

***Opening the black box:  
Explaining the effects and mechanisms of  
municipal performance in climate change***

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**Abstract.** Classic explanations about organizational capacity to respond to climate change focus on issues of political decision-making, governance, and the policy process. However, the relationship between climate change and local government management is hence treated as loosely connected. Due to its growing implications for greenhouse gas emissions as a consequence of population increase in developing countries, this paper uses the waste management sector as a case study to examine how variation in local governance factors may have differential effects on the performance of two waste services. Specifically, solid waste collection from the streets, on one side, and the final disposal of waste, on the other, may be affected differently by the organizational characteristics of municipalities. This distinction is significant since the differences in the complexity of providing them may reflect the gaps in municipal administrative capacity to adequately address increasingly complex service delivery needs related to waste. It may also illustrate the influence that the relationship (or lack thereof) of local political actors and civil society organizations with municipalities has on producing differential outcomes between these two waste management services. The issue becomes more urgent in the context of population growth in urban areas and the need for an effective climate change policy that incorporates waste. Using a mixed method research design, this paper conducts a comparative study based on a panel dataset of Peruvian municipalities from eight states between 2014-2016 and interviews and ethnography of four case studies of Peruvian municipalities. This study intends to fill the gap in the political science and public management literatures regarding the conditions, procedures, and relations inside developing country municipalities and how they may explain performance differentials.

**Keywords:** Local governments, service delivery, waste management, administrative complexity, civil society participation, political support, mixed methods, Peru.

**This is work in progress. Please do not cite.**

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# 1. Introduction

Answers to the puzzle of how to improve organizational capacity to deal with climate change tend to be concentrated on addressing problems of political commitment, negotiations on the allocation of resources, and international governance (Dimitrov 2016; Kern and Rogge 2016; Levin et al. 2015; Roberts et al. 2018). The policy initiatives that gain increasing attention, on the one hand, pertain to the mitigation of climate change effects. Another set of organizational measures concern the adaptation to the effects of climate change. Perhaps the two factors that have received more significant consideration in the literature are the creation of collaborative governance arrangements and the extent to which governments commit to reducing the intensity of emissions in their countries, through regulations, incentives and enforcement measures (Howard-Grenville et al. 2014; Koppell 2015, 57; World Bank 2017, 262).

However, national governments and international organizations are almost exclusively the principal stakeholders in this context, and thus the primary unit of analysis of scholarly work. In addition, academic research published in top management and core social science journals, as those in political science, have insufficiently addressed climate change as an organizational problem (Goodall 2008; Wright and Nyberg 2017, 1634), much less to how it relates to the management of developing country local government bureaucracies and its interplay with civic engagement and political support. Scholars and development practitioners thus typically treat the relationship between climate change and municipal management as loosely coupled, assuming that climate change threats are better dealt with via the emergence of new collaborative governance arrangements at the national and international levels. We, therefore, have more limited knowledge about the role that local governance institutions and municipal administration have on climate change adaptation and mitigation efforts in the developing world. This paper aims to address the lack of local-level analyses in these environments.

Nevertheless, climate change has placed municipalities in a high-pressure context, demanding quick adjustments to implement adaptation and mitigation measures to offset or revert its damaging effects. The emission of greenhouse gases through human activity is the primary source of the increase in the global average temperature of the Earth's surface (IPCC 2013). Specifically, the waste management sector, a central responsibility of municipalities, is highly relevant because of its contributions to greenhouse gas emissions from inadequate disposal and incineration and its potential to help reduce emissions (Ackerman 2000; UN-Habitat 2010). Waste is estimated to contribute between 3-5% of human-generated emissions globally, but if the procedures of collection, treatment, disposal, and reuse of waste were managed correctly, emissions from sectors such as manufacture, transport, and agriculture are expected to also be significantly reduced (UNEP 2010). This evidence implies that local waste management capacity does have an essential role in climate change (Guerrero, Maas, and Hogland 2013, 222). Therefore, the *within* conditions and processes of municipalities are essential as well as how these interact with external pressures, actors and unpredictabilities; a fact that is often overlooked by current approaches to the study of organizational performance, neglecting insights from classical organizational theory (Galbraith 2002; Hannan and Freeman 1984; Lawrence and Lorsch 1967; Mintzberg 1983; Pfeffer and Salancik 2003; Thompson 1967). However, when faced with this grand challenge and the uncertainty it produces, municipalities' already existing limitations are more likely to aggravate, highlighting hardwired organizational weaknesses in their structures and administrative operations. For instance, in Peru, about 60% of all 1,874 municipalities are capable of managing the collection of trash daily or at least every other day, yet roughly 70% dispose of trash on informal open-air dump sites (National Statistics Institute of Peru 2016). This occurs even though the same office in all municipalities

manages both services. The question is, then, what does the difference in performance between the two waste management services illustrate about the complexity of each task and the matching capacity of municipal environmental offices to deliver them? And, could political support or the engagement of civil society help compensate when administrative conditions do not correspond with the complexity of the task? These are the guiding questions of this paper.

The goal is thus to advance knowledge on these issues using insights from organizational theory, organizational performance, political economy of service delivery, and decentralization that illustrate the added value of looking inside the bureaucracies of developing countries. The central question is whether and how municipal administrative complexity, in terms of specialization and equipment, and its interaction with local political support and civil society participation, affect the performance of waste management services of distinct complexity differently. More broadly, this research project highlights the organizational implications of the governance of climate change policy at the local level, focused on waste management.

Two different but complementary methodological approaches are used to answer these questions: (i) One, centered on understanding the *causal effects* of the characteristics of municipal administrative complexity, and its interaction with local political support and civic engagement, on the differential performance of two solid waste management services (removal and disposal), and (ii) the other, aimed at uncovering the *causal mechanisms* of these two solid waste management services in four municipal case studies and identifying the conditions that may influence the differential effects.

## **2. Theoretical Framework and Hypothesized Effects**

Recent scholarly discussions on climate change have brought to the fore the value of including the participation of subnational governments on climate change action. They highlight municipal initiatives related to the implementation of local policies that control carbon emissions, such as imposing a carbon tax, emissions trading programs and reducing deforestation; modes of inter-governmental and stakeholder coordination to mitigate climate change effects at the city level; frameworks to facilitate increased policy alignment and linkages between multilateral organizations and national governments with subnational and non-state actors, or; the centrality of municipalities in the execution of climate change policies on the ground (Chan et al. 2015; Hsu et al. 2015; Hsu, Weinfurter, and Xu 2017; Jordan et al. 2015; UNFCCC 2014). However, these studies rarely pay attention to the way that the organizational or administrative conditions of municipalities may play out, positively or negatively, in the planning and implementation of measures addressing climate change, especially in the developing world. This is a significant oversight that could potentially overestimate the effects of such policies and collaboration arrangements as well as limit our ability to more fully understand the role and challenges of local governments, as organizations, to carry out these initiatives.

Notwithstanding this newly discovered value in the prospect of increasing the participation of local governments in climate change action, since the 1980s most democratic regimes have gradually implemented decentralization reforms with the idea of improving the provision of public services and making policy decisions more accountable through a closer interaction with citizens (Channa and Faguet 2016; Davies and Falletti 2017; Grindle 2007). Local governments have hence received greater power to provide public services, with more formal political, administrative and fiscal attributions. Yet, decentralization has not consistently demonstrated that local governments are more efficiently managed and unequivocally enhance the wellbeing of their populations in developing countries. Some explanations emphasize that the type and degree of authority and resources devolved by the central government may not have been adequate or sufficient, how the

organizational strength built over time by local opposition parties may increase the likelihood of confrontation to reduce the incumbent mayor's new powers, presence of a weakly organized civil society, the inadequacy of using standardized decentralization models for a complex and heterogeneous process, or how the sequencing of reforms generates a particular balance of power between the national and subnational governments that affects the design of decentralization and degree of autonomy and capabilities available for municipalities (Falleti 2005; Goldfrank 2007; Smoke 2015).

In addition to the effect of these broader structural and institutional challenges to decentralization and its expected outcomes, other studies in comparative politics and public management assess municipal performance by looking at the characteristics of these organizations. Measuring municipal performance in terms of accountability, fiscal management, tax revenue expansion, policy implementation, or service delivery, this work finds that there is high variation in the results and argues that they are driven by certain dimensions of local governance, like municipal organizational and fiscal capacity to administer resources and implement policies, meritocratic recruitment and career development prospects for civil servants, mayor's managerial experience and education, local political stability and interests, and civil society participation in decision-making (Aragon and Casas 2008; Avellaneda 2009, 2012; Batley et al. 2012; Evans and Rausch 1999; Faguet 2004; Gore et al. 2018; Grindle 2007; Loayza, Rigolini and Calvo-Gonzalez 2011; Martinez 2017; Nelson 2007; Rausch and Evans, 2000; Rothstein and Tannenbergh 2015).

For example, Evans and Rauch (1999) examined state agencies in semi-industrialized countries and found that key structural characteristics of "Weberian" bureaucracies, such as meritocratic recruitment and predictable career ladders, have a positive effect on economic growth. In a similar investigation, Rauch and Evans (2000) identified that public agencies with meritocratic hiring processes and offering career prospects strongly predict lower levels of bureaucratic corruption and increased efficiency. Other scholars have examined whether poor public spending on services as healthcare leads explanations about disappointing health outcomes, but have found that spending in itself is not a core problem (Filmer and Pritchett 1999; Filmer, Hammer and Pritchett 2000; Lewis 2006). Their discussions address the fact that perhaps bureaucratic effectiveness is the single most important factor for better health results and that meritocracy and incentives in human resource policies are the most efficient measures (Filmer, Hammer and Pritchett 2000; Lewis 2006).

With regards to characteristics of political authorities, Avellaneda (2012) examined how mayors' demographic characteristics in 40 Colombian municipalities between 1999-2005 affected their success in obtaining regional and national grants that increase their municipal revenues. Among several important findings, the author observes that mayors with private and public sector experience (relative to those who do not have any) have greater success in getting grants approved (from both the state and national governments). Similarly, research by Avellaneda (2009) on local government performance in Colombia examined how school enrollment is higher in municipalities whose mayors have more years of education. The results from both studies are observed only in municipalities where external constraints such as the presence of paramilitary groups are absent.

Municipal capacity was studied by Aragon and Casas (2009), who measured its effect, in terms of managing infrastructure projects, on the propensity to spend budgetary increases allocated by the central government in Peru. Their research concludes that the scarcity of human resource management skills alongside mayors' lack experience in office reduce municipal capacity for budgetary planning and spending. Loayza, Rigolini and Calvo-González (2011) also evaluated municipal capacity to spend the extra budget allocations in Peru and identified positive effects in municipalities where the budget allocation size is smaller, the proportion of white-collar municipal staff is higher, the average years of schooling are higher, have less urbanization, have larger poverty rates, mayors were elected with high share of votes, and when the mayor is an incumbent. They

conclude that increasing municipal budget “without technical support and sustained capacity-building efforts is not wise policy” (26).

This literature reveals the breadth and diversity in the factors used to explain bureaucratic performance, especially of local governments. However, the effects of *state capacity* -typically measured as effective spending on public goods and enforcement of property rights and contracts- on development outcomes, such as poverty, education, health or even climate change, have been insufficiently studied by empirical research and focus on cross-country variations (Savoia and Sen 2015, 446-449). This is particularly true if state capacity is understood in terms of the *administrative complexity* of public organizations. And, as it has been shown, assessments about municipal performance tend to concentrate on particular administrative factors, relying on the use of statistical methods (Groenveld et al. 2015; Meier 2008; Pitts and Fernandez 2009; Roberts 2017). This approach, however, neglects insights from classical organizational theory that actually illustrate the added value of looking at the interactions of the structural components and mechanisms inside bureaucracies (Galbraith 2002; Hannan and Freeman 1984; Lawrence and Lorsch 1967; Mintzberg 1983; Pfeffer and Salancik 2003; Thompson 1967). In other words, although current public management research has captured insights from organizational theory about the importance of intra-organizational factors, it does not elucidate how and why these components interact with each other to provide public services, less so with external pressures, actors and unpredictabilities. This is another significant oversight that could overestimate the effects of administrative characteristics and lead us to only partially comprehend the challenges of local governments to deliver services. What this suggests is that looking at what happens within subnational governments may be critical to understand what precludes the proper implementation of climate change adaptation and mitigation measures (Goodall 2008; Howard-Grenville et al. 2014; Koppell 2015, 57; World Bank 2016, 2017, 262; Wright and Nyberg 2017).

### **Administrative Complexity**

For classical organizational theorists as Lawrence and Lorsch (1967), the differentiation among subunits within an organization and the extent of their internal integration and coordination will improve their capacity to manage the pressures from their external environment and the attainment of their goals. The following statement further explains the value of examining the internal conditions of organizations:

“[s]ince the primary concern was with the internal functioning of organizations, it appeared that one useful way to conceive of the environment of an organization was to look at it from the organization outward. This approach is based on the assumption that an organization is an active system which tends to reach out and order its otherwise overly complex surroundings so as to cope with them effectively. Then as the organization becomes differentiated into basic subsystems, it segments its environment into related sectors ... The importance of this variability can easily be obscured by the usual approach of thinking of an organization’s environment as a single entity” (Lawrence and Lorsch 1967, 4-5).

This means that, in order to achieve its goals, an organization should make adjustments to its internal functioning by adopting a structure -specializing or differentiating subunits and adopting integration or coordination procedures- that *matches* or *fits* the complexity of the task and thus its environment. It is argued that “[a] poor fit between structure and environment leads to failure; a close fit leads to success” (Jones 2010, 111). Therefore, whether organizations attain their goals or expected performance levels, is regarded by these scholars as dependent on their capacity to modify internally to adapt and process the influence and resources (i.e. human resources, information, technology, strategic alliances, relation with relationship with stakeholders) it is able to gather from

its environment to perform a given task (Fernandez and Rainey 2006; Scott and Davis 2007, 95; Jones 2010, 3). For Mintzberg (1983), these two dimensions of structure, as differentiation and integration, are contradictory but inherent to the nature of organizations that are built by dividing labor into different tasks that are coordinated through different mechanisms to effectively fulfill the goals of the entity as a whole. He also suggested that complex organizational tasks would benefit from the implementation of coordination mechanisms based on standardizing the work process, output or skills required. Galbraith (2002), on the other hand, proposed more flexible coordination arrangements, or lateral coordination processes, that facilitate rapid internal response to organizational structures that are difficult to reform or increasingly uncertain external environments. Thompson (1967), however, was concerned with organizational processes or mechanisms and argued that the tasks and units of the technical core are operationally linked through something he called *organizational rationality*, referring to the input, process and output activities that are setup aiming for effective performance within an organization.

Therefore, opening the black box of bureaucracies is a central matter in organizational theory. It regards the structural features of organizations, including unit specialization and coordination and the processes and resources within them, as fundamentally associated with the nature and complexity of the task, even under uncertain external environments as climate change. This means that, for organizational theorists, the degree of complexity of a task demands equally complex adjustments to the internal management of an organization as well as the presence of necessary human and material resources, particularly in those with weak administrative capacity. This is true for municipalities in developing countries, which tend to be unable to adequately perform in the delivery of services that require greater internal differentiation or specialization, coordination, procedure specification, and resources. It can hence be expected that their inability to carry out such internal administrative modifications affects their performance to provide certain services relative to those for which they may be sufficiently specialized and equipped with resources. This may be the case of services that involve more complex tasks and thus administrative conditions in contrast to services that entail more simple tasks and for which a municipality may already be sufficiently specialized and equipped with resources, as in the case of waste management (Shekdar 2009). This is currently an unexplored research approach, in both political science and public management, and is at the core of this paper's contribution.

### **Political Support and Civil Society Participation**

The extent to which municipalities interact with the external environment and its pressures, such as the influence of politicians and demands from civil society, may also be important factors for differential performance. Support by political authorities for policies, or the lack thereof, is amply recognized as significant for government performance (Crabtree and Durand 2017, 149; Fernandez and Rainey 2006; Goggin et al. 1990; Guerrero, Maas, and Hogland 2013; Heller 1996; Leonard 1977, 249). What triggers this behavior could be assessed in terms of leaders' commitment and shared interests with their communities (Leonard 1982); their experience and education, serving as proxies for managerial and political ability (Avellaneda 2009, 2012), or; the degree to which patronage, special interest group power or other political elite calculations are present, which may affect the implementation of key reforms for local government performance as decentralization (Grindle 2007, 86; Nelson 2007). Political support for policies or sectors is hence unevenly allocated. This is especially salient when political action is needed to address structural and institutional issues as patronage, decentralization and administrative reform that entail changes that have limited benefits and high political costs in the short run, particularly if these adaptations imply greater accountability, civil society participation and contestation, and a new distribution of power. This occurs because the demands that politicians receive from the population tend to prioritize rapid

expenditures and expansion of services, neglecting deeper reforms that take time and affect entrenched elite interests (Grindle 2012; Nelson 2007, 86). This, in turn, may lead to the intentional marginalization by politicians of more complex services that need internal administrative adjustments and resource investment for their adequate provision, especially if it occurs in the presence of organized and politically active civil society groups and their historically-shaped informal behavioral norms and expectations about what the state should deliver (Gore et al. 2018; MacLean 2010).

A significant amount of literature view the lack of government accountability as the main explanation of service delivery failures, regardless of the existence of governance arrangements (Filmer, Hammer and Pritchett 2000; Lieberman 2015; World Bank 2003; World Bank 2017). The role of civil society is valued as central for accountability and many scholars have found that their participation in service delivery tends to improve performance. One way that government performance is affected by civil society is through the extent of its organized engagement and horizontal interactions with respect to the issues that pertain its community, as opposed to relations based on clientelism and patronage. In time, this involvement is believed to build trust, attitudes of collaboration, social support networks as well as pressure on public authorities where participation is higher, thus creating a more accountable and responsive delivery of services, even under different political regimes (Putnam 1988, 1993; Tsai 2007). Collaborations between government and non-state actors, such as NGOs, have also been found to lead to improvements in service provision, increasing the accountability and legitimacy of bureaucracies in developing countries as well as their administrative capacity (Brass 2016). A high degree of cooperation of NGOs with government can result in their incorporation into the state's organizational arrangement hence becoming a key component of bureaucracies' service delivery mechanisms, sometimes blurring the boundaries between them (Brass 2016, 217; Brass et al. 2018). This demonstrates the internal adjustments that bureaucracies implement in association with non-state or civil society organizations to provide better services. Different types of these hybrid service provision regimes have been identified, varying, on the one hand, in the way the state is involved, providing services directly or formally outsourcing, or, on the other, how non-state private actors informally replace state provision when services are deficient or non-existent (Post, Bronsoler and Salman 2017). Governance arrangements such as these involve a degree of collaboration between individual or organized actors whose interaction is constrained by sets of rules or regimes (formal or informal) for the achievement of a societal objective (Lynn, Heinrich and Hill 2000, 234-235; Thomson and Perry 2006). Some scholars, however, claim that effective civil society collaboration for service delivery in poor urban communities is actually influenced by the extent to which participants share an ethnic identity, arguing that more homogeneous communities are more likely to collaborate because they are able to ensure compliance by using social sanctioning and cooperation norms as a result of their social ties (Habyarimana et al. 2007). Therefore, civil society and non-state actors contribute, complement and many times replace government in important ways in the provision of services, particularly when the latter does not have the administrative and operational capacity to do so.

### **The Case of Waste Management**

Using the waste management sector in Peruvian municipalities provides an excellent opportunity to study these issues due to the growing significance of solid waste management problems from population growth, the high diversity of outcomes between comparable municipalities, the administrative complexities of providing this service that demand suitable organizational capacity and thus high municipal costs, and the potential to illustrate how the provision of waste services of different levels of complexity may be contingent on the extent of organizational correspondence of these administrative entities (Aleluia and Ferraro 2017; Guerrero,

Maas, and Hogland 2013; Lohri, Camenzind, and Zurbrügg 2014; Schübeler, Christen, and Wehrle 1996; UN-Habitat 2010). In Peru, in 2002, it was estimated that the total municipal solid waste generation was 12,986 tons per day, or about 4.74 million tons that year. While 73.7% of this total was collected by municipalities, only 19.7% of the total was disposed in formal landfills (Ministry of Environment of Peru 2016, 13). In 2014, waste production increased to 7.5 million tons of municipal solid waste, of which roughly 30%, or 2.25 million tons, were adequately disposed of in landfills. The remaining 5.25 million tons were dumped in informal open-air sites by municipalities themselves, after their personnel had collected it from the streets (National Statistics Institute of Peru 2015). These differences in the provision of waste collection and disposal is also observed in cities from other countries and is explained by the political, organizational and social implications that appear in the provision of disposal services relative collection (Guerrero, Maas, and Hogland 2013; Shekdar 2009). Studying waste management is also important for a number of other reasons. It is relevant because of its implications for greenhouse gas emissions from inadequate disposal and incineration (Ackerman 2000; UNEP 2010; UN-Habitat 2010); its consequences on public health and sanitation, particularly for vulnerable populations (Fobil et al. 2008); and, its effects on the value of property, private investment and thus employment generation (Schübeler, Christen, and Wehrle 1996).

## Hypotheses

Drawing from this literature, this paper proposes three hypotheses to account for the differential performance between solid waste collection and waste disposal. With respect to the causal effects of characteristics of administrative complexity on the differential performance of solid waste removal and disposal, the first working hypothesis argues that:

**Hypothesis 1:** The more internally specialized and equipped (or administratively complex) a municipal waste management office is, the more likely it will have the capacity to equally deliver both complex waste management services, as the adequate disposal of solid waste, as well as simple waste management services, as solid waste collection from the streets. Conversely, the less internally specialized and equipped it is, the less likely it will have the capacity to properly dispose of solid waste but the more likely it will be capable to provide solid waste collection services.

The effect of characteristics of administrative complexity, however, is contingent on its interaction with local political support and civic engagement. Therefore, a complementary hypothesis states that:

**Hypothesis 1.1:** The performance of both solid waste disposal and collection is also affected by civil society participation in the decision-making of and local political support for waste management.

Finally, to attempt to uncover the causal mechanisms of these two solid waste management services and identify the conditions that may influence the differential effects, the second working hypothesis claims the following:

**Hypothesis 2:** Performance differentials between waste collection and disposal services increase contingent on four conditions: (i) greater political support to implement one waste service, (ii) political support is materialized through improvements to administrative complexity related to only one service, (iii) sequential administrative procedures that lead to



service provision exist and are relatively more developed only for one service, and (iv) civil society participation is focused on the provision of one service.

This paper fills the void by studying how the extent of coherence between administrative and task complexity, and the resulting processes, may have differential effects on the performance of two waste management services provided by municipalities, such as waste collection and disposal. This includes assessing how political support and civil society participation for waste management buffers or complicates the administrative setup. The purpose is to fill the gap in the political science and public management literatures regarding the conditions, procedures and relations inside developing country municipalities and how they may explain performance differentials.

### **3. Data, Variables, and Methods**

Testing these hypotheses requires the use of a mixed methods approach. Mixed methods research is methodological strategy to increase causal inference when research questions concentrate on understanding both causal effects and causal mechanisms (Collier, Brady and Seawright 2010; Gerring 2017; Seawright 2016). Therefore, this paper works with a quantitative panel dataset of Peruvian municipalities from eight states between 2014 and 2016 and qualitative data gathered through field research in Peru during the summer of 2018 (George and Bennett 2005; Gerring 2017; Lieberman 2005; Seawright 2016).

Through the use of quantitative methods, the objective is to identify variations among municipalities of similar sizes in key administrative, political and socioeconomic dimensions and their causal effects on solid waste collection and disposal. The plan is therefore to focus on three recent years, 2014–2016, and a subsample of municipalities from the states of Arequipa, Ayacucho, Cajamarca, Cusco, La Libertad, Lambayeque, Piura, and Tumbes. These states were selected because they represent different geographic locations, face distinct levels of waste generation by their populations, and gather municipalities of different population sizes. Analyzing this data allows the exploration of the variation of causal effects in this part of the country.

[Insert Table 1. here]

The panel data contains information on organizational, socioeconomic, environmental and geographic characteristics of municipalities. The sources are different agencies of the Peruvian government, as the Ministry of Finance, National Statistics Institute of Peru, and the National Jury of Elections. The main source of information, however, is the National Registry of Municipalities of Peru (RENAMU, for its acronym Spanish) administered by National Statistics Institute of Peru (INEI, for its acronym Spanish). It annually collects data reported by the statistics or administration offices of each municipalities on multiple dimensions regarding their administrative operations, civil society participation, and services they provide. INEI sends every year a detailed manual to all municipalities by email and regular mail, and the completed questionnaire is sent back to INEI for data processing and analysis. It is thus a panel dataset that contains information on all municipalities. This dataset is also complemented with data from the other agencies that collect information on the financial, political, social, and geographic characteristics at the state and local levels.

With the qualitative section of the study, the objective is to obtain in-depth data from these additional cases to gather detailed information about the differences in the conditions and causal mechanisms between the two services. Field work took place in Lima and four municipalities of different sizes in the province of Canchis, state of Cusco, Peru, for five and a half weeks. Through

this work, valuable qualitative evidence was obtained about how these municipalities manage solid waste and the challenges they face. Twelve semi-structured interviews were held with national government and municipal personnel involved in waste management and decentralization as well as local trash collectors' associations, in addition to nine participant observations of the waste collection process, untreated dumping sites, and specific meetings of environmental offices (see Table 2 for the list of interviews and observations).<sup>2</sup> This data collection techniques facilitated the gathering of information on these critical actors in the context in which they conduct their regular activities, allowing the setting to help uncover potentially new explanations and mechanisms (Kapiszewski, MacLean and Read 2015, 238; Wedeen 2010).

With regards to case selection, for the qualitative part of the study, four municipalities were purposefully chosen because they are representative of the different population sizes found in Peruvian local governments. The selected municipalities were Marangani, San Pablo, Sicuani, and Tinta. Using a “most different cases” design has allowed the exploration and explanation of the possible differences and commonalities that could be found in the causal mechanisms of municipalities of different population sizes. In addition, this purposive sampling is appropriate when the objective of research is explanatory about the range of variation, which in this context is of causal mechanisms (George and Bennett 2005; Gerring 2008, 2017; Seawright and Gerring 2008). To better understand the administrative division in Peru and what types of local governments these municipalities represent, it is important to know that, within each of the 25 Peruvian states, the country is managed by provincial municipalities (similar to US counties) and these in turn are subdivided into district municipalities (similar to US cities). Both provincial and district municipalities are considered local governments and have their own jurisdictions and specific functions, with provincial governments prevailing over districts in certain tasks. Provincial municipalities manage their own territories, separate from the district municipalities it contains, and serve as the provincial capital. The municipality of Sicuani is representative of the group of provincial municipalities of Peru, which account for roughly 7% of all 1,874 local governments in the country and hold most of the its population. The district municipalities of Marangani, San Pablo, and Tinta are representative of roughly 60% of Peruvian local governments (Ministry of Finance of Peru 2018).

## Dependent Variables

The dependent variables of the study measure the extent to which municipalities remove solid waste from the streets and dispose of it adequately as through the use of landfills. To quantitatively assess *solid waste collection*, it is measured using a binary variable of the frequency in number of days per week waste is collected by municipalities. It has the following two categories regarding trash pickup: Less or equal to two days per week (0, 1 or 2 days), and every other day or daily (more than 2 days and up to 7 days). A higher frequency of collection reflects higher municipal performance in the provision of this service. To quantitatively measure the second dependent variable, *solid waste disposal*, the data is measured using a binary variable on whether less than 65% of the total waste collected by a municipality is disposed of in a dump site. This threshold is the average proportion of total waste collected by municipalities in the sample that is disposed of in dump sites. These data are found in RENAMU gathered annually by the National Statistics Institute of Peru and

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<sup>2</sup> Approval from the IRB was obtained for this field work. This involved interviewing top managers of the Solid Waste Management general division of the Ministry of Environment, and the Secretary of the Decentralization Secretariat and the Deputy Secretary for Territorial Development of the same agency, all based in Lima, and; managers of municipal environmental offices, council members, and waste collectors' associations from the four municipalities.

are expected to vary across municipalities in a particular year and across years for any given municipality.

To evaluate these dependent variables based on the qualitative data gathered, a numeric score is developed to quantify the quality of performance of both services in the four municipal case studies. A number of components or characteristics are identified based on the literature to analyze the quality of the provision of the service. Therefore, a set of these are identified for solid waste collection and another set for solid waste disposal. On the one hand, the quality of *solid waste collection* is measured by the extent of implementation of a (i) waste collection routine with specified personnel, routes and times; availability of (ii) cleaning equipment and (iii) operational vehicles; (iv) coverage of the municipal territory, and; (v) whether the streets are clean. On the other hand, the quality of solid waste disposal is analyzed in terms of the degree of implementation of a (i) waste disposal routine with specified personnel, routes and times; (ii) having a landfill; (iii) whether the dump site is clean (if no landfill exists); investment on infrastructure to treat and control liquids contaminated by waste that may damage groundwater and surface water (known as leachate), as (iv) geomembranes and (v) septic drains; (vi) whether dumped waste is covered; (vii) having perimeter fences, to control waste from moved away by the wind and prevent access to animals (Guerrero, Maas, and Hogland 2013; Jeswani and Azapagic 2016; Kjeldsen et al. 2002).

Each one of these components is given a score, between 0 and 2, assessing the extent to which they are present or not in a given municipality. If it is present, the municipality is given two points for a component; if it is partially present, it receives 1 point, and; if it is not present, zero points. Then, according to the number of components, these points are added to give a total *performance quality score*. A municipality is qualified as having high performance, if it receives half or more of the total points possible for the service, or low performance, if it obtains less than half. Since solid waste collection performance is evaluated using five components, the score will go from 0 to 10, where high performance is considered when a municipality received between 5 to 10 points and low performance when it is awarded between 0 to 4 points. Similarly, since solid waste disposal performance is evaluated using seven components the scale will hence go from 0 to 14, where high performance is determined when a municipality obtains between 7 to 14 points and low performance when it is gets between 0 to 6 points. This is how the performance quality score is structured to measure the dependent variables using the qualitative evidence from the four municipalities.

## **Independent Variables**

The primary independent variable of the study captures the administrative features of municipalities to illustrate the administrative complexity of a municipal environmental office. The objective is to explore the extent to which the complexity of the municipal office in charge of waste management corresponds with the services provided. In this paper, *administrative complexity* is understood as the degree to which the relevant municipal office is internally (i) *specialized*, which means having differentiated organizational structure, coordination processes, diagnostic and policy documents, and tasks specific to each one of the two waste services, and (ii) *equipped*, in terms of having separate trained personnel, budget allocation, and operational infrastructure, to equally implement each of the studied waste services.

Given the limited quantitative data available to illustrate these specific characteristics of the municipal offices in charge of waste management and about the management of the two services, for the quantitative part of the study, specialization is measured by using binary variables that show whether a municipality has (or not) the following: An environmental office or unit (since there is no national data on waste management offices in particular), and general diagnostic and policy

documents for waste management. Moreover, to measure how equipped the office is, this paper uses data on whether a municipality has (or not) operational trucks for waste management. Therefore, to analyze hypothesis 1 we measure the causal effect of these administrative characteristics on each of the two outcome variables.

However, on the other hand, a numeric score is used to quantify administrative complexity using the qualitative data obtained through field work in the four municipal case studies. To assess specialization, the components used capture the existence of distinguishable administrative features between both waste services are having differentiated (i) organizational structures in the office responsible of waste management, (ii) internal coordination processes, as procedures within the office specific to the management of the service, (iii) external coordination processes, as procedures specific to the service to coordinate its management with external actors, (iv) routine planning, (v) data management, (vi) diagnostic, (vii) policy, and (viii) system. How equipped the office is contingent on whether the office has differentiated (i) trained personnel, (ii) operational computers, (iii) operational trucks, (iv) personnel having the necessary equipment to perform their tasks, such as office supplies, cleaning equipment for waste collection and disposal personnel, (v) budget, based on that programmed and reported to the Ministry of Finance annually. Both specialization and equipment of the office are evaluated separately for each of the two services.

Therefore, administrative complexity is observed according to the extent to which these components are clearly distinguishable as pertaining to one or the other service. The scores of each municipality on both specialization and equipment are added to obtain the total *administrative complexity score*. Each one of the components of specialization and equipment are, separately, given a point, between 0 and 2, assessing the extent to which they are present or not in a given municipality. If it is present, the municipality is given two points for a component; if it is partially present, it receives 1 point, and; if it is not present, zero points. Then, according to the number of components, these points are added to give a specialization score, on the one hand, and an equipment score, on the other. Since specialization is measured through eight components, a total of 16 points are possible and will be classified as having high specialization if it obtains between 8 to 16 points and as low specialization if it receives 0 to 7 points. The equipment score is based on five components, therefore a municipality with high equipment is one that has a score between 5 to 10 and low equipment when it has between 0 to 4 points. Overall, after adding these scores, a municipality is qualified as having high administrative complexity, if it receives a score between 13 to 26 for each service, or low administrative complexity, if it obtains a score between 0 to 12. This is how the administrative complexity score is structured to measure the main independent variable using the qualitative evidence from the four municipalities.

The two other main independent variables are the extent of local political support and civil society participation. The role of *local political support* is explored through the material contribution of political authorities, as the mayor and municipal council members, for the improvement of the provision of both services, through these actors' interactions with the waste management office or unit. The provision of adequate resources is recognized in the literature as crucial for policy implementation (Goggin et al. 1990). Budgetary allocations to the office, hiring or transfer of new personnel to the office, training, and approval of municipal environmental ordinances are some examples of support. To evaluate hypothesis 1.1, and given the lack of quantitative data to directly capture this concept, it will be measured via a proxy variable of the percent of the total municipal budget allocated to waste management. This data is collected from RENAMU. For the qualitative analysis of the municipal case studies, this is measured by whether interviewees from the offices indicated if they have received concrete support of the mayor for the implementation of both services through allocation of the necessary budget, resource acquisition, or expressed recognition about the importance of the implementation of both waste management services.

With regards to *civil society participation*, it refers to the whether and how organized groups of civil society participate in decision-making processes organized by the municipality, especially with regards to waste management. To evaluate hypothesis 1.1, and given the lack of quantitative data to directly capture this concept, it will be measured via a proxy variable of formal participation, as civil society participation in collaborative budgeting processes led by the local government and also through a variable on whether the municipality has (or not) a Municipal Environmental Commission, which by is required to involve the participation of civil society. Both are binary variables obtained from RENAMU. In the four case studies, this concept is measured using the qualitative information gathered on whether the municipality interacts (or not) with civil society organizations for the provision of both services.

### **Control Variables**

Other variables are included in the quantitative part of the analysis to control for alternative explanations for the two dependent variables. The first set of these reflect the administrative capacity of the municipality as a whole. This is captured by the percent of its total employees out of the total population. The analysis also includes the number of operational computers in the whole municipality has with access to the internet, indicating how well equipped it is to perform administrative tasks, overall. Since empirical research finds that the political capital, experience and education of the mayor may help explain the effect of local politics on the performance of waste management, the analysis incorporates the share of the electoral vote in 2014 with which the mayor won the elections, whether the mayor has more than one year of public sector experience at a mid-management level or more, and whether the mayor has a bachelor's degree (for descriptive statistics see Table 2).

[Insert Table 3 here]

### **Estimator**

Using the panel dataset of all municipalities, a regression analysis using random effects is applied to examine the causal effects on a model using solid waste collection as a dependent variable and another model using waste disposal in dumpsites as the dependent variable. Both are binary dependent variables: The former capturing whether municipalities collected waste more than two days per week and, the latter measuring whether municipalities disposed of more than 50% of their waste in dumpsites. Therefore, a binary logit regression model with random effects is used to test the effects on both models of variables capturing administrative complexity, local political support, and civil society participation (Cameron and Trivedi 2010, 621). Standard errors are clustered by municipality to adjust for correlations between observations across different years for the same municipality (Cameron and Miller 2015).

### **Conditions and Causal Mechanisms**

The purpose of analyzing the condition and causal mechanisms of both waste services in the four municipal cases is to understand when and how the independent variables examined influence the appearance of a divergence in the performance between waste collection and disposal. The qualitative evidence obtained from interviews, participant observations, and municipal policy documents allow this study to address the second hypothesis that aims to uncover the conditions and causal mechanisms that may explain the differential performance. They are identified using the

conceptualization and measurement regarding the presence of the components of administrative complexity, political support and civil society participation as well as on the performance quality of the two waste management services.

Therefore, the methodological approach used to identify whether a condition exists or not in a given municipality is based on the identification and analysis in these sources of evidence for the presence or absence of the four conditions outlined in the second hypothesis. The expectation is that differential performance between the two services will be more likely if more of these four conditions are present. As a result, interviewee responses are used to evaluate condition (i) about differentiated political support from the mayor or council members for the implementation of both waste services. Similarly, interviewee responses and participant observation in the offices responsible for waste management are examined to capture condition (ii) regarding the existence of differentiated material improvements to the administrative complexity for managing waste services as a consequence of political support. If there are observable improvements to a component of administrative specialization or equipment that can be directly associated to the support of the mayor or council members, based on the indicated sources of evidence, then this condition is qualified as present. Information from interviews, municipal policy documents, and participant observation is used to analyze condition (iii) on the existence of sequentially interconnected administrative elements and procedures within the offices to provide one but not the other waste service. Finally, evidence from interviews, municipal policy documents, and participant observation is also assessed for condition (iv) that states that one service receives greater participation from civil society.

However, process tracing is the methodological approach used to identify whether a sequential relationship exists between the conditions and components of the causal mechanism, using the data collected through interviews, participant observation, and analysis of secondary sources (Bennett 2008; Bennett and Checkel 2014; Collier 2011; George and Bennett 2005; George and McKeown 1985). Starting from the outcomes, separately looking at both waste collection and disposal, the analysis moves backward in time working to identify the most proximate causal factor using the qualitative evidence gathered to verify the temporal relationship between one factor and the other in the sequence. This is done to identify how political support, civil society participation, and administrative complexity are temporally related as part of a sequence of factors that generate the causal mechanism of waste collection and disposal. Understanding the sequential processes in each case will help uncover some important conditions that may help elucidate the hypothesized differential performance between simple and complex waste management services. This inductive approach is suggested for phenomena or cases where available information and theories are insufficient or not well explicated (Bennett 2010, 209; Bennett and Checkel 2014, 18; Freedman 2010). Therefore, the hoop and smoking gun tests are used to discard alternative hypotheses about causal relationships and confirm an observed temporal linkage. The hoop test is used to analyze the evidence to reject alternative hypotheses and identify a causal factor as necessary but not sufficient to cause an output factor in the mechanism. The smoking gun test is used to examine the data to confirm an explanation that a causal factor was sufficient but not necessary to cause an output factor in the mechanism. This is done to analyze the causal mechanism in each of the four municipalities and for each of the two waste services.

Notwithstanding, in this paper causal mechanisms are defined as a sequence of conceptual factors that have different causal and temporal relationships with one another to produce waste services as outcomes, which may vary depending on the municipal context. This approach to causal mechanisms is especially informed by the work of Faletti and Lynch (2009) who argue that they are “relational concepts ... [that] explain the link between inputs and outputs ... [and] interact with the contexts in which they operate” (1147).

## 4. Preliminary Results

The results of the quantitative analysis are reported on tables 3 and 4 and show the effects on the performance of solid waste collection and solid waste disposal in eight states of Peru across three years. The sample has 1,952 observations with municipalities as the unit of analysis. Models 1 and 3 include four separate binary variables of administrative specialization and equipment of the office in charge of waste management, to account for administrative complexity. However, models 2 and 4 use an index of administrative complexity aggregating each of the four variables and adding them, creating a score ranging from 0 to 4 for each municipality per year.

The different methods of interpretation used, based on the odds ratios (Table 3) and the average marginal effects (Table 4), show that some features of administrative capacity and civil society participation affect the likelihood of more frequent waste collection and of reducing waste disposal on dumpsites. Using model 1, what this illustrates is that, in the case of waste collection frequency, in municipalities that have an environmental policy and more waste collector trucks, the odds of collecting solid waste more than two days per week increase by a factor of 2.8 and 2.00, respectively, holding other variables constant. The results are significant at the 5% level (two-tailed), with a p-value of 0.02 and 0.01, respectively, rejecting the null of no effect of both variables on municipal waste collection frequency, as stated in hypothesis 1. Both explanatory variables are considered components of specialization and equipment, which are the two dimensions of administrative complexity and seem to be relevant for improvements in the provision of this waste service. Similarly, a positive effect is found on waste collection frequency in municipalities where collaborative budgeting is used as a decision-making space with the involvement of civil society. The results are statistically significant at the 10% level (two-tailed) and show that the odds of having a higher waste collection frequency are improved by a factor of 1.4 when civil society participates in collaborative budgeting processes, with a p-value of 0.08. This means that local governments that allow the access of civil society to participatory mechanisms such as this one, are more likely to perform better in the collection of solid waste. Model 3 examines the effect on the likelihood of disposing less than 65% of waste in open air dump sites, which is an inadequate method of disposing of trash and the average proportion of waste collected municipalities dispose in this way. Here it is used as a threshold. The estimates show that having an environmental office reduces the odds of dumping less than 65% of municipal waste by a factor of 0.71, which is statistically significant at the 10% level (two-tailed) and a p-value of 0.08. The results also show that an additional waste collector truck reduces the odds of throwing less than 65% of municipal trash on open air dump sites by a factor of 0.89, with statistically significant results at the 10% level (two-tailed) and a p-value of 0.05. However, the implementation of collaborative budgeting processes increases the odds of dumping less than 65% of waste into a dump site by 1.30 and is significant at the 10% level (two-tailed) with a p-value of 0.06.

Using the administrative complexity index in place of the variables measuring office specialization and equipment, Model 2 shows that the municipalities that have more of these components (thus having higher scores) the odds of collecting waste more than twice a week increase by a factor of 1.73. These results are statistically significant at the 1% level (two-tailed) with a p-value of 0.003. Nonetheless, this measure does not have a statistically significant effect on the likelihood of disposing of waste into dump sites, per results from Model 4. Civil society participation in collaborative budgeting does have positive effect on both dependent variables, increasing the odds of more frequent waste collection by a factor of 1.43 and of throwing less than 65% of

collected waste on dump sites by a factor of 1.31. Both are significant at the 10% level with p-values of 0.08 and 0.06, respectively.

No significant results for the odds ratios are found for the proxy of local political support for waste collection, regarding the percent of the total municipal budget allocated to waste services in general, in any of the four models. However, other proxy measures of political capability illustrate the contrary. For instance, municipalities whose mayors have a bachelor's degree or higher are more likely to collect waste more than two times a week, increasing the odds of waste collection by 2.23 in Model 1 and by 2.27 in Model 2, both statistically significant at the 10% level. Similarly, municipalities with mayors that have one or more years of public sector management experience in middle or high level management positions have a greater likelihood of disposing less than 65% of waste into dump sites, increasing the odds by a factor of 1.56 in Model 3 and 1.53 in Model 4, both statistically significant at the 5% level.

[Insert Table 4 here]

The average marginal effects illustrate a similar scenario. Confirming the results from the odds ratios, the average marginal effects show that local governments that have an environmental policy have a higher probability of collecting waste more frequently. Model 1 illustrates that, on average, the probability of higher trash collection is expected to increase by 7% in municipalities that have such policy relative to those that do not. Although this policy does not affect the probability of reducing waste disposal in open air dump sites, with no statistically significant results found in Model 3, municipalities that have an environmental office have a reduced probability of proper waste disposal, or less than 65% of collected waste, that is 5% less than those that do not have this office. These findings are statistically significant at the 5% and 10% levels, respectively. To the contrary, a standard deviation increase in the number of waste collector trucks, or 2.4 more trucks, improves the probability of collecting waste more times a week by 11%. However, this reduces the probability of throwing less than 65% of municipal waste into a dump site by 4%. These results are significant at the 1% and 5% levels, respectively. The counterintuitive outcomes from Model 3, on having an environmental office and more collector trucks reducing the probability of adequate disposal may be explained by the fact that these offices may be structured to exclusively address waste collection at the expense of disposal and that having more equipment, such as trucks, allows such municipalities to reach dump sites to simply get rid of the collected waste. This occurs in contexts where administrative complexity does not match the demands of this more complex task of properly disposing of collected waste.

Moreover, implementing collaborative budgeting as participatory mechanisms increase municipalities' probability of more frequent trash collection by 2.4% and the likelihood of dumping less than 65% of waste by 4%. The results show that, on average, in local governments that decide their budgets collaboratively with their populations, the probability of improvements in both waste services is higher, relative to those that are less participatory. These results are significant at the 10% in models 1 and 3. These same results are found in models 2 and 4. However, the administrative complexity index increases the probability of more frequent waste collection, by 4%, for a one-unit increase in the score (significant at the 1% level), while it has no effect on improving the probability of adequate waste disposal.

As with the odds ratios, no significant average marginal effects are found for the proxy of local political support for waste collection measured by the percent of the total municipal budget allocated to waste services in general, in any of the four models. However, models 1 and 2 show that the probability of more waste collection increases by 6% in municipalities with mayors that have a bachelor's degree or higher relative to those that do not. Models 3 and 4 similarly show that



municipalities led by mayors with mid- to high-level management experience in the public sector are more likely to throw less waste into dump sites, with a probability that is roughly 6.5% higher relative to those with less experienced mayors.

[Insert Table 5 here]

However, the data collected from the interviews and participant observations in four municipal case studies show a clearer picture about the degree to which administrative complexity and the performance between waste collection and waste disposal are associated. It also elucidates why there is a differential performance between two services that are provided by the same office and are part of waste management services as a whole. The performance quality score for waste collection of the four municipalities falls within the high performance area and, while the administrative complexity score of only two municipalities is in the high complexity area, the other two are just below the threshold of 13 points (see Diagram 1). This indicates that the offices in charge of waste management in the four municipalities have high or almost high administrative complexity for the provision of waste collection and can be qualified as having a high performance quality of such service. Although the municipalities of Tinta and San Pablo are categorized as having an office with low administrative complexity, meaning that they are not fully specialized and equipped to provide this particular service, both with a score of 11 points, they are still capable of delivering a high quality waste collection service, with scores of 8 and 6 points, respectively, over the threshold of 5 points. The municipalities of Sicuani and Tinta, however, are qualified as having offices with high administrative complexity, although at the lower end of the category, obtaining scores of 16 and 15, respectively, and also as providing high quality waste collection services, with 8 and 9 points, respectively. The fundamental difference between these two groups of municipalities is that, in terms of administrative complexity, Tinta and San Pablo do not have fully specialized organizational structures for waste collection services, sharing the office, personnel and tasks with other services, as well as lacking trained personnel and data collection of any kind for this task. With regards to performance, San Pablo is behind the other municipalities because it only partially has a waste collection routine and does not have a compactor truck and one of its collector trucks was inoperative. Notwithstanding, what is noticeable is that the four municipalities are able to perform quite well in the delivery of waste collection even with some administrative complexity deficiencies. The association between administrative complexity and waste collection performance does seem to be relevant, with some degree of office complexity being necessary but possibly not sufficient for performance quality.

[Insert Diagram 1 here]

The opposite situation is observed for the provision of waste disposal services. All four municipalities are qualified as low in both the level of administrative complexity and the quality of waste disposal performance (see Diagram 2). The reason is that, regarding administrative complexity, all four offices providing waste management lack any specialization for the provision of waste disposal. They do not have a differentiated organizational structure, internal and external coordination procedures, have partially separate task routine planning from waste collection, do not gather data and have no disposal system set up. Of the four, only Sicuani and Marangani have a waste disposal section on their waste management diagnostic and policy documents, although insufficiently elaborated for the level of complexity of this service. All four municipal offices are also poorly equipped, with no trained personnel for managing and supervising this service and partially earning points for having operational but slow computers, having collector or compactor trucks but

not in the amount their managers regard as appropriate. Only in Sicuani and Marangani the administrative and field personnel are partially equipped with supplies to perform tasks related to this service, whereas in Tinta and San Pablo hardly any such supplies are available. A budget is only allocated in Sicuani and partially in Marangani, but none provided in the other two local governments. Therefore, overall, Sicuani and Marangani score 8 points each on this measure whereas Tinta and San Pablo obtain 3 and 2 points, respectively. Similarly, their performance scores are low essentially due to the fact that none of them use a landfill and some fail to have a clean and treated dumpsite with basic protective infrastructure as the use of geo-membranes and septic drains to control for leachate or perimetric fences and covering waste. Sicuani, however, does have geo-membranes in some areas of the dump site and one septic drain for the large and disperse dumping locations, which is also uncontrolled and supervised. Perimetric fences and waste covering with soil are partially found in San Pablo, while Marangani is partially organized with a cleaning routing for the dumpsite. Tinta also, to a certain extent, covers some of the waste dumping holes. Given that they lack in administrative specialization and equipment as well as in performance quality, the four municipalities assessed are qualified as low-low in the two measures. Clearly, the deficits in administrative complexity appear to be relevant for the performance of waste disposal services. This may indicate that the association between administrative complexity and the performance of this service is central, requiring office specialization and equipment particularly to its provision as necessary for performance quality, although more evidence is needed to determine whether it is sufficient. However, based on the results, the lack thereof is sufficient to affect the quality of waste disposal performance.

[Insert Diagram 2 here]

With regards to the conditions and causal mechanisms, Diagrams 3, 4 and 5 show that there are somewhat different arrangements and degrees of association between factors for the provision of waste collection and disposal services in any one municipality. Therefore, administrative complexity, political support, and civil society participation have different temporal relationships between each other within a given municipality when comparing the causal mechanisms of waste collection and waste disposal as well as across municipalities. Examining these differences in the sequential processes between services and across municipalities further elucidates the conditions and factors that are necessary or sufficient to produce differential performance outcomes. In addition, looking at the causal mechanism inside a waste management office, disaggregated into certain key components of administrative complexity, show that the sequential ordering may vary across these four cases and still lead to a high performance, as in the case of waste collection. Some components may even be absent, such as the lack of a specialized waste management office and team, yet waste collection services will still be adequately provided. For instance, while offices of Sicuani and Marangani have different sequences and all key administrative complexity components present and have a high collection performance, the offices of Tinta and San Pablo are able to have similar performance levels of this service despite being sustained only by the presence of an inertial annual budget and diagnostic and policy documents drafted almost at the same time. A major distinction in the conditions and causal mechanisms between these two sets of local governments, however, is that Sicuani and Marangani have some level of political support from mayors or council members and civil society organizations closely participating in the delivery of waste collection services. In Tinta and San Pablo political support to this service is weak and the offices have no interaction with civil society organizations to collect waste.

The low performance of the provision of waste disposal services can be explained by the absence or weak interaction of central factors and limitations in the administrative complexity causal mechanism. Of the four municipalities, only in Marangani it was made evident that the office received a weak, but present political support for this service. Although this condition was recognized as fundamental for administrative complexity and, through it, for the adequate provision of both services, no political support was received in Sicuani, Tinta, and San Pablo. With regards to administrative complexity, what is noticeable is that even with the presence of specialized diagnostic policy documents, a budget allocated for infrastructural investment, and operational truck, these appear to be not necessary and not sufficient conditions to achieve a higher level of performance in the municipality of Sicuani. Likewise, the interaction, although weak, of the office with strong civil society organizations for the provision of disposal services is neither necessary nor sufficient to improve its performance. Contrary to what would have served in terms of administrative complexity to perform well in the provision of collection services, in Marangani, having operational trucks, specialized implementation teams and routines for disposal services are neither necessary nor sufficient to deliver disposal services adequately. A weak interaction with civil society organizations has a similar contribution. The offices in Tinta and San Pablo, with three administrative complexity components absent, five weakly present, and no support from civil society organizations, and further show that these deficiencies in their causal mechanisms within the office are at least sufficient to produce worst disposal performance measures. What the four cases do have in common is that not one of them has a specialized waste management office or unit dedicated to waste disposal and three of them have no specialized management teams for this service (and one only partially fulfilling this condition).

[Insert Diagrams 3, 4 and 5 here]

## **5. Preliminary Conclusions**

Under development.

## APPENDIX

Table 1. Peruvian States: Per Capita Generation of Household Solid Waste (in kilograms per day).

State	Year					Avg
	2013	2014	2015	2016	2017	
Ucayali	0.66	0.64	0.65	0.66	0.66	0.65
Callao	0.66	0.61	0.65	0.59	0.6	0.62
Lima	0.59	0.61	0.6	0.6	0.6	0.60
Loreto	0.55	0.63	0.61	0.62	0.57	0.60
Cusco	0.6	0.64	0.55	0.56	0.57	0.58
San Martin	0.55	0.59	0.54	0.55	0.55	0.56
Piura	0.59	0.5	0.56	0.55	0.54	0.55
Lambayeque	0.51	0.51	0.57	0.56	0.57	0.54
Ancash	0.55	0.49	0.56	0.55	0.52	0.53
Cajamarca	0.54	0.53	0.54	0.53	0.51	0.53
Amazonas	0.52	0.54	0.52	0.53	0.53	0.53
La Libertad	0.54	0.51	0.53	0.5	0.51	0.52
Junin	0.51	0.48	0.52	0.53	0.54	0.52
Ayacucho	0.52	0.46	0.54	0.5	0.53	0.51
Ica	0.53	0.5	0.5	0.5	0.5	0.51
Apurimac	0.58	0.46	0.46	0.51	0.51	0.50
Arequipa	0.49	0.48	0.48	0.49	0.49	0.49
Puno	0.47	0.56	0.47	0.43	0.45	0.48
Madre De Dios	0.45	0.42	0.45	0.51	0.51	0.47
Huanuco	0.5	0.48	0.45	0.44	0.44	0.46
Tacna	0.49	0.46	0.46	0.44	0.44	0.46
Tumbes	0.46	0.44	0.47	0.46	0.46	0.46
Huancavelica	0.49	0.47	0.46	0.43	0.43	0.46
Moquegua	0.39	0.42	0.41	0.44	0.44	0.42
Pasco	0.43	0.45	0.38	0.4	0.41	0.41
Avg	0.53	0.52	0.52	0.52	0.52	0.52
Max	0.66	0.64	0.65	0.66	0.66	0.65
Min	0.39	0.42	0.38	0.40	0.41	0.41

Source: National System of Environmental Information, Ministry of Environment of Peru.

**Table 2. List of Interviews and Participant Observations.**

**I. Interviews**

No.	Agency Name	District	Province	State	Agency Level	Agency Type	Unit
1	Municipality of Sicuani	Sicuani	Canchis	Cusco	Local	Provincial government	Environmental Management Office
2	Community Kitchen Central of Sicuani - Left Margin	Sicuani	Canchis	Cusco	Local	Non-governmental (Trash Collectors Association)	Management
3	Municipality of Sicuani	Sicuani	Canchis	Cusco	Local	Provincial Government Council	Environmental Committee
4	Community Kitchen Central of Sicuani - Left Margin	Sicuani	Canchis	Cusco	Local	Non-governmental (Trash Collectors Association)	Management
5	Community Kitchen Central of Sicuani - Right Margin	Sicuani	Canchis	Cusco	Local	Non-governmental (Trash Collectors Association)	Management
6	Municipality of Tinta	Tinta	Canchis	Cusco	Local	District government	Rural Basic Environmental Sanitation Office
7	Municipality of San Pablo	San Pablo	Canchis	Cusco	Local	District government	Municipal Technical Area and Basic Sanitation Office
8	Municipality of Marangani	Marangani	Canchis	Cusco	Local	District government	Municipal Technical Area Office
9	Ministry of Environment	Jesus Maria	Lima	Peru	National	Ministry	General Direction for Solid Waste Management
10	Ministry of Finance	Lima	Lima	Peru	National	Ministry	Directorate for Quality Expenditures
11	Presidency of the Council of Ministers	Lima	Lima	Peru	National	Ministry	Decentralization Secretariat, Main office
12	Presidency of the Council of Ministers	Miraflores	Lima	Peru	National	Ministry	Decentralization Secretariat, Sub-secretariat of Territorial Development
13	National Institute of Statistics and Informatics	Jesus Maria	Lima	Peru	National	National Institute	Statistics General Office

**II. Observations**

No.	Type of Observation	District	Province	State
1	Waste disposal locations, left and right margins of Sicuani	Sicuani	Canchis	Cusco
2	Solid waste collection route, midnight walk with mothers from the Community Kitchen Central of Sicuani - Left Margin	Sicuani	Canchis	Cusco
3	Observation of waste disposal at market – Right margin	Sicuani	Canchis	Cusco
4	Observation of waste removal at market – Right margin	Sicuani	Canchis	Cusco
5	Meeting of Environmental Management Office, Municipality of Sicuani	Sicuani	Canchis	Cusco
6	Visit to informal dump site	Sicuani	Canchis	Cusco
7	Visit to informal dump site	Tinta	Canchis	Cusco
8	Visit to informal dump site and waste collection and segregation site	San Pablo	Canchis	Cusco
9	Visit to informal dump site and compositing facility	Marangani	Canchis	Cusco

**Table 3. Descriptive statistics.**

Variable Label	Mean	Standard Deviation	Min.	Max.	Count	Percent
<i>Dependent Variable</i>						
Municipality collects waste more than two days per week?						
No			0	0	755	38.60
Yes			1	1	1,203	61.40
Municipality disposes < than 65% of waste in open air dump site?						
No			0	0	1,274	65.07
Yes			1	1	684	34.93
<i>Independent Variables</i>						
Municipality has an environmental office?						
No			0	0	870	44.40
Yes			1	1	1,088	55.60
Municipality has an environmental diagnostic?						
No			0	0	1,305	66.60
Yes			1	1	653	33.40
Municipality has an environmental policy?						
No			0	0	1,599	81.70
Yes			1	1	359	18.30
No. waste collector trucks functioning	0.79	2.43	0	75		
Municipal budget allocated to waste collection, transport, and disposal (% of total)	0.03	0.20	0	8.00		
Population participates in collaborative budgeting process?						
No			0	0	962	49.10
Yes			1	1	996	50.90
Municipality has a Local Environmental Commission?						
No			0	0	1,415	72.30
Yes			1	1	543	27.70
<i>Controls</i>						
Total municipal HR as a % of population	1.14	1.22	0	16		
Number of computers with access to internet <sup>1</sup>	35.40	79.83	0	1,370		
Mayor's share of the electoral vote (% , 2014)	35.97	10.02	0	72.00		
Mayor has $\geq 1$ year of experience in mid- to high-level public sector management?						
No			0	0	1,164	59.50
Yes			1	1	791	40.50
Mayor has a completed bachelor's degree?						
No			0	0	1,146	58.60
Yes			1	1	809	41.40
Observations					1,958	

Sources: National Registry of Municipalities of Peru (RENAMU), National Institute of Statistics and Informatics (INEI) and National Elections Jury (JNE).

<sup>1</sup> Number of computers with access to internet: Refers to the number of personal computers with access to the internet.

Table 4. Random Effects Logit Regression Explaining the Odds of Municipal Waste Collection and Disposal.

	DV: Waste Collection		DV: Waste Disposal	
	M1	M2	M3	M4
<b>Independent Variables</b>				
Environmental office (Yes/No)	1.31 (0.419)		0.71* (0.138)	
Environmental diagnostic (Yes/No)	1.58 (0.557)		1.29 (0.271)	
Environmental policy (Yes/No)	2.76** (1.188)		1.29 (0.306)	
No. waste collector trucks functioning	1.99** (0.542)		0.89* (0.055)	
Administrative complexity index (0-4 score)		1.73*** (0.319)		0.98 (0.081)
Municipal budget allocated to waste (% of total)	4.06 (4.447)	4.12 (5.035)	0.51 (0.621)	0.42 (0.550)
Collaborative budgeting (Yes/No)	1.43* (0.293)	1.43* (0.289)	1.30* (0.185)	1.31* (0.186)
Local Environmental Commission (Yes/No)	1.16 (0.399)	1.18 (0.390)	0.91 (0.194)	0.95 (0.200)
<b>Controls</b>				
Total municipal HR as a % of population	0.96 (0.121)	0.94 (0.113)	1.06 (0.069)	1.06 (0.070)
Number of computers with access to internet	1.04* (0.020)	1.04** (0.020)	1.00* (0.002)	1.00 (0.001)
Mayor's share of the electoral vote (%)	0.97 (0.021)	0.97* (0.019)	0.98 (0.010)	0.98 (0.010)
Mayor ≥1 year of public sector management experience (Yes/No)	0.67 (0.301)	0.74 (0.307)	1.56** (0.313)	1.53** (0.309)
Mayor completed bachelor's degree (Yes/No)	2.32* (1.077)	2.27* (0.997)	1.02 (0.213)	0.97 (0.204)
<b>N</b>	1,952	1,952	1,952	1,952

Standard errors in parentheses

\* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01, \*\*\*\* p < 0.001

Table 5. Average Marginal Effects for Municipal Waste Collection and Disposal.

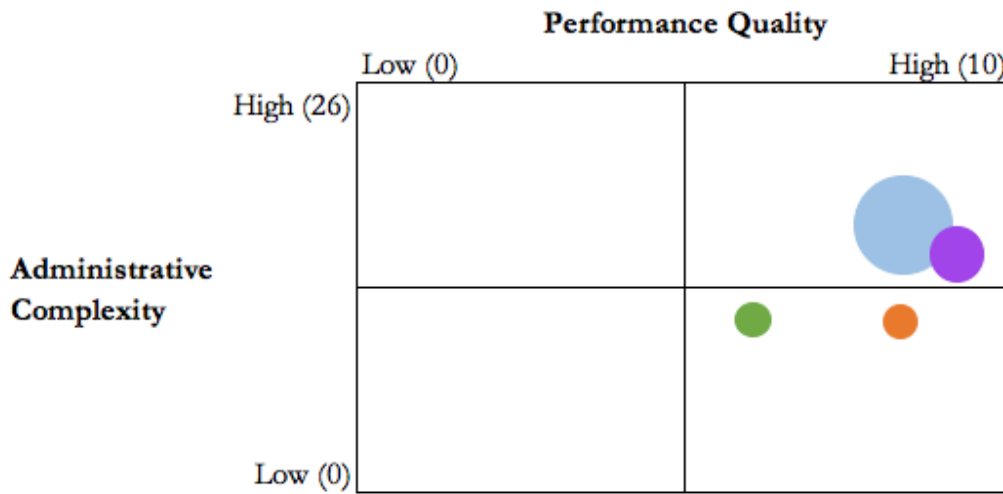
	DV: Waste Collection		DV: Waste Disposal	
	M1	M2	M3	M4
<b>Independent Variables</b>				
Environmental office (Yes/No)	0.019		-0.047*	
Environmental diagnostic (Yes/No)	0.031		0.037	
Environmental policy (Yes/No)	0.069**		0.038	
No. waste collector trucks functioning (+SD)	0.113***		-0.041**	
Administrative complexity index (0-4 score)		0.040***		-0.003
Municipal budget allocated to waste (% of total) (+SD)	0.019	0.020	-0.019	-0.024
Collaborative budgeting (Yes/No)	0.024*	0.026*	0.039*	0.039*
Local Environmental Commission (Yes/No)	0.01	0.012	-0.013	-0.007
<b>Controls</b>				
Total municipal HR as a % of population (+SD)	-0.003	-0.005	0.01	0.01
Number of computers with access to internet (+SD)	0.192**	0.219***	0.036*	0.02
Mayor's share of the electoral vote (%) (+SD)	-0.024	-0.025*	-0.023	-0.022
Mayor ≥1 year of public sector management experience (Yes/No)	-0.028	-0.023	0.066**	0.063**
Mayor completed bachelor's degree (Yes/No)	0.058*	0.059*	0.003	-0.004
N	1,952	1,952	1,952	1,952

Standard errors in parentheses

\* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01, \*\*\*\* p < 0.001



Diagram 1. Case Studies: Categorization of Administrative Complexity and Waste Collection Performance.



Legend:

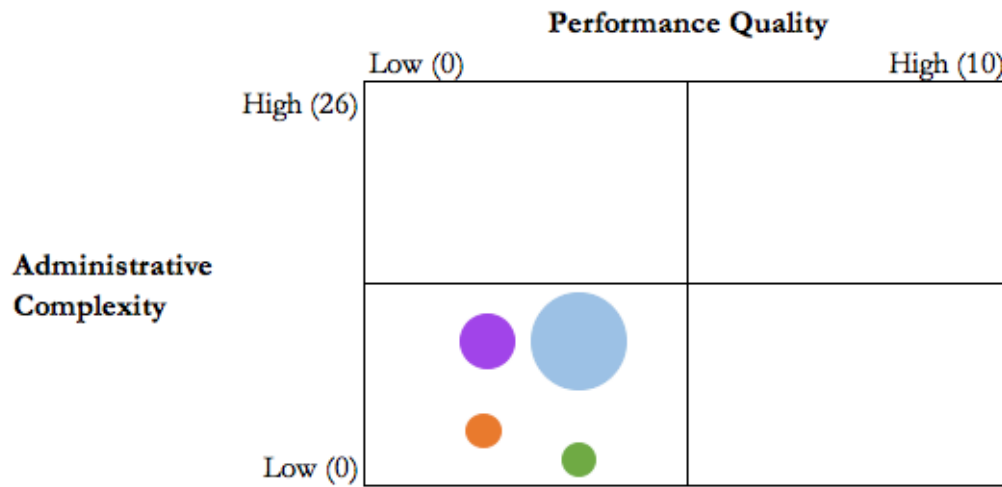
1. Scores (Admin. Complexity / Performance Quality)

Sicuani	16/8
Tinta	11/8
San Pablo	11/6
Marangani	15/9

2. Circle sizes: Municipal population

5,000 - 10,000	
10,001 - 15,000	
15,001 - 45,000	
45,001 - 75,000	

Diagram 2. Case Studies: Categorization of Administrative Complexity and Waste Disposal Performance.



**Legend:**

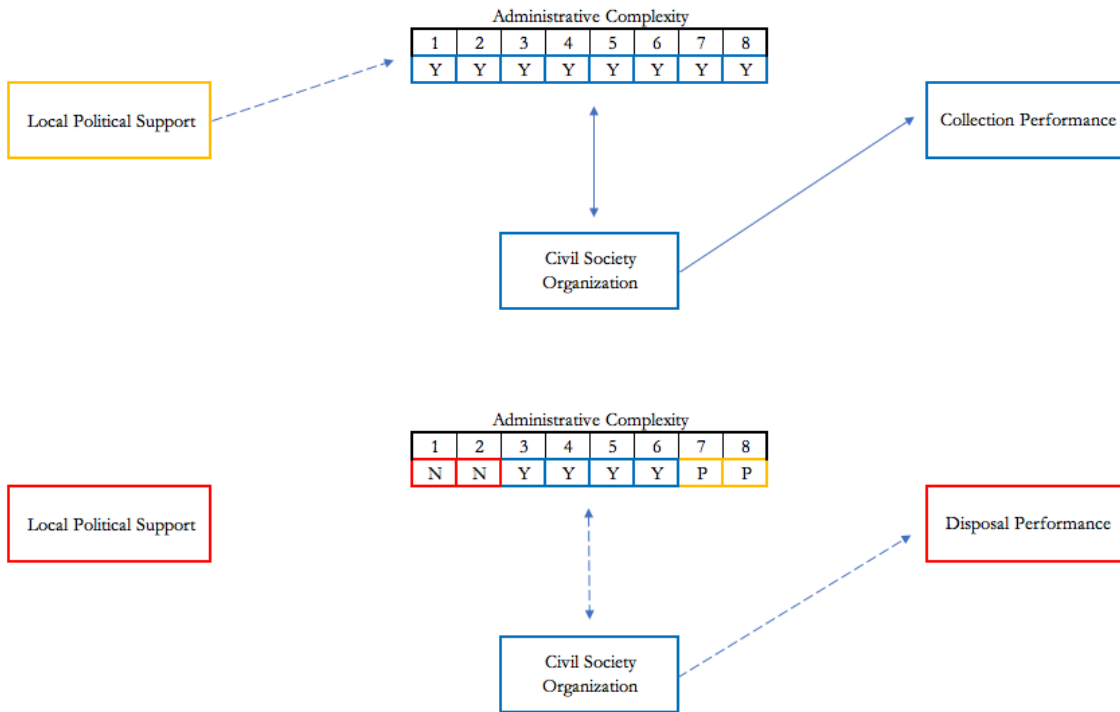
1. Scores (Admin. Complexity / Performance Quality)

Sicuani	8/3
Tinta	3/2
San Pablo	2/3
Marangani	8/2

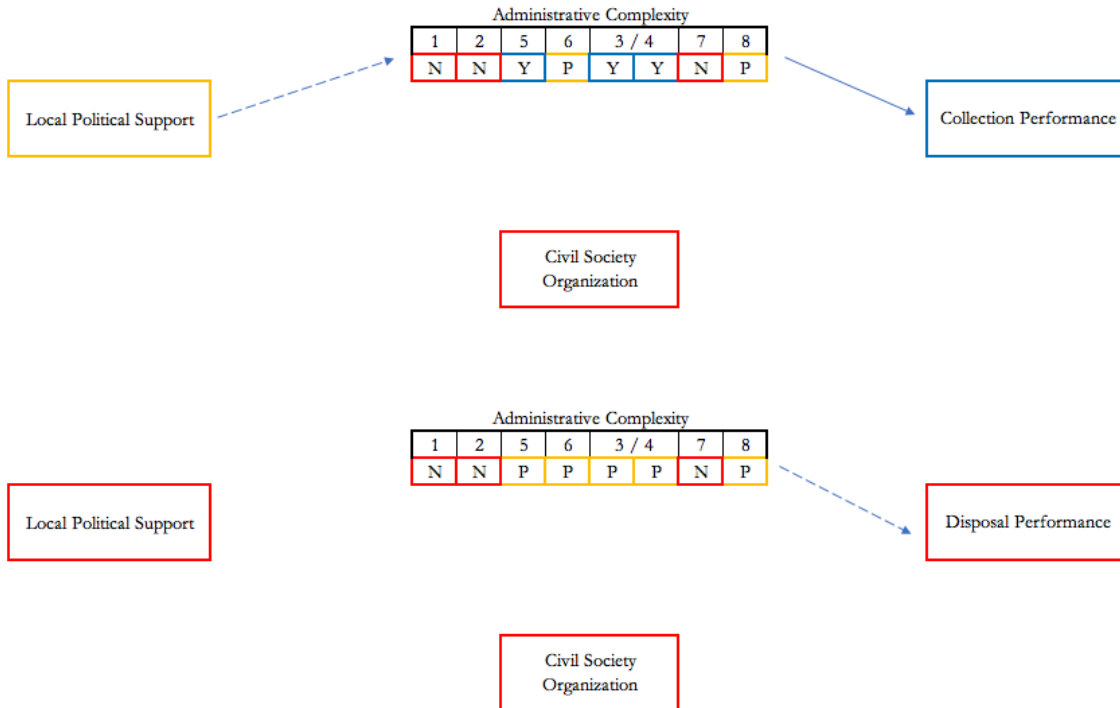
2. Circle sizes: Municipal population

5,000 - 10,000	
10,001 - 15,000	
15,001 - 45,000	
45,001 - 75,000	

Diagram 3. Municipality of Sicuani: Conditions and Causal Mechanisms of Waste Collection and Disposal.



**Diagram 4. Municipalities of Tinta and San Pablo: Conditions and Causal Mechanisms of Waste Collection and Disposal.**



**Legend:**

**I. Causal mechanisms and key components of administrative complexity:**

1. Waste management office
2. Specialized management team
3. Diagnostic
4. Policy
5. Budget
6. Operational trucks
7. Specialized implementation team
8. Specialized implementation routine

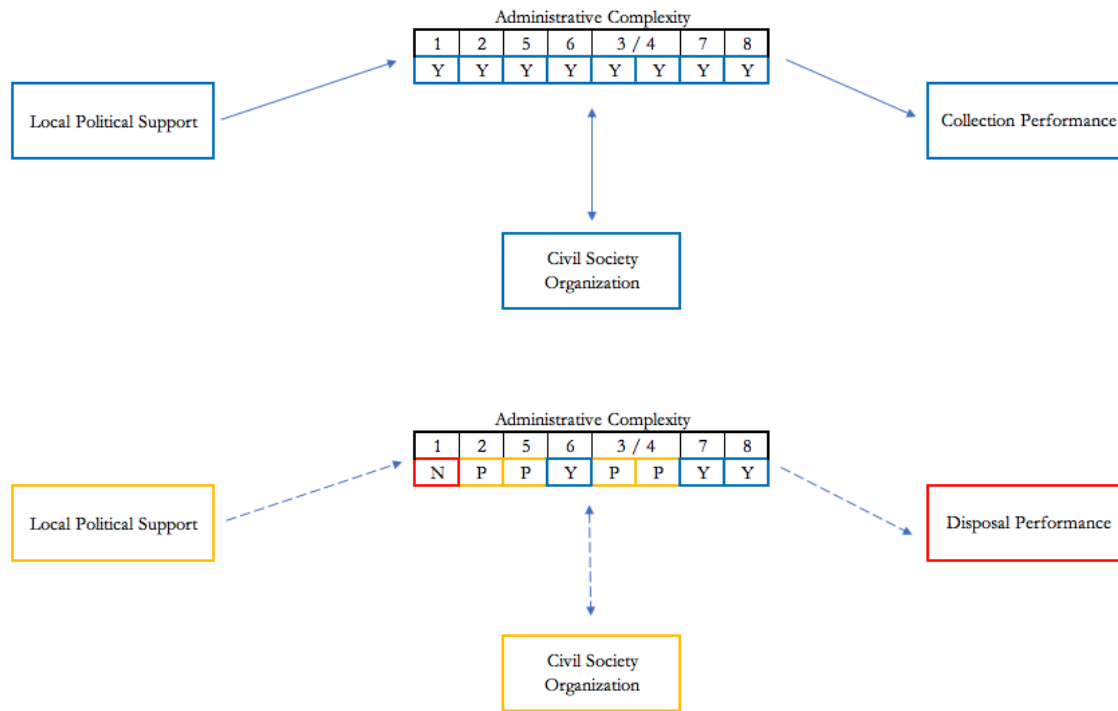
**II. Condition quality:**

- Y = Yes, present
- P = Partially present
- N = Not present

**III. Arrows:**

- = Antecedent condition affecting subsequent condition.
- - - → = Antecedent condition weakly affecting subsequent condition.
- ↔ = Conditions mutually affected.
- ↔ (dashed) = Conditions mutually affected, but weakly.

Diagram 5. Municipality of Marangani: Conditions and Causal Mechanisms of Waste Collection and Disposal.



**Legend:**

I. Causal mechanisms and key components of administrative complexity:

1. Waste management office
2. Specialized management team
3. Diagnostic
4. Policy
5. Budget
6. Operational trucks
7. Specialized implementation team
8. Specialized implementation routine

II. Condition quality:

Y	= Yes, present
P	= Partially present
N	= Not present

III. Arrows:

	= Antecedent condition affecting subsequent condition.
	= Antecedent condition weakly affecting subsequent condition.
	= Conditions mutually affected.
	= Conditions mutually affected, but weakly.

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