

# The Role of Actors and Incentives in Municipal Solid Waste Management: a Case Study on Muzaffarnagar, India

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## Abstract

The ever-increasing urban population and a growing middle class are leading to a burgeoning solid waste problem in Indian cities. While legislation has been passed to address the growing waste issue, there has been limited compliance by municipal governments. One of the key changes and challenges resulting from the new legislation is that municipal governments are now responsible for household waste collection. This is both a major expense for municipal governments, and also involves influencing the behaviors of every household in a city.

While the 2000 Municipal Solid Waste Management (and Handling) Rules legally bind a municipal government to be responsible for municipal solid waste management (MSWM), a closer look at MSWM systems reveals a range of waste service providers that is much more complex than a single provider. Each actor's incentives shape their participation in the MSWM system. Thus the municipal government, though the responsible party for MSWM, does not always direct the outcomes of a MSWM system. This begs the question: what actors influence municipal solid waste management (MSWM)? How do their incentives shape the activities and outcomes of a MSWM system?

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## INTRODUCTION

In India, a growing urban population, rising household incomes, and increasing use of disposable products, are leading to an increase in the total amount of waste generated in urban areas.<sup>1</sup> On average, urban waste is estimated to be growing by 1.3% per year, per capita.<sup>2</sup> To address the burgeoning municipal waste issue in Indian cities, the national Indian government passed the 2000 Municipal Solid Waste Management (and Handling) rules.<sup>3</sup> This extended a municipal government's responsibility for waste management to include, "collection, storage, segregation, transportation, processing and disposal of municipal solid wastes" in the municipal area.<sup>4</sup> There remains low compliance with the 2000 MSW Rules and varying levels of success in municipal solid waste (MSW) management systems. Estimates suggest that close to 70 to 90% of waste is collected in larger Indian cities while in smaller cities, less than 50% of waste is collected.<sup>5</sup>

While the 2000 MSW Rules legally bind a municipal government to be responsible for municipal solid waste management (MSWM), a closer look at MSWM systems reveals a range of waste service providers that is much more complex than a single provider. Each actor's incentives shape their participation in MSWM systems. Thus the municipal government, though responsible for MSWM, does not always direct the outcomes of a MSWM system. This begs the question: what actors influence MSWM? How do their incentives shape the activities and outcomes of a MSWM system?

Elinor Ostrom, Larry Schroeder, and Susan Wynne, authors of *Institutional Incentives and Sustainable Development*, emphasize the role of incentives in the success or failure of infrastructure. While their focus is predominantly on physical infrastructure, their lessons can be extended to infrastructure that also has a service component, such as water and energy. Municipal solid waste management, like water and energy, involves both a service and infrastructure to be effective.

Ostrom, et al., point to a variety of reasons for infrastructure failure ("poor design, lack of resources, inadequate training, lack of coordination, opportunistic behavior and overly centralized

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<sup>1</sup> Mufeed Sharholy et al., "Municipal Solid Waste Management in Indian Cities: A Review," *Waste Management* 28, no. 2 (2008): 459–67, doi:10.1016/j.wasman.2007.02.008.

<sup>2</sup> Ranjith Kharvel Annepu, "Sustainable Solid Waste Management in India" (Columbia University, 2012).

<sup>3</sup> From here forward, the 2000 Municipal Solid Waste (Management and Handling) Rules will be referred to as the 2000 MSW Rules.

<sup>4</sup> Government of India Ministry of Environment and Forests, *Municipal Solid Wastes (Management and Handling) Rules, 2000*, 2000.

<sup>5</sup> Annepu, "Sustainable Solid Waste Management in India."

institutions”) yet the one common culprit between infrastructure failures is misaligned incentives.<sup>6</sup> Incentives can be both positive and negative and occur throughout various infrastructure phases.<sup>7</sup> Ostrom, et al., developed a framework to evaluate how institutional arrangements influence incentives in infrastructure design. In other words, Ostrom, et al., analyze how the rules and structures in infrastructure systems shape actor’s incentives.

Using a portion of Ostrom, et al.’s framework, this research aims to identify and analyze how incentives between various waste management providers contributed to the existing waste system in Muzaffarnagar, Uttar Pradesh (population 392,451). Ostrom, et al.’s theory on sustainable infrastructure frames the story of the shortcomings of Muzaffarnagar’s MSWM system, where a complex set of incentives both obvious and concealed led to the limited success of the new MSWM system. A case study using Muzaffarnagar offers a chance to address the intricacies of how different actors and their incentives shape MSWM systems in a small to medium-sized Indian city.

## THEORY AND FRAMEWORK

For Ostrom, et al., the first question when evaluating infrastructure is whether that system is sustainable. Their definition of sustainability is borrowed from the World Bank, which “considers a project sustainable if the economic rate of return it generates is at least equal to, the opportunity cost of the capital.”<sup>8</sup> While this suggests an evaluation highly driven by financial efficiency, Ostrom, et al., clarify that the goal of all development is to leverage limited resources to generate the maximum benefits.<sup>9</sup> Equity and economic efficiency are often trade-offs. Policymakers must decide which benefits are most important -- at what level and at what cost.<sup>10</sup> If infrastructure does not deliver net benefits that outweigh the costs, it should be allowed to deteriorate.<sup>11</sup>

A common debate around infrastructure delivery centers on *who* delivers the system. The debate centers around whether the private (market) or public (state) sector is responsible for delivery.<sup>12</sup> According to Ostrom, et al., the duality of this debate suggests that neither the failure of

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<sup>6</sup> E. Ostrom, L. Schroeder, and S. Wynne, “Institutional Incentives and Sustainable Development: Infrastructure Policies in Perspective.,” 1993, 283 pp. pg. 8.

<sup>7</sup> Ibid.

<sup>8</sup> Ibid. Pages 13 – 14.

<sup>9</sup> Ibid.

<sup>10</sup> Ibid.

<sup>11</sup> Ibid.

<sup>12</sup> Karen Bakker et al., “Governance Failure: Rethinking the Institutional Dimensions of Urban Water Supply to Poor Households,” World Development, Special Section (pp. 2045-2102). The Volatility of Overseas Aid, 36,

the market nor the failure of the state are nuanced enough to paint the full picture of what drives the success or failure of infrastructure. This binary debate does not reflect that both types of actors (public and private) may be involved in the same infrastructure at the same time in different aspects, thus collectively influencing the outcomes of the infrastructure.<sup>13</sup> Nor does this debate reflect the multiplicity of actors involved in any infrastructure system or how they act at different scales within those systems.

According to political scientist Mark Bevir, the “Modern State” has many actors with varying levels of influence.<sup>14</sup> The state is no longer able to “command” the actions of other actors and must find new routes to achieve its goals.<sup>15</sup> According to the rational behavior theorists, under which Ostrom, et al.’s theory would be considered, the state must then use incentives to “steer” different actors in a shared direction.<sup>16</sup>

Because a diverse set of actors contribute to MSWM in Indian cities, understanding the range of incentives that influence their actions may help policymakers determine what types of incentives need to be amplified or mitigated to achieve the desired outcomes. Ostrom, et al. note that, “Incentives are more than just financial rewards and penalties. They are the positive and negative changes in outcomes that individuals perceive as likely to result from particular actions taken within a set of rules in a particular physical and social context.”<sup>17</sup> As actors operate at different scales, incentives also act at different scales.

### **Factors that Shape Incentives**

Numerous factors shape incentives and the rules or institutions that direct incentives. Once incentives exist, it is difficult if not impossible to remove those incentives as “many well-placed individuals benefit from the current system.”<sup>18</sup> Ostrom, et al., outline several factors that influence the structure of incentives. The two that will be explored through this research are information asymmetry and system attributes.

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no. 10 (October 2008): 1891–1915, doi:10.1016/j.worlddev.2007.09.015; Ostrom, Schroeder, and Wynne, “Institutional Incentives and Sustainable Development.”

<sup>13</sup> Bakker et al., “Governance Failure.”

<sup>14</sup> Mark Bevir, *Democratic Governance* (Princeton University Press, 2010).

<sup>15</sup> *Ibid.*

<sup>16</sup> *Ibid.*

<sup>17</sup> Ostrom, Schroeder, and Wynne, “Institutional Incentives and Sustainable Development.” Pg. 8.

<sup>18</sup> *Ibid.* Page 2.

## Information Asymmetry

Information asymmetry occurs when information is not equally available to all actors in a system. Information is often obscured or not easily obtainable by policy makers. In addition, policy makers do not value all types of information equally. The two types of information relevant in any system are: local time and place knowledge and technical knowledge. Technical knowledge is an understanding of the regularities about how different variables respond regardless of their context.<sup>19</sup> This knowledge is more scientific in nature and thus, more generalizable. Local time and place knowledge, on the other hand, is locally driven information that provides the context for fitting a specific solution to a particular situation.<sup>20</sup> It includes:

1. “Local social and physical environmental characteristics
2. Various types of production strategies employed in a region
3. Human or physical capital presently underutilized in an area
4. Existing institutional arrangements that could be used to construct or maintain infrastructure facilities”<sup>21</sup>

Effective infrastructure designs incorporate both types of knowledge.<sup>22</sup> Yet most system designs focus on and leverage only technical knowledge.<sup>23</sup>

Local time and place information, by nature is decentralized and held by many people.<sup>24</sup> It can be expensive to acquire and integrate into a system design.<sup>25</sup> Yet the integration of local and time place knowledge provides important contextual information that shapes the design of a system and its fit into a local context.<sup>26</sup> Thus, when information asymmetry exists, the lack of shared information can counteract potentially beneficial collaborations.<sup>27</sup> This is in part because it is difficult for actors to estimate or understand the value that other actors provide.<sup>28</sup> In Muzaffarnagar, this information asymmetry is evident through the exclusion, whether intentional or not, of many of the existing local MSWM actors. The current system design emphasizes the technical knowledge provided by the private waste organizations more than the local knowledge

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<sup>19</sup> Ibid. Page 50.

<sup>20</sup> Ibid.

<sup>21</sup> Ibid. Page 50.

<sup>22</sup> Ibid. Page 301.

<sup>23</sup> Ibid. Page 301.

<sup>24</sup> Ibid.

<sup>25</sup> Ibid.

<sup>26</sup> Ibid.

<sup>27</sup> Ibid.

<sup>28</sup> Ibid.

held by the numerous existing actors in MSWM. This bias has resulted in several challenges within the MSWM system.

### **System Attributes**

The various attributes of infrastructure design are another major factor in shaping the incentive structure in any infrastructure. Two key attributes introduced by Ostrom, et al., and explored in this research are nonexcludability, the inability to exclude a non-paying user from receiving the benefit, and subtractability, where one user's use of the system subtracts potential value that would otherwise be gained by another user.

#### ***Nonexcludability***

Nonexcludability is the inability of the infrastructure provider to exclude a non-paying user from receiving the benefits of the service. In contrast, excludability means that the infrastructure provider is able to exclude a non-paying user and prevent them from gaining the benefits of that infrastructure. Excludability is directly linked to recouping operation costs in infrastructure. If consumption or use of the infrastructure cannot be withheld, then users have less incentive to pay the tax or fee associated with the infrastructure. This can threaten the financial vitality of a system.

In a MSWM system, excluding individuals from receiving the benefit of the service provided is not ideal. If one user (or many users) defaults and is excluded by choice or by design, other users in the shared area also experience the consequences of that user's default. Thus, if one household throws their waste on the road, other households in that area will not experience the full benefit of the waste service provision because of that waste being disposed in a public area. In essence for a MSWM system to be effective in removing the environmental, health and aesthetic damage caused by uncollected waste, all residents must properly dispose of their waste. Moreover, when the structure hinges on a per user fee or tax, the financial sustainability of the system depends on the majority of users paying to receive the benefit of the system.

There are at least two situations where excludability and nonexcludability matter in Muzaffarnagar's household waste collection system: 1) *service provision* where the service provider has the option to exclude those who do not pay from receiving direct service; 2) *household fee payments* where the user can opt out of paying their fee. Nonexcludability and excludability shape the incentives within the Muzaffarnagar MSWM system.

### **Subtractability**

Subtractability is when the joint use of a system subtracts from other users potential value gained through the system.<sup>29</sup> When one user's benefit from the system subtracts from another user's ability to gain value, the design of that system inherently reflects subtractability.<sup>30</sup> In some infrastructures, joint use has limited or no impact on the flow of benefits through a system. In other systems value is easily subtracted through joint use and this influences the flow of benefits through a system.<sup>31</sup> If joint use of a system leads to subtractability then more attention needs to be paid to how value or benefits of that system are allocated.

The subtractability examples provided by Ostrom, et al., are mostly related to water usage, where subtractability has an obvious role. One liter of water used by one person often means that the next person has one less liter of

water to use. The parallel in waste management is the type of waste (food waste, recyclables, landfill waste) and also the weight or volume of waste. Not all waste has an equal value. The value or benefit to be subtracted depends on the value the user perceives. Different actors value different aspects of waste, at different scales. Some actors, such as the informal recycling sector, value small amounts of segregated waste based on the market value for that waste. Other actors, like the for-profit, private waste organization, often value large amounts of waste based as their incentive system is structured on tipping fees paid per metric ton of waste. This value gradient impacts the way in which subtractability is perceived throughout Muzaffarnagar's MSWM system.

**Table 1: Criteria for Evaluating System Performance by Ostrom, Schroeder and Wynne**

<b>Criteria</b>	<b>Definition</b>
Economic Efficiency	The magnitude of change in net benefits, given a change in resource allocation
Equity	Equity has two component: <b>fiscal</b> , where those who pay receive the benefit; <b>redistributional</b> , where distribution is meant to include all people and not just those who are able to pay
Accountability	The decision makers must be accountable to the final users
Adaptability	The institutional arrangements must be able to respond to the changing environment

### *Measuring Infrastructure*

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<sup>29</sup> Ibid.

<sup>30</sup> Ibid.

<sup>31</sup> Ibid.

The final question of any system is whether it is meeting the goals of its designs. Incentives play an important role in how or whether a system meets the criteria by which it is evaluated. Ostrom, et al., propose four criteria to evaluate performance: economic efficiency, equity, accountability, and adaptability (see Table 1). Trade-offs exist for each of these factors.<sup>32</sup> Yet, Ostrom, et al., argue that each of these criteria impact the long-term sustainability of infrastructure. While a full evaluation of the entire system would require a detailed survey of the context beyond the capacity of this study, this study focuses on analyzing the incentive structures at play. Analyzing Muzaffarnagar's MSWM system against these four criteria uncovers a range of outcomes that will be shared after the Muzaffarnagar case is presented.

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<sup>32</sup> Ibid.

## MSWM CONTEXT IN INDIAN CITIES

In February 1998, a committee arranged by the Indian Ministry of Urban Development (MoUD) and comprised of various government officials throughout India gathered to discuss waste management in Indian cities. In the preamble to the report, the committee called MSWM, a “tenacious problem,” and the largest share of municipal expenses are spent on waste management.<sup>33</sup> They contended with the fact that while it was common to see 30 to 50% of the staff and resources employed by a city directed towards waste, collection and disposal, service quality had declined.<sup>34</sup> The committee noted that while major metro areas collect between 70 to 90% of waste generated, smaller cities only collect an estimated 50% of waste.<sup>35</sup> At that time, most cities had not developed long-term waste management plans, despite the fact that waste and urban populations continued to rapidly increase.<sup>36</sup>

Many years after the 1998 MoUD report, with waste rates continuing to rise as population and income levels increase, findings from various researchers suggest that the current waste management situations were still far from ideal. When the 2000 MSW Rules were implemented, municipal responsibility for waste management was extended to include, “collection, storage, segregation, transportation, processing and disposal of municipal solid wastes” in its municipal area.<sup>37</sup> The new legislation put legal pressure on cities to identify a plan of action for managing waste while also dramatically extending the role of the city in waste management.

Eight years after the 2000 MSW Rules were implemented, researchers from two Indian governmental departments, the Indian National Environmental Engineering Research Institute (NEERI) and the Central Pollution Control Board (CPCB), conducted a study in fifty-nine Indian cities that had populations over one million people.<sup>38</sup> Of the 59 cities, they found that “no single

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<sup>33</sup> S.R. Shukla et al., “Manual on Municipal Solid Waste Management” (Ministry of Urban Development, Government of India, May 2000), [https://www.academia.edu/8811695/Manual\\_on\\_municipal\\_solid\\_waste\\_management\\_MoUD\\_GOI\\_2000.pdf](https://www.academia.edu/8811695/Manual_on_municipal_solid_waste_management_MoUD_GOI_2000.pdf).

<sup>34</sup> Ibid.

<sup>35</sup> Ibid.

<sup>36</sup> Ibid.

<sup>37</sup> Government of India Ministry of Environment and Forests, Municipal Solid Wastes (Management and Handling) Rules, 2000.

<sup>38</sup> Sunil Kumar et al., “Assessment of the Status of Municipal Solid Waste Management in Metro Cities, State Capitals, Class I Cities, and Class II Towns in India: An Insight,” *Waste Management* 29, no. 2 (February 2009): 883–95, doi:10.1016/j.wasman.2008.04.011.



municipality or local body has complied with the guidelines stipulated by the 2000 MSW Rules.”<sup>39</sup> As of 2004, MSW collection efficiency for each Indian state showed that the average collection rate is 72%.<sup>40</sup> While the high collection efficiencies may paint a positive picture of current collection in India, numerous articles and personal experience demonstrate that open dumping is still widespread.<sup>41</sup> Many cities still need a more comprehensive and effective means to collect waste throughout the city.<sup>42</sup>

Household waste collection is one of the areas where improvement is needed most. When the NEERI and CPCB team analyzed household collection, they found that while most cities have an existing community bin system; only 7 of the 59 cities surveyed had achieved “full” house-to-house collection.<sup>43</sup> Although they failed to define “full” collection, it can be interpreted to mean that door-to-door collection is available throughout the city. Of the 59 cities, 23 cities had no house-to-house collection, including major metropolises like Delhi and Kolkata.<sup>44</sup>

Needless to say, waste collection continues to be a challenge for municipalities. This is true despite the fact that municipalities dedicate a sizable amount of their budget towards MSWM. Existing data suggests that 5 to 50% of a municipal budget is dedicated to MSWM, which compares to the MoUD report which noted that 30 to 50% of municipal staff and resources are dedicated towards MSWM.<sup>45</sup> The largest portion of the MSWM budget, as much as 80 to 95%, was often allocated towards collection and transportation.<sup>46</sup> In Muzaffarnagar, the city spends 35% of its budget on MSWM.<sup>47</sup> This provides one data point for what percentage of budget is allocated towards MSWM in smaller cities. Mega cities, like Delhi and Mumbai, allocate a smaller percentage towards MSWM than smaller cities.<sup>48</sup> The NEERI and CPCB team found that mega cities are

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<sup>39</sup> Ibid.

<sup>40</sup> Sharholy et al., “Municipal Solid Waste Management in Indian Cities: A Review.”

<sup>41</sup> Ibid.

<sup>42</sup> Kumar et al., “Assessment of the Status of Municipal Solid Waste Management in Metro Cities, State Capitals, Class I Cities, and Class II Towns in India.”

<sup>43</sup> Ibid.

<sup>44</sup> Ibid.

<sup>45</sup> Ibid.; Chikarmane Poornima and Anjor Bhaskar, *Messing Around with Waste* (Infochange, August 2013), <http://infochangeindia.org/urban-india/analysis/messing-around-with-waste.html>; Shukla et al., “Manual on Municipal Solid Waste Management.”

<sup>46</sup> Sharholy et al., “Municipal Solid Waste Management in Indian Cities: A Review.”

<sup>47</sup> Pankaj Aggarwal, Interview with Mayor of Muzaffarnagar, In person, August 13, 2014.

<sup>48</sup> Kumar et al., “Assessment of the Status of Municipal Solid Waste Management in Metro Cities, State Capitals, Class I Cities, and Class II Towns in India.”

spending 5% to 10% of their budget on MSWM.<sup>49</sup> While the low budget allocation could suggest mega cities are efficient in MSWM, the NEERI and CPCB team observed that budget allocation does not necessarily reflect actual MSWM results.<sup>50</sup>

While numerous studies and several governmental documents point to the gaps in MSWM systems in India,<sup>51</sup> they fail to detail what types of systems are employed in each type of city with each set of actors. The work by NEERI and CPCB identifies and delineates the different status of waste management systems and details the actors in different cities. Yet, their focus, which is on cities with populations of over one million people, misses an important urban segment – cities with populations under one million people. As of the 2011 Census, there were 497 cities in India that collectively represent 19% of India’s population.<sup>52</sup> While India is known for its megacities like Delhi, Mumbai and Kolkata, 90.5% of Indian cities (350 cities) have populations between 100,000 people and one million people.<sup>53</sup> 108.3 million people live within the boundaries of these 350 cities, comprising 48% of India’s total urban population.<sup>54</sup> They generate a substantial amount of waste each year. One estimate suggested that 37% of MSW in India is generated in cities of this size each year.<sup>55</sup>

The sheer number of cities with populations under one million people, suggests an urgent need to understand what types of MSWM systems are working for these cities. Research on MSWM systems in smaller cities is limited. This gap identified in the research would not be an issue if the success rates of MSWM systems were similar for large and small cities. But current estimates suggest that this is not the case; smaller cities are collecting a significantly smaller percentage of the waste generated than the percentage of waste collected in larger cities.

Collection is one of the key measures of success for any waste system.<sup>56</sup> There exists little information on the challenges and successes in MSW collection in smaller cities. Even the information on larger cities tends to focus on more technical information about MSWM– for

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<sup>49</sup> Ibid.

<sup>50</sup> Ibid.

<sup>51</sup> Sharholy et al., “Municipal Solid Waste Management in Indian Cities: A Review”; Kumar et al., “Assessment of the Status of Municipal Solid Waste Management in Metro Cities, State Capitals, Class I Cities, and Class II Towns in India.”

<sup>52</sup> 2011 Census of India, Census (India: Government of India Ministry of Home Affairs, 2011), <http://www.census2011.co.in/city.php>.

<sup>53</sup> Ibid.

<sup>54</sup> Ibid.

<sup>55</sup> Annepu, “Sustainable Solid Waste Management in India.”

<sup>56</sup> Shukla et al., “Manual on Municipal Solid Waste Management.”

example, developing a cost model for different stakeholder roles,<sup>57</sup> analyzing the coverage ratio and the types of waste generated<sup>58</sup> or projecting how population growth influences waste generation rates in large municipal areas.<sup>59</sup> Much of the research, like that conducted by NEERI and CPCB, is largely technical in nature and analyses the current waste systems. These work focuses on collection coverage, budget spent by the municipality and amount of waste generated. While useful in understanding existing conditions and realities, it does not shed light on how MSWM systems were designed to work versus how they actually work when implemented. While public and private actors are commonly referred to in existing research, few case studies focus on the diversity and variety of actors involved in Indian MSWM systems. This highlights the need for more actor-oriented research on waste management in Indian cities. Moreover it highlights a need to be able to understand and compare the different waste management providers in different cities.

### **Actors in MSWM**

While Indian municipal governments are responsible for developing and implementing a waste management system, numerous actors work in this sector and influence the provision of waste management. The actors that are most often referenced are municipal governments (public sector), waste organizations (formal private sector), wastepickers and kabadiwalas (informal private sector). There is currently little analysis on how various actor arrangements and their incentives influence the results of waste management systems in Indian cities.

A study on Mumbai found that while there are many case studies on MSWM that explore community and private involvement in MSWM in developing countries overall, there are few case studies on Indian cities that detail alternative models of MSWM systems.<sup>60</sup> Moreover, there are few cases that show how both informal and formal actors influence the MSWM system.<sup>61</sup> The examples that exist are limited. For example, a wastepickers' cooperative in Pune wrote a draft report on the "Economic aspects of Informal Sector Activities in Solid Waste Management" where they detail their

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<sup>57</sup> Sarika Rathi, "Alternative Approaches for Better Municipal Solid Waste Management in Mumbai, India," *Waste Management* (New York, N.Y.) 26, no. 10 (2006): 1192–1200, doi:10.1016/j.wasman.2005.09.006.

<sup>58</sup> Kumar et al., "Assessment of the Status of Municipal Solid Waste Management in Metro Cities, State Capitals, Class I Cities, and Class II Towns in India"; Dimpal Vij, "Urbanization and Solid Waste Management in India: Present Practices and Future Challenges," *Procedia - Social and Behavioral Sciences*, The International Conference on Emerging Economies - Prospects and Challenges (ICEE-2012), 12-13 January 2012, 37 (2012): 437–47, doi:10.1016/j.sbspro.2012.03.309.

<sup>59</sup> Vij, "Urbanization and Solid Waste Management in India."

<sup>60</sup> Rathi, "Alternative Approaches for Better Municipal Solid Waste Management in Mumbai, India."

<sup>61</sup> Ibid.

argument for including the informal sector. A case study on Kanpur outlines the key roles served by different actors in the waste system and highlights room for improvement but does not include an extensive analysis of the actors.<sup>62</sup> As previously mentioned, Ostrom, et al., highlight the need to put actors and incentives at the center of sustainable infrastructure. Well-aligned incentives, according to Ostrom, Schroeder and Wynne, are the key consistent variable in any sustainable infrastructure. To understand the incentives, the actors must also be understood.

## **The Public and Private Sector**

At the municipal level, the public sector, specifically Indian municipal governments, are legally responsible for MSWM systems. In much of the research on waste management, the critiques of government-provided systems are limited expertise, budget and efficiency.<sup>63</sup> Ostrom, et al., point out that public provisions can create opportunities for special treatment for influential citizens.<sup>64</sup> These criticisms lead to the conclusion that the state failed to deliver the publicly provided MSWM system, commonly called the “failure of the state.” In response, the gap left by the public sector’s failure may be filled by the private sector where the market is supposed to enable a more efficient MSWM system delivery.<sup>65</sup>

The rise of the private sector in waste management in India came in the 2003 with the launch of several private waste management companies.<sup>66</sup> Specifically, this is the private formal sector made of for-profit and non-profit organizations that are often recognized by the Indian government. The rise of the private sector was influenced by the 2000 MSWMH Rules, which pushed cities to develop a more comprehensive waste management system. It suggests that privately operated waste management systems in India are still a relatively new form of MSWM delivery. Moreover it shows the rise of incentives that attract different players into the MSWM

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<sup>62</sup> Hina Zia and V. Devadas, “Municipal Solid Waste Management in Kanpur, India: Obstacles and Prospects,” *Management of Environmental Quality: An International Journal* 18, no. 1 (January 9, 2007): 89–108, doi:10.1108/14777830710717749.

<sup>63</sup> Sharholy et al., “Municipal Solid Waste Management in Indian Cities: A Review”; Kumar et al., “Assessment of the Status of Municipal Solid Waste Management in Metro Cities, State Capitals, Class I Cities, and Class II Towns in India.”

<sup>64</sup> Ostrom, Schroeder, and Wynne, “Institutional Incentives and Sustainable Development”; Susan E. Chaplin, “Cities, Sewers and Poverty: India’s Politics of Sanitation,” *Environment and Urbanization* 11, no. 1 (April 1, 1999): 145–58, doi:10.1177/095624789901100123.

<sup>65</sup> Ostrom, Schroeder, and Wynne, “Institutional Incentives and Sustainable Development.”

<sup>66</sup> S. Yedla and S. Kansal, “Economic Insight into Municipal Solid Waste Management in Mumbai: A Critical Analysis,” *International Journal of Environment and Pollution* 19, no. 5 (2003): 516–27.

system. In this case, the need for municipal governments to adhere to the legal mandate by the 2000 MSWMH Rules. Of the 59 cities surveyed by the NEERI and CPCB team, eight of the 59 cities had integrated private partners to fulfill the transportation needs of their MSWM system.<sup>67</sup>

The private sector is often praised for cost effectiveness and efficiency. Not surprisingly, like the public sector, the private sector also has limitations. While the private sector can be more financially viable in some circumstances, it may limit service coverage for poorer areas where the profit margin is lower. While technology and private sector integration are frequently offered as solutions, they are not the “silver bullet” municipalities expect.<sup>68</sup>

### **The Informal Sector**

While the private sector is often assumed to be large-scale for-profit organizations, it can also include individual actors in the informal sector. There are many definitions of the informal sector. Exploring these definitions in detail goes beyond the scope of this thesis. For the sake of this thesis, the main difference between the informal and formal sector is government regulation. Formal work is regulated and recognized by the government; informal work is not recognized nor regulated.

The informal sector’s work often stems from a personal need to generate income and to survive.<sup>69</sup> The informal waste sector includes: a) wastepickers, who sort and pick out recyclables at various dumpsites and sell these recyclables to kabadiwalas, who are also informal recyclers; b) kabadiwalas, who purchase high value recyclables from households and sell these recyclables to other kabadiwalas or local industry; and c) private sweepers, who are hired by households to clean the toilets and remove the trash.<sup>70</sup> Private sweepers deal with all types of household waste. Wastepickers and kabadiwalas are the two actors involved in recycling. For clarity, when kabadiwalas are referred to as collectively, I will refer to them as informal recyclers.

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<sup>67</sup> Kumar et al., “Assessment of the Status of Municipal Solid Waste Management in Metro Cities, State Capitals, Class I Cities, and Class II Towns in India.”

<sup>68</sup> Poornima and Bhaskar, *Messing Around with Waste*.

<sup>69</sup> Mansoor Ali, “The Informal Sector: What Is It Worth?,” *Waterlines* 17, no. 3 (January 1, 1999): 10–11, doi:10.3362/0262-8104.1999.004.

<sup>70</sup> *Ibid.*

Many studies of the informal waste sector focus on wastepickers. In any Indian city, wastepickers are estimated to make up roughly one to two percent of a city's population.<sup>71</sup> Less is known about the percentage of private sweepers, who are employed directly by households, and kabadiwalas, who purchase recyclables from households, organizations or wastepickers, working in Indian cities. Few, if any, research quantifies the impact of the informal sector in smaller cities or any examples of informal recycler inclusion. Much more research on the informal sector has been completed in larger cities, perhaps due to the greater number of NGOs conducting research in large cities.

The informal sector's work is both intentionally and unintentionally excluded from MSWM systems. Invisible service providers, like the informal waste sector, often contribute great value to public service provision and are rarely recognized.<sup>72</sup> Informal recyclers, in particular, benefit municipal governments by extracting recyclables that would otherwise require further segregation or processing to extract the same financial and material value. Extracting recyclables also leads to greater landfill diversion rates, in effect allowing municipalities to spend less money on transit and segregation and costs them less to maintain a landfill.<sup>73</sup> Given that wastepickers are estimated to recycle between 6 to 15% of waste in some Indian cities, their contribution cannot be underestimated.<sup>74</sup> Estimates of waste diversion by kabadiwalas and private sweepers is less clear, given that most studies are centered only on wastepickers.

Informal recyclers are often excluded for many reasons. Governments prefer to engage with formal methods and actors. Information asymmetries also make it difficult for other parties to quantify the value of their work making it difficult for municipal governments to assess and integrate the work of informal sectors within the MSWM system. For municipal governments, estimating the value of the informal sector's work is expensive and is a barrier to engaging the informal sector. Information asymmetries between the informal sector and municipal governments are one reason that potential beneficial collaborations between the informal sector and other MSWM actors are overlooked.<sup>75</sup>

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<sup>71</sup> Chintan India, *Who Recycles Your Waste?* (Chintan, 2012), <http://www.chintan-india.org/documents/factsheets/chintan-who-recycles-your-waste-factsheet.pdf>.

<sup>72</sup> Ostrom, Schroeder, and Wynne, "Institutional Incentives and Sustainable Development."

<sup>73</sup> David C. Wilson, "Development Drivers for Waste Management," *Waste Management & Research* 25, no. 3 (June 1, 2007): 198–207, doi:10.1177/0734242X07079149.

<sup>74</sup> Madhushree Sekher, "Tackling Society's 'Detritus:' Stakeholder Partnerships and Urban Service Delivery in India," *Asian Journal of Political Science* 9, no. 2 (2001): 54–77, doi:10.1080/02185370108434191.

<sup>75</sup> Ostrom, Schroeder, and Wynne, "Institutional Incentives and Sustainable Development."

The social status of informal sector workers plays an important role in how they are perceived. Research in Pune and our research in Muzaffarnagar found that many wastepickers, kabadiwalas and private sweepers are Muslim<sup>76</sup> or in a “Scheduled Caste.” “Scheduled Caste” means that the Indian government recognizes this population of people as a historically marginalized population. Research on social conditions in Northern India, where Muzaffarnagar is located, notes that Muslims and people who are considered “Scheduled Caste” are more likely to have a difficult time finding stable employment and to have low incomes, highlighting the need for informal waste work.<sup>77</sup> Finally, their marginalized status in Indian society is a social incentive for excluding informal recyclers from the formal system.

The arguments for inclusion of the informal sector are multi-pronged. The inclusion of the informal sector is a potential route to affordably expand waste service.<sup>78</sup> Working with the informal sector offers an opportunity for the city to improve livelihoods, increase worker safety and encourage employment.<sup>79</sup> Ostrom, et al., further highlight that a combination of local and non-local actors can bring value when scientific and indigenous knowledge are mixed.<sup>80</sup>

There are few examples of municipal governments intentionally including the informal recyclers into their MSWM systems. Pune (population: 3.1 million people) and Bangalore (population: 8.4 million people) are two of the most celebrated models of informal recycler inclusion. In 2007, the Pune Municipal Corporation (PMC) has a memorandum of understanding (MOU) with SWaCH,<sup>81</sup> a worker-owned cooperative, to give SWaCH the responsibility for door-to-door waste collection in 40 percent of the city.<sup>82</sup> By 2013, SWaCH had 2300 members and served over 400,000 households.<sup>83</sup> PMC was one of the first municipalities to approve waste collection by wastepickers.<sup>84</sup> Bangalore’s inclusion model depends on a network of actors that help organize and

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<sup>76</sup> Many of the wastepickers and the majority of the kabadiwalas interviewed in Muzaffarnagar are Muslim.

<sup>77</sup> Craig Jeffrey, “‘A Fist Is Stronger than Five Fingers’: Caste and Dominance in Rural North India,” *Transactions of the Institute of British Geographers* 26, no. 2 (June 2001): 217–36, doi:10.1111/1475-5661.00016.

<sup>78</sup> Sharholy et al., “Municipal Solid Waste Management in Indian Cities: A Review.”

<sup>79</sup> Poornima and Bhaskar, *Messing Around with Waste*.

<sup>80</sup> Ostrom, Schroeder, and Wynne, “Institutional Incentives and Sustainable Development.”

<sup>81</sup> SWaCH stands for Solid Waste Collection and Handling or, officially, Seva Sahakari Sanstha Maryadit.

<sup>82</sup> “SWaCH,” SWaCH, 2013, <http://www.swachcoop.com/>.

<sup>83</sup> *Ibid*.

<sup>84</sup> Poornima Chikarmane, “Integrating Waste Pickers into Municipal Solid Waste Management in Pune, India” (WIEGO Policy Brief, July 2012), <http://wiego.org/publications/integrating-waste-pickers-municipal-solid-waste-management-pune-india.a>

coordinate local wastepicking efforts throughout the city. In 2011, legislation in Bangalore changed to support the registration of wastepickers, itinerant waste buyers (also known as kabadiwalas) and scrap dealers.<sup>85</sup> This was the first step in integrating wastepickers into the waste system, where wastepickers serve as waste collectors and recyclers, all within the city's system.<sup>86</sup> These models are regarded as promising examples of how the informal sector can be incorporated into delivering urban services at a low-cost in Indian cities, in such a way that benefits informal recyclers. Bangalore and Pune's models provide examples that illustrate how informal recyclers can be integrated into municipal government-designed MSWM systems.

### **Summary of Literature Review Findings**

In summary, updating MSWM systems to comply with 2000 MSW Rules still presents a challenge to municipal governments. Existing research suggests that smaller cities may have had less success complying with the 2000 MSW Rules. Smaller cities are less successful in collecting waste than large cities, suggesting a need to better understand how MSWM systems operate in smaller Indian cities. Yet, little research has been conducted on MSWM systems in smaller Indian cities with populations under one million people, even though 48% of urban populations in India reside in cities of this size.<sup>87</sup> One of the key obstacles in MSW collection is household collection that is still a relatively new responsibility for municipal governments and tends to require a large portion of any MSWM budget. More research needs to be done to understand the complexities and challenges in household waste collection.

While research and news articles herald the inclusion of the informal recycling sector, few sources document how the work of private, public and informal sector influences the MSWM system. This research explores the role of public, private and informal institutions in household waste collection, using Muzaffarnagar, a smaller city with a population under one million people. Muzaffarnagar provides us with a new case study to help address some of the gaps identified in existing literature.

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<sup>85</sup> Chaya Chengappa, "Organizing Informal Waste Pickers: A Case Study of Bengaluru, India" (Women in Informal Employment: Globalizing and Organizing (WIEGO), March 2013), <http://wiego.org/sites/wiego.org/files/resources/files/Chengappa-Organizing-Informal-Waste-Pickers-India.pdf>.

<sup>86</sup> Ibid.

<sup>87</sup> 2011 Census of India.



## METHODOLOGY

The main goal for this research was to identify and analyze the MSWM actors and their incentives in Muzaffarnagar's MSWM system. To limit the scope of the research, this work focused on household waste collection, one part of the MSWM system. Field research and secondary source research was conducted. The field research team was comprised of the 2014 MIT D-Lab Waste class, Shri Ram Group of Colleges and MIT Tata Center Fellows (including the author). The field research consisted of many interviews and a waste audit. The author conducted secondary source research.

Through group fieldwork over a total of three weeks in August 2014 and January 2015, 153 interviews were conducted with the major stakeholders in the Muzaffarnagar MSWM system, a waste audit was conducted with sixty-eight households and various secondary data was collected. Interviewees were selected to represent each of the major stakeholders—households, wastepickers, kabadiwalas, private sweepers, the private waste organization, and the municipal government. Interviews were semi-structured and qualitative. They often led to introductions to other interviewees through the snowball approach. Many interviewees were interviewed more than once to build trust and clarify any outstanding questions. The goal of the interviews was to understand each actor's role in the MSWM system and to identify their incentives within the system. The full list of interviews can be seen in the appendix in Table A.

With any MSW analysis, it is helpful to understand how much waste is generated on a regular basis. The waste audit was designed to measure an average daily waste generation rate per household. As waste can vary depending on income, households were selected from low, middle and high-income areas. The faculty and students at Shri Ram Group of Colleges in collaboration with the managers at A2Z (a private waste organization that serves the majority of the city) worked together to assess income levels. The MIT team collected waste from households, with help from A2Z waste collectors and managers. This team also surveyed households to count how many household members lived in each household. In the low-income area fourteen households were sampled, twenty-seven in the middle-income area and twenty-seven in the high-income area. A total of sixty-eight households were sampled and a total of 122 waste samples were collected.

Data from a variety of secondary sources, including the 2011 census, company profit and loss statements, and the contract between A2Z Infrastructure Limited and the Muzaffarnagar Municipal Corporation were used to clarify key details. This provided information on the number of households within the city limits, the number of customers served by A2Z, household fee payment

rate and A2Z's profitability. Finally, a literature review was conducted to understand the existing status of MSWM in India.

## **Limitations**

There are several limitations with this research, mainly due to the limited time available to conduct research by the author and the limited scope of this thesis. Understanding the full incentives of actors in any system in the span of three weeks is difficult. There are a variety of existing relationships that are complicated by culture and history that can be challenging to unfold as a researcher within three weeks. This research did not extend into analyzing some of the more ingrained and complex factors that influence the MSWM system. For example, poverty in a city has a dramatic influence associated with who receives the benefits of household waste collection but also who is working in waste management. I explored the latter by including the informal sector but did not have time to understand the dynamics around how poverty influences service delivery. For Indian cities, where 25 to 75% percent of people live below the poverty line, a key question for household waste management is which types of collection work when a significant percentage of potential users are not able to pay for waste collection. Moreover, what types of incentives encourage municipal governments to provide service to low-income households?

As is true with any qualitative research, the explanations from various interviewees does not always match exactly. Much time was spent trying to triangulate different stories to understand the current status of the MSWM system in Muzaffarnagar as the information given by different stakeholders did not always align. Thus, we had to continuously go back to different actors to ask the same sets of questions with a different lens.

This research is also limited by the scope, which is focused at the city-level. Beyond the 2000 MSW Rules, I did not explore how state and national governments influences Muzaffarnagar's MSWM system. Exploring the state- and national-level incentives would provide more information on what shapes the municipal-level incentives in Muzaffarnagar.

Waste management has many different facets. Among these facets, household waste collection, in particular, is challenging, as there are so many actors to influence. In the Muzaffarnagar city limits, there are 64,000 households. One of the challenges of this research was identifying a narrow enough scope to provide meaningful results, while also attempting to provide value to the community that it researched. My hope is that this work results in a better understanding of the MSWM system in Muzaffarnagar and provides meaningful lens to understanding MSWM systems in other Indian cities.

## CASE STUDY: MUZAFFARNAGAR

In 2010, Muzaffarnagar Municipal Corporation called for proposals from private companies for a strategy to update and operate the city's MSWM system.<sup>88</sup> The municipal government sought to modernize their system and to comply with the 2000 MSW Rules.<sup>89</sup> The expansion entailed extending the MSWM system to include door-to-door waste collection, transportation, treatment and processing. This was a large change from the previous system where street sweeping was the only city-managed means for collection. At that time, all collected waste was dumped in city landfills, unprocessed and untreated.

A2Z Infrastructure Limited, a private Indian company, won the bid to fulfill Muzaffarnagar's MSWM needs.<sup>90</sup> A2Z was then and continues to be viewed as a pioneer in MSWM.<sup>91</sup> They were the first to integrate collection, transportation, processing and treatment into one workflow run by a single organization.<sup>92</sup> They have deployed this model in more than 24 Indian cities, including Muzaffarnagar.<sup>93</sup>

As stipulated in the contract between A2Z and the Muzaffarnagar municipal government, A2Z is responsible for ensuring "that all MSW generated within the Concession Area [municipal area] is collected, segregated and transported to the MSW Processing Facility..."<sup>94</sup> In effect this meant that A2Z became responsible for keeping the entire city clean. Since A2Z's arrival, the only waste management role that municipal government continues to serve is street sweeping to clear the any remaining waste from city streets. One of the key service extensions, and the focus of this paper, was servicing households with a door-to-door waste collection system. This was the first door-to-door waste collection system implemented in Muzaffarnagar.

The new MSWM system in Muzaffarnagar was designed to offer households two means for disposal: either daily door-to-door collection or disposal through convenient dumpsters placed throughout the city. Households receiving door-to-door delivery were expected to separate wet and dry waste at the household level to enable A2Z to collect cleaner organic and inorganic waste. This

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<sup>88</sup> State Urban Development Agency Data (2011 census)

<sup>89</sup> From here forward, the 2000 Municipal Solid Waste (Management and Handling) Rules will be referred to as the 2000 MSW Rules.

<sup>90</sup> Aggarwal, Interview with Mayor of Muzaffarnagar, August 13, 2014.

<sup>91</sup> Mohit Kansal, A2Z Infrastructure Limited (MIT, 2014).

<sup>92</sup> Ibid.

<sup>93</sup> Ibid.

<sup>94</sup> "Uttar Pradesh Concession Agreement between A2Z Infrastructure Limited and the Muzaffarnagar Nagar Palika Parishad," February 12, 2011.

held the promise of generating more revenue for A2Z from waste byproducts.<sup>95</sup> Households were also expected to pay a monthly service fee of 30INR (\$0.50USD), which was a new fee in Muzaffarnagar.<sup>96</sup>

All waste collected would then be transferred to the secondary collection sites that serve as temporary storage in Muzaffarnagar. These sites are located throughout the city, often unmarked. From there, the waste would be transported to the A2Z processing center to be processed through a series of filters that would separate compost and refuse derived fuel (RDF)<sup>97</sup> as byproducts. Any remaining waste would be landfilled.

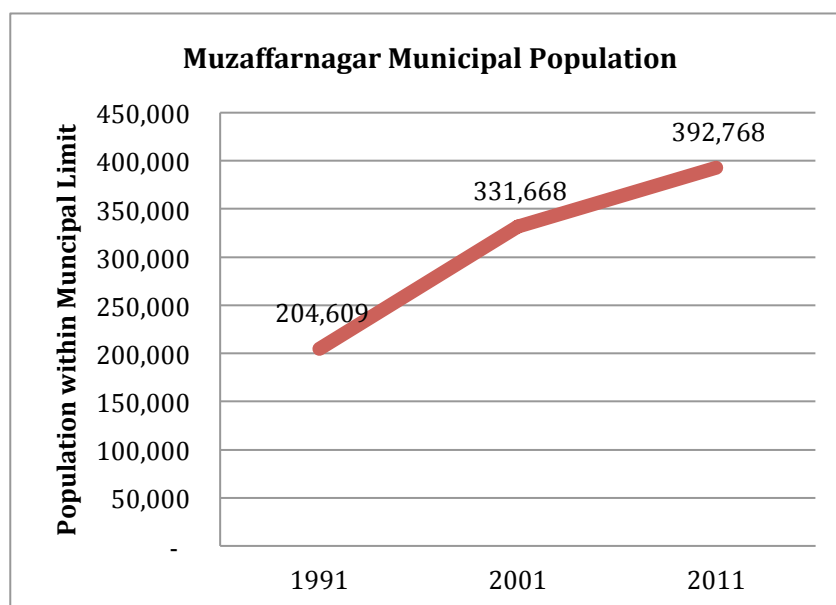
As a result of A2Z's work, around 70% of waste is currently collected from households. A2Z is also helping to divert a significant percentage of waste from the landfill. However, more than 30% of waste remains uncollected and only 21% of households are paying their monthly household fee.<sup>98</sup> A closer look at the MSWM system in Muzaffarnagar suggests the challenges in service coverage and household fee collection resulted from a series of misaligned incentives.

## Background

The Muzaffarnagar municipal government has always viewed waste management as an important responsibility.<sup>99</sup> However until recently waste disposal was not a major issue for the city

government.<sup>100</sup> The majority of the municipal waste had historically been organic or biodegradable which would naturally be composted or consumed by animals. Thus, waste was not a major

**Figure 1 Muzaffarnagar City Population within Municipal Limits, According to Census Data**



<sup>95</sup> Aggarwal, Interview with Mayor of Muzaffarnagar, August 13, 2014.

<sup>96</sup> Ibid.

<sup>97</sup> Refuse Derived Fuel (RDF) is shredded, combustible municipal solid waste that is sold as fuel.

<sup>98</sup> A2Z Infrastructure Limited, "A2Z Wardwise User Collection Charges," 2014.

<sup>99</sup> Aggarwal, Interview with Mayor of Muzaffarnagar, August 13, 2014.

<sup>100</sup> Ibid.

concern until more recently, as waste material streams diversified (including an increasing fraction of inorganic material) and the city's population increased.<sup>101</sup>

Muzaffarnagar's population has grown dramatically over the past 20 years.<sup>102</sup> Between 2001 and 2011, the population grew by 1.7 percent annually.<sup>103</sup> The census counts show that between 1991 and 2011, the urban population almost doubled in size from around 200,000 to close to 400,000 people (see Figure 1).<sup>104</sup>

Outside the municipal boundary, the population is also growing steadily. Since 1991, four urban areas<sup>105</sup> have been growing on the edges of Muzaffarnagar with annual population growth rates between five to seven percent.<sup>106</sup> With these four additional urban areas, the total Muzaffarnagar metropolitan population is closer to 500,000 people.<sup>107</sup> A local geographer noted that this count is likely conservative as it includes only the population that resides in the official urban areas.<sup>108</sup> Within the greater Muzaffarnagar area, the population is likely closer to one million people.<sup>109</sup> While the population has grown substantially in and around Muzaffarnagar, the municipal boundary, and thus the municipal responsibility for waste management has not expanded in 40 years.<sup>110</sup>

The next urban plan for Muzaffarnagar will be released in 2021. At that time, a decision will be made on whether the municipal boundary should expand to incorporate a population that resides beyond the city boundary.<sup>111</sup> This could legally extend the municipal responsibility for waste management to the population surrounding Muzaffarnagar's municipal limits.<sup>112</sup> Over the next six years, if the population within the city continues to grow, the amount of waste produced in

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<sup>101</sup> Ibid.

<sup>102</sup> S.C. Kulshresthra, Interview with Chairman of Shri Ram Group of Colleges in Muzaffarnagar, in person, August 15, 2014.

<sup>103</sup> Office of the Registrar General and Census Commissioner, Delimitation Commission of India, and Rand McNally International Atlas 1994, "Muzaffarnagar City Population Data," City Population, February 26, 2014, <http://www.citypopulation.de/php/india-uttarpradesh.php?adm2id=0902>.

<sup>104</sup> Ibid.

<sup>105</sup> To be identified as urban requires a certain population density within a given area.

<sup>106</sup> Office of the Registrar General and Census Commissioner, Delimitation Commission of India, and Rand McNally International Atlas 1994, "Muzaffarnagar City Population Data."

<sup>107</sup> Ibid.

<sup>108</sup> Kulshresthra, Interview with Chairman of Shri Ram Group of Colleges in Muzaffarnagar.

<sup>109</sup> Ibid.

<sup>110</sup> Ibid.

<sup>111</sup> Ibid.

<sup>112</sup> Ibid.

the city will also grow, putting greater demand on the current system. This context highlights the urgency to develop a long-term MSWM plan and to better understand the gaps in the current MSWM system.

### **Household Waste Generation in Muzaffarnagar**

The first challenge in attempting to understand any waste system is to determine how much waste is produced. We conducted a household waste audit to set a benchmark and understand the current status of the MSW generation in Muzaffarnagar. The data derived from waste collected from 68 households showed an average waste generation rate of 0.315 kilograms per person per day (see Appendix, Table B). Using this rate, an average family of six people would produce around 1.89 kilograms of waste per day. At the municipal level with 64,000 households, this translates to 123.5 metric tons of household waste generated daily within the municipal limits. On a daily basis, A2Z collects around 120 metric tons of waste, which includes household and business waste. 120 metric tons is less than the amount of waste generated daily by households alone. This gap suggests that A2Z is collecting less than the total amount of waste generated in Muzaffarnagar.

The waste composition was on average 59.5% organic and 40.5% inorganic. There were few high value recyclables (such as plastic bottles, metal, and glass) found in the waste audit. It is likely that kabadiwalas collected a lot of the valuable recyclables ahead of time.

### **MSWM Actors in Muzaffarnagar**

The set of actors involved in Muzaffarnagar's MSWM system is diverse and each has different incentives to perform different parts of the waste management system. These actors include:

1. *The Muzaffarnagar Municipal Corporation*, which is the municipal government responsible for MSWM
2. *A2Z Infrastructure, Limited*, the private waste organization that has contracted with the city to provide MSWM services
3. *Kabadiwalas*, who purchase recyclables from households and sell them to other actors in the waste sector
4. *Wastepickers*, who collect recyclables from dumps throughout the city to sell for profit
5. *Private sweepers*, who are part of the Balmiki community, who are hired by households to clean their toilets and take out the trash<sup>113</sup>

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<sup>113</sup> Aggarwal, Interview with Mayor of Muzaffarnagar, August 13, 2014.

### **Muzaffarnagar Municipal Corporation**

The Muzaffarnagar Municipal Corporation is the responsible party for the municipality's waste management. At present the municipal government oversees three main aspects of the MSWM system in Muzaffarnagar: monitoring and enforcing A2Z's work, employing and managing the municipal street sweepers, and following up with A2Z customers who do not pay their monthly fees. The city currently spends 35% of the municipal budget on MSWM.<sup>114</sup> The majority (30%) of the MSWM budget covers the costs for daily street sweeping, for which the city employs 535 permanent municipal sweepers and 360 temporary municipal sweepers.<sup>115</sup> The remaining 5% of the MSWM budget covers the municipal tipping fee payment to A2Z. Waste management employees are the largest fraction of municipal workers.<sup>116</sup> The municipal sweepers collect 12 metric tons of waste per day. A2Z, on average, collects 120 metric tons of waste daily, including the 12 metric tons of waste collected by street sweepers.<sup>117</sup>

Monthly household waste collection fees cover part of the expenses for MSWM service. The monthly fees are collected by A2Z and then transferred to municipal accounts. As previously mentioned, only 21% of all households pay their monthly service fees to A2Z.<sup>118</sup> The municipality enforces the fee payment by sending notices to non-paying customers. It is interesting to note that no interviewees commented on the level of effectiveness of the notices.

### **A2Z Infrastructure Limited: the Private Waste Organization**

A2Z Infrastructure Limited is a large Indian waste management company. As of 2014, A2Z had contracts with 24 Indian cities to develop and run their MSWM systems. They have earned several company awards for their innovative concept of waste management, which integrates all the MSWM steps so that one service provider can manage the entire system. For A2Z this streamlined process allows them to gain financial value throughout the entire MSWM process.

A2Z is currently in a ten-year contract with the Muzaffarnagar Municipal Corporation to provide waste service to all households and businesses in the city limits.<sup>119</sup> To fulfill their contract,

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<sup>114</sup> Pankaj Aggarwal, Interview with Mayor of Muzaffarnagar, In person, January 12, 2015.

<sup>115</sup> Ibid.

<sup>116</sup> Ibid.

<sup>117</sup> A2Z, Interview with A2Z Infrastructure, Limited, In person, January 12, 2015.

<sup>118</sup> A2Z Infrastructure Limited, "A2Z Wardwise User Collection Charges."

<sup>119</sup> "Uttar Pradesh Concession Agreement between A2Z Infrastructure Limited and the Muzaffarnagar Nagar Palika Parishad."

A2Z employs 272 people.<sup>120</sup> Of that, 170 people are hired as door-to-door waste collectors. A2Z also hires managers that collect monthly fees from A2Z's customers: 30INR from households, 40INR from shops, and 100INR from schools and hotels.<sup>121</sup>

A2Z gives any collected fees to the municipal government.<sup>122</sup> Through this system, A2Z has three revenue streams: tipping fees paid by the municipal government for each metric ton of waste collected, and the revenues generated by the two waste byproducts, compost and RDF.<sup>123</sup> The municipal government pays A2Z 650INR for each metric ton of waste collected.<sup>124</sup> The market rate for compost is around 1,400INR per metric ton. Raw RDF materials are sold for 945INR per metric ton and up to 5000INR per metric ton for RDF blocks.<sup>125</sup> Through A2Z's current processing technique, one metric ton of waste converts to 19% compost and 14% RDF, and 2% of that waste is disposed through landfill.<sup>126</sup> The remaining waste is lost in the process due to water evaporation (or other losses).

For A2Z, one metric ton of waste represents between 1000 to 2800INR (\$17 to 27USD) in revenue potential from the waste byproducts.<sup>127</sup> This revenue would be an addition to the 650INR-tipping fee. Using the average household waste generation rate, we can estimate that to collect one metric ton of waste from households, requires collecting waste from 530 households in a single day.<sup>128</sup> At its current operating levels, A2Z spends almost 800INR per metric ton of waste collected.<sup>129</sup> Hence, the potential profit generated per metric ton is between 200 to 800INR (\$4 to 13USD). This assumes that A2Z is able to sell all the byproducts generated (which is not currently the case). At their current level, A2Z is spending more on collection than it is able to make in revenue.

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<sup>120</sup> A2Z, Interview with A2Z Infrastructure, Limited.

<sup>121</sup> Aggarwal, Interview with Mayor of Muzaffarnagar, August 13, 2014.

<sup>122</sup> A2Z, Interview with A2Z Infrastructure, Limited.

<sup>123</sup> Refuse Derived Fuel (RDF) is shredded, combustible municipal solid waste that is sold as fuel.

<sup>124</sup> Aggarwal, Interview with Mayor of Muzaffarnagar, January 12, 2015.

<sup>125</sup> Market values calculated by A2Z Project and Loss Statements for 2014 – 2015.

<sup>126</sup> A2Z, Interview with A2Z Infrastructure, Limited.

<sup>127</sup> This assumes that all the RDF and compost generated is sold.

<sup>128</sup> This is assuming that each household generates roughly 0.315 kilograms of waste and that A2Z's waste collectors serve 200 households each. Salary costs are based on the assumption that collectors are paid 5200 INR per month and work six days a week.

<sup>129</sup> This excludes fixed costs covered by A2Z. To arrive at this, I took the sum of the monthly averages of salary, diesel and vehicles expenses divided by the total amount of waste collected per month over one year.



## Informal Recyclers

The impact of informal recyclers is significant. Research in other Indian cities suggests that informal recyclers recycle between 6 to 15% of waste in Indian cities.<sup>130</sup> Applying this estimate to the current household waste generation level in Muzaffarnagar would mean that between 7 to 18.5 metric tons of waste is recycled daily through the informal sector. More research would need to be done to confirm the total impact and number of informal recyclers in Muzaffarnagar.

Needless to say, they are an important part of Muzaffarnagar's informal waste system. The municipal government does not regulate nor recognize the work of informal recyclers in the current MSWM system. In Muzaffarnagar, there are two types of informal recyclers: Kabadiwalas who purchase recyclables from other parties and wastepickers who collect and sort recyclables from dumpsites in the city.

Recycling is a vehicle for producing income and their work shows that the market price for recyclables acts as an incentive for its collection. Waste is no longer seen as something to get rid of but something of value to collect for livelihoods. A common link between kabadiwalas and wastepickers is that many informal recyclers are Muslim.<sup>131</sup> In Uttar Pradesh, Muslims and people that are "Scheduled Caste" are more likely to have a difficult time finding stable employment.<sup>132</sup> They are also more likely to have low incomes.<sup>133</sup> Recycling provides much-needed income for informal recyclers.

### Kabadiwalas

Kabadiwalas are known as the itinerant waste buyers, scrap dealers or aggregator recyclers. Kabadi means junk or waste in Hindi. Kabadiwalas operate at different scales of business – large and small. Some kabadiwalas, who I will refer to as aggregate kabadiwalas, buy bulk quantities of recyclables from other informal recyclers.<sup>134</sup> Many of the aggregator kabadiwalas also have several employees to help them sort and recycle. Other kabadiwalas move door-to-door to purchase high-value recyclables, such as newspapers, electronics, and plastics, from households and businesses. One household mentioned they have a long-standing relationship with a kabadiwala; this

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<sup>130</sup> Sekher, "Tackling Society's 'detritus.'"

<sup>131</sup> Interviews with Muzaffarnagar Wastepickers, interview by MIT D-Lab Waste Class Shri Ram Group of Colleges, January 2015; MIT D-Lab Waste Class Shri Ram Group of Colleges, Interviews with Muzaffarnagar Kabadiwalas, January 2015.

<sup>132</sup> Jeffrey, "A Fist Is Stronger than Five Fingers."

<sup>133</sup> Ibid.

<sup>134</sup> Shri Ram Group of Colleges, Interviews with Muzaffarnagar Kabadiwalas.

kabadiwala buys their recyclables on a monthly basis.<sup>135</sup> The key difference between kabadiwalas and other waste workers is that kabadiwalas purchase recyclables and by doing so, incentivize households and organizations to recycle.

In Muzaffarnagar, our team interviewed thirteen kabadiwalas operating at different scales. Kabadiwalas purchase materials like newspaper, tin, iron, aluminum, cardboard, and electronics. The average monthly income reported was 15,700INR (\$260).<sup>136</sup> The range of monthly income was from 4500 to 20,000INR (\$75-330).<sup>137</sup> Only three of the thirteen kabadiwalas reported their daily collected weight of recyclables - this ranged from 175 to 1100 kilograms. Some kabadiwalas work independently while others employ up to 30 people.<sup>138</sup> Those with the highest salary sell directly to local industries, showing a direct link between the materials purchased by kabadiwalas and industry. A survey of sixteen kabadiwalas in Muzaffarnagar noted that they earn 200 to 300INR per month in exchange for around 3.4 kilograms of recyclables.<sup>139</sup> At the household level kabadiwalas' purchase of recyclables lowers the total amount of waste collected by A2Z and also lowers the value of the material streams that A2Z collects.

### **Wastepickers**

Wastepickers who collect recyclables from dumpsites throughout the city are the other key player in Muzaffarnagar's informal recycling sector. Research in various Indian cities estimate that one to two percent<sup>140</sup> of any urban population make their living through wastepicking. In Muzaffarnagar, one to two percent of the urban population is 3,900 to 7,800 wastepickers. More research would need to be conducted to validate the estimate of the total number of wastepickers in Muzaffarnagar.

For this research, 41 wastepickers were interviewed in Muzaffarnagar. On average, they collect 120 kilograms of recyclables each day.<sup>141</sup> Collectively, the 41 wastepickers that were interviewed recycled 4.9 tons of recyclables each day.<sup>142</sup> Wastepickers' income ranged from 75 to

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<sup>135</sup> This comment came from a household in the high-income area during the waste audit.

<sup>136</sup> Shri Ram Group of Colleges, Interviews with Muzaffarnagar Kabadiwalas.

<sup>137</sup> Ibid.

<sup>138</sup> Ibid.

<sup>139</sup> Ibid.

<sup>140</sup> While this is a commonly cited percentage, there is little information on how the number of wastepickers in a city may change depending on a city's profile.

<sup>141</sup> Interviews with Muzaffarnagar Wastepickers.

<sup>142</sup> Ibid.

400INR daily.<sup>143</sup> Most wastepickers work six to seven days per week. This translates to incomes between 1800 to 12,000INR (\$30 to 200USD) per month depending on the time worked and the types of materials collected.<sup>144</sup> The market value for materials varies widely. For example, on the high end, a kilogram of human hair is worth an average of 1200INR.<sup>145</sup> On the low end, glass has a market value for around three rupees per kilogram. The collected recyclables are later sold to kabadiwalas.

### **Private Sweepers**

An estimated 1,000 people, known as Balmikis, serve as private sweepers in Muzaffarnagar. They represent a small proportion of the overall Balmiki population in Muzaffarnagar. The Balmiki are part of the government identified “Scheduled Caste,”<sup>146</sup> meaning the Indian government recognizes them as a historically marginalized population. They have historically been responsible for cleaning toilets and removing human waste. While not all Balmikis are actively working as sweepers, many formed a union to represent their interests.<sup>147</sup> Balmikis are employed throughout the MSWM system as private sweepers, A2Z employees and municipal sweepers.

Households and businesses hire private sweepers to remove the solid waste and clean their toilets on a daily basis. A private sweeper earns between 50 to 100INR per household per month. However the private sweepers’ work challenges the value of A2Z’s door-to-door household collection service offered by A2Z. From the household perspective, both private sweepers and A2Z collectors are responsible for disposing household waste. Yet private sweepers take the waste directly from the house, while A2Z require a household to give their waste to the collector. When walking through one neighborhood, we noticed that there were small piles of waste intentionally placed in the street away from a nearby household. The A2Z collector noted that A2Z did not always serve some households that were already served by private sweepers. At the household level, sweepers are incentivized to simply remove waste from households, but there is no infrastructure

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<sup>143</sup> Ibid.

<sup>144</sup> Ibid.

<sup>145</sup> Ibid.

<sup>146</sup> “Scheduled Caste” is one of the marginalized populations, as identified by the government of India. Balmikis are not actually a caste, but considered one of the lowest classes in orthodox Hindu. The more common name is “Dalit” that represents the “Scheduled Caste.” More information is available here: <http://www.ncdhr.org.in/dalits-untouchability>

<sup>147</sup> Details on the distinction between the three unions

or incentive (financial or otherwise) to enable and encourage private sweepers to dump their waste in a formal “secondary collection sites.”

### **Analysis of the MSWM Incentives**

A variety of incentives drive the actions of each actor involved in Muzaffarnagar’s MSWM system. As Muzaffarnagar moved from its previous system to the current system, these incentives played a significant role in the outcome of the MSWM system. To return to Ostrom, et al., theory on sustainable infrastructure, a few factors are relevant in the case of Muzaffarnagar. Those factors include the information asymmetry that exists between different actors in the Muzaffarnagar system and the system design attributes. In this case, the lenses of extractability and subtractability will be applied to explore how those two system attributes impacted the system outcome.

### **Information Asymmetry**

Ostrom, et al., distinguish between two types of knowledge: local time and place knowledge and technical knowledge.<sup>148</sup> They argue that the integration of both types of knowledge leads to better systems and potentially beneficial collaborations between different actors.<sup>149</sup> Technical knowledge is more scientifically driven about the regularities that exist amongst different systems regardless of their context.<sup>150</sup> In Muzaffarnagar, A2Z provides technical knowledge through their experience in 24 cities with the types of systems, processes and treatments that improve the MSWM system. Local time and place knowledge provides the contextual information that would help form the system for the local context.<sup>151</sup> Local time and place knowledge in Muzaffarnagar included that held by the informal waste sector and the information about the contextual factors and existing actors that influenced A2Z’s operations.

The design of the Muzaffarnagar MSWM system did not include local actors or contextual factors. Waste collection, processing and revenue were all negatively affected by the limited recognition of local actors and contextual factors. Initially, A2Z planned on offering two modes of collection, being able to process the total amount of waste collected daily and to generate revenue from waste byproducts. Challenges arose in both modes each area as A2Z implemented their plan.

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<sup>148</sup> MIT D-Lab Waste Class Shri Ram Group of Colleges, Interviews with Muzaffarnagar Kabadiwalas, January 2015.

<sup>149</sup> Ibid.

<sup>150</sup> Ibid. Page 50.

<sup>151</sup> Ibid. Page 50.

### **The Challenge to Change Ingrained Incentives**

The original household waste collection system design incorporated two modes of waste collection: distributed dumpsters throughout the city and door-to-door collection. The collection system depended on households using the two collection options and recognizing enough value in those collection options to pay a monthly collection fee of 30INR (\$0.50USD). The options were a major change from what households had previously been incentivized to do. Prior to A2Z, neither dumpsters nor trash bins were placed in public areas for households to use. Households were also not required to pay for the waste service. As a result, residents did not use the dumpsters. The change in the fee collection will be explored in the next section.

The system change also challenged the actors that ran the waste system before A2Z. Prior to A2Z, the municipal sweepers ran the entire MSWM system allowing them to effectively control how the system worked and the benefit they received.<sup>152</sup> They swept the waste from the streets and transported that waste to different landfills throughout the city. When A2Z contracted to deliver the MSWM system, the role of the municipal sweepers was diminished as A2Z took over the dominant role in the MSWM system delivery. This displaced municipal sweepers from their previously powerful role in the MSWM system. Their power was threatened, incentivizing them to also threaten A2Z's power. For the municipal sweepers, the dumpsters were seen as valuable source of metal and a way to impact A2Z's implementation. Some of the dumpsters were stolen and sold for scrap metal.<sup>153</sup> When A2Z waste trucks initially started operating in the city, they were perceived as a threat to existing waste workers. Stones were thrown at the trucks to push A2Z out of Muzaffarnagar.<sup>154</sup>

This example also shows the difficulty of changing ingrained incentives. As Ostrom, et al. note, incentives are hard to change because "many well-placed individuals benefit from the current system."<sup>155</sup> This was true of the municipal sweepers in Muzaffarnagar. They had a lot to lose, both in power and financial benefit gained through their role running the MSWM system. The thrown stones and stolen dumpsters made for an aggressive environment for A2Z to launch in and showed the powerful role that existing waste actors can play when their incentives are not represented in new system designs.

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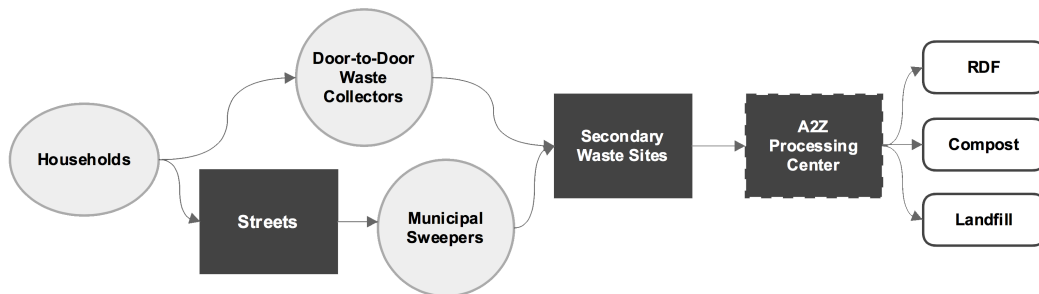
<sup>152</sup> Aggarwal, Interview with Mayor of Muzaffarnagar, January 12, 2015.

<sup>153</sup> Ibid.

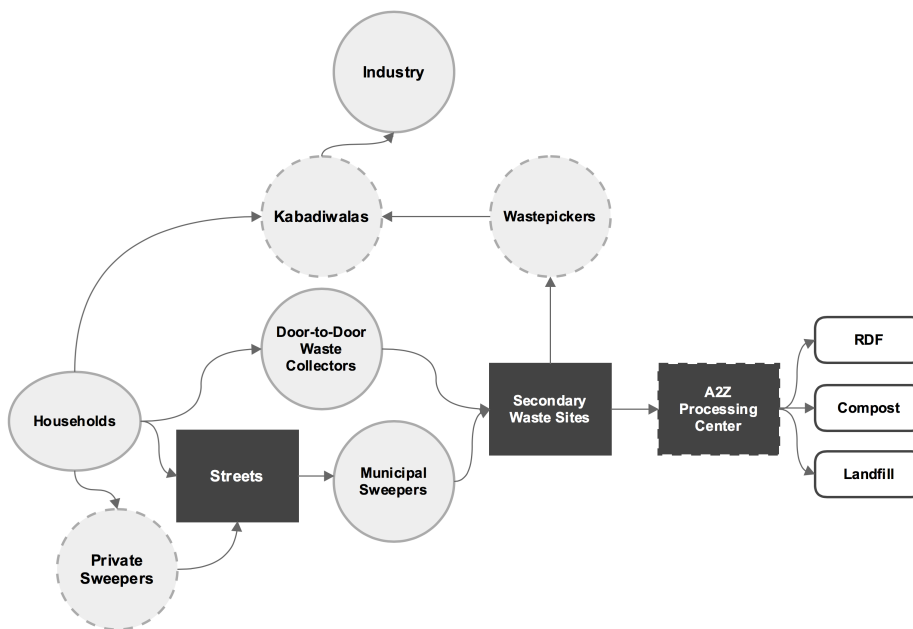
<sup>154</sup> A2Z, Interview with A2Z Infrastructure, Limited.

<sup>155</sup> Ostrom, Schroeder, and Wynne, "Institutional Incentives and Sustainable Development."

Much of the challenges can be traced back to a bias for technical knowledge that framed the initial MSWM system design. The design recognized two MSWM actors: A2Z and the municipal government. While the municipal sweepers were recognized through the municipal government, their role was diminished in the new system. The design also did not recognize other existing parties in the MSWM system in Muzaffarnagar. The difference in the model designed by A2Z and the system that existed in reality can be seen in the diagrams below. The system that actually occurs is far more complex than a two-actor system.



**Figure 2 Muzaffarnagar MSWM system design with A2Z**



**Figure 3 Muzaffarnagar MSWM System Design with Informal Sector**

### Utilizing Local Knowledge

The limitations of the local knowledge extended beyond the aggression caused by the municipal sweepers. One of the innovations that A2Z brought to Muzaffarnagar was the ability to process large amounts of mixed waste<sup>156</sup> and divert a substantial proportion of that waste from municipal landfills. A2Z's financial incentive depended on A2Z being successful at selling RDF and compost as two resulting waste byproducts. Upon implementation, the processing machine was only able to operate for eight hours per day. Only 90 metric tons of waste can be processed in eight hours, thus limiting A2Z's total processing ability.<sup>157</sup> Given that households alone produce on average 132 metric tons of waste per day and A2Z collects around 120 metric tons of waste per day, 90 metric tons is far less than the total amount of MSW produced daily. Between the city and A2Z's plans, the electricity needed to run the processing machines was overlooked.

Moreover, the market for compost and RDF proved to be weaker than expected. A2Z has had substantially lower sales of its waste byproducts (compost and RDF) than expected. This suggests that market in the Muzaffarnagar area is not ripe for RDF and compost. While numerous factors influence the sales of any product, the limited success of the waste byproduct sales suggests that local knowledge was not integrated. Local knowledge would have helped A2Z better evaluate the types of waste byproducts that are valuable in the local market.

A2Z's original design was not fully realized because they overlooked the existing incentive structures at the household level, the actors involved in the MSWM system and the contextual factors, like the market's ability to support the waste byproducts produced by A2Z and the electricity limitations. In the case of Muzaffarnagar, the celebration of A2Z's technical knowledge distracted any focus on leveraging the local knowledge that was necessary for the technical knowledge to be effective. As a result, A2Z is not as profitable as it had planned. The weaker-than-expected market limits A2Z's financial incentive to continue to invest in the MSWM system and for households not served by the system to dispose of their waste more effectively.

In addition, the initial aggression from municipal sweepers limited the options for household waste collection. There remain only two ways for households to dispose of their waste: door-to-door collection or on the street with the expectation that municipal sweepers will sweep the streets. The municipal sweepers' scrap metal sales of the dumpsters ultimately incited the

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<sup>156</sup> Mixed waste is waste that is unsegregated and contains a combination of different waste types. In this case, mixed waste would be all household or organizational waste (food, wrappers, paper, and more) in one comingled pile.

<sup>157</sup> A2Z, Interview with A2Z Infrastructure, Limited.

removal of all the dumpsters from city streets has negatively impacted the equity of the MSWM system. As a result, households that are currently unable to pay for the door-to-door collection system have little convenient household waste disposal choices.

### **The Lines of Excludability and Nonexcludability**

By system design, households are expected to pay for the benefit of receiving door-to-door waste collection. The door-to-door household collection service hinged on households paying a monthly household collection fee of 30INR (\$0.50USD). The reality upon implementation is much more nuanced. Excludability and nonexcludability play an important role in the financing and equity of Muzaffarnagar's household waste collection system.

At the household level excludability is a factor in two ways: 1) ability for A2Z to exclude households; 2) ability for households to opt out of paying for the service and/or receiving the service. At present A2Z recognizes only 71% of households in the city as its customers.<sup>158</sup> The 29% of households left without household waste collection service are described as unable to pay and thus do not receive door-to-door collection service.<sup>159</sup> This means that, by design, a segment of society is excluded from the door-to-door household waste collection service. Given the initial removal of the dumpsters, there exists no other convenient means for households who are unable to pay their monthly fee to dispose of their waste. This exclusion raises the issue of redistributive equity, one of the criteria proposed by Ostrom, et al., to evaluate a system against. Redistributive equity is when users that are not able to pay for the benefit, can still receive the benefit.

The backup for any waste that is not collected or disposed of directly from households are municipal sweepers, who are expected to sweep any leftover waste from the streets. The system design would suggest that the waste generated by the 29% of households who are not currently served through household collection would instead happen through the work of municipal sweepers. The results of the waste audit hint that municipal sweepers are not gathering all the waste generated by this population. We found that on average 123.5 metric tons of waste is produced daily by households.<sup>160</sup> That equates to roughly 36 metric tons of waste produced daily by the 29% of households excluded from household waste collection. At best, if all municipal sweepers were deployed to serve the areas with uncollected waste, municipal sweepers would still collect

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<sup>158</sup> A2Z Infrastructure Limited, "A2Z Wardwise User Collection Charges."

<sup>159</sup> A2Z, Interview with A2Z Infrastructure, Limited.

<sup>160</sup> This was calculated by multiplying the average waste generated per household by the total number of households in the municipal area.

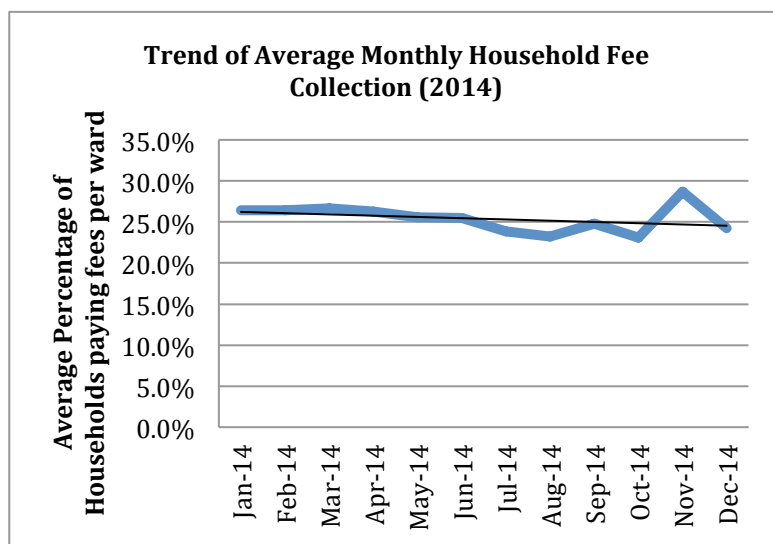


only one-third of the waste produced by this population.<sup>161</sup> This means an additional 24 metric tons of waste remain uncollected daily through the household waste collection system. Excluding 29% of households from household collection shows that A2Z is able to exclude users from receiving the full potential benefit. This exclusion limits the redistributive equity by the initial service delivery lines and by the excludability designed into the system.

### *The Free Rider Incentive*

The practice of excluding households that do not or cannot pay the household fee is not universally implemented throughout the city. A2Z's records indicate that of the 71% of households they are serving, only 30% pay the monthly household collection fees. A2Z states that they deliver service to all households that identified as part of their 71% customer base, regardless whether those households pay the fee. This means that the other 70% of households that are receiving the service without paying for it are effectively free riding and gaining the benefit of the MSWM system without cost to themselves. In Muzaffarnagar's 45 municipal wards, the average percentage of households paying the monthly collection fee varies. At worst, none of the households served pay a fee; at best 56.5% of households receiving the service in a ward pay the fee.<sup>162</sup> This is problematic for the system's financial sustainability.

One of the incentives that results from A2Z's continued service regardless of fee payment is the incentive for other households to free ride, or to receive the benefit but not pay for that benefit. Customers who find out that other households are not paying will be wary of being perceived as "suckers" and may opt out of future payments.<sup>163</sup> A2Z's



**Figure 4 2014 Monthly Household Fee Collection Overall, Data from A2Z's 2014 Wardwise User Charges**

customer fee data from January to December 2014, indicates that the household fee payment rate

<sup>161</sup> Collectively, municipal sweepers collect 12 metric tons of waste per day.

<sup>162</sup> Data is from A2Z's 2014 Wardwise User Charges data.

<sup>163</sup> Pankaj A2Z, Interview with A2Z Infrastructure, Limited, In person, January 12, 2015.

varies from ward to ward. Of the 45 wards, the monthly fee payment rate increased in 7 wards, stayed roughly the same in 10 wards and decreased in 27 wards. Overall on average, the monthly fee collection rate per ward decreased over a one-year period suggesting that more households are free riding (see Figure 1). This means that a smaller number of households paid their monthly fee at the end of the year than in the beginning of the year. For the municipal government, less fees collected translates to less total funding to cover MSWM expenses.

### *Financial Incentives in Household Waste Collection*

If A2Z continues to serve the households that do not pay, the question that arises is what incentives drive A2Z to continue to deliver services to households that do not pay? In other words, why does A2Z encourage and enable free riders? Ostrom, et al., suggest that if users cannot be excluded in a fee-based system, the service provider is disincentivized from providing a quality service and from investing in maintenance and operation of the infrastructure. This would suggest that A2Z would stop delivering their service, especially to the free riding households.

By examining A2Z's incentives, it is easier to imagine why they would continue to collect waste regardless of fee payment. The system financial design insulates A2Z from varying household fee collection rates. While A2Z's collects the user fees, it turns those fees directly over to the city.<sup>164</sup> The city pays A2Z a tipping fee per metric ton of waste collected. While this fee system does not counteract the negative incentive for households to free ride, it may counteract A2Z's incentive to underinvest in the system. To return to Bevir's concept of the modern state, he suggests that the state is no longer the commanding player in any policy theater.<sup>165</sup> Thus, the state must steer rather than command other actors. In this case, the state insulates A2Z from fluctuations in household payments. The municipal government pays A2Z a tipping fee regardless of how many households pay the monthly fee. The city, instead of A2Z, absorbs the impact of household fee payment rates. This acts as an incentive to A2Z to continue to provide service to households regardless of whether they pay the monthly fee.

This leads to a system with unclear lines of accountability for the quality of service. In the current system, A2Z's service quality is not directly linked to the number of households that pay the monthly fee. This means there is little incentive for A2Z to deliver better service to customers.

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<sup>164</sup> A2Z, Interview with A2Z Infrastructure, Limited.

<sup>165</sup> Bevir, Democratic Governance.

Instead, the system is designed with the assumption that the 650INR tipping fee paid per metric ton by the city to A2Z encourages A2Z to collect bulk quantities of waste.

Of course, door-to-door household waste collection is not an efficient way to collect a metric ton of waste. Collection and transportation are the most expensive part of A2Z's system.<sup>166</sup> Assuming households produce an average of 1.89 kilograms per day,<sup>167</sup> collecting one metric ton of waste entails visiting around 530 households in a single day.<sup>168</sup> This costs A2Z 650INR just to pay waste collectors to collect waste from households and transport that waste by foot and cart to a transfer point. This means that the municipality's tipping fees cover door-to-door collection, a service that is delivered specifically to households that can pay, but may not be paying their fee. The marginal cost to collect an additional ton of waste is equal to the marginal revenue paid by the city to A2Z for collecting that same ton of waste. This suggests that the 650INR-tipping fee is not strong enough to act as a long-term incentive for A2Z, when other revenues are not as strong.

One additional factor that drives A2Z's incentive structure is the market for waste byproducts. A2Z's original financial model depended on generating enough revenues between the tipping fee and through sales of compost and RDF to cover the A2Z's expenses. Compost and RDF are generated through A2Z's processing system. The market rates for compost and RDF are: 1400INR per metric ton of compost and between 945 to 5000INR per metric ton of RDF sold.<sup>169</sup> If A2Z were able to sell all the byproducts generated through the waste system, the potential profit generated per metric ton would be between 200 to 800INR (\$4 to \$13) depending on the combination of byproducts produced.

In reality, A2Z has not been able to sell all of the byproducts generated. The projected revenues have not been realized and thus impacts A2Z's incentive to collect more waste. At the moment, A2Z has no major financial incentive to collect more waste or to deliver quality service to households. This incentive structure limits the effectiveness of the household waste collection system.

To generate a steadier source of revenue for MSWM, the municipal government is currently exploring the possibility of implementing a waste tax where all municipal residents would be taxed

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<sup>166</sup> A2Z's 2014 Company Financial Statements.

<sup>167</sup> This assumes that the average household in Muzaffarnagar has six residents, as seen through the 2011 Indian Census.

<sup>168</sup> This is assuming that each household generates roughly 1.89 kilograms of waste and that A2Z's waste collectors serve 200 households each. Salary costs are based on the assumption that collectors are paid 5200 INR per month and work six days a week.

<sup>169</sup> Market values calculated by A2Z Project and Loss Statements for 2014 – 2015.

equally. A move to a tax-based would, in theory, distribute the cost of the household collection system to be more widely shared across many more households. In practice, through instituting a community tax, the service transforms to a nonexcludable good where everyone pays and everyone receives the benefits.<sup>170</sup> At first glance, this seems like a strong solution to both increase the funding for MSWM system and to eliminate free riders. As such a large portion of the municipal population is already receiving the benefits but not absorbing the cost for the benefits of the household waste collection, the question raised is would a municipal tax change the incentive structure at the household level?

Once incentives, like the free rider incentives, are established, it is difficult if not impossible to change those incentives.<sup>171</sup> Households are already encouraged to free ride on the service and may do the same when a tax is implemented. They have no incentive to alter their behavior. Without improving the incentives or enforcing the tax, household behavior is unlikely to change.

Moreover, a tax would not adjust one of the key and important incentives in the current model: A2Z's incentive to collect more waste and be more accountable to its users. This incentive would only change if A2Z's incentive structure were linked to the quality of service provision. One potential benefit of the current model is that it enables the municipal government and A2Z to see what users prefer and their willingness to pay.<sup>172</sup> "When exclusion is feasible, preferences are revealed as a result of many quid pro quo transactions," note Ostrom, Schroeder and Wynne.<sup>173</sup> Households have three known waste disposal options: dispose their own waste, hire a private sweeper to dispose of their waste, or use A2Z's household collection. Given that only 21% of all households currently pay, gathering information on household preferences may help inform future iterations of MSWM systems in Muzaffarnagar.

### **Subtractability**

In many Indian cities, the informal recycling sector influences the material flows through the city. Muzaffarnagar is no different. One of the concerns raised in interviews with A2Z and the municipal government was whether the informal recycling sector limits the revenue generated by

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<sup>170</sup> E. Ostrom, L. Schroeder, and S. Wynne, "Institutional Incentives and Sustainable Development: Infrastructure Policies in Perspective.," 1993, 283 pp.

<sup>171</sup> Ibid.

<sup>172</sup> E. Ostrom, L. Schroeder, and S. Wynne, "Institutional Incentives and Sustainable Development: Infrastructure Policies in Perspective.," 1993, 283 pp. Page 78.

<sup>173</sup> Ibid. Page 78.

A2Z and the municipal government.<sup>174</sup> This is the idea of subtractability, when one user's benefit from the system subtracts from another user's ability to gain value.<sup>175</sup>

In any system there is a spectrum of options on whether municipal governments decide to include, exclude or simply recognize another actor. Plenty of research calls for the integration of the informal sector without acknowledging the transaction cost involved with both recognizing their value and integrating them in a current system. For both reasons, exclusion or lack of recognition is thus common in Indian MSWM systems. While exclusion is a seemingly simple solution, it assumes that the informal sector is unconnected to other agents in the city. Moreover, it assumes that the actors in the informal sector are operating at the same scale as other operators.

The informal sector is often referred to as a separate entity within MSWM systems. Yet, they are connected with many other actors within the city, including industry, households and less directly, the municipal government. At the household scale, kabadiwalas purchase recyclables directly from households, providing households with an extra 200 to 300INR in income per month. While 200 to 300INR is not a substantial amount of income, the money incentivizes households to segregate their waste. This financial incentive at the household level will be difficult to change now that it exists.<sup>176</sup> It is unlikely that households would stop selling their recyclables to kabadiwalas unless a different and improved incentive was offered to households.

The secondary question is then, how do wastepickers, the other active party in recycling at smaller scales, influence the waste value stream? Wastepickers are active daily picking waste out of the secondary collection sites and other dumpsites throughout the city. Their work is at an entirely different scale than A2Z's work. Wastepickers spend between 6 to 12 hours daily sorting recyclables from other types of waste. They work on average seven days a week. Their income depends on being able to search the informal and formal dumpsites throughout the city and to segregate the valuable waste into smaller, more valuable segments. Comparing the work streams of A2Z and wastepickers begs the question, would A2Z be able to replicate at the municipal scale what wastepickers achieve collectively as individuals?

A2Z's comparative advantage in the MSWM system is handling bulk quantities of waste. Its revenue model and the technology used are both leveraged when A2Z is collecting and processing large amounts of waste. For example, A2Z's largest cost outlay is related to door-to-door waste

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<sup>174</sup> A2Z, Interview with A2Z Infrastructure, Limited; Aggarwal, Interview with Mayor of Muzaaffarnagar, August 13, 2014.

<sup>175</sup> Ostrom, Schroeder, and Wynne, "Institutional Incentives and Sustainable Development."

<sup>176</sup> Ibid.

collection, where they handle smaller quantities of waste. The waste processing system used by A2Z built is designed to process more than 90 tons of waste per day and to segregate waste into three categories: compostable waste, RDF, and land fillable waste.

Informal recyclers, on the other hand, segregate materials to finer detail and often are dealing with less material volumes. Wastepickers and kabadiwalas often work in factors of kilograms, whereas A2Z is working in metric tons of waste. While aggregator recyclers are likely working at larger total quantities closer to the range of A2Z's work, they also employ several staff to segregate waste by material type and depend on a network of relationships with other recyclers to purchase pre-sorted waste. A2Z's current model depends on efficiently moving several tons of waste through many processes daily with few relationships. They are not set up to handle specific material streams. In other words, excluding wastepickers and kabadiwalas from the MSWM system does not have a clear value for A2Z.

While this sounds counterintuitive to A2Z's profit model and comparative advantage, there are at least two key issues in A2Z's current system: they cannot process all the waste on a daily basis due to electricity shortages at the processing plant and they are not able to sell 100% of compost or RDF. Adding an additional processing step would cost A2Z more money. This means that the informal sector's work may not be in direct competition with A2Z. Even if A2Z were to collect the waste currently collected by the waste sector, thus increasing their total waste collected, they may not be able to sell the additional recyclables given the weak market. It thus is unclear what the total benefit would be from excluding the informal sector.

From the city government's perspective, the informal sector offers a hidden and unrecognized value. Research estimates that around 10 to 15% of waste is recycled each year through informal recyclers. While more research would need to be done to understand the full impact of informal recyclers in Muzaffarnagar, using 10% as a starting point would mean that the informal sector saves the city a minimum of almost three million rupees in tipping fees annually (\$49,000). That represents 4,506 metric tons of waste recycled each year. The city currently benefits more from the informal sector than it recognizes. The informal recyclers are currently the only party recycling at the household level. They save the city money and their recycling offers a source of income to marginalized populations.

This initial analysis suggests that there is more to gain from including informal sector's work than there is to gain by excluding them from the current MSWM system. One of the challenges in any city system is the transaction costs associated with gaining information, especially about the informal sector that is often made of a collection of individuals. Ostrom, et al., note that it is often

difficult, if not impossible, to truly understand the full benefits and costs of any system, nor is it possible to have all information. Yet, while the transaction costs are high to understand the full picture of the informal sector's role. The transaction costs to exclude the informal sector are also high.

## CONCLUSION

In any infrastructure system analysis, the first question that arises is if the system should be sustained? As previously stated, for infrastructure to be sustained, it should continue to deliver economic benefits to users that outweigh the costs of maintaining that infrastructure.<sup>177</sup> Ostrom, et al., offer four criteria to evaluate system performance: economic efficiency, equity, accountability, and adaptability (see Table 1 for details). While detailed research is necessary to analyze these criteria extensively, Ostrom, et al., note that an initial analysis can identify how existing incentive structures influence the system outcomes.<sup>178</sup> Analyzing Muzaffarnagar's MSWM system using the criteria of economic efficiency, equity and accountability finds a range of possible outcomes.

### Economic Efficiency

Economic efficiency is defined as the magnitude of change in perceived net benefits given a change in resource allocation.<sup>179</sup> From the city's perspective, the comparison point for net benefits and cost is how the MSWM system before A2Z, compares to the current MSWM system with A2Z. The net benefits can be a combination of social, environmental and financial benefits achieved for some cost to the municipal government.

The current system revision has the potential to change the social dynamics around household waste collection – either positively or negatively. For the first time in Muzaffarnagar, a household fee will be associated with waste collection. In theory, this would encourage households to associate a value with household waste collection, by requiring households to pay a per household fee. The 21% of households that are paying their household fee are already connecting a value with the service. It is likely that the 50% of households receiving the benefit of household collection but not paying the fee are not attaching a benefit with the fee. The latter case makes it difficult for the municipal government to implement any future fee increases or taxes. If households are incentivized to see the value in waste collection, the long-term social benefit could be positive. At the moment, whether the change in social dynamics is a net benefit or net cost has yet to be seen.

Environmentally, as a result of the new system, A2Z is currently helping the city divert a substantial amount of waste from the municipal dumps. Before, 100% of waste collected would go to municipal dumps and now just 2% of the city's waste ends up there.<sup>180</sup> Long-term, this diversion

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<sup>177</sup> Ibid. Page 11.

<sup>178</sup> Ibid.

<sup>179</sup> Ibid. Page 112-113.

<sup>180</sup> A2Z, Interview with A2Z Infrastructure, Limited.



rate depends on the strength of the compost and RDF market. Without a strong market, A2Z will see unsold backflows of compost and RDF, which may end up being disposed of in municipal dumpsites. This may be an incentive for A2Z and the municipality to explore alternative ways to utilize the material value in household waste.

Financially, the municipal government is only spending 5% of the municipal budget on A2Z's system to achieve 70% door-to-door household waste collection while collecting on average 120 metric tons of waste daily.<sup>181</sup> An additional 30% of the municipal budget covers the employment of municipal sweepers who collect 12 metric tons of waste daily. While 35% of the municipal budget is extensive, the 5% that goes to A2Z provides a substantial benefit to the city. Yet, for the system to be sustainable and valuable to users, significant changes need to be made to improve the financial sustainability and equity of the current system. The financial incentives in the existing system are not sustainable for A2Z's current financial model.

To summarize, the overall benefits of the current system appear to be positive economically for the municipal government. Yet, these benefits could be stronger if the additional criteria (equity, accountability and adaptability) were also more clearly positive in their outcomes.

## **Equity**

The MSWM system is achieving neither fiscal nor redistributive equity. Only 30% of the households that receive the benefit of the household waste collection system, actually pay for the benefit, suggesting that fiscal equity is low. As a result, the city is considering implementing a waste tax to improve the fiscal equity, where more households would be encouraged to pay for household waste collection. Yet, this may not be the solution to improving fee collection because users are already incentivized to free ride on the existing system. Whether households pay through a tax or a household fee may be irrelevant as households are increasingly likely to evade paying their household fees. Changing this free rider incentive will require updating the existing service and enforcing the fee or tax payment to ensure that there are less total free riders in the system.

Redistributive equity is also a flaw in the current system. Presently, 29% of households have no convenient means to dispose of their waste, nor can they depend on the municipal sweepers who collect waste from the city streets on a daily basis. The initial plan for 300 waste bins to be placed throughout the city was one mechanism to offer another disposal option for households that cannot afford door-to-door collection. Since the original distribution of dumpsters throughout the city failed, neither A2Z nor the city has tried any additional options for alternative

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<sup>181</sup> Ibid.

mechanisms to collect household waste. Exploring other collection mechanisms would be one way to increase the redistributive equity in the system.

To change the redistributive equity of the system, the city would need to prioritize equity in its system design. The current system was designed assuming that a one-size system suits all people. The fact that 29% of households are not served by any MSWM system and only 21% of all households in the city pay the monthly fee suggests that approach is not appropriate. Moreover, it shows that the city is effectively subsidizing the cost of door-to-door collection for households *who are able to pay* but not covering the cost of alternative collection options for household that *cannot pay*. This suggests that the city prioritizes fiscal equity over redistributive equity. This is problematic for the poorer communities that are not served. If the city desires to fully comply with the 2000 MSWMH Rules, it needs to explore alternative options for household waste collection that serve the entire population of the city more fairly.

The only area where redistributive equity exists (though not by design), is at the secondary collection sites where wastepickers have access to waste. Here, wastepickers are able to compete with the A2Z on recovering value from waste. Exploring how the informal sector is included or excluded is another meaningful lens for evaluating redistributive equity and possibly household waste collection.

### **Accountability**

The current MSWM system, especially as it relates to household fee collection and tipping fees, does not have clear measures of accountability. A2Z collects household fees but is not directly paid based on household fees. A2Z is protected from being directly accountable to households for service quality. The fact that the city collects household fees prevents A2Z from being incentivized to collect more household fees. Even though A2Z is responsible for delivering the service there is no mechanism for evaluating whether their service is of the appropriate quality at the household level. This structure prevents any direct feedback from either side; households cannot argue for better service and A2Z do not care if households pay or not.

Incentives should be implemented which encourage service quality and provide baseline measurements of performance. A2Z's pay should be tied to this performance. A2Z should be responsible for fee collection instead of the city, which would create a direct incentive for them to track and make households pay. This would encourage A2Z to collect more household fees. The households would then be more directly involved with the service provider and should have the ability to refuse to pay for unsatisfactory service.

## **Adaptability**

A2Z and the municipal government responded initially to disagreements from municipal sweepers when implementing the A2Z MSWM system. This highlights that this MSWM system was implemented without leveraging or involving local actors or incorporating local context. This lack of involvement led to aggression between A2Z and the municipal sweepers. When A2Z recognized that its market potential was less than expected, it did not attempt to try to generate revenues through other products or services. In other words, the current system is not adaptable to the changing environments in which it operates.

To improve Muzaffarnagar's MSWM system, I propose that the overall incentive structure needs to be changed. In comparison with the previous system, the current MSWM system is positive from the perspective of economic efficiency, yet it still has several undesirable incentives. These include the exclusion of 29% of households from receiving household waste collection, a free rider benefit, no strong financial incentives for A2Z to deliver quality service and almost no inclusion of local knowledge or actors in the system.

Different types of incentives could be explored to incentivize action in each area. For example, the city could work with A2Z to develop a financial structure where A2Z and the municipal government share the household waste fees. This might help to address both A2Z's limited financial incentive and enable the city to also collect more total household fees. It could also address the incentive for A2Z to address the free rider incentive by encouraging A2Z to enforce fee collection. A2Z and the municipal government could work together to explore different collection mechanisms for low-income communities. This could mean exploring some variation of the previously tried dumpsters, as a new approach for household waste disposal but also limiting the major collection expenses associated with door-to-door household waste collection.

Finally, the municipal government would benefit from exploring mutually beneficial collaborations with the informal sector or least, recognizing their existence and seeking to amplify the work that they do. There are compelling arguments to involve the informal sector, both from the financial and equity perspective.

## **Summary**

*“More important than any specific recommendation that we might make is the recognition that motivating individuals to take a long-term perspective and the interests of a wide diversity of unknown individuals into account when making choices is among the more difficult tasks that*

*practitioners face. There are no quick fixes and no simple solutions.” – Ostrom, Schroeder and Wynne<sup>182</sup>*

The initial research questions in this thesis explored the actors that influence the MSWM system and how their incentives shaped the outcomes of the MSWM system in Muzaffarnagar. This research demonstrates that actors’ incentives heavily shape the outcomes of any MSWM design. For example, the municipal sweepers whose early aggression against A2Z’s entry into the city influences the diversity of household waste collection options, the free rider incentive has shaped the willingness of households to pay for household waste collection and the market factors have limited the financial incentives for A2Z to continue to deliver a quality MSWM system. This demonstrates that while the municipal government is legally mandated to deliver the MSWM system, it cannot effectively do so without understanding the existing incentive structure, both formal and informal. Effectively providing MSWM requires leveraging the local knowledge that has often been ignored by municipal governments. Regardless of whether a municipal government wants to or has the resources to recognize the informal sector, the informal sector has the capacity to change the outcomes of the MSWM system. In addition, behaviors at the household level must also be recognized to truly understand what incentives should be amplified, changed or removed.

Existing incentives will impact the result of any new system. For municipalities that are developing or updating their MSWM system, spending time early on to incorporate local knowledge into the system design and recognizing the existing actors in MSWM will save costs in the long term. In Muzaffarnagar, understanding and even building off the work of existing waste actors would have led to a substantially different system, possibly even resulting in a more sustainable MSWM system.

Many questions remain for future research. One of the main questions that remains is how cities of different sizes compare. Exploring which actors matter in different types of cities would be useful to better assess the types of incentives to explore when designing a new system. When municipal governments update their MSWM system, a large question is what types of arrangements between different actors produce what types of results. While there is some creativity in cities like Pune and Bangalore with integrating the informal sector in the MSWM system, other types of actor arrangements need to be documented and compared to make it easier for policy makers to envision new arrangements. Documenting the incentives that encouraged the actors in different

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<sup>182</sup> Ostrom, Schroeder, and Wynne, “Institutional Incentives and Sustainable Development.” Page 214.

arrangements to work together is another important layer of future research. Finally, as MSWM continues to be a challenge for Indian cities, case studies that document the steps a municipal government took to transition from an older system to a new system would help other municipal governments learn from past failures and successes.

## APPENDIX

**Table A: Interviews Conducted in Muzaffarnagar**

<b>ID</b>	<b>Interviewee</b>	<b>Sector</b>	<b>Organization</b>	<b>Position</b>	<b>Interview Dates</b>	<b>Number of interviews</b>
1	Pankaj Aggarwal	Municipal government	Muzaffarnagar Municipal Corporation	Mayor	8/13-16/2015 1/12/2015; 1/19/2015; 1/23/2015	6
2	Anjith Singh	Municipal government	Muzaffarnagar Municipal Corporation	Executive Officer	1/22-23/2015	2
3	Sanitary Food Inspector and Health Inspector	Municipal government	Muzaffarnagar Municipal Corporation	Public Health department	1/16/15	1
4	Ravinder Singh	Private sector	A2Z Infrastructure Limited	Executive Management	8/14/2015; 1/14/2015- 1/16/2015	4
5	Operation Managers with A2Z	Private sector	A2Z Infrastructure Limited	Operation Managers	8/14- 15/2015; 1/19/2015	3
6	Various (listed in additional sheet)	Informal sector	Recyclers	Wastepickers	8/15- 16/2015; 1/14-26/2015	37
7	Various (listed in additional sheet)	Informal sector	Recyclers	Kabadiwalas	8/15- 16/2015; 1/14-26/2015	13
8	Various (listed in additional sheet)	Households	City residents	Households	1/14/2015 - 1/25/2015	68
9	Narendra Manjoor and one other Union representative	Informal sector	Private sweepers	Union representatives	1/16/15	2
10	Dr. S.C. Kulshreshthra	University	Shri Ram Group of Colleges	President	8/15/14	1
11	Shri Ram Students and Faculty	University	Shri Ram Group of Colleges	Students and staff	1/25/15	16

**Table B: Data Collected from Household (HH) Waste Audit**

<b>Income Category</b>	<b>Area Name</b>	<b>Date</b>	<b>Total Weight (kg)</b>	<b>Total HHs</b>	<b>Household Members</b>	<b>Organic</b>	<b>Inorganic</b>	<b>Daily Weight per Person (kg)</b>
Low Income	Rehdaspuri	1/23/15	53.15	14	111	0	0	0.479
Middle Income	Dwarikapuri	1/14/15	16.40	27	142	55.18%	44.8200%	0.115
Middle Income	Dwarikapuri	1/22/15	31.55	27	142	64.50%	35.50%	0.222
High Income	Jat Colony	1/21/15	56.45	27	121	50%	50%	0.467
High Income	Jat Colony	1/22/15	35.2	27	121	68.32%	31.68%	0.29
			<b>Average</b>			59.50%	40.50%	0.315
			<b>Std. Deviation</b>			0.08	0.08	0.158
			<b>High</b>			67.90%	48.90%	0.472
			<b>Low</b>			51.10%	32.10%	0.157

**Table C: Interview Results from Kabadiwalas**

<b>ID</b>	<b>Name</b>	<b>Age</b>	<b>Work Experience</b>	<b>Income (INR/Mo)</b>	<b>Material Collected (kg/day)</b>	<b># Empl-oyees</b>	<b>Sells to</b>
1	Gufraan	45	13	15,000	-	3	Industry
2	Nafees Ahmad	29	10	20,000	-	2	Industry
3	Ali Ahmed	43	8	-	-	1	Industry
4	Hazi Shajeed	35	12	20,000	-	2	Industry
5	Billu	-	0.5	20,000	175	1	Industry
6	Rohit	18	1.5	6,000	-	7	Kabadiwala
7	Mukarrum	21	10	-	-	-	Industry, Kabadiwala
8	Mohamed	38	2	-	-	-	
9	Ashok	56	10	-	-	-	
10	Mustakim	55	25	4,500	200	-	Kabadiwala
11	Naim	38	14	-	1100	17	Industry
12	Puwan	55	6	20,000	-	20	Industry
13	Yameen	48	25	20,000	-	30	Industry



**Table D: Interview Results from Wastepickers**

<b>ID</b>	<b>Name</b>	<b>Age</b>	<b>Work Exper-ience</b>	<b># Days worked</b>	<b>Income (Rs/day)</b>	<b>Material Collected/day (kgs)</b>
1	Aadin	14	11	2	150	-
2	Aameer Alam	18	1	7	150	-
3	Ajay	17	9	7	250	-
4	Ameer Alam	25	16.5	7	150	-
5	Anil	32	8.5	-	-	-
6	Annu	25	15	7	150	-
7	Ashok	56	10	-	-	-
8	Bishal	16	-	7	45	8.5
9	Budh Singh	50	35	7	150	-
10	Chand Babu	22	11	5	200	-
11	Channi	30	5.5		-	-
12	Charanjeet	25	15	7	150	-
13	Dilnawaz	13	-	7	75	-
14	Eshan	12	-	7	75	-
15	Ezad	14	-	7	75	-
16	Guljaar	20	10	-	200	-
17	Hattap	12	5	7	200	-
18	Irfan	12	1	5	550	100
19	Irfan	30	8	6	200	-
20	Jissa Khan	14	2	-	250	-
21	Kamaal A	30	10	6.0	250	-
22	Kamal	36	9	-	-	-
23	Khalid	28	20	6	300	200
24	Lakshman	39	20	7	150	-
25	Mukarrum	22	18	7	150	-
26	Nafisa	-	-	-	83	175
27	Naterpal	56	40	7	150	-
28	Parveen	16	5	6	400	150
29	Pawan	15	2	4	225	-
30	Praveen	34	28	7	325	200
31	Rahul	21	12	4.5	250	150
32	Ravi	21	15	7	150	-

33	Saddam	18	8	6	400	55
34	Sajeed	21	8	5.5	350	-
35	Salman Khan	16	0.5	6	200	-
36	Shahvej	8	2	6	250	100
39	Sonu	24	10	7	-	-
40	Sonu	15	5	7	-	-
41	Tulsi	-	5.5	6	325	-
42	Shazad	-	-	-	550	150
43	Shahazad	16	3	-	150	50
44	Anish	17	-	7	350	100

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