 4) build decentralized waste processing systems for organics and non-recyclables that create benefits for and minimize impacts on host communities; and 5) site all facilities more equitably by building community consensus.

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Introduction

As India industrializes and urbanizes, increasing consumption is driving growth in waste generation, putting pressure on existing waste management systems. Until the late 1990s, Indian cities relied on a combination of municipal waste collection and informal recycling collection and processing. In recent years, however, communities living near existing landfills have organized to close the landfills: during the same period it has become more difficult to find new sites for landfills as urban areas sprawl outwards. This local resistance to landfills is forcing cities to develop alternative waste management systems.

Many municipal decision-makers are looking to private companies to handle their waste collection and to waste-to-energy facilities to process their city’s mixed waste. These centralized technological systems are not socially equitable, however, as they require a single community to bear the burden of a city’s waste processing; they are not economical for the city or the companies running them because their high initial costs lock both parties into long-term contracts even as other conditions change; they damage local air and water quality; they are not stable as they create dependence on a single facility, which is subject to failure for technical or social reasons; and they threaten the livelihoods of waste pickers. Fortunately, this centralized pathway is not the only solution to the waste crisis. This essay argues that for Indian cities the combination of building the capacity of the informal sector for waste collection and investing in decentralized waste processing is more socially equitable, economically efficient, and environmentally benign; it will also better protect the livelihoods of India’s large population of waste pickers and prove more resilient in the face of changing economic and social conditions.

I base this argument on data gathered from an analysis of waste management in Indian cities. In 2013 and 2014, I conducted more than 50 interviews with city staff, waste pickers and staff of waste picker advocacy groups, research scientists, restaurant managers, waste facility plant managers, and community groups in Pune, and 25 more interviews with similar groups in Delhi, Bangalore, and Mumbai. I also conducted an extensive literature review. My experience studying environmental policy in India and setting up decentralized food waste processing systems in Delhi from 2007 to 2010 has also informed my argument. This essay focuses on the city of Pune, which has faced the
same challenges as many other cities in India but has responded differently. Pune has ongoing conflicts at all of its landfill sites that have lasted for more than 20 years. Since 2005, Pune has committed to villages around the current landfill site in Uruli Devachar to send only processed or inert garbage. To achieve this goal, Pune invested in two centralized waste-to-energy facilities, neither of which has lived up to its design capacity. On the other hand, Pune began a strong partnership with a waste picker cooperative, SWaCH, which both stands for Solid Waste Collection Handling and means clean when translated. Pune also invested in decentralized biogas plants and mandated large food waste generators, restaurants and hotels, to separate their waste. These decentralized approaches have been much more effective.

Pune’s approach to waste management is still evolving. The city faces ongoing protests at both its landfill site and the centralized waste-to-energy plants; is contending with legal challenges over the siting of its food waste plants; and has a vexed relationship with Pune’s waste picker cooperative, SWaCH. Still, Pune’s experience highlights the risks and challenges of centralized waste management, while demonstrating the potential of the combined approach of investing in the informal sector and instituting decentralized waste processing. This paper uses the analysis of Pune’s case to create guidelines for cities to make this approach work best. These recommendations suggest that cities should: 1) create long-term and proactive municipal waste management plans; 2) focus on eliminating non-recyclable and non-biodegradable waste streams; 3) invest in the capacities of the informal sector for waste collection and recyclables sorting; 4) process waste locally to minimize impacts on and benefit host communities; and 5) ensure equitable siting and thus stability by engaging the community through a consensus building process.

**India’s Urban Waste Management Challenges**

India’s population growth, urbanization, and transition to a larger middle class are combining to shift consumption patterns in the country’s cities and towns, exacerbating existing waste management challenges. Given increases in packaged goods consumption, non-biodegradable wastes are growing most rapidly. Still, organic waste remains a
significant concern because of the methane it generates during decomposition and the health impacts that are possible throughout its disposal. Amidst these changes, the informal sector remains a critical player in Indian waste management, keeping thousands of tons of recyclables out of the landfills every year and generating jobs for an estimated 2 percent of the population in major cities (Chaturvedi, 2011). Because of these demographic changes and the size of the informal sector, India's waste context is unique. Solutions that may have worked in Europe or North America, including waste-to-energy or centralized sorting facilities, create more negative impacts when transferred to India, given the size of the informal sector. Instead, increasing the capacity of waste pickers and building decentralized processing makes more sense in India than investing in centralized collection and processing.

**Increasing Waste Generation**

Demographic changes are the core factor in increasing waste generation in Indian cities. Population growth and rural-to-urban migration are causing rapid expansion in city size. National urban population percentages have been steadily increasing, from 17.7% in 1950 to 28.7% in 2005 and an expected 32.2% in 2015 (Asnani & Zurbrugg, 2007). This national trend of rising urban populations translates to even higher growth in certain cities: Bangalore's population increased 47% between 2001 and 2011, while Pune's increased 30% during the same period (India Census Data 2011, 2012). Cities with such high population growth face difficulty scaling waste management systems, particularly as waste per capita also continues to increase.

Waste generation per capita correlates closely with income: increased affluence in Indian cities leads to increased consumption overall, particularly of packaged goods. While volumes of organic waste—food and yard waste—continue to grow, it is the non-recyclable wastes that are increasing most rapidly. Plastic increased from 1% of India's municipal solid waste in 1996 to 9% in 2005, while organic waste went from 42% to 47% during the same time (Asnani & Zurbrugg, 2007).

While the increase in the percentage of organics is slightly smaller than the increase in plastics, the total volume of organics is much larger. Organics are a critical part of waste management, not only because of their volume, but also because it generates impacts on
communities throughout its movement. Food waste creates impact on communities generating it, as disposal in bins on the streets can attract rodents, can breed mosquitoes and other insects bearing diseases, and can create strong odors as it decomposes. Once collected, the movement of organic waste creates direct economic and environmental costs in its transportation. The arrival of hauling trucks bearing organics creates smell, traffic, and air pollution in communities hosting processing facilities. If disposed of in landfills, it generates methane, a powerful greenhouse gas.

Despite the problems it causes, organic waste is also an underutilized source of value for a city. When processed via composting or anaerobic digestion, biodegradable waste becomes valuable nutrients for the soil and, in the case of anaerobic digestion, methane and energy. Given these increases in all types of waste generation, the current capacity of the informal sector and the municipality to perform waste collection is strained. Some cities, including Delhi, Kanpur, and Surat, have hired private contractors to collect waste, and in most of these cases, also process it. Many residents and NGOs interviewed believe that the municipal bidding process for waste contracts is corrupt, and even private companies report that they paid city staff to gain many of these contracts.

Social Pressure to Close Landfills

Whether waste is collected by municipalities or by private haulers, most of urban India's waste is taken to landfills. Landfills in most Indian cities—including Delhi, Bangalore, and Pune—are near or beyond capacity. 12 of Delhi's 14 landfill sites are now closed. Many of the communities surrounding landfill sites across the country are putting political and legal pressure on cities to close the landfills that remain, given the adverse impacts landfills have had in their neighborhoods. Landfills attract dogs and can be a breeding ground for mosquitoes and pests. Since many landfills were built without any lining, chemicals leach into soil and groundwater and can even make land unfit for agriculture. Given the heat generated as organics decompose, landfills often catch fire in India, and landfill fires generate toxic air pollution, with high levels of carcinogenic dioxins (Annapu, 2014). Having waste trucks run through communities disturbs the peace and can be dangerous to pedestrians. These combined factors lower quality of life and property
values, so it is not surprising that communities bearing these burdens for decades are demanding landfill closure.

Protests from these host communities are spread across the country, from attacks on waste truck drivers and arson of landfill facilities in Srinagar, Kashmir in 2010 to a 2013 hunger strike led by the President of the local council, or Panchayat, in Vilappilsala, Kerala in the South (Annepu, 2013). Waste facilities have been blocked by host communities in Bangalore and in Pune, leading to waste build-ups in the streets.

Critics disregard these protests as simply NIMBYism and assume that communities do not understand the realities of waste needing to be processed somewhere. However, these protests are rooted in a demand for environmental justice with recognition of the inequity of a single community bearing the burden of an entire city’s waste. Environmental justice provides insight on why communities respond negatively to hosting large-scale waste processing facilities and why these responses are costly and unstable for cities and companies.

It is easier to calculate impact on a community measuring only the quantifiable impacts of air and water pollution that could threaten human health or the losses in property value discussed earlier. However, residents are also affected by emotional, social, and psychological impacts (Layzer, 2012). Emotional impacts that affect quality of life include nuisance factors of traffic, noise and smell. Citizens also are impacted by the social stigma of living near a landfill. Stigma is accentuated in India given waste’s connection to caste and class. Psychologically, communities perceive stronger impacts when they feel a sense of injustice or inequity. Additionally, people are more likely to think an outcome is unjust if they were not consulted in the decision. Scientists have also shown that citizens perceive a greater impact if they have less confidence in the implementing agency or the
technology being applied. (Zeiss & Atwater, 1987). Writing off these perceptions is risky, since they all affect how any community will respond to a waste facility.

Perceptions of equity and procedural justice are very relevant in India, since citizens living near landfills feel that the facilities were imposed on them without any participation, and they continue to feel excluded from decision-making. This discontentment in the process often translates into greater dissatisfaction with the final siting decision.

Global surveys of waste facility host communities have shown that acceptance to waste facilities decreases if waste is coming from outside of the neighborhood, and acceptance decreases even more sharply if the waste is coming from outside of their municipality. Zeiss and Atwater (1987) attributed this to perceptions of fairness: waste generated by residents is seen as fair to dispose of locally, but one community bearing the burden of waste from "outside" is seen as unfair. The more locally waste can be processed, the less unfair it will seem to the host community, which is a strong case for decentralized waste processing.

Cities should care about environmental justice not only from a sense of ethics, but also because dissatisfaction and protests are very costly. James Hamilton (1993) outlines potential costs of this type of collective action for firms, and in this case, for cities. Communities can organize to block a permit before any construction begins, costing the company and the city the cost of that RFP and permitting process. When permitting or actual construction is slowed, there are opportunity costs for the company. Furthermore, all parties have to pay the high costs of litigation if communities file a suit.

Cities should also pay attention to dissatisfaction with waste facilities because the likelihood of more effective environmental justice organizing in India may increase after some of the recent high profile waste protest movements in Kerala, Pune, and Bangalore. Social movement researchers have analyzed the likelihood for citizens to get involved to be based on many factors, including the obvious economic or emotional connection to the campaign. Citizens would also join a campaign to close or block a landfill based on the potential benefit from a successful campaign, the costs of involvement, and the benefits of involvement, including sense of community and relationships, regardless of the outcome the perceived, and the probability that a campaign would be successful (Hamilton, 1993; Mueller, 1979). Given these recent environmental justice campaigns, more communities in
India understand the threats of landfills and are learning potential tactics to stop their expansion. This is making it harder for Indian cities to find new locations for landfills, since communities have begun organizing as soon as the city proposes a new site and since state- and national leaders have set requirements that cities must process all waste within their city limits. With villages nearby off-limits, cities are less likely to find any host for landfills (“Denied landfill sites, civic body in a bind,” 2013).

**Environmental, Economic and Social Impacts of Waste-to Energy Plants**

With this increasing social and logistical pressure to close landfills and the challenges of considering new landfills in any community, many cities see waste-to-energy facilities as an immediate and efficient solution. Waste-to-energy plants can handle large volumes of mixed waste with smaller spatial footprints and simultaneously generate needed energy, which reduces dependence on fossil fuels (Annepu, 2011). Some studies report that incineration generates less than a third of the greenhouse gas emissions as compared with landfills. Incineration reduces the volume of waste that goes to landfill by 90 percent on average, sending only one-tenth of the volume as ash to landfills. Incineration can also effectively eliminate the risk of community exposure to medical wastes (Tammemagi, 1999). Since waste-to-energy converts waste into energy and gases, including the carcinogenic dioxins generated when plastics are burned with other materials, all recognize that air pollution is a concern. Proponents argue that any pollution waste-to-energy generates is less of a threat to air quality than unlined landfills are to water resources. It is easier to remove air contaminants from a point-source of pollution—the emissions stack—than it is to prevent the contamination from a large landfill or many informal dumping sites from polluting the water. Additionally, compared with the pollution caused by landfill fires, the emissions of waste-to-energy plants seem much smaller: research in France shows waste-to-energy facilities emit .01% of the dioxins that open burning does (Annepu, 2014).

While waste-to-energy does have some clear benefits in comparison to unlined landfills and open burning, this isn’t an effective comparison. Unlined landfills and open burning are not solutions: waste-to-energy may be better than those options, but that does not make it good. Also, much of the research done on environmental impacts happened in
Europe, which has a very different waste mix and cultural context. In India, waste-to-energy facilities create environmental, social and economic challenges.

As mentioned, turning waste into energy guarantees the production of waste gases, including carcinogenic dioxins (Tammemagi, 1999). While dioxin production was shown lower in waste-to-energy facilities than open burning, most plastics that generate dioxins when burned do not have to be burned at all if they are recycled. Many scientists have shown higher levels of cancer and reproductive disorders in neighborhoods around waste-to-energy plants than in control communities (Cordier et al., 2010; Shy et al., 1995). Dioxins are produced more frequently when the plant is not combusting waste completely, such as when wastes with a high moisture content, including food and yard waste, are mixed with other waste streams. Given the high content of these organic wastes in India, the production of dioxins is likely to be higher than what was measured in Europe. It is indeed possible to remove the bulk of toxic materials from facility emissions, but air quality technology is very expensive and can be the major cost of constructing and operating such a waste-to-energy plant (Tammemagi, 1999). Given the cost, companies are unlikely to implement high quality air scrubbing unless it is enforced. Given minimal air quality monitoring of these facilities, such enforcement is unlikely.

Beyond air pollution concerns, there are questions about methane and carbon emissions from waste-to-energy facilities. Proponents describe them as climate change solution, since they can replace the need for coal-fired power plants and eliminate methane emissions from landfills (Annepu, 2014), but opponents cite research showing that waste-to-energy facilities release more CO2 emissions per megawatt-hour than any other energy facility (Global Alliance for Incinerator Alternatives, 2014). Burning recyclables also represents a loss of energy efficiency. Since recycling materials reduces the energy needed for production from virgin materials, combusting or gasifying otherwise recyclable materials eliminates this opportunity.

The fate of recyclables is also a real concern to waste advocacy groups, including Global Alliance for Incinerator Alternatives and Women in Informal Employment: Globalizing and Organizing. They are concerned about incinerators because they threaten waste pickers' “right to waste.” Wastepickers lose access to waste, and thus their livelihood, when private companies collect all waste to process in a single facility (Chaturvedi, 2011).
Researchers at the World Institute of Sustainable Energy outlined a set of economic challenges for waste-to-energy in India (Personal communication, March 2014). In India, given the high moisture content of the waste stream, incinerators or other waste-to-energy systems can never operate at the same efficiency as they do internationally with a drier waste mix. In some cases, they cannot operate at all: a waste-to-energy plant in Delhi shut down operations after one week, because the waste was too wet to burn (Patel, 2014). Even in the best case, wet waste means the plants generate less energy or refuse-derived fuel than as designed, often making them not economically viable in the long term.

Additionally, the regulatory environment for sale of electricity is complicated, and it can take years from the initial operations of a facility before a plant received approval for electricity sale to the grid. This dramatically changes a plant’s return on investment, since a major source of revenue may not appear until years later than expected.

Furthermore, since incinerators tend to have much higher initial capital costs than recycling or composting programs, they often require longer contracts from the city to guarantee a return on investment (Denison & Ruston, 1990). These contracts are for up to 30 years; such long-term agreements lock a city into a commitment to waste-to-energy, regardless of other changes that take place. These contracts may include waste floors, or minimum values of waste that must be sent to waste-to-energy facilities. This structure removes incentives for a city to invest in other processes to manage waste.

Lastly, since incineration is often seen as a panacea to solve all waste problems, cities can become locked into dependence on a single private entity. If these facilities face any problems, such as a technological malfunction, a labor crisis, or a social protest, cities are debilitated. To continue providing services, cities have to resolve the situation, sometimes bailing out these private companies, to ensure that waste can still be processed and thus removed from city streets. This bailout can take the shape of financial donations or the donation of staff, as has happened in early 2014, in Pune.

While most of these economic and environmental concerns about centralized waste-to-energy facilities are global, the social concerns in India are unique. Some argue that waste-to-energy is more efficient than the informal sector, but efficiency is not a city’s only goal. Systems that threaten the jobs of hundreds of thousands of people in the informal waste sector may create more poverty, unrest, and associated urban challenges.
Informal Sector

It is important to consider the impacts of waste infrastructure on the informal sector because of its scale and impact. The informal waste management system in India is extensive; there are thousands of waste pickers and informal recycling middlemen earning a living from waste. Estimates are that 1-2% of the urban population is waste pickers: the estimated number of waste pickers in Delhi alone is 160,000 (Chintan India, 2012). Recycling rates in many Indian cities rival that in the highly formalized recycling systems of Europe, largely because of this informal sector. The German development aid organization, GTZ, studied the Indian informal sector and reported recovery rates of recyclables up to 80%. GTZ calculated that the informal sector in Pune is responsible for reducing greenhouse gas emissions by 295,000 tons by reducing transportation and landfill emissions (“Round and round it goes,” 2009, “Waste Pickers and SWM,” 2014). Wastepickers’ recycling diversion avoids between $3 million and $9 million in cities’ tipping fees (Gunsilius, Spies, & Garcia-Cortes, 2011; “Waste Pickers and SWM,” 2014).

In many cities, waste pickers not only sort garbage and extract recyclables but also conduct door-to-door collection. This is organized formally in partnership with the government, for Chintan in parts of Delhi and SWaCH in parts of Pune, and is conducted informally in many other Indian cities. In most of these cases, residents pay a monthly user fee, of 10 to 50 Rupees ($0.25-$1). This makes the system very low cost to the cities.

However, this low-cost waste collection to cities and residents comes at a cost of under-paid human labor exposed to hazardous materials. Wastepickers are exposed to needles, sanitary waste, medical waste, and rotten food when they sort through waste. Many waste pickers receive lower prices than they deserve for the recyclable goods they collect, particularly if they do not have space to sort or store waste. Increased quality of segregation and increased aggregation both increase sale price and waste picker income. Wastepickers can be victims of discrimination, based on social stigma around waste sorting tied to caste. Wastepickers and their children often do not have access to education or other basic services because of the perception of their work (Chaturvedi, 2011).

Advocacy organizations that exist to protect waste picker rights, change policy and education the community exist only in a few of India’s largest cities. Chintan, in Delhi,
works to educate waste picker children to provide the next generation more opportunities, while ensuring they have time to be with their families and work alongside their mothers and go to school. KKPKP, SWaCH’s parent organization in Pune, is a waste picker union that protects rights and lobbies for more services for waste pickers.

Given the challenges of working in the informal sector, some argue that the best way to reduce risks of waste pickers is use technology for collection and sorting and to transition waste pickers into other careers. However, at the moment, there are few other options available to many waste pickers, and most waste picker unions see the implementation of centralized, formal collection as a threat to their members’ livelihoods. Given the millions of people across the country dependent on wastepicking as a profession, any changes to the existing system must take them into consideration.

**Pune’s Response to Waste Management Challenges**

Pune has faced all of the challenges outlined above—increasing waste generation; social pressure to close landfills; economic, environmental and social impacts of waste-to-energy plants; and a strong, organized informal sector. Pune is one of the fastest growing cities in India. This growth combined with increasing affluence has led to significantly increased consumption and waste generation. Community organizing for landfill closure has forced the city to consider alternatives over the past 20 years. In the late 1990s, Pune invested in two large-scale waste-to-energy plants. After failures of those systems to run at capacity, Pune found itself with more landfill protests, and chose to build a strong—although certainly not perfect—partnership with SWaCH, a local waste picker union, to formalize widespread door-to-door collection, and it has created effective regulation of hotels and restaurants that mandates separation of food waste which is sent to decentralized processing units. Pune is widely seen as a success story ("PMC’s waste disposal impresses officials," 2013, “Pune model...socially relevant, says study,” 2012), but its challenges also offer excellent opportunities to understand the limits of centralized waste processing and to see ways to improve decentralized waste systems. As Pune has learned the hard way, strong investment in the informal sector for collection and in decentralized waste processing is more stable in the face of change.
**Urban Context: Social and Geographical Factors**

Many say Pune has been able to implement decentralized waste processing because it has a young and liberal population. While others argue Pune is like every other large city in India in that regard, it is important to review Pune’s key social and political context. First, Pune is a rapidly growing, highly-educated city, located in the state of Maharashtra. Pune is the ninth-largest city in India, with a population of 3.1 million in the city center and 5 million in the greater metropolitan area, according to the 2011 census. It is one of India’s fastest-growing city, increasing 30% between 2001 and 2011 (*India Census Data 2011, 2012*). This increasing urban development is leading to reduction of the city’s green spaces. Pune was once known as Indian’s garden city, but as land values increase in the urban core, many of these gardens are being replaced by commercial or residential development. Sprawling construction is spreading outwards, turning previously agricultural areas into apartment buildings, industrial complexes, or corporate campuses.

Much of the city’s growth is particularly in the youth demographic. After Bangalore, Pune is India’s second home for technology and outsourcing companies, with major campuses of Wipro, Infosys, and others employing thousands of young Indians in Pune’s urban periphery. Pune is home to hundreds of colleges and is often referred to as the Oxford of India (Chhapia, 2013). Pune’s high percentage of educated, young professionals may make it slightly more liberal than other areas in the country.

Pune has also had a long history of social change, serving as the seat of many Indian social movements including the anti-caste movement and the movement for girls’ education. Gandhi had a deep connection to the city and is buried along with his wife at the Aga Khan Palace in Pune. Those who have described this history of social movements draw a connection to the presence of so many universities and intellectuals in the city. However, residents emphasize that Pune is not so different from other Indian cities, and those working in waste management emphasized that Pune faces the same challenges of convincing any population to change (Personal communication, 2014).

**Waste Protests as Drivers of Change**

Pune may have distinct social conditions, but it faces the same waste challenges as other cities. In the 1980s and the early 1990s, Pune managed its waste like most other
cities at that point in time: all of its waste was taken to an unpopulated area outside of the city and dumped in an unlined, untreated landfill. In Pune’s case, the landfill was in Paud, an area in the western urban periphery. Initially, the landfill was surrounded by a buffer zone of forests. As the city expanded, land value in this area began increasing, and more residential areas were zoned and built around the landfill. Those new residents began to organize, exerting political pressure on the city to shut down the landfill and search for a new location. The residents of Paud won the court case against the Pune Municipal Corporation in 2001, and so Pune was required to close the dumping ground (Dutta & Pallavi, 2014).

Under this pressure to close the Paud landfill, the city identified a site in a former quarry in Uruli Devachar, in what was then the urban periphery south of the city. Pune began using the quarry pits as another unlined landfill. Within a few years, the villagers of Uruli Devachar and neighboring Phursungi began to experience serious changes to their communities and lives. Community members reported contamination of their water and soil from landfill leaching, which rendered their land no longer arable. The communities also experienced decreases in air quality, particularly during times of landfill fires (Personal communication, March 2014).

Almost as soon as the site was chosen, the citizens of Uruli Devachar and Phursungi began what would be come more than 15 years of protests and lawsuits against the city. Early protests were aggressive, with villagers slashing tires and attacking waste haulers, and elicited brutal responses from the police, who beat protestors and arrested large numbers of them. After this first wave of violent protests, organizers shifted tactics to approaches more inspired by Gandhi. Nonviolent direct action has dominated, with protests ranging from blocking trucks from entering the landfill or other waste facilities to marches of thousands of people from the landfill to Pune’s government offices.

Image 2: Photograph of an early march to the main municipal office. From Phursungi movement archives
center, bearing waste which they delivered to the ward office (City Hall) courtyard and
directly to politicians' desks. Protests have often had a spark, in addition to the long-term
concerns. In 2010, 2011, 2012, and 2014, residents have protested during landfill fires,
which release toxic gases into their community.

During landfill protests, some of which lasted for more than a month, residents
prevented the city from being able to dispose of its waste the landfill. These blockades
meant that the city could not collect waste, since they lacked anywhere else to dispose of it,
which created waste build-ups across the city. Residents reported increases in rats, dogs
and mosquitoes, in addition to increased odor and unsightliness. In some areas, desperate
for space, residents set fire to these piles, creating air quality concerns (Image 4). As waste
piled up in their streets, citizens across the city became concerned with the disposal of
waste and put political pressure on city officials from neighborhoods across the city.
This local political pressure has mounted to a state or even national level. In December 2013, in response to the Uruli Devachar protests, Maharastra's Deputy Chief Minister, Ajit Pawar, visited the village and the waste processing sites. Soon after, he gave clear direction to local city staff that they should find new locations for decentralized waste management systems (“Pawar calls for decentralised garbage treatment process,” 2013). In April 2014, after legal action brought by residents, the Bombay High Court required the Pune Municipal Corporation (PMC) to take action to dispose of waste in the city (“Garbage pile-up: HC orders PMC to dispose of waste,” 2014). These court rulings and political mandates did not provide any guidelines on approach. Therefore, while broader political pressure drove Pune to solve the crisis and invest in new waste management approaches, it was city staff who decided how to respond: in the late 1990s, investing in centralized capacity creation, and throughout, in decentralization—waste reduction, diversion, recycling, and decentralized organics processing.

Interviews with city staff in Pune, Bangalore and Delhi in January 2014 indicated that there are a few key factors that can influence a municipality’s decision: these all did play a role in Pune. A city’s exposure to waste management technology or systems can influence what leaders see as possible. All city staff said they watched closely what was happening in other cities. In some cases, this can create a herd mentality: several cities invested in waste-to-energy in the late 1990s or early 2000s and have experienced the challenges at the same time. National subsidies have tended to fund larger infrastructural projects, pushing cities towards centralization. Corporate lobbying and nonprofit advocacy both work to emphasize the benefits of their approach. Media coverage also plays a role in highlighting specific types of successes. Pune’s focus on informal sector partnerships and decentralized waste processing has gotten more high profile media coverage, including in the popular show Satyamev Jayate in March 2014, when Bollywood star Aamir Khan visited landfills, waste picker groups, entrepreneurs, and cities across the country (Satyamev Jayate / Don’t Waste your Garbage, 2014).

Given all of these factors, the city of Pune made two very different decisions in response to the protests and associated political pressure in the late-2000s. Using a centralized approach, Pune responded to the pressure to process large volumes of waste and built two centralized waste-to-energy facilities. They were designed to process 1700-
2200 tons per day together, but they have never run at this full capacity and have created other problems in the city. However, the city was also influenced by national regulation, effective informal sector organizing, and a demonstration of effective decentralized organics processing. Pune has made significant investments in decentralization and the informal sector. Its two distinct approaches offer much to learn about the impacts and limitations of each.

**Pune's Investments in Centralized Waste Technology**

In 2008 and 2009, Pune contracted with two private companies to construct waste-to-energy facilities and constructed a lined landfill. Pune's goal was to process all non-recyclable waste in the waste-to-energy plants and send only the residual ash to the landfill. The larger plant is Refuse-Derived-Fuel (RDF) plant on the same site as the landfill, designed for 1500 tons per day. Run by Hanjer Biotech, it is referred to as the Hanjer plant. A smaller plant (700 tons per day design capacity) is a thermal gasification plant in Ramtedki Hadapsar that is run by Rochem Separation Systems.

![Image 5: Manual sorting in a facility like Hanjer and Rochem. Waste moves on a conveyor belt between these staff, as it moves between two mechanical trommels. Photo by author, January 2014.](image)

Both facilities receive mixed waste from the municipal bins around the city, and are paid about 800 Rs ($16 USD) per ton. They both use a combination of mechanized sorting and manual sorting (Image 2) to extract higher value recyclables and organics from the mixed waste. Recyclables are sold, and organic waste is “composted,” generally while still mixed with other waste, which decreases the quality of the final compost. The remaining
mixed waste is then processed to generate energy and/or Refuse-Derived Fuel. Neither facility is running at capacity; in fact, both are running at less than 50% of their design capacity. Both plants face similar challenges, but also have some distinct factors based on their economic models and their locations.¹

Rochem Separation Systems

Rochem is a gasification facility, which processes mixed waste and generates electricity. The city delivers mixed waste bins that include 15-30 percent organic waste, in addition to a mix of high-value recyclables, plastic bags, and other materials. Outputs from Rochem include 15 to 20 percent compost, 4 to 5 percent landfill-bound ash, and 1 to 2 percent recyclable materials. 15 to 20 percent is released throughout the process as moisture, and about half of the waste is gasified and converted into energy.

While the initial design proposal was 700-750 tons per day, the current facility can process only 200 tons per day since they only have one of four potential towers running. So far, the system produces 2 MW of energy from gasification, which currently is being used only to cover the energy costs of their facilities. The rest is “dumped,” as of January 2014, because the state and national energy ministries did not give Rochem permits to connect or sell to the grid. The permitting process takes years, and the company had not accurately estimated the amount of time it would take to gain permission for sale of their electricity. Since the sale of electricity was a key component of their business model, without permission to sell power, the plant cannot afford to expand.

¹ I have far more information about Rochem’s operation than Hanjer’s, and most information about Hanjer is from secondary sources. This is because the staff at Rochem took the time to show our team (myself and partners from SWaCH) around, and described their process in great detail. We were denied entry into the Hanjer facility, perhaps because in both January and March of 2014, we arrived soon after a large fire and during times of protest at the facility.
The Rochem plant may also face challenges in the future from their neighbors: an apartment complex is directly adjacent to the gasification towers at the Rochem plant. This area is zoned industrially, but a major residential complex called Hill Side was constructed at roughly the same time. In January of 2014, the developers were building a 100-foot high wall between the two facilities, after community members complained, “During last year’s monsoon, the leachate... from the garbage was all over the area (Isalkar, 2013).” While the responsibility for this construction lies with developers and the city’s zoning and permitting departments that allowed residential construction next to waste gasification, residents will bear the burden, potentially blocking operations and affecting both the company and the city at large.

Hanjer Biotech:

Hanjer faces many of the same challenges as Rochem, only at a larger scale. Hanjer is located between Uruli Devachar and Phursungi, where it is connected to the current landfill. The facility’s design capacity is 1500 tons per day (“My Hanjer City: I love Pune,” 2011), but as of March 2014, the Hanjer facility was only processing 200 tons of waste per day, less than 20 percent of the design capacity (Gumaste, 2014; Kulkarni, 2014a). The extremely low capacity in early 2014 was due to a January 2014 fire that destroyed an entire processing unit worth Rs 5.5 crore, or $10,000,000 (Isalkar, 2014). While the
company reports that it was not garbage but an electrical spark that started the fire, the large piles of garbage in the facility and the surrounding landfill all caught fire, creating huge air pollution concerns in the surrounding community.

For neighbors in Uruli Devachar and Phursungi, the fire sparked another wave of protests. Bhagwan Bhadale, a community leader in the protests, said to a Times of India reporter, “Massive clouds of smoke have covered the twin villages. We have blocked garbage containers from entering the villages from Friday. We will not allow the Pune Municipal Corporation to bring garbage here until the fire is doused and waste piled up at the depot is processed and cleared (Isalkar, 2014).” Residents of Uruli Devachi and Phursungi followed through on this and blocked all garbage trucks from delivering more waste until the fire was put out (Isalkar, 2014).

Bhadale and his neighbors were not only protesting the direct impacts of the fire itself, but also what they saw as a long-term capacity gap in the facility. While Hanjer committed that it would process 1500 tons per day and would only send 15 to 20 percent of the waste to landfill as ash (“Hanjer Technology,” 2011), residents believed that the percentage of waste going to landfill throughout 2012 and 2013 was higher—and that the waste sent to landfill was never even processed. The Center for Science and Environment estimated that Hanjer was processing only 600 tons of the 1,200 tons the plant received throughout 2012 and 2013 (Dutta & Pallavi, 2014).

It would have been nearly impossible to be running at capacity before the fire, given just how understaffed the facility was. By January 2014, only 25 of the 200 staff that
Initially worked there were still employed, and some of these 25 staff were on strike for payment of back-owed wages, according to some residents interviewed. The plant also owed hundreds of thousands of dollars for back-owed electricity bills. Plant managers reported their financial constraints were due to a lack of demand for the RDF and plastic pellets, since demand was lower and since Chinese companies were selling at much lower prices.

Between the fire, the strike, their financial challenges, and the protests, Hanjer simply could not process the city’s waste, and residents continued blocking the facility from accepting waste, since it was clear any waste would just be sent to landfill. Together, these factors put the city in a state of desperation, given their dependence on Hanjer to process the majority of the city’s waste. In February 2014, the Pune Municipal Corporation (PMC) gave Hanjer 80,00,000 Rs, or more than $130,000 USD, to pay their outstanding bills (“Pune Municipal Corporation allots Rs 80L for Hanjer plant,” 2014, p. 8). PMC also allocated 50 of its own staff to work at the Hanjer facility.

This financial and manpower contribution to a private party is remarkable, given the city’s claims of low staff and limited funding, and the city’s lack of payment of its other waste partners, including SWaCH, the waste picker cooperative. This intervention is indicative of just how reliant Pune was on a single facility and the direct financial costs and cost of city-wide stability that such single dependence has. It also shows the importance of company’s interested in implementing these facilities having the necessary time to really understand the waste mix, the regulatory context, and the competitive environment that they are entering.

Pune has now demanded that both Hanjer and Rochem run at full capacity or Pune will cancel their contracts with the companies.
However, this is physically impossible for both plants, given the stage of Rochem’s expansion (1 out of 4 towers) and the damaged infrastructure in Hanjer, and is likely to be not economically viable for them to expand to full capacity either. While these problems have emerged most vividly in 2014, there were problems with centralized processing facilities from the early days of its implementation, which explains why Pune chose to invest in decentralized waste processing in the mid-2000s when another crisis arose.

**Pune’s Investment in Decentralized Waste Processing**

In 2007, driven by the combination of ongoing protests and waste buildup and the National Municipal Solid Waste Rules of 2000 (called the MSW Rules 2000) which regular waste collection throughout the city, Pune knew it needed to change its waste collection system. Pune briefly considered a partnership with private sector for collection, but effective organizing by KKPKP, the Pune waste pickers' union and guidelines within the MSW Rules 2000 convinced Pune to work with the informal sector for waste collection. The regulation also mandated that cities separate organic waste at source and process organics separately. Pune was one of the first cities to actually take action following those guidelines when it created its decentralized processing systems in 2008 and 2009 (Dutta & Pallavi, 2014). The city chose to 1) partner with the informal sector for door-to-door waste collection and recyclables processing; 2) tackle organic waste by regulating the largest food waste producer—restaurants and hotels; 3) process the commercial organics at decentralized facilities; and 4) create incentives for new and existing residential complexes (societies) to begin composting their own waste.

*Informal Sector Partnerships*

Pune was able to partner with the informal sector for household collection and recyclables diversion fairly quickly because of the existence of a strong waste pickers' organization. KKPKP is a waste pickers' union that was founded in 1993 to support the rights of waste pickers across the city. In 2007,
KKPKP saw an opportunity to partner with the city to serve in organized door-to-door collection. They created SWaCH, a separate cooperative with a set number of waste pickers working to collect waste from households, and in 2008, the city contracted SWaCH to provide door-to-door collection services for single-family homes and apartment buildings in 40% of the city's area.

This arrangement is financially far less demanding on the city than its work with private players. SWaCH waste pickers are paid collection fees by each of the 100 to 200 households they cover; these fees can represent about half of a waste picker's total monthly earnings. They earn the other half through the sale of the recyclables they collect. Most SWaCH members earn between 4,000 and 10,000 Rs per month, or $80-$200 USD, depending on the neighborhoods that they cover. These waste pickers pay 5 percent of their earnings to SWaCH to cover costs of the supervisors, who help mediate between neighborhoods and SWaCH members. They help guarantee reliability for the residents and safety for the members.

SWaCH members divert 40 percent of the waste they collect from going to landfills or waste-to-energy plants, and save the city millions of dollars in transportation and processing costs (Gunsilius et al., 2011; “Waste Pickers and Solid Waste Management,” 2014). The city provides SWaCH with space in some areas of the city and has provided identity cards to all SWaCH waste pickers, giving them credibility as a part of the partnership. The blue SWaCH jackets also help
lend that professional credibility to waste pickers. Pune Municipal Corporation provides funding to SWaCH that is allocated towards health insurance and other services for their members, though this has been underpaid or unpaid for much of the contract period.

Wastepickers still have real challenges in Pune: they lack access to space to sort and aggregate recyclables, and without financing from the municipality, SWaCH has had to cut supervisors and managers, decreasing the reliability and safety of the system. Without specific sorting space, waste pickers do minimal sorting on the street. This means they face criticism from neighbors who don't want waste on their streets and are at risks of traffic accidents. It also means waste pickers get lower prices for their recyclables, since they don't have space to segregate and aggregate their goods. Their buyers pay more per kilogram if material is in larger volumes and more finely sorted. Cutting funding for or underpaying SWaCH is a mistake for the city. It ignores the volumes of waste SWaCH's members divert and the associated costs, plus removes supervisors, who play a critical role in the reliability and smoothness of the service.

The process of organizing waste pickers in Pune has not been easy for KKPKP and SWaCH, and it cannot happen overnight. KKPKP had been working for a decade with waste pickers before launching SWaCH and partnering with Pune. For this reason, engaging the informal sector is often not seen as the immediate solution to a waste problem. However, waste pickers already play an important role in urban waste management; if they are given space and credibility, they can provide even better services and earn a better livelihood.
In 2009, soon after beginning their partnership with SWaCH, the city built its first biogas plant. A Pune-based biogas company, Enprotech Solutions, showed municipal staff their functional plants in the nearby city of Thane and the municipality decided to build one pilot in Pune (Dutta & Pallavi, 2014). After the success of the first plant, Pune opened tenders for and launched construction of biogas facilities to turn food waste into energy, mechanized composting facilities for dense urban composting, and vermicomposting facilities: there are now 20 biogas plants, and 27 expected to be online by the end of the year. In 2009, the city enacted and began enforcing regulation to ensure that all restaurants and hotels—the largest generators of organic waste—would separate food waste. While Pune city staff did not inform all businesses about the regulations and the costs of non-compliance, all of the 25 restaurants interviewed in January 2014—covering 5-star hotels catering events for hundreds to streetside dhabas that seat 10-15 people at a time—were aware of the regulation and did separate their food waste. The city reports 80-90 percent compliance across all restaurants, which is unusually high for any Indian regulation. This level of compliance is possible because of very effective enforcement: if a restaurant mixes food and other wastes, municipal waste collectors simply do not pick up their garbage. For restaurants of any scale, this is a very powerful threat, since having rotting food nearby is unhygienic and unappealing for customers.

Once municipal staff collect the separated food waste from restaurants, they bring it to one of the organics processing facilities in the city. These facilities include 20 biogas facilities across the city, as of March 2014, one large-scale mechanized composting facility (2 tons per day), and two large-scale vermicomposting facilities, each designed to process 100 tons per day. Even the city admits that not all of the biogas facilities are operational; in January 2014, municipal staff said that 14 of the 17 municipal biogas plants in the city were operational. Citizens estimated that perhaps only 10 were operating, but even if this were the case, the overall percent of active capacity would be higher than the 20 percent capacity utilization in the centralized facilities.
The biogas plants range in size from processing 3 to 10 tons of organic waste a day and generate methane gas to run small generators that power streetlights near each facility. The total power generation that this represents is low compared to the city’s entire electricity consumption, but since the city uses this electricity directly, the biogas plants don’t have to go through the hurdles of regulatory power sale.

Biogas plants are not perfect and face their own challenges. Since excess gas cannot be stored or processed, the plants have to flare off methane, which is inefficient and creates odor in the neighboring areas. Waste arriving is processed very quickly which minimizes odors, but the trucks delivering waste do create traffic and local air pollution. The biggest concern to the neighbors has been the generators, which run all night. They are so noisy that even after a double sound-insulating canopy, the sound reaches the neighbors. Given these challenges, which most affect immediate neighbors, design and siting of these facilities is critical. Pune’s showcase biogas plant is located in an administrative and industrial area in Aundh, with its only neighbors a waste transfer station, a mechanized composting facility, and municipal offices. However, a number of biogas facilities have been designed and constructed in residential areas, even though city regulation requires any biogas facility to be 100 – 150 m away from any residential area.
One such example is the My World Society in Aundh, an upper middle-class apartment complex. During apartment sales, developers told prospective residents that municipal regulation required a certain percentage of the facility’s land to be used for public works. Residents were initially told this might be a park or a playground. As larger construction began next door, they were told it was a water tank. Only after they had paid and moved in did it become clear that the facility next door was a biogas plant, scheduled to have trucks of food waste arriving throughout the day and running a generator throughout the night to power local streetlights.

Image 14: View from one of the balconies of the MyWorld apartment complex onto the biogas plant. The facilities are less than 20 m apart. Photo by author, January 2014.

The facility is not yet operational, but residents brought a lawsuit against the city for breaking its own regulations, which require at least 100 m between a waste facility and a residence. Their first case was dismissed, as the community hadn’t brought in independent legal council, but the society’s welfare association plans to bring the suit again once the plant becomes operational. This time, residents with legal backgrounds and professional legal practices are involved.

It is unfortunate that such cases have occurred in Pune, generally seen as the leader in decentralized organic waste processing in India. The construction of a biogas plant
adjacent to a residential facility indicates a lack of coordination across city departments, particularly the zoning and the waste management departments. It is critical that these decentralized waste processing facilities be sited in areas that will have the lowest possible impact on the surrounding community—such as industrial or commercial areas where there are fewer people at night—and when sited in residential areas, be designed to minimize these impacts. Processing the gas directly into kitchens, for example, would eliminate the generator and thus the nighttime noise.

In addition to the biogas plants it constructed, Pune built several composting facilities, including two 100 tons per day vermicomposting facilities, Diksha and Ajinta, and a 5 ton per day mechanized composting system, all of which are in industrial areas. They have had fewer siting concerns due to their locations in industrial areas and the fact that their facilities are operated only during the day, with no nighttime noise pollution concerns. While these large-scale composting facilities are processing commercial waste, Pune has encouraged communities to build small-scale composting facilities within their own residential complexes.

**Residential or Community Composting**

In 2009, the city also structured incentives for communities to compost their own waste. Any residential society—what Pune calls a neighborhood or apartment complex—built after 2010 is required to build composting pits. Plus, any society in Pune that is composting its own waste gets property tax benefits. More than 10,000 of the roughly 80,000 residential complexes in Pune now have vermicomposting systems running (Dutta & Pallavi, 2014).

Harmony Society, an upper middle-class apartment complex in Pune, is a great model of how this residential composting can succeed.
Passionate residents began organizing their neighbors to invest in composting pits and coordinated with SWaCH staff to design the pits and the management system. These residents and SWaCH staff have trained the community to separate wet and dry waste at the household level, through door-to-door trainings and community festivals. Thanks to this outreach, 48 out of 50 households in Harmony Society separate effectively. The wet waste is mixed with garden waste in simple, low-cost, and very effective concrete structures located around the perimeter of the parking lot. Two waste pickers manage the entire composting process, mixing the food scraps, garden waste, and accelerating enzymes. The community uses the compost in the shared gardens, and residents can also bring compost up to their own balcony gardens. Residents interviewed are very pleased with the outcome, whether they were initially motivated by environmental concerns, tax benefits, or interest in more beautiful gardens.

With its partnership with the informal sector and its investment in residential and decentralized commercial food waste processing, Pune has demonstrated that decentralization is possible and more stable than centralized systems. It has also shown that decentralization takes time to build effectively. Pune benefited by having a strong informal sector organization in place when they sought to invest in informal collection. Giving SWaCH waste pickers municipal credibility means that even more recyclables are collected and diverted at a very low cost to the city. Similarly, investing in organic waste processing has been able to keep thousands of tons of food waste out of the landfill every month. Threatening non-collection created strong incentives for restaurants to separate food waste. The bulk of biogas plants in the city are operational, but even when one is not,
there are 15 or 20 more that continue to run. This makes the system much more resilient than centralized processing. While the MyWorld siting demonstrates a failure of the city to plan systematically and coordinate between departments, these failures are avoidable. If community engagement and systemic design are applied earlier on to have more appropriate siting of waste management facilities, such resistance could be avoided entirely.

**Recommendations**

Pune’s model demonstrates the potential of working with informal sector partners to facilitate waste collection and recyclables processing. It also shows that waste separation regulation can be enforced effectively if the right incentives are put in place. Decentralized processing facilities at local residential or commercial levels can be effective if siting concerns are addressed through strategic planning and greater community engagement. Pune’s case also demonstrates several of the key challenges with centralized waste processing. If a centralized facility has economic, social, or technical problems, it can cause citywide disruption thus creating political and social instability. Waste-to-energy is not economically sustainable for companies or for cities. Plus, centralized facilities create a greater sense of environmental injustice for one community.

The following recommendations emerged from my research, and can help city staff more effectively implement the combination of informal collection and decentralized processing. Community members, waste picker organizations, technology developers or private companies should use these recommendations to inform their own planning and activities moving forward, as well. To address their waste challenges, cities should:

- **Create long-term, proactive and holistic waste management plan**: Indian cities cannot afford to react exclusively to current waste crises, but must create a holistic long-term vision for waste management. To do so, they should coordinate policies across zoning, planning, water and waste departments.

- **Focus on eliminating non-recyclable and non-biodegradable waste streams**: Since population and affluence growth will continue to increase, cities should address the types and volumes of physical materials being consumed.
Materials regulation and Extended Producer Responsibility (EPR) are critical to control the growth in waste production.

- **Invest in the capacities of the informal sector by providing space and credibility**: Supporting the informal sector makes sense environmentally, economically and ethically. If the informal sector is supported with workspace and municipal credibility, waste pickers can remain a critical part of the system and become more effective.

- **Process waste locally to minimize impacts on and benefit host communities**: Cities should create more incentives for households or neighborhoods to process their own organics and mandate large commercial generators to separate their organic waste. Processing commercial organic waste should integrate the concerns and interests of any facility’s neighbors. Biogas and non-recyclable waste processing facilities should integrate context-appropriate technology and must be held to the highest possible environmental standards. Waste-to-energy plants should be used as the last resort, rather than as the default solution.

- **Ensure equitable siting by engaging the community in consensus building**: Consensus building should be used in planning and development to ensure equitable distribution of facilities and citizen engagement. This will lead to more economically, socially, and politically stable waste management systems.

*Create Long-Term, Proactive, and Holistic Waste Management Plans*

Waste generation is only continuing to grow in India: Pune’s projections alone are that daily waste generation will double to 3,600 tons by 2031 (Dutta & Pallavi, 2014). Pune and other cities like it cannot afford to be reactive in their waste management planning. Designing waste systems only when cities are under pressure from citizens, courts, or government mandates eliminates the time for social, political, economic and technological analysis. Without this analysis, cities will sacrifice the long-term decision-quality. Instead, cities should begin planning processes in advance of a crisis and make plans that are
resilient to long-term change. Plus, cities should implement these plans with commitment from all city departments.

Too many cities have made decisions like Pune has when under political or social pressure. Bangalore's city staff members were very clear that the protests they faced in 2012—and the waste crisis that followed as garbage piled up in the streets—drove the city to dramatically change its waste management policy. Interviews with city staff indicated that the pressure to find any solution during these moments of crisis decreased overall decision time. They had less time to analyze the current system, including exact waste mix, and to identify appropriate technologies or systems for their context. Cities give such short periods of time that bids for technologies are open, companies rush economic or technical analysis. Private waste companies in other cities in India admitted that they vastly underbid for what tipping fees should be, partly because of faulty economic analysis, but also partly because of the rush to submit a bid (Kansal, 2014). Pune demonstrates this: Rochem management did not effectively predict the time lags for energy regulation and so could not scale, and Hanjer miscalculated demand and competitors for their outputs. Rushing the process also decreases design and construction stages and eliminates time for community engagement in the process. A lengthier decision-making process that involved more community input and more background waste research can produce waste management schemes with fewer pitfalls.

Cities need to be planning much further ahead with respect to their waste management. Cities should be regularly analyzing waste generation in their community and tracking trends in growth patterns, particularly of population, affluence, and associated changes in consumption. Most importantly, cities should recognize the potential for unpredictable changes and build resilient systems that can cope in multiple future scenarios. This type of adaptive planning increases the likelihood that cities invest in systems that make sense in the present and in the future.

When creating and implementing these plans, city departments must coordinate for such long-term waste planning. Zoning boards cannot allow for the construction of residential facilities in close proximity to large waste processing facilities that violate the existing laws on the books with respect to the distance between such facilities and homes. Engaging in long-term planning between departments can decrease this likelihood, with
the city committing to saving particular areas of space for waste management and preserving buffer zones.

The three recommendations that follow are specific elements to consider when developing these long term plans: waste reduction, informal sector engagement, and encouraging decentralized waste processing.

**Focus on eliminating non-recyclable and non-biodegradable waste streams**

The most cost-effective way to manage waste is to prevent its production. To do so, cities can expand regulation on non-recyclable, non-organic waste and can implement Extended Producer Responsibility, holding producers accountable for the wastes that their products generate.

While materials regulation is critical, enforcement in India has been challenging. The national government mandates that all biomedical waste must be incinerated. However, in the absence of local enforcement, syringes, IVs, and blood-contaminated cloths still end up in landfills and even in organic waste processing facilities. Similarly, as of early 2014, no Indian city is following all codes of the Municipal Solid Waste Rules of 2000 (Annapu, 2014; Asnani & Zurbrugg, 2007).

However, with the commitment of either state- or municipal-level enforcement, some regulations have been successfully implemented. India’s hill states of Uttarakhand and Himachal Pradesh have managed to eliminate the majority of plastic bag use with strong enforcement driven by the states’ interests in protecting the environment to maintain tourism. In Pune, thin plastic bags were banned in 2012, and the same regulation required that thicker plastic bags be sold to customers rather than given. These laws were not enforced until after the 2014 protests, when communities demanded that the city take action on plastic bags, given that they make up such a large fraction of waste in the landfill. In response, the Pune Municipal Corporation increased the price per bag and began fining vendors distributing thin plastic bags illegally (“340 kg banned plastic seized, vendors booked,” 2014, “HC rejects interim stay plea on PMC’s plastic ban,” 2014, “PMC faces legal battle over plastic bag, thermocol ban,” 2014). Regulation can be enforced if regions are committed and see clear benefits.
For materials that cannot be banned but still are hard to recycle, Extended Producer Responsibility, known as EPR, is another viable option. EPR holds producers responsible for the waste their products generate, which drives them to create reverse supply chains for their materials or change the design process to make materials easier to recycle or reuse. It can be implemented with a mix of government regulation, corporate-driven responsibility, and consumer pressure. In India, EPR could be a valuable approach for materials that are in large volume but are very hard to recycling, including diapers, sanitary napkins, electronic waste, and multilayer packaging. In each case, a relatively small number of producers are responsible for the bulk of this waste. EPR is most effective when it is at a national or international scale, but it is possible regionally. For example, the state of Maharashtra could be able to enforce such regulation, since it is a large state with commercial influence. Given that Maharashtra includes Pune and Mumbai, which both struggle with waste issues, and given the support that the Maharashtra High Court has shown for more effective waste management, the state does have a clear reason to put responsibility on producers. Given the size of the state and its influence, this would also have a powerful national influence. Other states and cities could implement EPR for waste streams that are particularly challenging for them.

Just as in the direct connection seen in the plastic bag bans, states can implement and enforce materials regulation or EPR if they see a clear benefit for their state’s core interest. Regulation may be more effective when it is possible to simply ban a material, but for products that cannot be eliminated from the current system, cities and states should consider holding producers responsible for their products’ wastes.

*Invest in the Capacities of the Informal Sector By Providing Space and Credibility*

Since the majority of the materials India relies on are recyclable or compostable, it is important to consider how to collect, separate, and process them. The informal sector already has a strong role in waste collection and processing, and with investments of space and support, cities can expand the role of waste pickers into collection and processing, as Pune has done.

Since KKPKP had worked for years to organize waste pickers, the city of Pune was able to engage the informal sector for waste collection rapidly and effectively. SWaCH took
the responsibility of formalizing waste picker’s responsibility for collection within communities, and the city lent credibility to their work. Organizations like SWaCH and KKPKP cannot be built overnight, so cities should identify partners to help organize waste pickers in preparation for formal partnerships. The cities can then support those organizations by establishing transparent funding structures for the waste picker services and organizations, setting aside sorting areas, and by supporting programs that reduce the stigma associated with the profession.

Wastepickers tend to work on their own, with some set routes and a great deal of flexibility. Building the reliability of waste pickers to serve a specific community at the same time every day is a significant change, but this can create major benefits for waste pickers. Organizations like SWaCH that can help to do this training and coordination is a real benefit for a city. SWaCH’s supervisors help serve as a link between communities and waste pickers, addressing any concerns or disagreements that arise and ensuring continuity of a neighborhood’s collection services if a waste picker cannot collect on a given day or period of time. In a city like Bangalore, where no single city-wide organization exists, the city has identified multiple partners to serve these roles, with each having a clearly defined geographic scope and an overlapping scope of implementation. These single or multiple partners are critical to the success of informal collection, and the coordinating organization is providing a service in addition to that which waste pickers serve.

Since waste picker organizations make the waste sorting service more consistent, cities should allocate funds to support these organizations, even if residents are paying waste pickers directly. Pune has argued that waste picker cooperatives should become completely self-sustaining within five years and for this reason withheld funding for SWaCH for at least six months in 2013 and 2014. At the time of writing, this balance had not been settled. Were waste pickers to be paid per ton for the waste they divert from landfills into the recycling supply chain, Pune would owe the waste pickers millions of dollars. Paying waste pickers and waste picker organizations for the work they do is fair: if the households are paying a small amount for waste collection, the city should certainly cover the cost of supervisors, health insurance, and the overall coordination.

However a city decides to structure the financial arrangements with waste picker groups, it must be transparent with citizens about who is paying for what. Some citizens in
Pune, Bangalore, and Delhi said that since they pay the government taxes, which include fees for municipal services, they should not have to pay again for waste collection. If cities encourage the waste pickers doing door-to-door collection to ask for user fees to support themselves, the municipality should make it clear to all citizens why this is necessary and explain what services are and are not covered in municipal taxes.

The city can also improve the financial sustainability of waste pickers and waste picker organizations by allowing waste pickers to generate more revenue with the waste they collect by promoting establishment of sorting sheds and scrap shops. Providing space to segregate and aggregate recyclables would improve the prices waste pickers receive. Cooperatively owned scrap shops, like the one that KKPKP runs in Pune, dramatically increase the value that all waste pickers get. In both cases, if a city gave waste pickers central, large, underutilized space for sorting, storing and scrap shops, it could provide valuable in-kind support.

To improve the conditions of the informal sector, cities should also implement policies that increase access for waste pickers and their children to formal education systems and that reduce stigma. Pune is very public about the importance of SWaCH, but could do even more to ensure that waste pickers are treated fairly by all those who they interact with.

**Process Waste Locally to Minimize Impacts on Host Communities**

While the informal sector can process the recyclables, organic waste and non-recyclables should be processed with decentralized waste management. Not only does decentralized waste processing reduce transportation costs, but it also more equitably distributes the burden of waste processing, which may make these facilities more acceptable by surrounding communities. Facilities can be designed and regulated to minimize community impacts.

The greatest level of decentralized processing happens at a household with residential composting. Pune and SWaCH have encouraged this very well with the city's tax incentives and SWaCH's implementation capacities. In the communities we interviewed that were home to such facilities, it was a source of pride: not only were they composting their own waste and reducing the burden on the city, but they were also generating high
quality, free compost to improve the quality of their gardens. Highly publicized tax incentives can increase the implementation of residential composting.

Next, biogas systems that are effectively designed to use gas directly, bottle gas, or use silent generators would minimize the major impact on communities. With appropriate design and minimum distance requirements followed by the city, small-scale biogas plants create very minimal impact on a community, and should be scaled across all cities. Enforcing commercial waste separation with the threat of non-collection has been very effective, and could be implemented at a household level by staff doing door-to-door collection as well. Removing organics from a mixed waste stream greatly reduces the burden of the remaining waste.

Still, to process the waste that remains—the waste that cannot be recycled, composted, or banned—cities should invest in facilities that are designed more appropriately for the Indian waste context and implemented more responsibly. Centralized waste-to-energy facilities do not make sense: they pose too many economic, environmental, and social challenges in the Indian context. Waste-to-energy facilities of any size should be a last resort, not the default, and should be held to the highest standards on environmental and social impact.

Cities should ensure that they receive bids from companies that are committed to working at a smaller scale and processing only truly non-recyclable wastes. This will help respect the work of the informal sector and waste pickers’ right to waste. Some critics of this approach argue that waste-to-energy only works when it is able to capture economies of scale, processing upwards of 500 tons per day. If that is the case, I argue that indicates that waste-to-energy is not an appropriate solution. A citywide or national commitment to decentralized waste processing will drive the creation of new technological solutions that can process these wastes at a smaller scale. Plus, if all other wastes are diverted through implementation of the previous recommendations, there simply will be less waste to process, and it is more efficient to size a small facility than to run a larger facility at partial capacity.

Structurally, cities and companies should rethink the nature of their contracts to create positive impact and increase the operating capacity of these facilities. Currently, agreements between cities and waste-to-energy facilities bind cities to send a set volume of
waste—or all of their waste—to a single plant. Instead, contracts could be set up to incentivize diversion before the plant, encouraging both cities and the companies to be invested in waste picker success. For example, the city could pay based on total tonnage delivered, while the plant would only receive funding based on non-recyclables processed. The difference would go to a fund to support citizen led programs for recycling and waste diversion. Or, cities could support only modular waste-to-energy facilities, which would be economically viable to run at a small size and could be expanded only if waste generation increases.

No matter what, any such facilities should be held to the strictest environmental standards to ensure that communities near these facilities are not exposed to dioxins or leachates from waste ash. The challenges of siting any such facility and the difficulty of guaranteeing perfect environmental performance in India, it only further emphasizes the importance of using waste-to-energy as a last resort, rather than the default.

*Ensure Equitable Siting By Building Community Consensus*

Siting of all of these facilities—biogas, non-recyclables processing, and even residential composting systems—can be challenging. Some city staff have joked that the real challenge with a decentralized model is having 10 communities protesting instead of just one. I believe that engaging communities in a true consensus building process would minimize that response by siting facilities equitably and engaging the community throughout the planning process.

Environmental injustice has significant impacts on a city at large, since community demands for justice create costs and social instability. The contrast of environmental justice concerns is most stark in the case of Uruli, where a rural community that does not generate large volumes of waste is bearing the burden of higher-income communities’ consumption. The questions of environmental justice enter a grey area in a case like MyWorld, where a higher income, higher consuming community has discovered a biogas plant being constructed next door. If we recognize that no single community should bear the entire burden of a city’s waste, we must also consider how to site decentralized facilities in a way that minimizes impact on all communities. Engaging the community in the waste planning process makes equitable siting more likely and makes the facility’s
construction and operation more acceptable to whichever community the facility ends up near. Using a consensus building approach to waste management systems design helps communities to think creatively about their options and develop a waste strategy that makes sense for their urban ward. It allows a city to address citizens’ concerns before construction begins, reducing the risks of future dissatisfied residents, disruptive protests and expensive lawsuits.

My recommendations for how Indian cities could run such a consensus-building approach are based on Larry Susskind’s *Negotiation Credo for Controversial Siting Disputes* (1990), which has been successfully applied in many other cities around the world to gain maximum community acceptance for waste processing facilities (Kunreuther, Fitzgerald, & Aarts, 1993). I have translated the 13 points of the credo into 6 steps for running such a process in India, based on the specific challenges of the unique Indian waste context. Cities should build community consensus around waste management planning and facility siting by: (1) build trust through transparency and by honestly admitting past mistakes; (2) reaching agreement on the severity of the problem; (3) creating a wide range of potential solutions; (4) designing the most viable solutions to minimize local impacts and identifying benefits for the community that would make the community better off by compensating for any remaining negative impacts; (5) setting in place strong environmental standards and contingent agreements if any standard should be broken; and (6) ensuring equitable regional distribution at a city-scale (Susskind, 1990).

To begin, Susskind (1990) suggests that cities and potential businesses involved in waste management should build trust through honesty and admitting past mistakes. This is critical in India where people have vivid memories of and resentment towards recently failed waste management interventions, particularly those that were touted as “sustainable solutions.” This justified skepticism among citizens about claims of low-impact future projects can prevent acceptance of any future facilities. Even without direct negative experiences, citizens may have low confidence in waste facilities because of media coverage of “failing” waste plants (Kulkarni, 2014b). Honestly admitting past mistakes, avoiding exaggeration about the benefits of the proposed system, and being clear current risks can build trust. This will help move the conversation away from the past and towards future solutions (Susskind, 1990).
Next, the municipal government should unite the city residents around the scale of the waste problem. In some cities, including Pune, most residents have experienced the negative impacts of poor waste management and irregular collection, and already recognize that the collection and processing of waste is a serious problem. To date, cities like Pune have seen this concern translated only into political pressure in the form of protests and lawsuits. These cities should instead see citizens' frustration with the current system as an opportunity and direct that energy towards participating in building better solutions. In cities where residents do not see waste as a critical issue, municipalities can use media and other forms of outreach to raise concern about the waste problem.

This will set the municipality up to bring together representatives of key stakeholders groups to brainstorm about all possible solutions to the waste crisis. This conversation should go beyond just proposing alternative locations or mere changes to existing plans. Instead, together with stakeholders, the city should create a comprehensive list of approaches to address the root problem, including any impacts on and benefits generated for host communities. Once a complete list of options is assembled, the city and stakeholder representatives should compare the impacts and benefits of each to taking no action. This process is important for stakeholders to not only feel agency, but also to have an understanding of why some intervention is necessary.

Once some specific interventions are decided to be clearly preferable, minimizing impacts while also addressing the solution, Susskind suggests that the city seek volunteer communities for potential facilities, asking neighborhoods to propose what specific package of benefits could compensate them for anticipated impacts. Types of compensation to consider include tax benefits, neighborhood improvements, access to gas generated by biogas plants, or lower priced electricity. Pune is already providing tax benefits for communities that are composting their own waste, for example. This is not intended to pay residents to endure major damages: instead, the design process should prioritize minimizing the impacts on that specific community. For example, in communities where unemployment, electricity failure, and lack of green spaces is a concern, a small-scale biogas facility held to high environmental standards could create positive benefit if it is designed to be low-noise and if the community is able to get jobs, compost, and power as a part of the arrangement.
Contingency plans for any host community and for the city at large should also be developed at this stage. If anything goes wrong with a single plant or if the planned facility is not meeting its commitments to the community, there must be a clear process for what response the city, the community, and the plant management would take. If a community knows they have a clear pathway to be heard if there is a problem, they will be less likely to file a suit or organize a disruptive protest: communities do this to ensure they are heard.

Even given the collaborative process throughout that will help to increase equitable distribution, the city should still ensure that there is geographic distribution of all waste processing facilities (Susskind, 1990). One way to do this is to assign different values of points to all Locally Undesirable Land Uses (LULUs), including waste processing, sewage treatment, power generation, or other municipal services that could have negative community impact. The city should ensure that these “LULU Points” are equally distributed, so that each ward or district would have the same number of points. This would prevent any single community from bearing the entire city's waste. When using LULU Points to measure equitable distribution, it is important to divide the city into the smallest possible unit of measurement, so that facilities cannot simply be sited in the lowest-income part of each region.

Together these six steps of a consensus building process for siting waste management facilities would help Indian cities achieve more fair, efficient, and stable outcomes. Furthermore, when part of the decision-making process, community members are less likely to feel resentful about the outcome. This will create greater social and political stability in urban waste management systems at large.

Conclusion

For the combination of informal sector collection and decentralized processing to work best, the recommendations above should all be incorporated into a city's approach. They are all interconnected and support each other's success. The long-term planning process will work best if representatives from communities, all relevant city departments, and other stakeholder groups are engaged from the beginning. Citizen engagement will make the stage of waste reduction and materials regulation much easier. Bringing
communities into the process would allow concerned residents to transform their frustration into tactics for local waste reductions. Residents of a given society who have more input into the decisions have a greater sense of procedural justice and a stronger desire to reduce and process their own waste. Building the capacity of the informal sector means there will be much less waste to process in decentralized waste-to-energy facilities. Following these recommendations together using a consensus-building approach can create a much more stable waste management system.

An initial response to the consensus-building approach is that it is expensive and time-consuming to engage in such a participatory public process. Indeed, it will be costly for the city, any potential technology providers, the project implementers, and the community members involved. However, it is important to compare these costs and time demands not simply to the “best case alternative,” in which one entity proposes and implements a solution seamlessly, but to the current realistic situation, in which any party dissatisfied can significantly slow down the process, adding to time and cost at another point in implementation. The total time and financial costs of political and social opposition to waste facility construction are enormous. While consensus-building activities do take time and financial investment, they are less expensive than weeks of blocked waste disposal or rushed design and construction that cannot meet a city’s real needs. A consensus-building process is not a silver bullet solution, but it can greatly improve any city’s siting process and can play a critical role in holistic waste management when it is combined with the investment in waste reduction, incentives for local waste processing, and increased space and credibility for the informal sector.

These recommendations are specifically designed for the urban Indian waste challenges, based on the analysis of the current condition and the case of Pune. However, there are elements that are relevant more broadly. Many growing cities in Latin America, Africa, and other parts of South Asia have increasing populations and affluence, so face the same rapid growth in consumption and waste disposal. Cities like Cairo, Panama City, and Managua, for example, have a strong informal sector that is threatened by centralized waste collection and processing, just as Indian cities do. Communities living next to landfills and centralized waste-to-energy facilities have organized debilitating protests in Ixtapaluca, Mexico, where residents bear the burden of Mexico City’s waste ("Protests
continue over DF garbage disposal,” 2012), in Naameh, Lebanon, where Beirut’s waste goes (Knutson, 2014), and in several landfill sites in Panama (“Anti-landfill protest replaces Carnival partying,” 2014). Around the world, communities that have had air, water and communities polluted by nearby cities’ wastes will no longer stand for it. Focusing on waste diversion, building recycling and the informal sector, and processing wastes in decentralized facilities will be more effective than landfills in these cities, too. Cities in India and around the world facing these challenges must work to reduce pressure on host communities now, before affected citizens launch protests and generate reactive waste planning.

Waste management can feel like an overwhelming issue in India, with many stakeholders and very different vested interests. For years, cities have looked to build “efficient” systems in pursuit of a single firm or technology that can solve the problem. This approach has generated political and social instability. By looking to assets that already exist in Indian cities, particular the informal sector, and building their capacity while also investing in decentralized waste management, cities can build waste systems that are much more stable in the face of change. These systems may not seem to be efficient on the surface—they will have hundreds of thousands of people employed—but they will serve Indian cities much more effectively in the long-term as cities and consumption continues to grow.
Works Cited


