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Country report

The effectiveness of inter-municipal cooperation for integrated sustainable waste management: A case study in Ecuador

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ABSTRACT

There is an increasing awareness that effective waste management is essential for transitioning towards a circular economy and achieving sustainable development goals. Scholars have studied inter-municipal cooperation (IMC) as a governance solution with the potential to generate economies of scale and reduce financial costs in waste management. However, previous research has not yet focused on measuring the effectiveness of different types of cooperation on social and environmental outcomes. We analyse the effect of different types of IMC, ranging from indirect to collaborative, on Integrated Solid Waste Management (ISWM) indicators. Our embedded qualitative case study in the emerging metropolitan region of Cuenca-Azogues (Ecuador) found that municipalities that invested in more complex cooperation types achieved better integrated waste management performance, particularly on final disposal, citizen participation, inclusion of recyclers and environmental sustainability.

1. Introduction

Across the world, municipalities are the main actors responsible for adequately managing municipal waste. Failing to fulfil this responsibility leads to health, environmental, economic, aesthetic, territorial and social concerns (Wilson, 2007; Marshall and Farahbakhsh, 2013). Although waste per capita has been reduced in high-income countries (OECD, 2013), this is not the case in the developing world. Combined with rapid urbanisation, this increased waste production overwhelms local authorities and national governments (Tacoli, 2012; Yousif and Scott, 2007). Historically, there have been at least five development drivers of solid waste management, which include: 1. public health, 2. environmental protection, 3. resource value of waste and closing the loop, 4. institutional and responsibility issues and 5. public awareness (Wilson, 2007). In developing countries, public health continues to be the main driver, which is also reflected in the fact that these countries focus on waste collection and allocate little investment to waste treatment (Wilson, 2007; Hoornweg and Bhada-Tata, 2012). Municipalities in these countries focus on avoiding waste accumulation in houses and public spaces, but sustainable waste treatment, which is primarily an environmental concern, is far from a top priority. As a result, dumping and landfilling are the most frequent waste disposal methods in the Global South (Ikhlayel and Nguyen, 2017). However, increasing awareness among both government authorities and citizens regarding sustainable development goals, climate change, and the emergence of the concept of the circular economy provide new opportunities for choosing more holistic approaches.

Holistic approaches often require governance innovations. Inter-municipal cooperation (IMC) is a governance alternative for municipalities that have traditionally managed their waste independently and want to improve performance or reduce costs. Scholars have focused on comparing the financial benefit of IMC against other forms of service delivery, particularly privatisation (Bel and Warner, 2016). The results indicate that, under particular circumstances, IMC helps reduce costs (Bel and Warner, 2015; Struk and Bakoš, 2021), while in other situations, it increases transaction costs (Sørensen, 2007). Nevertheless, empirical studies that measure IMC effectiveness beyond financial parameters are unusual. Some exceptions relate IMC to service quality (Blåka et al., 2021) and quality and decision-making autonomy in health services (Arntsen et al., 2021) in Norway or public service resilience (Elston and Bel, 2022) in England. This scarcity is problematic, particularly for the waste management sector, where environmental and

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social parameters are as relevant as the financial ones.

An evident research gap is a connection between types of IMC and outcomes in Integrated Solid Waste Management (ISWM). Regarding types of IMC, an emerging IMC theory provides a typology to differentiate manifestations of IMC in emerging metropolitan regions (Villalba Ferreira et al., 2020). Concerning ISWM outcomes, The Wasteaware benchmark indicators provide a framework that builds on previous work in more than 50 cities worldwide (Wilson et al., 2015). Our paper combines these different strands of literature in an embedded qualitative case study. We focus on measuring how different types of IMC in the emerging metropolitan region of Cuenca-Azogues (Ecuador) affect the performance of ISWM efforts.

ISWM emerged in the 1990s from a demand for a more cohesive perspective for managing waste beyond dumping and landfilling (Marshall and Farahbakhsh, 2013). This approach strives to generate a balance between environmental effectiveness, social acceptability, and economic affordability (McDougall et al., 2001; Morrissey and Browne, 2004; Petts, 2000). Increasingly ISWM is framed within the circular economy concept as a strategy to eliminate waste from the design of products and services to support sustainability and compliance with the Sustainable Development Goals (SDGs) (Geissdoerfer et al., 2017). However, in developing countries, ISWM and circular models are exceptions rather than rules. Eliminating open-air dumps is one of the first challenges for ISWM.

As one of the first in Latin America, Ecuador developed a National Program on ISWM in 2007 as a strategy to eliminate all open-air dumps by 2017. This strategy included the promotion of IMC as a governance mechanism to achieve waste management outcomes. This policy context provides an opportunity to study the link between IMC and waste management outcomes. However, no academic publications of the Ecuadorian case measuring this link exist to date. To find a relevant case within Ecuador, we did some preliminary desk research that indicated the provinces of Azuay and Cañar were suitable for understanding the connection between IMC and waste management performance. Azuay and Cañar are located in the southern part of Ecuador. They include 22 municipalities that adopted IMC to a different extent and that have different outcomes regarding indicators such as closing air-dumps. In 2018 Cañar became the first province to eliminate all dumps (Castillo, 2018, June 21). This makes Cañar a unique case worth studying in comparison with neighbouring provinces with similar geopolitical characteristics. However, to conclude the effect of IMC on the broader ISWM, a more extensive analysis is required. Thus, our research question is as follows: **To what extent do different IMC types explain variations in ISWM outcomes?** To answer this question, we examine the relationship between the different manifestations of IMC in eight subcases in these provinces and waste management outcomes measured by ISWM. Following this introduction, we present a literature review where we analyse the work of scholars on IMC and ISWM. This leads to the elaboration of our own theoretical framework. In section 3, we explain the research strategy. The results of each indicator are presented in section 4. A discussion of these results in connection with existing literature follows in section 5. We finalise the paper with conclusions and recommendations for further research.

2. Literature review

2.1. Inter-municipal cooperation

IMC is conceptualised in two different ways. A first approach is to consider IMC as a particular service delivery form involving mainly the joint public-public partnership, next to, for example, private provision or provision by one municipality (Dijkgraaf and Gradus 2013; Bel and Warner, 2016). A second approach defines IMC more broadly as the joint provision of services with a variety of cooperation and production possibilities (Bel et al., 2014: Blåka, 2017; Voorn et al., 2019; Bel and Belerdas-Castro, 2021).

The first definition of IMC has been most common in the research linking IMC and the performance in solid waste management. Most of this research focuses on evaluating the effect of different service delivery forms on cost reduction. Scholars (Bel and Warner, 2015; Dijkgraaf and Gradus, 2013; Hulst and Montfort, 2007) identified six service arrangements which include: 1. re-allocation of responsibilities to other levels of government, 2. privatisation, 3. direct public production, 4. municipality-owned firm or agency, 5. IMC and 6. amalgamation.

Results indicate that in some cases, IMC helps reduce cost (Bel and Costas, 2006; Bel and Mur, 2009; Bel et al., 2014; Dijkgraaf and Gradus, 2013; Struk and Bakoš, 2021; Zafra-Gómez et al., 2013) while in other situations it does not (Sorensen, 2007; Garrone et al., 2013; Dijkgraaf and Gradus, 2014). While IMC may increase efficiency by returns to scale (Bel and Warner, 2015), it could also increase transaction costs (Brown and Potoski, 2003; Lamothe et al., 2008; Carret al., 2009; Levin and Tadelis, 2010; Shrestha and Feiock, 2011; Hefetz et al., 2012). Transaction costs from cooperation involve information, negotiation, monitoring, and agency costs (Feiock, 2007).

IMC contributes to reducing costs (compared to privatisation) when there is a lack of competition in the private market (Levin and Tadelis, 2010; Girth et al., 2012). This is because when there is a thin market, the cost of contracting out to the private sector and monitoring the fulfilment of the contract is higher. However, the results are different in contexts of weak sanctioning power among municipalities (Marvel and Marvel, 2007), territorial coordination issues and political differences (Lowery, 2000; Feiock, 2007; Tavares and Camões, 2007). This contradictory evidence may indicate that other variables interact with the outcomes, and thus a more in-depth exploration is required. Bel and Warner (2015, p. 62) briefly suggested the particular governance of the cooperative arrangements might play a role in explaining these differences.

Moreover, conceptualising IMC as a particular service delivery instead of a cooperation process between municipalities limits the scope of research. While this conceptualization is useful when comparing service delivery options, it does not address the characteristics of cooperation processes independently of the public or private nature of the arrangements. Blaka (2017) argues that organizational forms of cooperation are often lumped together while they are in fact different governance arrangements.

In the second perspective, IMC is defined as the joint provision of municipal public services (Agranoff and McGuire, 2003; Hulst and Montfort, 2007). Under this approach, IMC could take various forms and shapes and include public-public as well as public–private cooperation. Within this strand of literature, scholars identify five dimensions to categorize IMC. The first dimension is the degree of institutionalization, which, as Warner (2006) indicates, falls in a spectrum from informal to formal arrangements. The second dimension is the task performed, which could be operational (i.e. service delivery), or for coordinating public policy (Bel and Warner, 2015). Third, the number of functions could either be single purpose or multipurpose. Fourth, the governance structure permits a categorization into a single entity (i.e. public company) or multi-governmental when, for instance, inter-municipal councils deal with the cooperation. The last dimension refers to the form of representation in which either elected officials or appointed managers represent the municipalities in cooperation arrangements.

In line with this second perspective, a common variation in IMC is the contractual agreement or joint organisation (Blaka, 2017). For Voorn et al. (2019) types of IMC include informal coordination, formalized coordination through contracts, delegation, and centralization Aligned to this literature, Villalba Ferreira et al. (2020) provide a new IMC typology. The authors identify five dimensions of the cooperation process. These dimensions are Type of Interaction, Commitment, Governance Complexity, Representation and Degree of Institutionalization. Each of the dimensions has three empirical variations which constitute three different types of IMC: 1. Indirect, 2. Transactional and 3. Collaborative (Table 1).

Table 1
Types of IMC. Source: Villalba-Ferreira et al., 2020.

Dimensions	Types of Cooperation		
	Indirect	*Transactional*	*Collaborative*
1. Type of interaction	Knowledge exchange	Buying/Selling	Shared management
2. Commitment	Uncommitted	Contractual	Partnership
3. Governance complexity	Low	Middle	High
4. Representation	Unclear	Managers	Elected officials
5. Degree of institutionalization	Informal	Formal	Formal

Indirect is the most basic type of cooperation where municipalities engage in active information sharing and joint training to improve their performance. Municipalities benefit from the learning process and can easily stop the cooperation since there are no signed agreements or consequences. Transactional requires a formal contract between municipalities, often for buying or selling services to each other. The contract defines the duration and parameters of the collaboration, and breaking it has consequences such as paying a penalty or decreased trust. Collaborative IMC implies a higher level of commitment and governance complexity because shared management is involved. Municipalities create an institution that makes investments and takes risks. Breaking the partnership involves higher transactional and political costs.

2.2. ISWM

The term ISWM has its origins in the early 1990s when international agencies and civil society organizations (CSO), dissatisfied with the purely technical approach to SWM, promoted the creation of a more holistic approach adapted to the concept of sustainability (Wilson et al., 2013). As a result, UNDP, UN-Habitat and the World Bank set up a collaborative programme on SWM, which concluded with a conceptual framework coined ISWM (Schübeler et al., 1996). Overall, we see an important development from just landfilling waste to reaching ISWM, which pursues a balance between environmental effectiveness (planet), social acceptability (people), and economic affordability (profit) (Elkington, 1997; Marshall and Farahbakhsh, 2013).

Various efforts have been made to create and improve ISWM benchmark indicators (MacDonald, 1996; Hoornweg and Bhada-Tata, 2012; Tanguay et al., 2010; ElSaid and Aghezzaf, 2018; Singh et al., 2014). However, most of the research focused on high-income countries with some exceptions in developing countries (Suttibak and Nitivattananon, 2008; Coelho et al., 2012; Bringhenti et al., 2011; Aparcana and Salhofer, 2013).

Taking a global perspective, UN-Habitat generated a pioneering work of applying ISWM benchmark indicators to evaluate cities in low-, middle- and high-income countries across six continents (Scheinberg et al., 2010). Based on this work, Wilson et al. (2015) developed a comprehensive update and revision entitled the Wasteaware ISWM benchmark indicators (Table A2 in Appendix).

This framework combines quantitative indicators for the three main physical components (health, environment and the 3Rs – reduce, reuse and recycle) with a corresponding qualitative composite indicator for the 'quality' of service provision for each physical component. It also includes five qualitative, composite indicators that assess performance for the three main aspects of governance, namely inclusivity of stakeholders, financial sustainability, and sound institutions and proactive policies (Wilson et al., 2015, p. 340).

We made a few modifications to this Wasteaware framework. Given that our research focuses on measuring the effect of different types of IMC, which are themselves particular governance practices, we adjusted the governance dimension. While maintaining the aspects of inclusivity of stakeholders and financial sustainability, which can be operationalized as outcomes of IMC types, we dropped the aspects of sound institutions and proactive policies as they overlap with governance practices. We now call this dimension 'sustainability'. Next to social (inclusion) and financial sustainability, we added environmental sustainability to focus on the long-term environmental risks. In doing so, the three aspects of the sustainability dimension represent the People, Planet and Profit pillars in the model. Our framework includes social, economic and environmental parameters both in the physical and sustainability dimensions (Table 2).

For the physical dimension, we include waste collection and cleaning sub-categories within the People pillar because they relate to public health issues. In the Profit pillar, we include reducing, reusing and recycling as the main activities that are focused on either reducing costs or using waste as input for other economic activities. For the Planet pillar, we include waste disposal method since it is directly linked with aspects of environmental protection. The three sustainability aspects assess potential long-term success in the People, Profit and Planet pillars.

Regarding social sustainability, we focus on social inclusion measured in terms of citizen participation and formalization of informal waste pickers in the waste system. To assess citizen participation, we adapted the participation ladder framework (Arnstein, 1969) into five categories described in Table 3.

3. Methodology

We chose an embedded single case study as our research strategy to analyse one emerging metropolitan region that presents sub-cases based on different cooperation processes. The case is the emerging metropolitan region that connects two provincial capitals: Cuenca in Azuay and Azogues in Cañar province. Within the Cuenca-Azogues emerging metropolitan region, we grouped municipalities into sub-cases based on their type of IMC. Qualitative and quantitative data on IMC and ISWM for each sub-case was analysed using desk research and semi-structured interviews with relevant stakeholders.

3.1. Operationalization

For the operationalization, we provided indicators for independent and dependent variables. Based on Table 1 and our preliminary findings, we created the sub-units within the case study by clustering municipalities with similar cooperation characteristics. We conducted a qualitative assessment of the most predominant type of IMC based on cooperation characteristics between municipalities related to the type of interaction, commitment, governance complexity, representation and degree of institutionalization.

The dependent variable is ISWM outcomes. For the operationalization, we used Tables 2 and 3 and added indicators, operational definitions and sources (Table 4). As we did not manage to obtain detailed data on costs and subsidies for each municipality, we omitted the financial sustainability parameter from the analysis.

Table 2
ISWM dimensions. Source: Authors.

ISWM Dimensions	People	Profit	Planet
Physical	Health: Waste collection and sweeping coverage	3Rs: Reducing, Reusing and Recycling	Waste disposal method
Sustainability	Social Sustainability: citizen participation and social inclusion	Financial Sustainability: Costs and subsidies	Environmental Sustainability: long term risks of waste disposal method

Table 3
Participation characteristics. Source: Authors based on Arnstein, 1969.

Participation characteristics	Ladder
1. The municipality does not offer spaces for citizen participation	Non-participation
2. The municipality indicates to citizens how they should behave via radio, videos and public speeches	Passive indoctrination
3. The municipality informs citizens about the waste management activities and results	Informed Tokenism
4. The municipality offers spaces where citizens can file a complaint or share their suggestions (e.g., telephone numbers, web form, public consultations)	Responsive Tokenism
5. The municipality partners with neighbourhood associations and other citizen associations to consistently improve waste management. The municipality delegates waste management to neighbourhood groups.	Empowered Citizens

Table 4
Operationalization of Integrated Solid Waste Management Outcomes. Source: Authors.

ISWM Dimension	Indicator	Operational Definition	Sources
Physical	Waste Collection	Percentage of households that has access to reliable waste collection service	INEC + municipal data
	Sweeping Coverage	Geographic extension of solid waste sweeping over extension of streets and public spaces susceptible to sweeping, in %.	INEC + municipal data
	Reducing	Waste Generation Per Capita	INEC
	Reusing	Percentage of municipalities in a particular IMC cluster with segregated collection of waste (recyclable and non-recyclable)	INEC + interviews
	Recycling	1. Percentage of treated organic waste 2. Percentage of recuperated inorganic waste	Municipal data + interviews
	Waste Disposal	Main type of waste disposal open-air dumps, emerging cells or landfills	INEC + interviews
Sustainability	Social Sustainability	Type of citizen participation according to the participation ladder (Table 3) in waste management processes.	Interviews
		Extent of inclusion of vulnerable groups (waste pickers) in waste recovery system.	Interviews
	Environmental Sustainability	Assessment of the environmental risk in waste treatment and disposal method (waste disposal method, studies and municipal ordinance on ISWM)	INEC + interviews

3.2. Data collection and data analysis

The timeframe of our study is 2017–2018. We used desk research and semi-structured interviews with relevant stakeholders as our data collection methods. For the desk research, we reviewed official Ecuadorian documents, reports, newspaper articles and other relevant secondary publications, for example, laws and regulations. Also, we consulted the National Institute of Statistics and Censuses (INEC) for SWM and socio-demographic data. Official websites of municipalities, the Association of Ecuadorian Municipalities (AME) and national ministries such as the Ministry of Environment provided other complementary information on SWM arrangements and cooperation endeavours.

Regarding the interviews with relevant stakeholders, our preliminary desk research identified the first interviewees. The snowball methodology was used to identify the remaining respondents. A one-month immersion (24th of June to 26th of July 2018) in the region facilitated the conduction of face-to-face semi-structured interviews with stakeholders and informants from five municipalities, civil society, national and regional authorities, private and academic sectors. Similarly, the on-site presence allowed a general observation of the cooperation dynamics and the waste management performance in the region. We conducted 15 interviews, out of which 14 were recorded and transcribed. Respondents' anonymity was preserved to reduce socially acceptable or politically correct answers. In one interview, we did not record at the request of the respondent, and while we took notes, we did not code the results since no new information came up, confirming saturation of information.

Furthermore, one of our researchers participated in a week-long waste management course organised by the University of Cuenca where he conducted informal interviews to crosscheck information. This event gathered around 40 key stakeholders of the waste management sector in the region and served as an extra step to validate the information obtained from interviews, observations and desk research. This triangulation of different primary and secondary sources enhanced the reliability and credibility of the information obtained.

For the data analysis, we used the software Atlas TI, which allowed a systematic process for analysing the interview responses. After each interview, conducted in Spanish, we transcribed and uploaded the transcription to the software in the original language. We coded the respondents as R1 to R14. With all the interview documents, we created specific codes related to the research questions as well as some other relevant information collected during the interviews. After the coding, we translated all quotes to include them in a separate document. The codes allowed a comparison of relevant information, grouping ideas and organization for a more lucid qualitative analysis.

Most of the secondary and primary data are based on interviews and questionnaires answered by municipal officials. Therefore, when no other sources are available, the reliability of the information is limited to the accuracy of the respondents.

4. Results

This section presents the key results in the following order. First, subsection 4.1 highlights clusters of municipalities that have a common type of cooperation. Then, subsection 4.2 focuses on describing each cluster's ISWM outcomes, starting with the physical and moving to the sustainability indicators.

4.1. Types of IMC and clusters of analysis

The IMC typology was handy in classifying 22 municipalities in Azuay and Cañar. Our results indicate all municipalities have some level of cooperation (indirect, transactional and collaborative) in their waste management processes. We found one Indirect, two Transactional and one Collaborative cluster per province, adding to a total of eight clusters. Fig. 1 summarizes these findings in a map that shows clusters 1 to 4 in Azuay and 5 to 8 in Cañar province.

Indirect. We did not find a single municipality that does not cooperate with its neighbours. However, some describe their cooperation as basic activities such as sharing information and learning together through capacity-building workshops. Municipalities that only show this type of cooperation are grouped into clusters 1 and 5 and classified as Indirect IMC. The municipalities of Camilo Ponce Enríquez, Oña, Paute, Pucara and Sevilla de Oro (in Azuay) and the municipality of La Troncal (in

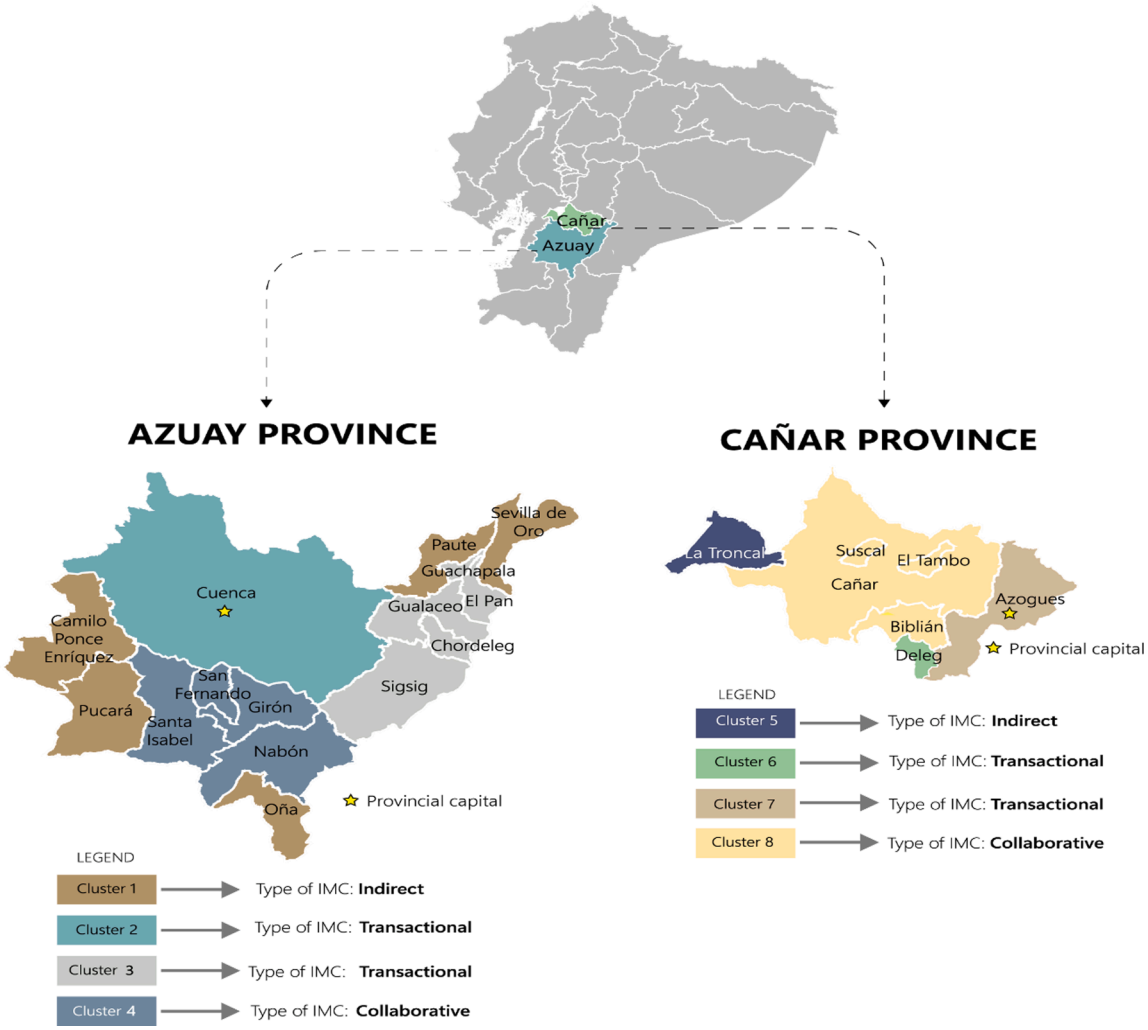

Fig. 1. Map of Clusters and Type of IMC in Azuay and Cañar. Source: Authors.

Cañar) only perform Indirect IMC. They are all small towns with a significant share of rural land, and thus the demand for integrated waste management is lower.

Transactional. Eight municipalities go beyond indirect IMC and engage in transactional cooperation either as buyers or sellers of services to their neighbours. Six of them buy services (clusters 3 and 6) while the remaining two (clusters 2 and 7), provincial capitals, sell their services to neighbouring municipalities.

In cluster 2, Cuenca operates a municipal waste management company (EMAC) which has autonomy over other administrative areas of the municipality. Cuenca started to cooperate in a transactional way when they had to buy neighbouring land to build their newest landfill. Having a bigger landfill opened the possibility to start offering the service of waste disposal to neighbours. In cluster 7, the municipality of Azogues manages waste through traditional In-House Public Management but also offers services of final disposal. Azogues representatives indicated that their political role as the provincial capital and the economic incentive to sell services motivated transactional cooperation.

Smaller municipalities that buy services from provincial capitals are categorized in clusters 3 and 6. In Azuay, municipalities in cluster 3 share a common past. They had a Public Joint Venture (2012–2016), but when it closed in early 2017, they resorted to transactional IMC as an emergency measure (buying services from cluster 2). In Cañar province, cluster 6 takes advantage of its geographical proximity to clusters 2 and 7 and buys waste management services from both providers. Respondents indicated that sometimes, particularly for small municipalities, it is easier and cheaper to buy the services than to invest in their structure.

Collaborative. In the 2017–2018 analysis period, a total of eight municipalities performed collaborative IMC. They are grouped in clusters 4 and 8. Municipalities in both clusters operate through Public Joint Ventures. These inter-municipal ventures are led by a board of mayors that oversees the work of an appointed management team. The operations are funded via a common waste management fee and contributions from member municipalities. Investing in these types of ventures implies new processes. These include a more complex governance model, higher transaction costs of coordination with various municipalities and adaptation to new standards and demands from a wider population. However, municipalities expect a high return from the expected economies of scale and other collaboration benefits such as aggregated technical capacity.

4.2. ISWM results

4.2.1. Physical dimension

Waste collection: % of houses covered and sweeping coverage.

Regarding waste collection, all municipalities reach to most, if not all, houses in their territory and collect waste. Similarly, there are hardly any differences in sweeping coverage since all municipalities have services to reach most streets and public areas (Table 5).

4.2.1.1. Waste per capita, segregated waste collection and recycling. In

Table 5
Physical results - Azuay and Cañar. Source: INEC, 2017, 2018 and interviews.

Clusters	**1**	**5**	**3**	**6**	**2**	**7**	**4**	**8**
IMC Type	Indirect		Transactional (buyers)		Transactional (sellers)		Collaborative	
Waste Collection (% of houses covered)	97-99	97-99	97-99	100	100	100	97-99	97-99
Sweeping Coverage (%)	90.2	97-99	97.9	100	99.9	100	83.5	100
Average collected waste per month per capita (Kg)	22.4	29.0	31.0	80.8	63.4	33.6	29.8	23.8
Municipalities with segregated waste collection (%)	40	0	0	0	100	100	100	100
1) Treated Organic Waste (%/month)	0.3	0.0	0.0	0.0	3.3	10.0	1.6	33.3
2) Recuperated Inorganic Waste (%/month)	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
Final Disposal Type (% of municipalities) 1) Open-Air dumps	20	0	0	0	0	0	0	0
2) Emerging Cell	20	100	0	0	0	0	0	0
3) Sanitary Landfill	60	0	100	100	100	100	100	100

waste per capita, we see a difference in outcomes. Cluster 6 (transactional buyer) produces a monthly average of 80.8 kg of municipal waste per capita, followed by cluster 2 (transactional seller) with 63.4 kg. The remaining clusters have lower waste production in the range of 22.4 and 33.6 kg/month/capita.

For segregated waste collection, municipalities require either specialized garbage trucks or separate times for pickup. These extra investments might explain why only 12 out of 22 municipalities engage in segregated waste collection. Only clusters 2 and 7 (transactional IMC, sellers) and 4 and 8 (collaborative IMC) do well in this area. Still, there is little recycling across the board, but clusters 2, 7 and 8 at least treat some organic waste.

4.2.1.2. Waste disposal. Regarding final waste disposal methods, landfill is the best, and open-air dump is the worst system available in the region. Only municipalities in Clusters 1 and 5 (both indirect IMC) use open-air dump and emerging cells. Conversely, all municipalities with Transactional (sellers and buyers) and Collaborative IMC deposit their waste in a sanitary landfill.

In Table 5, we indicate with the colours red (low), yellow(middle) and green (high) our assessment of the results.

4.2.2. Sustainability dimension

4.2.2.1. Social sustainability. Citizen Participation. The interviews revealed that in Clusters 1, 3, 5 and 6, municipalities inform citizens about the waste management activities and results through their websites and ad-hoc events. However, there is hardly any space to incorporate suggestions or to engage citizens. Therefore, we concluded that Informed Tokenism is the highest form of citizen participation in those clusters (Table 6). Clusters 2, 4 and 7 have a higher level of citizen participation because municipalities offer both digital and in-person forums to receive feedback from citizens as part of their annual activities. Nevertheless, the interviews indicate that while citizens and civil society organizations participate in these forums, their suggestions have a minimal influence on management decisions. For this reason, we categorize participation in these clusters as Responsive Tokenism.

Cluster 8 is the only one where we categorized the citizen participation as Empowered Citizens. In this cluster, citizens are involved in policy design, implementation and evaluation of the waste management system. Various respondents indicated that this is due to the indigenous heritage in Cañar. The province has a tradition of engaged citizens through assemblies known as "*cabildos*.".

Table 6
Sustainability results by cluster Sources: INEC plus interviews.

Clusters		1	5	3	6	2	7	4	8
Type of IMC		Indirect		Transactional (buyers)		Transactional (sellers)		Collaborative	
Social	Citizen Participation	Informed Tokenism	Informed Tokenism	Informed Tokenism	Informed Tokenism	Responsive Tokenism	Responsive Tokenism	Responsive Tokenism	Empowered Citizens
	Inclusion of vulnerable groups	Low	Low	Low	Low	Middle	Middle	Middle	High
Environmental	Degree of environmental protection in waste treatment and disposal	Middle	Middle	Low	High	High	High	High	High

Green: highest score; yellow: middle score; red: lowest score.

"The citizen assemblies here of Cuenca [Azuay] are created by the law of citizen participation. They are created by decree and the municipality has to implement the assemblies. It is a top-down process that only recently has begun to run. However, in Cañar[province] it is their [form of] organization since always. [There] you have a real social cohesion… From my perspective, that is linked to the success of the mancomunidad. That is something that I think does not have the mancomunidad of Santa Isabel or Rio Jubones [in Azuay province]" **R11.**

Inclusion of vulnerable groups focuses on the role informal recyclers play in the recycling process. Estimations indicate that up to 4 million people in Latin America obtain their livelihood by recuperating recyclable materials, such as cardboard, paper, glass, plastic and metal (PAHO et al., 2010). However, in Ecuador, only 6% of recyclers are formalized, often through an association of recyclers (EIU, 2017). In 2018, municipalities in Ecuador collected an average of 12,739 daily tons of solid waste nationwide, of which 84.7% (10,791 tons/day) were collected in an undifferentiated manner and only 15.3% (1,948 tons/day) in a differentiated way (INEC-AME, 2020). Despite this lack of differentiation, recyclers recovered 51% of recyclable material in the country's main cities such as Quito and Guayaquil (IRR, 2017), showing the potential of involving informal recyclers. We classify clusters into high, medium or low inclusion based on how included these groups are in the formal waste management system.

Clusters 1, 3, 5 and 6 score low and clusters 2, 4 and 7 score middle. In clusters 1, 3 and 5, municipalities are smaller, and thus, fewer recyclers are involved. Often one or two families of recyclers have informal agreements with municipal officers to access the waste before it reaches final disposal. In clusters 3 and 5, there are more recyclers than in cluster 1, but still, the arrangements are informal, and recyclers do not have specific contracts or social protection benefits. Deleg (6) buys final disposal services from Cuenca (2) and Azogues (7), and therefore its opportunities for involving recyclers are limited.

Clusters 2, 4 and 7 report having a basic organization strategy to include associations of recyclers in the waste process. Clusters 2 and 7 have higher numbers of recyclers which increases the demand for stricter training and safety protocols in the waste recovery process. According to respondents, provincial capitals also have more resources than smaller municipalities to invest in inclusion strategies. Cluster 4 has a similar level of inclusion as clusters 2 and 7, involving trainings and safety measures for the recyclers.

Cluster 8 shows the highest level of inclusion because the once informal recyclers now have a contract, a fixed salary and basic security and health benefits through a public purchases scheme.

"[EMMAIPC-EP, Cañar] The state was absent. Then I thought about a contract system with basic salary. They [recyclers] receive 335 dollars monthly. Fixed. In total they earn about $ 480 per month.[1] *They no longer depend only on the material they put together. Everyone earns that amount and they in return work properly, they cannot miss[their responsibilities]. They do not have a dependency relationship because we contract directly with the recyclers' association. The association is their boss. Through a system of public purchases from Ecuador now they are formal recyclers, legalized, in better conditions.* **R10**.

4.2.2.2. Environmental sustainability. Analysing the environmental dimension of sustainability, we assess the environmental risk in waste treatment and disposal methods. Given the limited data available on this aspect, we assess the environmental risks associated with the type of final disposal method. In addition, we examine if there are particular studies and specific municipal laws (ordinances) that regulate integrated sustainable waste management processes.

As mentioned earlier, 20% of municipalities in cluster 1 dispose of their waste in open-air dumps and 20% in emerging cells, while cluster 5 uses an emerging cell. Therefore, these clusters have a higher environmental risk than other clusters that use sanitary landfills. Although an emerging cell is much better than an open-air dump, it does not guarantee sustainable environmental protection of the area of the disposed waste in the long run. In addition, in interviews, we did not hear that La Troncal (cluster 5) has plans to build a landfill site or send waste to neighbouring municipalities.

Regarding studies to guide waste planning, clusters 2, 5, 6, 7, and 8 have done a specific waste study to guide their management plan. In clusters 1 and 4, respectively, 60% and 25% of municipalities have done a specific study, and none of the municipalities in cluster 3 (INEC, 2018). Cluster 3 previously had such a study for the Joint Public Venture. However, after its dissolution, the former members do not have yet specific studies to guide a sustainable waste management strategy (interviews).

When asked if the municipalities had a specific ordinance to regulate Integrated Sustainable Waste Management (ISWM), 80% of municipalities have one in Cluster 1, and 100% have one in Clusters 2, 4, 5, 6 and 8. In cluster 3, only Sigsig (20%) has one.

Overall, we assess long-term environmental protection as high in clusters 2, 4, 6, 7 and 8 (high scores in disposal type, studies and laws, or good practices) and middle in clusters 1 (low score in disposal type and

[1] They may earn additional income by selling waste that is not transferred to the municipality.

high in studies and laws) and 5 (middle in disposal type and high in studies and laws). Cluster 3 scored low (high in disposal type and low in studies and laws).

In Table 6, we gave colours to the assessments and numbers to indicate low, middle and high scores. It is clear that cluster 8, with collaborative IMC, has the highest performance in the sustainability dimension, while cluster 4 (also collaborative) is in second place. This is followed by the provincial capitals (clusters 2 and 7) that both engage in transactional IMC as sellers. Cluster 3 (transactional IMC) scores worst, and the two clusters that only practice indirect cooperation, 1 and 5, have similar and low overall scores.

5. Discussion of results

This section highlights the key results of the paper and discusses them in relation to the existing literature in the field.

First, most municipalities have a small size population, and they mainly cooperate via transactional and collaborative IMC. Out of the 22 municipalities, eight have chosen collaborative IMC. The same number opted for Transactional IMC, subdivided into six municipalities as buyers and two as sellers. Only six have opted to remain in the most basic Indirect type. These results indicate a high overall cooperation rate, with most of them choosing the transactional and collaborative types. Since only 3 (Cuenca, Azogues and La Troncal) of the 22 municipalities have populations of over 20,000 inhabitants, the result aligns with existing literature in Europe and the USA that indicates that small-size municipalities have the highest rates of and incentives for cooperation (Hefetz et al., 2012; Bel and Warner, 2014; Perez-Lopez et al., 2016).

Second, *the type of IMC does not affect ISWM performance in basic services such as waste collection and sweeping coverage*. This might indicate that services connected to the public health drivers of ISWM (Wilson, 2007) require fewer resources that, even at the smallest scale, municipalities can obtain optimal results.

Third, *the differences in the amount of waste collected per capita, which may point to successful efforts in reducing waste, do not seem to be related to the type of IMC*. They can perhaps be better explained by the income level, type of economic activity or size of municipalities, with larger ones (Cuenca and Azogues) performing worse than smaller ones.

Fourth, in *processes such as segregated collection, recycling and waste disposal, our results suggest the type of IMC affects performance*. Municipalities that only practice indirect cooperation do not (all) engage in segregated waste collection and still use open-air dumps or emerging cells. All municipalities with transactional and collaborative cooperation use sanitary landfills, and the clusters with collaborative cooperation plus the two provincial capitals (transactional sellers) are more advanced in recycling.

Fifth, *the type of IMC affects social sustainability*. Similarly to the previous result, transactional (sellers) and, most notably, collaborative IMC is linked to better performance than the Indirect type. Citizen engagement and inclusion of vulnerable groups require extra resources and specialized expertise to lead politically sensitive processes. Therefore, municipalities with formal contracts or shared ventures with neighbours have more structure to work on their social sustainability.

Sixth, *the type of IMC affects environmental sustainability*. The results suggest that municipalities that opt for transactional (buyers) and collaborative IMC score higher in environmental sustainability indicators. Besides the type of waste disposal, having ordinances and plans for environmental management affects the results in this dimension.

Overall, *when services in both the physical and sustainability dimensions involve high financial investments and complex management processes, the type of cooperation affects ISWM performance.* The higher financial and technical demand for such services positions transactional (sellers) and collaborative IMC with the advantage of pulling more resources. Transactional sellers have extra resources and have an incentive to reduce the extra amount of waste-to-landfill received from neighbouring municipalities. Similarly, those with collaborative IMC benefit from economies of scale and have higher incentives to increase the lifespan of their shared landfills. In contrast, those municipalities that only cooperate indirectly but continue with in-house management or those that buy services from neighbours have fewer resources and less urgency.

Our findings align with literature that indicates a positive relationship between IMC and better waste management performance (Struk & Bakoš, 2021; Zafra-Gómez et al., 2013). While these studies found that IMC helps municipalities reduce costs, our study stresses that specific types of IMC improve physical and sustainability performance. Similarly, other studies beyond the waste management field already found a link between IMC and the quality and sustainability of services (Blåka et al., 2021; Arntsen et al., 2021; Elston and Bel, 2022). However, to the best of our knowledge, our study is the first in the waste management area to establish a link between IMC types and physical and sustainability indicators.

6. Conclusion

The objective of our paper was to examine the relationship between types of IMC and outcomes in sustainable waste management, assessing the 22 municipalities in the provinces of Cañar and Azuay in Ecuador. We used a typology of inter-municipal collaboration to analyse the linkages between the type of collaboration of municipalities and their integrated solid waste management (ISWM) performance in both physical and sustainability dimensions.

From this research, we concluded that Municipalities in the Cuenca-Azogues region that invested in more complex cooperation proved to achieve more sustainable waste management outcomes. The type of cooperation is related to improving some ISWM outcomes. In both dimensions there seems to be a path towards better outcomes in the following order: Indirect, Transactional buyer, Transactional seller and Collaborative IMC.

It must be noted, however, that the transactional sellers were the two provincial capitals; this may imply that scale is an important factor. Larger municipalities can afford to remain in the transactional cooperation mode. In addition, basic services such as waste collection and sweeping do not show differences. This may indicate that collaborative cooperation mostly matters when the service is more costly or complex, like segregation of waste collection, final disposal method or recycling. In other words, if municipalities, particularly smaller ones, want to achieve more complex goals such as integrated waste management or circular economy models, they should also increase the complexity of collaborative governance arrangements.

The paper has some limitations. First, the number of cases (clusters) is small, so conclusions can only be drawn with caution. Second, the findings may be specific to the context in which the study was conducted and therefore broad generalizations to other regions cannot be made. Third, social and environmental impact studies on waste management in the region are scarce, and thus, most data are based on secondary surveys and interviews with public officials. This limits the scope of our study. Access to more data will provide opportunities for incorporating other elements such as financial sustainability and longitudinal waste reduction analysis to assess municipalities' performance better.

Further research could investigate if the observed successes of collaborative and transactional IMC experiences in the region hold if a longer time period is considered. In addition, broader generalizations on the effectiveness of IMC for ISWM could be made by comparing more cases and cases located in different regions.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.wasman.2022.07.008.

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