TOWARDS FLEXIBLE EVALUATION SCHEMES USING THE AVAILABLE INFORMATION – A CASE OF WASTE GOVERNANCE IN MEXICO

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ABSTRACT

Local governments face the need to achieve sustainability in the provision of public services and, to do so, proper governance is essential. This work proposes a method to assess governance in local WM systems based on a set of indicators that are flexible and robust enough to allow objective and reliable evaluation even where the information that is available is deficient. The proposal is based on a set of indicators divided into six categories which represent an increasing order of governance maturity: Institutional framework, Government effectiveness, Transparency and accountability, Network creation, Participation, and Corruption control. The paper presents the proposal and a first test in two Mexican municipalities, as an example of MSWM systems in an incipient stage of development, where there may be serious limitations in terms of access to information. The results show that the methodology can be replicated in different contexts and can be useful for making decisions about improvements in MSWM or for comparing them with others. In addition, sufficient information was obtained for a fist diagnosis of the cases studied, which indicates the coherence of the proposed framework: the results in the lower categories are better, and get worse as we progress through the following ones.

INTRODUCTION

In recent decades, local and national governments have prioritized environmental issues and sustainability in public agendas (Peterson and Hughes, 2017; United Nations, 1992, 2017). Environmental problems can affect large areas, but environmental prevention and protection actions have to be targeted toward every level, putting into practice the axiom *think globally, act locally* (United Nations, 1992).

Municipal solid waste management (MSWM) is a primary service covered by local governments. One of the most important challenges they face is to achieve Integrated Sustainable Waste Management (ISWM). This term, ISWM, was coined by Van de Klunder and Anschütz (2001) to capture the need for a multidimensional approach, in which stakeholders, technical and operational elements as well as sustainability aspects must be considered when planning Waste Management (WM) solutions. Moreover, ISWM must take into account the general principles of the WM hierarchy (European Commission, 2008), and adapt them properly to the local social, economic, and environmental context (Mourad, 2016). This is a complex objective for local authorities, especially in developing countries, since many of them do not have sufficient institutional capacity or are affected by periodic changes of government. It is therefore essential to ensure adequate governance in order to promote service quality. Hence, local authorities should monitor not only the quality of the service but also the governance processes (Bovaird and Löffler, 2003).

Assessing governance and thus detecting its weaknesses and strengths is the first step toward improving it. However, it is precisely those WM systems with poorly developed governance where information availability tends to be deficient, and this in turn hinders the improvement process.

This work proposes a method to assess governance in local WM systems based on a set of indicators that are flexible and robust enough to allow objective and reliable evaluation even where the information that is available is deficient. The objective of the new evaluation scheme is to help detect the deficiencies in WM governance, as a starting point for the proposal of improvements adapted to the local needs. This will also prevent the direct copying of solutions designed for developed countries and thus for totally different contexts. Starting with a review of the evolution of the concept of governance and its assessment in the area of WM, the following sections present the proposed method and two examples of implementation that show its usefulness even for developing MSWM systems.

GOVERNANCE

EVOLUTION OF THE CONCEPT

The concept of governance emerged in the 1980s as "the way power is exercised in the management of economic and social resources" (Hufty, 2008:2). Nowadays, the notion of governance is still under construction. However, over the years, the concept has converged to the desirable way of governing for lasting economic, social, and institutional development, involving all stakeholders in decision-making, execution, and evaluation (Bodin, 2017; Molas-Gallart, 2012; Stoker, 1998; Van der Heijden, 2016).

International institutions and authors have proposed quantitative parameters for assessing governance. Kaufmann et al. (2007) carried out a general review with measurement of national indicators in different countries as of 1996. Knack et al. (2002) proposed indicators focused on measuring public sector performance.

Assessing governance at the local level is especially controversial and challenging for several reasons, such as the difficulty in obtaining more detailed information, the great variety of local contexts that make it necessary to adapt the evaluation methods, the need to consider the local stakeholders in each case, etc. For this reason, various authors (Williams and Siddique, 2008) point out the difficulty in achieving a single evaluation methodology and, nevertheless, remark the interest of generating new instruments that can be adapted to different contexts.

GOVERNANCE IN MSWM

As a fundamental area among municipal services, the concept of governance has been present in research dealing with MSWM for many years. Without addressing the specific term, Schübeler (1996) included the political, institutional, and social dimensions as well as the technical, economic, and financial aspects in his proposed framework. Governance in WM was recognized more widely as of 2001, in the works published by Van de Klunder and Anschütz (2001), Whiteman et al. (2001) and Anschütz et al. (2004). This latter contribution includes a proposal for indicators that can be used to assess urban governance. These authors recognize governance as a key part of achieving effective WM, and suggest that this public service can be used as a proxy indicator to assess municipal governance or the governance of other public services.

Derived from this background, UN-HABITAT (2010) develops the theoretical and practical basis for governance in WM. Governance is assessed through three composite indicators (detailed below) that were applied in 20 different cities. Wilson et al. (2012) analyzed data from these cities and stressed the importance of good governance, alongside the more technological and physical components of the system. As the

indicators used are composite, the proposal is appropriate to compare some places with others, but does not allow identification of the areas in need of improvement in each WM system.

Marshall and Farahbakhsh (2013) underlined the key role of stakeholders and the political, institutional, social, and cultural context in moving toward ISWM. In this line, Gupta et al. (2016) highlighted the need for an institutional framework that includes policies, programs, and regulations. For his part, Bhuiyan (2010) suggested that a well-constructed public–private partnership can ensure effective WM and good urban governance.

The United Nations Environment Programme (UNEP) and the International Solid Waste Association (ISWA) published the Global Waste Management Outlook (Wilson et al., 2015), which includes a whole chapter on waste governance that analyzes various policy instruments, including direct regulation, and economic and social instruments, among others. This report highlights the relevance of some aspects that are difficult to quantify, such as politics, staff qualification and others, in the quality of the WM service.

Today, the relevance of governance in WM is beyond doubt, and so it is included in the planning or evaluation of every system (see, for example, Wilson et al., 2015; De Oliveira, 2019). Bugge et al. (2019) carried out an assessment of WM governance in accordance with the governance regime. Massoud et al. (2019) mentioned the importance of the participation and involvement of the various stakeholders. In addition to the traditional model, Nasir et al. (2017) added the technology variable, as a necessary tool to achieve governance.

All these proposals have theoretical support applicable to the contexts of developed countries, as well as at the national and sub-national levels. The scant availability of information in developing countries makes it difficult to perform these analyses in detail and thus delays the development of the MSWM systems.

EVALUATION PROPOSAL

CONCEPTUAL FRAMEWORK

As Tabi and Verdon (2014) pointed out, assessing the governance of a system allows it to be strengthened, as well as adapted to its context and to public well-being. Due to its multidimensional nature, analyzing governance makes it necessary to establish an analytical framework that clearly identifies the categories to be considered in the evaluation.

In the UN-HABITAT (2010) proposal for WM, governance is broken down into three main dimensions: 1a) inclusivity and equity, 2a) financial sustainability, and 3a) sound institutions and proactive policies. Works by other authors (Anheier et al., 2018; Bennett and Satterfield, 2018; Fiszbein et al., 2016; Huque and Jongruck, 2018; Kaufmann et al., 2010; Kaufmann et al 1999; Kaufmann et al., 2007; Wilson et al., 2015) converge in the following categories: 1b) accountability, 2b) political stability, 3b) government effectiveness, 4b) regulatory quality, 5b) rule of law, 6b) corruption control, 7b) participation, 8b) equity, and 9b) networking. In this context, for this research six analytical categories are proposed. The following paragraphs describe them in increasing order of governance maturity. The code between brackets shows which of the dimensions mentioned are covered by each of the proposed categories.

- *Institutional framework* (3a and 4b)

  This analyzes public policies that affect ISWM, as well as their implementation and the regulatory instruments thereof. It is the basis for the operation of any government, since the rules and work agreements must be formally established in writing, and then approved.

- *Government effectiveness* (2a, 2b and 3b)

  This analyzes the quality of public services, their degree of autonomy when under political pressure, the quality of the formulation and execution of policies, and the credibility of the government's commitment to these policies. It is proposed to analyze it quantitatively with performance indicators (González de Audicana et al., 2017), while also taking into account the perception of the population receiving the service (Kaufmann et al., 2009), so that information from the users as well from the providers of the service can be incorporated.

- *Transparency and accountability* (1b and 5b)

  This refers to the existence of instruments that allow the population to request information and evaluate the performance of their government, as well as granting the general public access to the municipal reports on MSWM.

- *Network creation* (1a, 7b and 8b)

  In accordance with the proposal by Whittingham Munevar (2005), this refers to the ability of governments to establish cooperation with other stakeholders, both public and private, in order to strengthen ISWM.

- *Participation* (9b)

  This addresses the possibility of each individual being included in the decision-making process, either directly or through legitimate intermediation institutions that represent their interests (Whittingham Munevar, 2005), as well as the responsibility of the population and the impact that its actions have on ISWM.

- *Corruption control* (6b)

  For this category, the definition of corruption proposed by Kaufmann et al. (2009) is adopted. This definition quantifies the extent to which public power is exercised for private gain, including small- and large-scale forms of corruption, such as the "capturing" of the State by select minorities and private interests.

EVALUATION THROUGH INDICATORS

This work makes use of the set of indicators proposed by Turcott and Lobo (2016) to evaluate the efficiency and effectiveness of ISWM. These indicators were originally grouped in four attributes (social, environmental, economic, and technical) and eight components (transversal topic, waste generation, prevention, street cleaning, collection, transfer station, recovery and treatment, and disposal). In this research, the indicators were distributed among the six categories proposed in the conceptual framework. Tables 1 to 3 show the indicators used in the study cases taken as examples in this work. Their distribution is unequal due to the existence, in general, of a greater number of indicators focused on technical or operational aspects, which are usually those for which there is a greater amount of information available. Consequently, there is a larger number of indicators assigned to G*overnment effectiveness*, which is reflected directly in the operational performance of the system. On the other hand, only one indicator could be

measured for the most advanced category, C*orruption control*, as a result of the initial stage of development of the WM in the context under study, where data and information availability are limited. In more advanced systems, a higher number of indicators could be used in this and other categories, as shown in Turcott Cervantes et al. (2018).

To assess each indicator there is a detailed methodological sheet available in Turcott Cervantes (2018) that includes reference values to classify the performance in three categories: good (green), regular (yellow) or deficient (red). Annex A includes a compilation of the reference values for the indicators employed here. Additionally, the methodological sheets describe the information required for the calculation of each parameter that allows the generation of a list of base data for the compilation and verification of their availability. Thus, technicians with some experience in WM can apply the method directly by consulting the service managers in the municipality under study.

Once the case studies (described below) and the information available in them had been analyzed, the aforementioned system was reduced to the 67 indicators shown in Tables 1 to 3.

Table 1. Proposed indicators, results, and information quality obtained for *Institutional framework* and *Transparency and accountability*.

Name of indicator		**Unit of measurement**	**Results**			
			Zapopan		*San Pedro Tlaquepaque*	
			IV [1]	*IQ [2]*	*IV*	*IQ*
Framework category: *INSTITUTIONAL FRAMEWORK*						
Existence of legislation		Qualitative	Yes	B	Yes	B
Existence of economic instruments			Partially	B	Partially	B
Planning for waste management			P.S.L.[3]	A	P.S.L.	A
Planning and policy for specific waste streams			P.S.L.	A	P.S.L.	A
Diagnosis for waste management			Yes	B	Yes	B
Presence of waste prevention in the legal framework and / or policies			Yes	B	Yes	B
Economic incentives for waste prevention			Yes	B	Yes	B
Average fee	Street cleaning	USD$/m^2	20.87	A	3.66	A
	Collection	USD$/t	11.96	A	47.45	A
	Transfer station		Not applicable [4]	-	0.06	A
	Landfill		7.14	A	13.55	A
Framework category: *TRANSPARENCY AND ACCOUNTABILITY*						

Average time for answering complaints	Days	2	A	2	A
Public availability of information	Qualitative	Yes	B	Yes	C
Existence of a specific fee (households)		No	A	No	A
Cost recovery for service provider	%	3	A	0,5	A

[1] IV=Indicator value
[2] IQ=Indicator quality: *A= High, B= Acceptable, C= Low and U= Unknown*
[3] P.S.L= Published by a Superior Level
[4] Although there is a transfer station in the municipality, there is no established fee

Table 2. Proposed indicators, results, and information quality obtained for *Government effectiveness*.

Name of indicator		Unit of measurement	Results			
			Zapopan		*San Pedro Tlaquepaque*	
			IV [1]	*IQ [2]*	*IV*	*IQ*
Framework category: *GOVERNMENT EFECTIVENESS*						
Street cleaning coverage		% ($m^{2)}$	82.0	A	N.A.	-
		% (Km)	27.4	A	N.A.	-
Population served by collection		%	100	B	100	B
Average distance from generation source to collection point		Meters	10	B	10	B
Availability of service	Street cleaning	%	70	B	100	B
	Collection		100	B	100	B
	Transfer station		100	B	N.A.	-
	Landfill		86	B	N.A.	-
Performance of the component	Street cleaning (manual sweeping)	m^2/employee/day	2637.2	B	1398.1	B
		km/employee/day	1.2	B	N.A.	-
	Collection	t/hour	0.8	C	1.1	C
	Transfer station		24.7	B	N.A.	-
	Landfill		6.79	C	N.A.	-
Operation rate of the facility	Collection	%	111.1	C	125.5	C
	Transfer station		146.4	C	N.A.	-
Displacement intensity for component	Transfer station	km/t	2.1	B	N.A.	-
Frequency of washing containers		Washes/year	N.A.	-	52	A
Frequency of washing collection trucks			N.A.	-	312	A
Continuous monitoring system in component	Transfer station	Qualitative	Yes	B	Yes	A
	Landfill		Yes	B	N.A.	-
Lifespan of landfill		Years	0.6	C	N.A.	-
Waste collected		%	98	C	99	B
Waste disposed of in landfill			100	B	N.A.	-
Public health risks	Street cleaning and collection	Qualitative	Yes	A	Yes	A
	Transfer station		Yes	A	Yes	A
	Recovery and treatment		Yes	A	Yes	A
	Landfill		Yes	A	Yes	A
Services waste generation rate		kg/per capita/year	7.58	A	N.A.	-
Construction and demolition waste generation rate			1.11	A	N.A.	-
Generation rate of drain cleaning waste and sludge from wastewater treatment plant			0.10	B	0.22	B
Compliance with legislation		Qualitative	Partially	B	Partially	B
Record of sanctions/notices			No	A	No	B
Coordinator of the service			Yes	B	Yes	B
Assignment of functions and responsibilities			Yes	B	Yes	B
Control of the provision of services			Yes	B	Yes	B
Level of users' satisfaction			Satisfied	A	Not satisfied	A
Number of sanctions		Number of sanctions per year/10,000 inhabitants	0.02	B	N.A.	-
Formal staff	Street cleaning	Employees /10 000 inhabitants	0.5	A	0.9	A
	Collection		0.8	B	0.001	B
	Transfer station		0.2	B	N.A.	-
	Landfill		0.06	B	N.A.	-
Average salary compared to the minimum wage	Street cleaning	%	316	A	263	A
	Collection		366	A	263	A
	Transfer station		316	A	N.A.	-

Name of indicator		Unit of measurement	Results			
			Zapopan		*San Pedro Tlaquepaque*	
			IV [1]	*IQ [2]*	*IV*	*IQ*
Framework category: *GOVERNMENT EFECTIVENESS*						
Benefits related to wage	Landfill	%	402	A	N.A.	-
	Street cleaning		100	A	100	A
	Collection		83	A	100	A
	Transfer station		100	A	N.A.	-
	Landfill		100	A	N.A.	-
Training and education strategies	Street cleaning	Qualitative	Yes	B	Yes	B
	Collection		Yes	B	Yes	B
	Transfer station		Yes	B	Yes	B
	Landfill		Yes	B	Yes	B
Aspects related to health and safety	Street cleaning		Partially	B	Partially	B
	Collection		Partially	B	Partially	B
	Transfer station		Partially	B	Yes	B
	Recovery and treatment		No	A	No	A
	Landfill		Partially	B	Yes	B
Management of contaminated sites			No management is carried out	A	No management is carried out	A
Intensity of water use	Street cleaning	L/t	26,263.6	B	N.A.	-
	Landfill		4.6	B	N.A.	-
Intensity of energy consumption	Street cleaning	kWh/t	2,641.3	B	N.A.	-
	Collection		N.A.	-	2.26	B
	Landfill		1.88	B	N.A.	-
Intensity of land use	Collection	m^2/t	0.021	B	0.014	B
	Transfer station		0.35	B	N.A.	-
	Landfill		0.28	B	N.A.	-
Intensity of greenhouse gas emissions	Street cleaning	$t\ CO_{2eq}/t$	0.72	B	N.A.	-
	Collection		N.A.	-	0.001	B
	Landfill		0.001	B	N.A.	-
Intensity of wastewater/leachate generated	Landfill	L/t	13.9	B	N.A.	-
Adequate management and legal compliance (Soil pollution)	Transfer station	Qualitative	No	B	No	B
	Landfill		Yes	A	Yes	A
Adequate management and legal compliance (Noise problems)	Transfer station		No	B	No	B
	Landfill		No	A	No	A
Adequate management and legal compliance (Odor pollution)	Transfer station		Yes	B	Yes	A
	Landfill		Yes	A	Yes	A
Wastewater/leachate management	Collection		No	B	No	B
	Transfer station		No	B	No	B
	Landfill		No	A	No	A
Aspects related to visual impact	Street cleaning and collection		Yes	A	Yes	A
	Transfer station		Yes	A	Yes	A
	Landfill		Yes	A	Yes	A
Budget for waste management			Yes	A	Yes	A
Percentage of the budget for waste management with respect to the municipal budget		%	4.1	A	4.9	A
Component cost	Street cleaning	$USD\$/m^2$	0.005	A	0.091	B
		USD$/km	14.3	A	Included in Street Cleaning (m^2)	B
	Collection	USD$/t	N.A.	-		B
	Landfill		3.1	B	N.A.	-

[1] IV=Indicator value
[2] IQ=Indicator quality: *A= High, B= Acceptable, C= Low and U= Unknown*
N.A.= Not answered

Table 3. Proposed indicators, results and information quality obtained for the *Participation*, *Network creation*, and *Corruption control* categories.

Name of indicator	Unit of measurement	Results			
		Zapopan		*San Pedro Tlaquepaque*	
		IV [1]	*IQ [2]*	*IV*	*IQ*
Framework category: *PARTICIPATION*					
Waste streams for reuse	Number of waste streams	0	A	0	A
Evolution of the municipal waste generation rate	%	4	B	0.9	B
Household waste generation rate	kg/per capita/year	376.7	C	295.2	B

Name of indicator		Unit of measurement	Results			
			Zapopan		*San Pedro Tlaquepaque*	
			IV [1]	*IQ [2]*	*IV*	*IQ*
Complaints and suggestions system		Qualitative	Yes	A	Yes	A
Procedures for communication, consultation and participation			Yes	B	Yes	C
Complaints for each 10,000 inhabitants		# complains /10,000 inhabitants/year	N.A.	-	51	A
Population for which environmental education and awareness actions are implemented		%	0.2	B	10	B
Households paying for the service			0	A	0	A
Framework category: *NETWORK CREATION*						
Institutional cooperation		Qualitative	Yes	A	Yes	A
Informal sector inclusion			No	B	No	B
Proportion of informal staff	Collection	%	44	B	53	B
	Recovery and treatment		100	B	100	B
	Landfill		81	B	N.A.	-
Framework category: *CORRUPTION CONTROL*						
Profile of staff in key positions		%	N.A.	-	N.A.	-

[1] IV=Indicator value
[2] IQ=Indicator quality: *A= High, B= Acceptable, C= Low and U= Unknown*
N.A.= Not answered

As a relevant part of the assessment, data quality was evaluated for each indicator according to the methodology reported in Turcott Cervantes et al. (2021), which considers the a) origin of the data, b) level of uncertainty, c) temporal coverage, and d) spatial coverage to obtain the global quality score for each of the indicators calculated: high (A), acceptable (B), low (C), and unknown (U).

CASE STUDIES

A limited budget, reduced capacity in terms of infrastructure and equipment, personal training and development, wage schemes and organizational structures, among others, restrict the monitoring and control of the MSWM system in developing countries and make it difficult to implement quality assessment procedures. In this context, two case studies in the state of Jalisco (Mexico) were selected as examples to apply the methodology and verify the usefulness of the proposed framework to reflect the level of development of governance.

Jalisco is ranked as the third Mexican state that generates the most MSW (INECC, 2012). It is also the second state with the highest percentage of selective collection, although less than 1% of waste sent for formal recycling is reported. 80% of the waste sent for disposal goes to landfill and controlled sites, about 15% of it goes to open dumps, and the rest has an unknown destination (INECC, 2012). Within this state, two municipalities in the Guadalajara Metropolitan Zone (GMZ), one of the main regions in Mexico in terms of its economic activity and the number of inhabitants, were selected: *Zapopan* and *San Pedro de Tlaquepaque*.

Zapopan is the second most populated municipality in the GMZ, and also the largest, with a population of 1,332,272 inhabitants and an MSW generation of 1492.5 ton/day (INEGI, 2016). Since 2005, it has ranked among the 10 municipalities that contribute the most to the National Gross Domestic Product (GDP) (SNIM, 2005). Tlaquepaque has 664,193 inhabitants generating 466.6 ton/day of MSW (INEGI, 2016). It is a well-known tourist spot, where the handicraft trade plays an important role. Its contribution to the National GDP is less than that of Zapopan.

In Mexico municipalities can provide the MSW management services autonomously, outsource them to private companies (by a concession contract) or form a *Paramunicipal Entity* or *Intermunicipality* with this objective. Zapopan is the only municipality in the GMZ with an autonomous management model. Tlaquepaque, however, has a mixed management model: the municipality is responsible for all activities except transfer and disposal, which are performed by a private company under a concession contract. In both cases there is a strong presence of the informal sector, which dominates the recovery and recycling of the waste.

For this study, a list of base information was compiled from each municipality through their transparency platforms. In addition, interviews with key stakeholders, population surveys and field tours at both landfills and their surroundings were conducted to corroborate and collect supplementary information.

RESULTS

NEED FOR INFORMATION OF QUALITY

Tables 1 to 3 show the indicators calculated for the municipalities studied. Zapopan provided enough information to calculate 63 indicators, while only 57 indicators could be calculated for Tlaquepaque. In both cases, high and acceptable quality information predominates (93% of the indicators answered in Zapopan and 96% in Tlaquepaque), which confirms the usefulness of the indicators chosen in this context, since they can be calculated with reliable information and used as the basis for decision-making on the matter. In addition, the method reveals areas where there is an absence of some data or it is unavailable to the evaluator, which implies deficiencies either in monitoring and control or in transparency or in both aspects, and this should be corrected.

Figure 1 (a) shows the global proportion of indicators assessed as good, regular or deficient levels of performance, as well as those that could not be completed due to a lack of information. Zapopan obtains a better overall rating than Tlaquepaque (46% of indicators with good performance vs. 36%, respectively).

[insert Figure 1]

Figure 1(b) shows the proportion of indicators assessed with a good, regular or deficient level of performance, considering only the common indicators, that is, those available in both municipalities. With this criterion, Tlaquepaque would obtain a slightly better score, when in fact there is greater uncertainty about the quality of its governance, as reflected in the lower availability of information. This highlights the sensitivity of the results to the amount of data provided, and therefore the need to include this amount as a variable in any detailed analysis of complex systems such as WM. The lack of information must be revealed in a poorer score. In addition, adopting an evaluation system in which the non-availability of information has a negative impact on the scores can promote the improvement of control and transparency.

The causes and impact of the lack of information are clearly manifested here in areas with a strong participation of the informal sector, such as recovery and treatment. As the data available is scarce in these areas, it is not possible to "schedule" an action plan for improvement and it makes it difficult to reach decisions about it. A first step toward improvement is, therefore, to generate the missing information.

ASSESSMENT BY CATEGORIES OF GOVERNANCE

Figures 2(a) and 2(b) show the results of the assessment obtained for each municipality disaggregated according to the governance categories that were defined.

[insert Figure 2]

Only for *Institutional framework* and *Transparency and accountability* did both municipalities have all the required information available and obtain similar assessments. The slight difference in *Institutional framework* is explained by different collection and landfilling fees: in Tlaquepaque they are higher and closer to the actual cost, and are therefore better evaluated.

Both municipalities obtain an identical score in *Transparency and accountability*, which corresponds to a good performance in social aspects (indicators in Table 1 *Average time for answering complaints* and *Public availability of information*) and a deficient performance in the economic ones (indicators *Existence of a specific fee for households* and *Cost recovery for service provider*).

The distribution of the evaluations in all the categories is similar in both municipalities, except for *Government effectiveness*, where Tlaquepaque has a high percentage of indicators that were not calculated due to lack of information. The differences between the two municipalities are associated with two main reasons: 1) difficulty in accessing information on technical aspects in Tlaquepaque, which is linked to a lack of control over the private company that operates the transfer station and the landfill, and 2) insufficient monitoring of environmental aspects within the municipality (mainly in street cleaning and landfilling).

This highlights the difference between *Transparency and accountability* from the municipal administration, which seems to be similar in the cases studied, and the transparency and accountability of the concessions with the administration, such as the private company in Tlaquepaque, which is the one that limits the information that is made available.

The differences in the *Participation* category are a consequence of the indicators concerning *Population for which environmental education and awareness actions are implemented*, which directly influence the *Evolution of the municipal waste generation rate*, with Tlaquepaque rated better on both aspects.

Network creation does not show any regular performance, and deficient performance predominates. This category groups various aspects related to the informal sector, where there is a great deal of room for improvement.

Finally, for C*orruption control,* only one indicator was proposed, which in both municipalities was not answered.

These results seem to corroborate the proposed conceptual framework, placing the institutional framework as the first necessary step to build governance in waste management. The lack of response in government effectiveness in Tlaquepaque makes it impossible to confirm that this is the second step to be consolidated. However, continuing from transparency and accountability, a sequential "evolution" toward governance is noted, consistent with the proposed framework: the level of performance in the different categories decreases as higher levels of system maturity are approached. Thus, the category of *Transparency and accountability* obtains a better evaluation than participation and this, in turn, is rated better than *Network creation*.

Systematic monitoring allows decision-makers to identify the failures and possible opportunities in the area under assessment (Tabi and Verdon, 2014). Grouping the indicators differently allows the diagnosis and possible solutions to be approached from a different perspective. Since the various stages of WM are usually operated independently, Figure 3 shows the results obtained with the indicators grouped

according to the WM stage analyzed. This assessment therefore helps to reveal the areas in greater need of improvement. Zapopan stands out with a better performance in almost all the stages of waste management, except for collection. Only two indicators were rated better in Tlaquepaque, both derived from the private management of the service: *Benefits related to wage* and *Average fee*. The first is due to the existence of a greater proportion of full-time contracts, associated with better wage benefits, and the second is because of a higher fee for collection services (implying better control over the income). On the other hand, five indicators with a lack of data in Zapopan belong to collection, and they diminish the score. This again highlights the impact of the scant availability of information, which in the case of Tlaquepaque becomes evident in the transfer station and landfill (managed by the private company) and the lack of control over recovery and treatment, which is borne entirely by the informal sector in both municipalities.

Several authors have analyzed the strengths and weaknesses of MSWM being operated by the public or private sectors (Massoud and El-Fadel, 2002; Soós et al., 2013). The general conclusion is that one particular management model is not inherently better than another. In this work, the results obtained reveal that Zapopan, where waste management is operated entirely by the public sector (except for the informal recovery already mentioned), displays a better performance throughout almost all the system. However, Tlaquepaque could reverse the difference by increasing the monitoring and control of the concessionary companies.

[insert Figure 3]

Having the suggested indicators as a reference allows the implementation of local public policies to be compared and evaluated, and the results may help to identify the areas in need of improvement. As a result, it may become possible to redefine the public policies and political actions.

CONCLUSIONS

Going a step beyond existing schemes to assess governance, which are focused on national and subnational scopes, this article proposes a new framework to evaluate WM governance at the local level. Based on existing methodologies, ISWM may be assessed through indicators categorized according to levels of governance, together with a system of evaluation of the quality of the information collected. A methodology like the one proposed in this work makes it possible to obtain a complete assessment that is deep enough to motivate changes in complex WM services. At the same time, it is also malleable enough to be useful in developing economies, where the quality of governance and the availability of information may be scant.

In a first test in two case studies in the Mexican context, the indicators obtained showed mostly high or acceptable quality, which means that the information compiled with the proposed method is robust and can be useful for making decisions about improvements in MSWM or for comparing them with others.

In addition, sufficient information was obtained for a first diagnosis of the cases studied, which indicates the coherence of the proposed framework: the results in the lower categories are better, and get worse as we progress through the following ones, until *Corruption control*, for which the result is negative.

However, both municipalities have deficiencies in the information, which indicates that developing their governance also requires an improvement in the monitoring and control system.

The examples reveal the importance of considering the availability of information as a fundamental aspect when an MSWM system is evaluated. Therefore, it is proposed to evaluate it explicitly, in the category of *Transparency and accountability*, and also to consider it implicitly, by including indicators without information within the set being evaluated. By doing so, for the same number of positive indicators, the overall score (positive percentage) will be smaller when fewer indicators have been answered.

The methodology has been developed to be replicated in local governments under different contexts. With this aim, the system can be improved in the future to evaluate more advanced MSWM by incorporating new indicators at high levels of maturity of governance, and also refining the proposed framework based on other case studies developed with the methodology presented here. A greater number of case studies will make it possible to generate a database for benchmarking and to expand the scope of diagnostics with comparative evaluations.

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