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Research article

Caste, mistrust and municipal inaction: The interwoven barriers for the integration of waste pickers in India

Lidia Juárez Pastor [a,b], Vrishali Subramanian [b], Stefano Cucurachi [b], Amineh Ghorbani [a,*]

[a] Faculty of Technology, Policy and Management, Delft University of Technology, Delft, the Netherlands
[b] Institute of Environmental Science, Leiden University, the Netherlands

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ABSTRACT

Solid waste management in low- and middle-income countries like India faces significant challenges due to the increasing waste generation that surpasses the current capacity. Therefore, the informal waste sector (IWS) is more vital than ever in handling consumer waste alongside municipal solid waste management (SWM) systems. However, the integration of the IWS into formal waste management systems remains unresolved due to adverse social and economic conditions. This study focuses on identifying the root causes that hinder the integration of the IWS in India's waste management system, using the city of Chennai as a case study. Adopting an institutional perspective, we analyse the institutional landscape of the waste management system, considering both formal rules (in policy documents) and informal rules (i.e., social norms and routines). The institutional network analysis reveals a significant misalignment in perceptions among governance levels concerning the integration of the IWS. The study shows a considerable gap between rules-in-form and rules-in-use, leading to 1) Preclusion of waste pickers in collecting door-to-door source-segregated waste (i.e., recyclables). 2) Unfair pricing in transactions with small aggregators. 3) Lack of ID cards for waste pickers. These barriers are ultimately rooted in caste discrimination, misalignment between governance levels, and the exclusion of waste pickers in the policymaking process. In conclusion, understanding and rectifying the institutional gaps and discriminatory practices are essential steps towards effectively integrating the IWS in India's waste management system, promoting a more inclusive and sustainable approach to waste management.

1. Introduction

Solid Waste Management (SWM) poses a significant challenge for India and other low- and middle-income countries as waste generation continues to outstrip the capacity of current linear waste management approaches. In these regions, municipal SWM systems coexist alongside informal waste sector (IWS) activities, which serve as alternative practices for managing and disposing of most generated waste (Jai Singh Rathore, 2020).

Evidence demonstrates that the IWS can improve social, economic, and environmental outcomes in SWM (Calderón Márquez et al., 2021). This improvement is made by reducing collection and disposal costs for waste management services (Wilson et al., 2006; Majeed et al., 2017), facilitating a substantial portion of recycling efforts by extracting recyclables and conducting door-to-door waste collection (Coletto and Bisschop, 2017; Kala et al., 2022; Jai Singh Rathore, 2020; da Silva et al., 2019; Indranil and Patel, 2022).

Despite the invaluable contributions of the IWS, waste pickers, who form a significant part of this workforce, endure adverse social and economic circumstances. They are subject to systematic marginalisation, characterised by asymmetric power relations, exploitative labour practices, discrimination, child labour, social exclusion, limited education access and fluctuating prices (Aparcana, 2017; Gall et al., 2020; Jai Singh Rathore, 2020). Yet, these waste pickers are responsible for extracting recyclables from mixed waste, engaging in physically demanding and least rewarding labour (Gall et al., 2020), all while working under hazardous conditions (Zolnikov et al., 2021).

India and other low- and middle-income countries, such as Brazil and Colombia, have legally recognised the IWS to promote its integration (Calderón Márquez et al., 2021). India acknowledged the IWS in 2016 by mandating its formalisation in the Solid Waste Management legislation. However, despite these policies, persistent barriers hinder its actual integration (Calderón Márquez et al., 2021).

According to Jai Singh Rathore (2020), these policies fail to

* Corresponding author.
E-mail address: a.ghorbani@tudelft.nl (A. Ghorbani).

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incorporate the already-existing service provision network of informal waste collection. This lack of integration can be because the IWS is treated as a problem rather than an opportunity to reorganise the waste chain, generating economic value and minimising environmental impacts (da Silva et al., 2019; Kala et al., 2022).

While legislating bodies acknowledge that integrating the IWS would yield diverse benefits via reducing recyclable waste in landfills and increasing recycling capacity, they interchange the term "integration" with legislation, reconciliation, and formalisation. Yet, proper integration requires the socio-economic inclusion of waste pickers in municipal SWM systems (Velis et al., 2012). Ideally, their occupation should be recognised as a service provision rather than perceived as scavenging (Harshey and Sharma, 2016).

Persisting barriers to successful integration may not solely lie within the integration strategies or interventions but may stem from other systemic factors. Various approaches to formalisation have yielded mixed results (Aparcana, 2017), indicating the influence of cultural and organisational factors on waste policy enforcement in India (da Silva et al., 2019). Therefore, understanding these barriers at the implementation level is crucial for policy adaptation and successful enforcement (da Silva et al., 2019). Shedding light on these issues can aid in developing future policies that address these barriers to integrate the IWS effectively.

The primary objective of this research is to investigate and identify the root causes that hinder the true integration of the IWS into India's SWM system, as mandated by the existing policy. Waste pickers in India have received support from formal organisations, encouraging action recommendations for local governments (da Silva et al., 2019). Yet, these rules-in-form are "neither transparent nor well-enforced (Helmke and Levitsky (2004: 42), as cited by Da Silva et al., 2019), calling for special attention to the rules-in-use, which are rooted in Indian culture, and specifically the caste system.

This study conducts a comprehensive and unique analysis of the formal and informal institutional landscape surrounding the IWS to address the aim. The study focuses on Chennai, located on the southeast coast of India and is the capital of the state of Tamil Nadu. It is the 5th largest city in the country, with an estimated population of 11.5M in 2022 (Population, 2022). This city has progressed less than other major cities of India in recognising and integrating the IWS into the municipal waste system (Citizen matters, 2022), thus making it an important case to explore.

Understanding institutions as 'the rules of the game in a society' (North, 1990), this research builds on the premise that institutions, i.e., formal and informal rules, guide the behaviour of actors. By studying policy documents to identify the formal rules and conducting interviews with key actors to identify the social norms and routines (i.e., informal rules), we perform an institutional network analysis (Mesdaghi et al., 2022) to pinpoint potential misalignments in the SWM sector to determine persisting barriers for integrating the IWS.

We contribute to the literature by offering a comprehensive institutional approach to enhance the understanding of waste policy implementation in India. Through our research, we delve into the specific rules-in-form and rules-in-use within the waste management system, shedding light on their discrepancies. By adopting a comprehensive institutional perspective, the study further extends the existing body of institutional research in this domain. Notably, our work builds upon and complements the studies conducted by Da Silva et al. (2019) and Indranil and Patel (2022), further enriching the understanding of waste management policy and its implementation in India by diving into the rules-in-form and the actual rules-in-use in the society.

Da Silva et al. (2019), highlight the importance of policy enforcement and suggest ethnic and caste-based divides as barriers for effective policy implementation. While taking an institutional approach, they do not dive into the actual formal and informal institutions that could unravel potential solutions to such societal divide or other institutional barriers for this lack of integration. Likewise, Indranil and Patel (2022) also take an institutional perspective on the matter but focus on actors rather than the rules that govern them. They emphasise the need to integrate the formal and informal sectors and the urgency of waste workers' working conditions. Following a similar institutional lens, our study is the first to capture the actual rules and regulations and put them against the informal arrangements among actors in the waste sector to identify potential discrepancies that affect successful integration.

The article is structured as follows: the next section presents the theoretical basis of this study, including the background for institutional network analysis and existing literature on the SWM system. Section 3 presents the research design and data collection procedure. Section 4 presents the results. Section 5 provides an interpretation and discussion of the results. Finally, Section 6 presents the main conclusions and policy-relevant implications inferred from the results.

2. Background: theoretical basis and case study description

This section first introduces the Institutional Network Analysis (INA) approach and consequently dives into the literature on SWM.

2.1. Theoretical background for institutional network analysis

The theoretical background of this paper is grounded in the Institutional Analysis and Development (IAD) framework (Ostrom, 2005). The IAD framework conceptualises institutions as sets of rules governing human interactions in specific contexts (North, 1990; Ostrom, 2005). This study focuses on the "action situation" concept within the IAD framework, which refers to the specific context in which individuals or groups interact and make decisions shaped by the institutional rules governing their behaviours and interactions in waste management settings (McGinnis, 2011).

The IAD framework incorporates "rules-in-use" as a fundamental element of any system. These rules-in-use represent the institutions that actors utilise within specific settings. On the other hand, "rules-in-form," also known as formal rules in the context of McGinnis (2011), consist of written regulations found in policy documents, statutes, regulations, or bylaws. While rules-in-form are explicitly documented, rules-in-use are spoken or tacitly understood as social norms, cultural practices, customs, or habits (Watkins and Westphal, 2016; Roggero et al., 2018).

The Institutional Grammar (IG) provides a further refined syntactical definition of both rules-in-form and rules-in-use (Crawford and Ostrom (1995)). IG provides a theoretical structure to analyse institutions and their constituent elements through a systemic coding process (Bushouse et al., 2021). This theoretical structure is a tool that has proven useful in providing a common framework for synthesising and understanding the content of institutional statements (Crawford and Ostrom, 1995; Basurto et al., 2010; McGinnis, 2011).

Similar to the concept of institution, an institutional statement is a "shared linguistic constraint or opportunity that prescribes, permits or advises actions or outcomes for actors"; said constraints and opportunities are either spoken, written or tacitly understood by the actors in a given empirical setting (Crawford and Ostrom, 1995). In IG, institutional statements are expressed as sets of six components, which are the unitary elements of the so-called ABDICO syntax (Crawford and Ostrom, 1995; Watkins and Westphal, 2016; Siddiki et al., 2011). The syntax identifies components common to every institutional statement (Crawford and Ostrom, 1995; Bushouse et al., 2021). No matter how institutional statements are expressed in natural language, the syntax allows for their comparison, analysis and synthesis, which helps understand complex policy issues (Crawford and Ostrom, 1995; see also Basurto et al., 2010). The six syntactical constituents are.

- Attribute: actor (individual or corporate) to whom the institutional statement applies.
- Object: receiver of the action of the institutional statement, which can be both animate (e.g. waster picker) or inanimate (e.g., waste).

- Deontic: prescriptive operator that specifies if an action may, must or must not, should or should not be undertaken by the relevant actor.
- Aim: denotes the action of the institutional statement.
- Context: conditions or the situation under which the statement is deemed appropriate or relevant.
- Or else: denotes the sanction to be applied if the statement is not complied with.

The IAD framework and the IG form the basis of the Institutional network analysis approach proposed by Mesdaghi et al. (2022). In this approach, rules-in-form and rules-in-use are coded using the IG and clustered into various action situations. For each action situation, one or more network diagrams are built where institutional statements are connected to each other.

INA aims to bring various rules related to an action situation together to gain a better overview of the institutional landscape/context and identify potential discrepancies between rules-in-form and rules-in-use. Compared to the mainstream social network analysis methods, the INA approach pays extra attention to the outcomes of institutions in the form of inanimate objects (e.g., contracts, waste) and the context within which the institutional statement applies (i.e., condition). The work closest to the INA approach is the NPI (networks of prescribed interactions) approach, which also has an institutional focus and uses the IG (Olivier, 2018). The NPI approach includes actors and their interactions (similar to a conventional social network diagram) and does not capture the context and outcomes. As this research focuses on how rules-in-form are being practised, we use the INA approach to include the context of these rules in our analysis as well as the inanimate outcomes of rules. These focal points in the institutional landscape/context can hint at the root causes of discrepancies related to expected outcomes (e.g. amount of waste) and the context (i.e., the conditions that the rules-in-form prescribe to waste pickers).

2.2. Informal waste supply chain and waste pickers

In low- and middle-income countries, the IWS typically consists of individuals or family groups of low status, sometimes micro-enterprises, and is characterised by being unregulated, unorganised, non-recognised, low-paid, untaxed and labour-intensive (Zolnikov et al., 2021; Gunsilius et al., 2011; Wilson et al., 2006).

The IWS is a supply chain in which various types of actors interact by collecting, buying and selling recyclables, namely, as in this research: 1) waste pickers and itinerant buyers, 2) small aggregators, 3) large aggregators, and 4) processors (Kabadiwalla Connect, 2020; CSE, 2021). Since profitability is determined by the ability to store, i.e., aggregate, and transfer waste in bulk (Indranil and Patel, 2022), we employ the term aggregator (in other studies, waste dealers or traders). It is worth noting that this supply chain only involves recyclables: materials from which the actors can earn money because they have an economic value in the market.

Usually, the informal waste recycling process starts with waste workers, typically referred to as waste pickers, who gather recyclables from mixed waste in landfills, community bins or the streets. Next to waste pickers, itinerant buyers can also collect recyclables from private houses. Both waste pickers and itinerant buyers sell the collected material to small aggregators. Waste pickers are usually affiliated with a single small aggregator and rely on them for "a wide range of services" (Indranil and Patel, 2022). Small aggregators also buy recyclables from formal waste workers, who are incentivised by the monetary reward they receive in exchange from the informal aggregators (Citizen matters, 2022). Small aggregators sort and aggregate the recyclables to sell to big aggregators, who own larger storage spaces to store the segregated material. Large aggregators sell to processors, who convert the waste into recycled or secondary raw materials sold back to the manufacturing industry. Although operating informally, waste aggregators and processors are organised and integrated into the recycling chain, besides having a stronger economic standing (Indranil and Patel, 2022).

The actors of this supply chain differ in their socio-economic status (CSE, 2021). Waste pickers are fundamental to waste management yet excluded from the formal labour market due to their "economically disadvantaged position" (Coletto and Bisschop, 2017). The informal waste supply chain's inability to "store waste for speculative gains" prevents waste pickers from moving up the chain (Indranil and Patel, 2022), remaining in vulnerable socio-economic conditions. In Indranil and Patel (2022), waste pickers reported daily earnings of 1–2 USD. These low returns are associated with caste and other forms of social exclusion. Waste pickers suffer chronic poverty and belong to marginalised communities (i.e., lowest caste or Dalits); they are ignored or harassed by society and are perceived as dirty (CSE, 2021). They lack access to health services and social security schemes. Unlike the rest of the actors in the chain, waste pickers work in hazardous conditions. Furthermore, waste pickers' access to waste is threatened by waste infrastructural transformations towards centralisation of waste management, for example, through waste-to-energy transformations or privatisation of collection services (Jai Singh Rathore, 2020).

2.2.1. The interface between the formal waste sector and the IWS

Regarding the IWS, national-level rules in India call for the recognition and integration of waste pickers into the formal system by "recognising informal waste collector organisations, facilitating their participation in SWM, including waste collection, establishing material recovery facilities or secondary storage facilities, incentivising waste recycling and encouraging local governments to formalise informal waste collectors" (Indranil and Patel, 2022). Nonetheless, the implementation of rules-in-form are hampered by various issues, such as a lack of financial resources and local infrastructure, inadequate planning or allocation of responsibility among actors (da Silva et al., 2019).

Informality primarily arises due to factors such as unemployment, stigmatisation, and insufficient financial resources for implementing adequate waste management practices (Da Silva et al., 2019). Three distinct perspectives on reasons for informality exist: 1) marginalised individuals who have been unsuccessful in securing formal employment; 2) the harmful or illegal nature of the job inhibiting the job from becoming formalised; and 3) individuals having the objective of circumventing bureaucracy and taxation (Coletto and Bisschop, 2017). In the informal waste supply chain, these distinctions are also evident, with waste pickers aligning with the first perspective while aggregators and processors align with the third perspective.

Lately, researchers have argued against a clear dichotomy between the formal and informal sectors, challenging formal-informal binaries in the waste sector (Harriss-White, 2018; as cited by Jai Singh Rathore, 2020). Contrary to common perception, Porter et al. (2011) argue that informality is not external to the formal system but rather originates from within formal structures. Coletto and Bisschop (2017) state that the "dichotomous view" does not reflect the complex reality of low- and middle-income countries. In fact, Harriss-White (2020) maintained that this binary is a simplification of unequal and coercive relations. Indranil and Patel (2022) suggest instead that the system consists of a formal-informal continuum, in which the efforts of formal and informal actors are mutually supportive. However, they claim a divide exists at the collection and segregation levels, where the formal-informal division "might be interpreted as a process of isolating and exploiting the poor for the benefit of the formal sector". This debate conveys the complexity surrounding waste management in India and other low- and middle-income countries.

2.2.2. Caste and waste picking

The caste system, the most important informal institution related to waste management, has historically stratified Indian society into a hierarchy of "religious, ethnic and hereditary classifications" (Indranil and Patel, 2022). Although caste no longer imposes or prescribes occupations, the lowest caste (Dalits), or "untouchables", have traditionally

performed the 'unwanted tasks', e.g., waste management (Indranil and Patel, 2022). This caste is associated with dirt and impurity (Rodrigues, 2009; as cited by Indranil and Patel, 2022).

According to Harriss-White (2020), waste picking is subject to "stigma, caste-stratified oppression, contracts interlocked through caste inequalities, and of patronage and exploitation intensified by caste". Under these cultural institutions, handling untreated waste is considered degrading, and waste picking is a naturalised occupation for Dalits (Jai Singh Rathore, 2020; Harriss-White, 2020, as cited by Indranil and Patel, 2022). Limited by their lack of skills, education and caste rank, waste pickers cannot find better options (Indranil and Patel, 2022).

In summary, the current body of literature examining the integration of informal waste pickers (IWS) addresses fundamental issues contributing to the lack of integration. These include factors such as caste discrimination, particularly prevalent in India, the challenge of securing formal employment, and obstacles within the formal structure that impede integration. However, the literature tends to remain at a broader level of analysis, focusing on overarching themes like caste without delving into specific root causes. Furthermore, there is a noticeable absence of in-depth exploration into the practical implementation of formal policies. Consequently, a concrete solution aimed at easing the unfavourable circumstances faced by IWS and enhancing the prospects of successful integration is yet to be identified.

3. Research design

This research takes an inductive approach (Bhattacherjee, 2012) where the process started with collecting formal and informal institutional data for the case study of Chennai and using the institutional network analysis approach to code and analyse that data. As such, no prior theories were used to hypothesize about potential causal relationships in our study.

3.1. Data collection

Data for this study was gathered using a combination of desk research and interviews. During the desk research phase, rules-in-form were extracted from key policy documents, specifically the national Solid Waste Management (SWM) policy (Solid Waste Management Rules, 2016), and municipal bylaws (Chennai Corporation, 2022c). The selection of these documents was made in consultation with experts in waste management in India. Desk research was conducted from February to April 2022, concurrently with the preparation for the interview phase. As we focused on the formal and informal institutions (i.e., rules governing behaviour, whether formal or informal) rather than actor behaviour, we defined our sampling population for the interviews from experts (e.g. University scholars), activists (e.g. from NGOs) and decision-makers (i.e., government bodies) active in the field in the city of Chennai. The list of organisations and employees was compiled in consultation with an NGO organisation and university scholar. All interviewees had comprehensive knowledge of how the interaction between the formal and informal sectors occurs and the type of formalities and informalities that influence these interactions. An overview of all interviewees is presented in Table A1 in Appendix A.

The questions in the semi-structure interviews were informed by common problems identified in the literature regarding informal waste picking, the type of interaction between actors in the formal and informal sectors, and the extent to which the rules-in-form are followed. As the research was conducted inductively, no prior hypotheses were drawn from the literature. The topics discussed during the interviews are presented in Table 1, with example questions for each topic. The full list of questions can be found in Appendix A. Before interviewing the participants, their consent to participate in the research was obtained. In total, we conducted 16 interviews, each lasting 25–60 min.

All interviews were held in May 2022 and were carried out in English, except for one that was performed in Tamil and translated to English by one of the co-authors of this article. The research was conducted remotely from the context of the case study through video calls and four phone calls. For the case of video calls, Teams and Zoom were used due to their transcription features. All interviews were recorded and transcribed. The transcripts from each interview were revised in detail, given that the automatic transcription did not attain 100% accuracy. Transcripts were stored following GDPR regulations.

Table 1
Topics and example questions for data collection (interviews).

Main Topics	Example Questions
Persisting barriers to the integration of the IWS	-What are the persistent barriers to the integration of IWS?
Potential measures	-What measures and/or policies do you think could be implemented to achieve real integration of the informal sector?
Rules and guidelines applicable to IWS and its integration	-Can you give a general overview of what the Rules 2016 meant for SWM and the informal sector?
Interaction between stakeholders: IWS and Formal Waste Sector, IWS-municipality, IWS-society, and actors within IWS	-What is the social perception of the IWS? -Can you elaborate on typical situations where waste pickers or IWS might suffer harassment from the authorities or other actors?
Common problems between informal stakeholders (especially waste pickers and aggregators)	-Can you describe what kind of problems are common between waste pickers and aggregators? - Are there problems with other informal actors and waste pickers?
Views on (integration of) the IWS	-What is the priority for organisation X when it comes to the integration of IWS?
Information asymmetry regarding price among informal stakeholders	-How do you think it can be ensured that waste pickers receive a fair price for recyclables?
Implementation status (actual integration efforts)	-What is the current situation of the IWS in Chennai? What has been done?

3.2. Data coding

We followed the steps outlined by Watkins and Westphal (2016) on extracting institutional data from interviews by first clustering the content into action situations based on the recurring topics identified in the interview transcripts. These clusters were verified with one of the experts, who was also an interviewee.

Once clustered, we discerned and selected only data containing institutional information. Although we used the recommendations suggested by Watkins and Westphal (2016) and Mesdaghi et al. (2022) for extracting institutional statements from interview transcripts, our approach to coding interview data differed in one crucial aspect. Instead of considering each sentence as a unit of analysis as they had suggested, we analysed the content at the paragraph level, extracting the core message implicit in a paragraph and coding it as an institutional statement if applicable. To minimise bias, two researchers independently conducted this process. If an interviewee referred to a specific rule-in-form, that specific rule was searched for in policy documents and only, if found, was formulated as a rule-in-form.

Once institutions were extracted, they were converted to institutional statements using the IG syntax (version 1.0) in Excel. We coded each ABDICO element with similar wording (e.g., rag picker or informal waste worker, coded as *waste picker*) to ensure all institutional statements could be linked later in diagram form. These statements were coded as rules-in-use.

To code institutions from formal documents, we followed the guidelines proposed by Basurto et al. (2010), starting from paragraphs, then dissecting them into sentences and using ABDICO to code each element of an institutional statement. These coded statements were listed as rules-in-form.

3.3. Building network diagrams

Network diagrams are compiled to perform the network analysis by connecting institutional statements in each action situation. An example of an institutional statement in diagram form is presented in Fig. 1. The full visualisation conventions for the network diagrams can be found in Appendix C. Two statements are considered to be connected to one another if the object [B] of the first institution enables condition [C] of the second one. As a convention in INA, animate objects are coded as part of the aim node, while inanimate objects are depicted as separate nodes.

The network diagrams allow for a visual representation of the institutional relationships in each action situation in terms of shared context and objects (outcomes) that link statements to each other. In addition to insights into the institutional setting, they also infer information about institutional discrepancies. These misalignments are represented in the diagrams in the form of black stars (see Fig. 2 for three examples of discrepancy). A discrepancy is identified when two institutional statements share all syntactical components except for the object, aim, *or* one or several conditions.

Next to the qualitative assessment of the institutional landscape and potential discrepancies between rules-in-form and rules-in-use, three network metrics described in Table 2 are calculated to add quantitative insights to support the analysis: centrality, embeddedness and institutional dependency rate (Mesdaghi et al., 2022) (.). First, the *centrality* of actors measures the importance of actors in following institutions in an action situation. Secondly, the *embeddedness* of inanimate objects measures the extent to which an object acts as a trigger for other institutional statements through 'activating' their context. In this manner, inanimate objects may 'act' as bottlenecks in the institutional setting to realise outcomes. Thirdly, the institutional dependency rate measures the density of the network, understood as the extent to which institutions rely on the execution of other institutions to take place.

IWS.

4. Results

In total, six action situations were extracted and finalised for the clustering of institutional statements: 1) Informal Waste Supply Chain, 2) Market and IWS, 3) Interactions between IWS and Formal Waste Sector, 4) Interactions between IWS and Society, 5) Solid Waste Management Agenda, and 6) Municipal Integration Obligations. The coding process led to 180 institutional statements in total. 28 rules-in-form and 74 rules-in-use (see Table B1in Appendix B for the full list of statements) were used to build network diagrams. We disregarded the remaining 60 coded institutional statements as they were not directly related to the defined action situation or the IWS in general.

In this section, we offer a concise overview of key insights regarding the integration of the IWS in SWM. In total, we identified 14 institutional discrepancies, which were uncovered by comparing the rules-in-form alongside the rules-in-use for each action situation. These discrepancies hinted at the root causes of policy failures within the integration process.

Additionally, we computed network metrics for each action situation to support our analysis further. Detailed results of these metrics and the complete set of diagrams can be found in Appendices E and D, respectively.

Our presentation of results is organised as follows: firstly, we present findings related to the formal institutional landscape (Section 4.1), encompassing aspects related to policy formulation and implementation. Following that, we delve into insights about the informal institutional landscape (Section 4.2), which pertains to aspects connected with caste, social norms, and informal practices.

4.1. Formal institutional landscape: policy making

4.1.1. Overview of the SWM institutional setting

In India, the most important formal institutions (i.e., rules-in-form) concerning waste management are established in the national waste policy, the SWM Rules 2016 (Solid Waste Management Rules, 2016). Next to the rules, the national program of Swachh Bharat Mission, initiated in 2014, aimed to tackle open defecation, achieve garbage-free streets and hygiene, and modernise municipal SWM (Indranil and Patel, 2022).

In the national regulations, source separation is mandated to increase waste recycling and minimise landfilling. Furthermore, the Rules legally recognise the IWS and mandate its integration into the formal municipal solid waste systems. The national policy is passed down to the state level and incorporated into the municipal bylaws for local implementation (Chennai Corporation, 2022c).

The local government or municipality is officially known as the Great Chennai Corporation (Chennai Corporation, 2022a). The SWM department of the Chennai Corporation is in charge of waste collection and management. In Chennai, the department manages seven transfer stations and two non-scientific landfills (i.e., unsealed dumps where there can be lixiviates and polluting spills). SWM services collect 5400 MT of waste from 90% of the city (Chennai Corporation, 2022b) on a daily basis. Primary collection is carried out door-to-door, and source separation is encouraged but not widely practised. Mixed waste is sent to transfer stations for secondary collection before final disposal to landfill. In some areas of the city, SWM operations are outsourced to a private company.

In the past, Chennai witnessed attempts to recognise and integrate waste pickers into the municipal solid waste system. In the 1990s, waste pickers were organised by a local NGO to provide SWM services (The Hindu,). In the late 2010s, several waste pickers who worked in the city landfills were surveyed and registered as a prior step to receiving occupational ID cards by a local civil group and the Municipality (CAG, 2015). However, these interventions were interrupted and did not improve waste pickers' living and working conditions, who consequently returned to operating informally.

Next to the public SWM service provision, in the areas of the city where these services are outsourced, the municipality mandates private contractors to employ waste pickers through tender contracts (CAG, 2019). *Yet, in the period during which the research was conducted, no waste pickers were part of SWM services neither by the municipality nor by a private contractor.*

4.1.2. Process of formal integration of waste pickers in SWM

National policymakers formulating the SWM policy agree on the need to integrate the IWS. This consensus has resulted in the legal recognition of the IWS in the Rules 2016. The legal recognition was intended for waste pickers only, under the assumption that scrap shops, waste aggregators and processors do not need the "protection" of the law as they are "already integrated into the recycling chain". The Rules were devised to protect waste pickers, given their socio-economic exclusion, and to protect their livelihood from other SWM plans that would restrict their access to waste (i.e., plans to combat littering or close transfer stations and landfills).

State policymakers formulate the state SWM rules based on the national policy. During this process, the interests of waste pickers are represented by policymakers, experts and NGOs. The state SWM policy is passed down to the local level in the municipal bylaws, which aim to incorporate the Rules 2016.

A clear barrier is identified in the local institutional setting for integrating waste pickers: According to the bylaws, the municipality *must* establish the mechanisms for integrating waste pickers "however they deem appropriate". In practice, according to the experts interviewed, the municipality did not consider the integration of waste pickers during the implementation of the bylaws (Fig. 2). This issue will

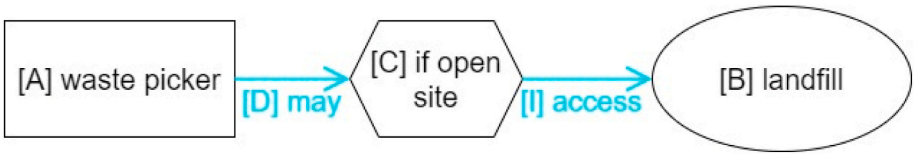


Fig. 1. Example statement in network format.

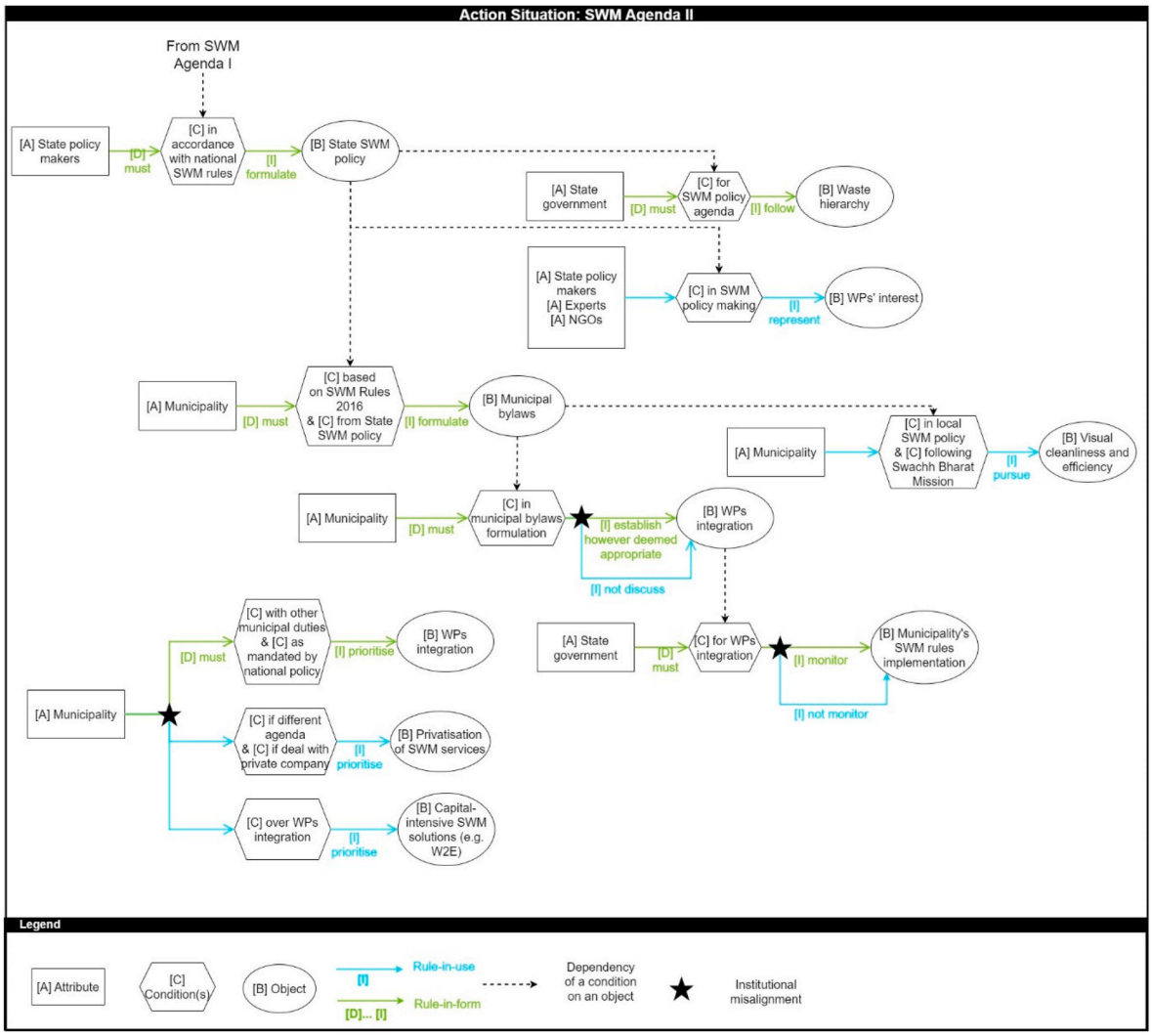


Fig. 2. Solid waste management agenda (II).

be further analysed in the following section.

4.1.3. Implementing integration policies locally

The organisation responsible for implementing the bylaws at the local level is the municipality. However, the diagrams reveal that the municipality is the major bottleneck for implementing the integration policy as it has thus far invested no effort in integrating waste pickers into the formal SWM system. This organisation is associated with a high number of non-conformance instances, i.e., the formal responsibilities set by SWM policy that are not undertaken by the municipality. More specifically, the rules-in-form that the municipality does not put into practice, as shown in Fig. 3, are: 1) the municipality must provide waste pickers with ID cards if they are unregistered; 2) the municipality must establish a system to recognise waste pickers' jobs; 3) the municipality must ensure waste pickers are integrated in SWM services, and that they have access to waste, so their source of livelihood is not threatened; 4) the municipality must provide waste pickers with training on SWM, in the event of integrating waste pickers in SWM services.

In several interviews, participants mentioned that most waste pickers have no identity proof,[1] while SWM policy mandates the municipality to register waste pickers by issuing ID cards as a means of identification. The argument that the municipality makes for not providing ID cards to waste pickers is the potential misuse of the cards. That is, according to the municipality, a waste picker with an ID card issued by the local government could potentially pretend to be a worker "from the

[1] Figures show that the last IDs handed out to waste pickers date back to 2018, and there were only very limited numbers.

Table 2
Description of measures.

Metric	Calculation	Range
Centrality	Number of links per attribute connecting them to conditions, divided by the average number of links per attribute connecting them to conditions (Janssen et al., 2006)	Range: [0, ∞] A high degree for an attribute implies an important position in the carrying out of institutions and the spread of information,
Embeddedness	Number of links directed out of the object, divided by the total number of links (in-degree + outdegree) per object.	Range: [0, 1] A high value for an object implies that high number of institutions are dependent on this object for their execution.
Institutional interdependency index (III)	Number of outdegree links from all objects divided by all possible outdegree links (i.e. every institution (i.e. object) being connected to all other institutions (only possible through conditions)). All possible connections = 0.5 *conditions * (conditions – 1)	Range: [0,1] A high value for a diagram implies that a high number of institutions in the diagram rely on the execution of other institutions for their own execution.

mistrust awareness programs or trainings if the municipality or NGOs give them, or to put it simply, by formal actors in any case (see full diagram in Appendix D, Figure D3).

4.2. Waste picking in practice: informal institutional landscape

The informal institutional landscape presents the social perceptions, as well as the informal practices of this supply chain, that influence how waste pickers navigate the IWS and waste system in general.

4.2.1. Caste

The informal waste supply chain is deeply steeped in caste stigma. While small aggregators and itinerant buyers are socially allowed to go door-to-door visiting households to buy recyclables, many citizens do not tolerate waste pickers coming to their houses. In other words, a rule-in-use (i.e., the norm) forbids waste pickers from buying recyclables from citizens' homes, and in this way, they are precluded from having access to source-separated and hazard-free recyclables. Citizens treat the actors of the informal sector differently, and this difference in treatment depends on the actors' caste and not on their informal status.

In fact, the law explicitly states that citizens must not disrespect any person from the low caste, but this is barely practised (see Fig. 4). Waste pickers are often transient or migrants and, in most cases, Muslims. Besides caste stigma, xenophobia and islamophobia are also evident in society, which heighten waste pickers' vulnerability to discrimination.[3]

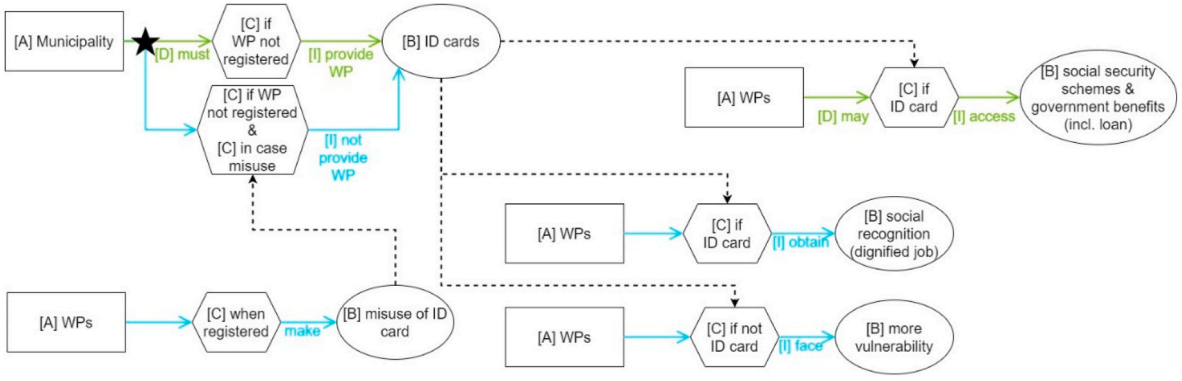


Fig. 3. Excerpt from the municipal integration obligation action situation (Figure D3.). This snapshot shows the embeddedness of the object "ID cards" and the institutions it activates.

municipality" in order to obtain higher status or social position and realise a hidden agenda.[2] Consequently, the integration process is blocked in this first step of registration.

As Fig. 3 highlights, the "ID card" object is highly embedded (network metric: E = 0.60) in the institutional environment, as possessing it enables various institutional rights. Obtaining an ID card allows waste pickers to access several government benefits and social security schemes, such as health services, primary education for their children, or a daily meal. For all purposes, waste pickers without IDs are non-existent in the formal system.

Next to the identification issue, there are also other problems with the formal integration of waste pickers. Most important are the unsuccessful programs or trainings launched to raise awareness among waste pickers about the use of personal protective equipment or the benefits of ID cards. These programs provided by NGOs or government entities have not thus far attracted waste pickers (see Fig. 3; see institutional statement S18 in Table B1). One of the experts reported that waste pickers

4.2.2. Waste pickers in the informal waste supply chain

The interaction between waste pickers and small aggregators is informal and is based on mutual loyalty and expectations. In fact, the object "waste picker loyalty" is highly embedded (E = 0,75) in this institutional setting. An example of loyalty-based interactions in this supply chain is that small aggregators make verbal contracts with waste pickers when waste pickers bring recyclables to their shops regularly. As reported by an expert on IWS, if verbal contracts are established for regular waste picker-aggregator transactions, small aggregators do better business. This unwritten contract entails the conditions that waste pickers must comply with in terms of the volumes of recyclables they should supply and whether this volume should be supplied on a daily or weekly basis.

Besides these verbal contracts, another dynamic in the informal waste supply chain is that the market sets the price, following supply and demand mechanisms. If the price of virgin materials changes in the formal markets, processors change the price they give for recyclable

[2] For instance, one of the interviewees shared the story where a waste picker deceived a family to get married to a higher-cast wife than his status would allow.

[3] Worth mentioning here that the awareness programs mentioned in Section 4.1, are not just targeting waste pickers but also citizens in general, to tackle this societal problem.

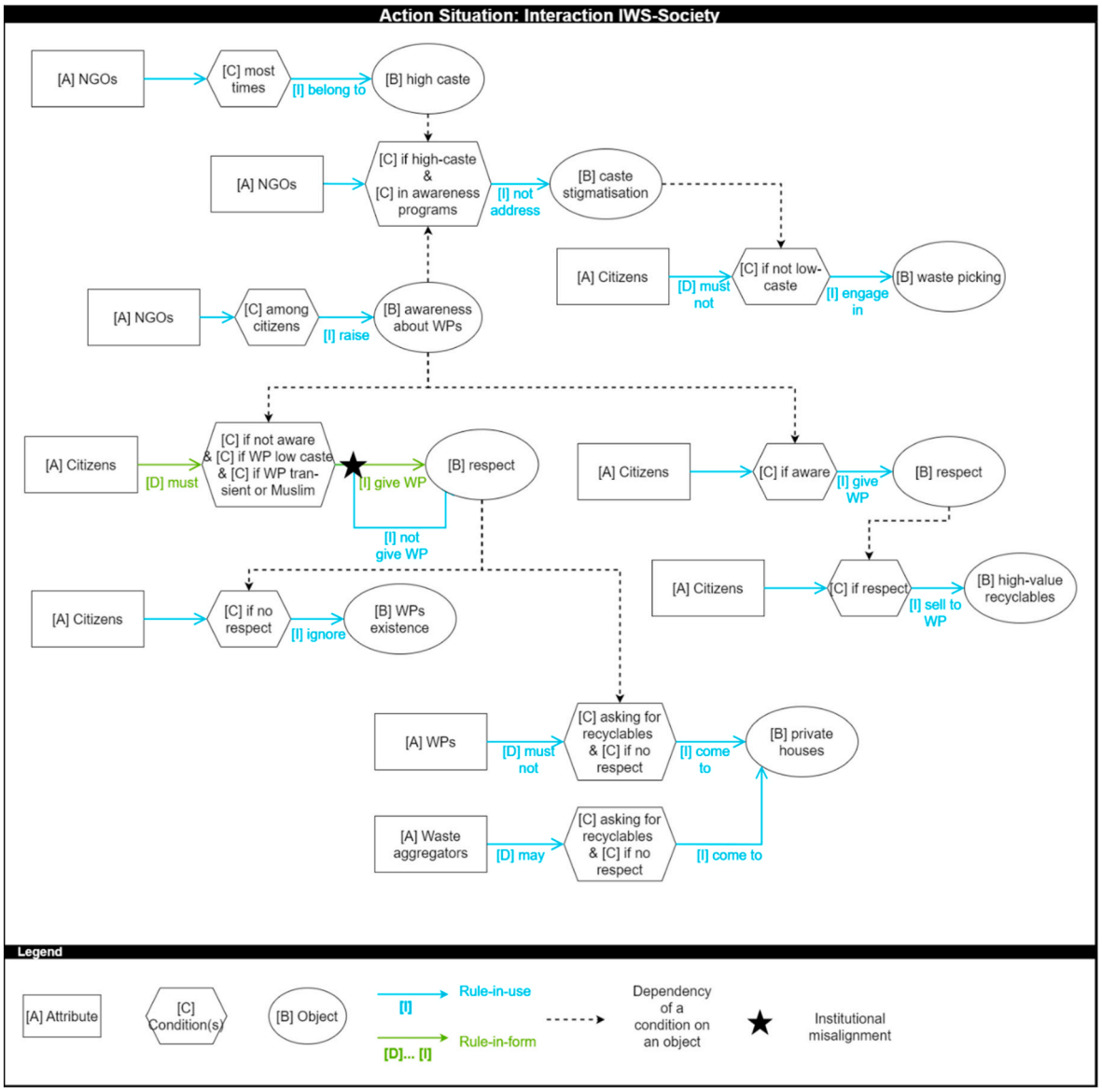


Fig. 4. Action situation Capturing Interaction between the IWS and the Society.

materials accordingly. Processors pass down pricing information to large aggregators, and, in turn, they pass it down to small aggregators.

Waste pickers have no bargaining power in their transactions with small aggregators. Small aggregators offer fixed recyclable prices and do not expect waste pickers to bargain. Therefore, waste pickers generally accept the price the scrap shop (i.e., small aggregators) gives. At the same time, small aggregators sometimes act as money lenders for waste pickers. Under such circumstances, the relationship between the waste picker and the aggregator becomes even more unequal, as the former owes money to the latter. Therefore, if the waste picker borrows money with a loan, they will be more disadvantaged in the next transaction (see S53, Action situation Market and IWS in Table B1.).

To summarise the results, we observed many discrepancies between different levels of governance, particularly at the national and local levels. The municipality's lack of prioritisation of waste pickers' integration may explain their inaction concerning registering waste pickers and issuing ID cards. At the same time, our research indicates that waste pickers do not perceive the necessity or advantages of formal registration. This finding suggests that even if the municipality were to register waste pickers actively, they might encounter resistance or unwillingness to participate in the process. Such behaviour could be attributed to waste pickers' mistrust of formal actors, a sentiment tacitly mentioned during interviews.

The absence of ID cards and official registration contributess to informal waste picking not being socially recognised as a valid occupation. Consequently, citizens are reluctant to engage with waste pickers who lack ID cards for purchasing recyclables door-to-door (B = social recognition, S22, AS Municipal obligations). This is also directly linked to caste discrimination (see S30 and N2 in Table B1)

Caste discrimination also influences the aggregator-waste picker relationship, placing waste pickers in a disadvantaged position within this dynamic. As a result, unfair pricing practices have become prevalent for waste pickers. This aligns with the findings of Indranil and Patel (2022), who assert that low returns for waste pickers are a consequence of caste and other forms of discrimination. Furthermore, the absence of regulations safeguarding waste pickers' interests heightens their vulnerability to exploitation by other actors in the value chain (Indranil and Patel, 2022).

5. Discussion

The primary aim of this study was to identify persistent institutional

barriers that hinder the integration of waste pickers into India's SWM system in order to propose short-term and long-term solutions. Through our investigation, we have contributed valuable insights that complement the extensive literature on the IWS and the integration of waste pickers by pinpointing misalignments between rules-in-form and rules-in-use. Our findings have brought to light a significant disconnect between the integration-related rules formulated at the national level within the SWM policy and their actual implementation at the municipal level and among various actors within the municipal waste management system. This disparity underscores the challenges in effectively translating integration policies into tangible actions on the ground.

In the case of Chennai, our research findings highlight three main root causes for the failure to integrate waste pickers into the SWM system, as shown in Fig. 5. First, our study reveals that the municipality emerges as the primary obstacle to the integration of waste pickers. The lack of proactive efforts by the local government to incorporate waste pickers into the waste management system showcases a significant disconnect between national and local governance, aligning with the 'great gap between legislators and implementing bodies' observed by Cézar Matos et al. (2016) in the context of waste management in Brazil, Russia, India, China, and South Africa (as cited by da Silva et al., 2019). Similarly, Pan et al. (2022) point to the disparity between national regulations and local interests, attributing it to the inadequacy of environmental policy implementation.

Moreover, our finding about the municipality as the primary bottleneck and its associated lack of action complements the conclusion that political will is pivotal in granting waste pickers recognition for their contributions to sustainable waste management (Gutberlet, 2021). Similarly, Rai Singh Rathore (2020) identifies 'municipal politics' as an unresolved hurdle.

Secondly, while the municipality's lack of action highlights the significance of political will at various governance levels, it does not represent the sole root cause for the limited integration of waste pickers into the SWM system. A notable aspect contributing to this issue is the lack of mutual trust between waste pickers and formal entities. While the municipality attributes a lack of trust (i.e., risk of misuse) as the reason for not formally identifying waste pickers through ID cards, our research uncovers that waste pickers also harbour mistrust toward formal bodies. There is a prevailing belief among waste pickers that awareness programs and support offered by formal entities may have hidden agendas.

Third, this mutual distrust is further compounded by the cultural discrimination faced by waste pickers in society. This discriminatory treatment is evident in the exclusion of waste pickers from higher-level decision-making processes concerning their working and living conditions, as mandated in the SWM Rules 2016. These complex dynamics of mistrust and discrimination serve as additional barriers hindering the effective integration of waste pickers into the formal waste management system.

Our findings corroborate the claim made by da Silva et al. (2019) that cultural factors, including ethnic and caste-based divides, impede policy enforcement in India. These factors lead to a misalignment between informal institutions (i.e., rules-in-use) and formal institutions (i.e., rules-in-form), rendering the policy ineffective (Watkins and Westphal, 2016). Discrimination against waste pickers is also present in society, giving them a disadvantage over the type of waste they can collect and the unfair pricing they face when selling that waste on the market. In essence, our research underscores the intricate interplay between institutional dynamics, cultural influences, and political will in the context of waste picker integration within the SWM system in Chennai.

The three root causes identified above shed light on the practical challenges waste pickers face in their integration into the waste management system. These challenges imply that waste pickers encounter the following difficulties.

1) Unable to collect source-segregated waste (i.e., recyclables) door-to-door: The lack of formal recognition and support from the

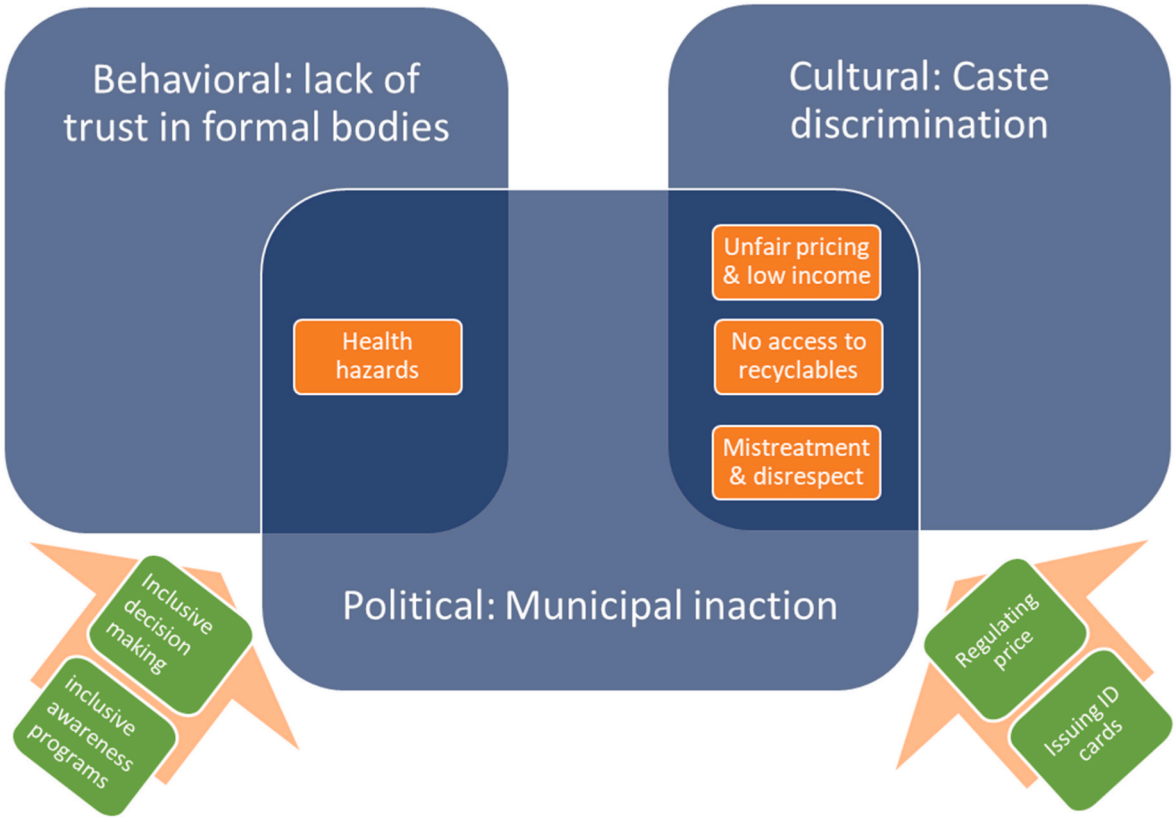


Fig. 5. Root causes for unsuccessful integration of waste pickers, negative impacts and intermediate solutions.

municipality and cultural discrimination hinder waste pickers' ability to access source-separated waste, limiting their opportunities to collect valuable recyclables directly from households.
2) Face unfair pricing and lower income in transactions with small aggregators: The discrimination experienced by waste pickers and their lack of formal recognition lead to exploitative pricing practices when selling collected materials to small aggregators. Consequently, waste pickers often receive lower incomes for their efforts compared to fair market value.
3) Mistreated and disrespected in society: Waste pickers face societal discrimination and marginalisation, resulting in mistreatment and lack of respect for their work. This devaluation of their contributions reinforces the social stigma associated with waste picking, further perpetuating their exclusion from mainstream society.
4) Exposure to health hazards: Waste pickers are regularly exposed to various health hazards while collecting and sorting waste. Working in unsanitary and hazardous environments increases their susceptibility to health risks, such as exposure to toxins, sharp objects, and infectious materials, without adequate protective measures. This poses significant threats to their well-being and overall health.

All-in-all, the interwoven relations between the three root causes of failure underscore the complexity of the integration process for waste pickers. Separately addressing each root cause may not yield sustainable results, as these causes are interconnected and reinforce one another. A comprehensive approach that tackles all three roots simultaneously is essential for successful integration. However, it is important to acknowledge that such an approach would require significant time and concerted efforts from various stakeholders. To truly address the needs of waste pickers and tackle these barriers, waste management policies must be complemented with broader social policies (Marello and Helwege, 2014).

Nonetheless, there are intermediate yet impactful solutions that could be implemented in the meantime to improve the livelihood of waste pickers.

1. Inclusive Awareness Programs: Conducting awareness programs organised by waste picker associations or with their active involvement would be instrumental in gaining their trust and promoting understanding and appreciation for waste pickers' work for the wider society.
2. Involvement in Decision Making: In compliance with policy mandates, including waste picker associations in higher levels of decision-making is crucial. Their input in shaping waste management policies and practices can lead to more inclusive and effective solutions and increase their trust in formal bodies. To support our argument, we see that in exceptional cases (i.e., Bangalore, Pune) where integration has been more successful, this involvement has already taken place in the form of, for example, waste picker-led initiatives (SWaCH, ; Dala, 2022).
3. Formal Recognition: Issuing ID cards for waste pickers is crucial to formally recognise and validate their role in waste management. This step would provide them with official identification and instil a sense of legitimacy and respect for their contributions, allowing them access to recyclables, among other benefits. Given the lack of mutual trust, this step should go hand in hand with the two previous efforts to be successful.
4. Fair Pricing Regulations: Implementing fair pricing regulations for recyclables would ensure that waste pickers receive just compensation for their efforts. Exploiting and unfair practices could be minimised by establishing transparent and equitable pricing mechanisms.

Implementing these intermediate solutions can lead to tangible improvements in the livelihoods of waste pickers while the broader and more complex integration challenges are being addressed. By proactively implementing these measures, stakeholders can contribute to a positive and supportive environment for waste pickers, ultimately paving the way for a more inclusive and sustainable waste management system.

6. Conclusion

This research identified three interwoven root causes for the failure of integrating waste pickers in the SWM system in India: behavioural (lack of trust), political (municipal inaction) and cultural (caste-driven discrimination). These root causes have major impacts, including: 1) inability to collect source-segregated waste (i.e., recyclables) door-to-door, 2) unfair pricing in transactions with small aggregators, and 3) lack of ID cards. To successfully integrate waste pickers and diminish their adverse impacts, these root causes must be simultaneously tackled. Yet, recognising the unique nature of these issues, it becomes apparent that a universal solution applicable to every country does not exist. Nevertheless, by adopting the methodology employed in this research—specifically, the identification of rules-in-use and rules-in-form, along with the analysis of their disparities—tailored solutions can be crafted for each distinct case.

While the root causes can only be addressed in the long run, various practical solutions can improve the livelihood of waste pickers in India, the most impactful and immediate one being issuing ID cards. Yet, other efforts need to be accompanied to make issuing ID cards successful. These efforts involve including waste picker associations in awareness programs to gain their trust in the programs as well as to decrease the (cultural) gap between them and government bodies. The latter outcome can also be addressed by inviting waste picker associations to various levels of decision-making from local to national, as also mandated in current SWM policies and practised in some other cities.

There are some important limitations associated with this study and avenues for further research. First, this research focused on a single case, namely the city of Chennai, to identify the root causes. While these root causes may hold for other cities in India that have had problems with integrating waste pickers into their SWM system, it may not hold for other countries such as China, given the different political and cultural context. However, it is important to note that economic inequalities can still lead to similar mistreatments even in countries with more homogeneous distribution of ethnicities. Another notable limitation of this study is the absence of direct interviews with waste pickers to capture their first-hand experiences and perspectives. Instead, we relied on input from NGO workers and other individuals closely affiliated with waste pickers to offer insights into their perceptions and daily routines. While these proxies provide valuable perspectives, the lack of direct engagement with waste pickers restricts a comprehensive understanding of their attributes and behaviours. Furthermore, obtaining on-the-ground knowledge and data about waste pickers could open avenues for employing alternative methodologies, such as agent-based modelling and simulation. These methods could enable a more nuanced examination of the impact of various interventions on the well-being and livelihood of waste pickers, offering a more holistic perspective on potential solutions.

CRediT authorship contribution statement

Lidia Juárez Pastor: Writing – original draft, Visualization, Investigation, Conceptualization. **Vrishali Subramanian:** Writing – review & editing, Validation, Supervision, Data curation. **Stefano Cucurachi:** Writing – review & editing, Supervision, Project administration. **Amineh Ghorbani:** Writing – original draft, Supervision, Methodology, Investigation, Formal analysis, Conceptualization.

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.

Data availability

Data will be made available on request.

Appendix A. Interviewee categories and interview topics and questions

Table A.1
Interviewee categories.

Relevant actors	
Government bodies	Greater Corporation of Chennai, SBM implementation in Tamil Nadu, CHEEO
Experts	IIT-Madras, Centre for Science and Environment (CSE), Kabadiwalla Connect, Anna University
Private sector	Waste processor
NGOs	CAG, Exnora, HHI, NOF
Waste pickers organisations	SWaCH, Alliance of Indian Waste pickers (AIW)

The list of topics to guide the interviews included the following.

1. Persisting barriers for the integration of the IWS.
2. Potential measures that can be implemented.
3. Rules and guidelines that apply to the sector and, in particular, to the integration of IWS.
4. Interaction between actors: IWS and Formal Waste Sector, IWS-municipality, IWS-society, and actors within IWS.
5. Common problems between informal actors (especially, waste pickers and aggregators).
6. Views on (integration of) the IWS.
7. Information asymmetry regarding price among informal actors.
8. Implementation status (actual integration efforts), to explore rules-in-use vs rules-in-form issues (especially about IWS' participation in the system (door-to-door waste collection), legal recognition, access to waste and to Material Recovery Facilities).
9. Decision-making processes at the local level (regarding IWS).

From the topics, questions were phrased to enquire about during the interviews. An overview of the questions is given below. In some cases, follow-up sub-questions are included under the main questions, in case it was possible to probe the respondent.

- What is the priority for organisation X when it comes to the integration of IWS?
- To what extent is the role and ways of working of the informal sector recognised by policymakers, in legislation and practice? Similarly: To what extent do you think legal recognition can or has contributed to the integration of the IWS?
- What is the current situation of the IWS in Chennai? What has been done?
- What are persistent barriers for the real integration of IWS?
- Are you aware of any efforts towards the integration of the informal sector, concrete plans or policies, by the municipal or the statal government?
- Are there issues with access to waste for the informal sector in Chennai (as in competition with the formal sector for the waste)?
- What is the motivation of the different types of actors to remain informal?
- What is the interaction between citizens and the IWS? Is it different for waste pickers and for aggregators? Similarly: What is the social perception of the IWS?
- What role does caste play in the (practical) recognition of the informal waste workers?
- There appears to be a social differentiation between waste pickers and aggregators (meaning they are perceived different), can you elaborate on this? Why is this the case?
- Do you have any current programs or plans for the IWS at Organisation X?
- What measures and/or policies do you think could be implemented to achieve real integration of the informal sector?
- waste pickers pick up from typically door to door, landfill, roadside bins, employed at apartment complexes, collection at gate (of commercial/ residential complex). Do they dedicate to one of these categories or is it common that they do several of them?
  - How do they choose where to get the waste from? And whom to sell it? Do they organise their job around a certain area?
- Can you elaborate on what are typical situations where waste picker or IWS might suffer harassment from the authorities or other?
  - What measures could tackle this?
- How do you think it can be ensured that informal workers waste pickers get a fair price?
- What are common problems that waste pickers or IB (itinerant buyers) can have with scrap dealers or small aggregators they sell the waste to?
- Is the IWS allowed/recognised in the recycling market? Similarly: Are there barriers or limitations for the participation of the IWS in the recycling market?
- Can you explain what MRF (material recovery facilities) are? Any interaction with IWS (access allowed?)?
- How could self-organisation lead to IWS integration?
  - How can this self-organisation be facilitated?
  - What are the key barriers for the self-organisation of the IWS?
- The concept of Self-Help Groups (SHG) is recurring in policy documents regarding SWM. Can you briefly explain how they are related to the IWS?
- Why is giving IDs and waste pickers registration usually the first step when integrating informal workers?
  - Why is it problematic (if this is the case)?
  - What steps follow normally?

- Can you give a general overview of what the Rules 2016 meant for SWM and the IS? Similarly: What practicalities did the SWM Rules 2016 bring, particularly for the IWS?
  - Are there any voids and/or conflicts in these Rules?
- Have you or organisation X participated in policy making or decision-making processes regarding SWM and the integration of the IWS?
  - Do the informal waste workers have a say?
  - How are strategies or measures chosen?
  - Are there any conflicts in what parties or actors consider a (successful) IWS integration?

Appendix B. Data coding: Institutional statements

Table. B.1
Institutional statements coded with IG 1.0. (A = attribute, D = deontic, B = object, I = aim, C = condition(s), O = sanction). The statement ID also reflects the type of institution (R = rule, N = norm, S = shared strategy).

Statement ID	Action Situation	Statement
R1	SWM Agenda I	National policymakers (A) must (D) set (I) national SWM agenda (B) for national implementation (C)
R2		National policymakers (A) must (D) formulate (I) national SWM rules (B) from national SWM agenda (C)
S1		National policymakers (A) prioritise (I) sustainable SWM (B) in national SWM rules (C)
S2		National policymakers (A) agree on and mandate (I) waste pickers integration (B) in national SWM rules (C)
R3		Ministry of Environment, Forest and Climate Change (A) must (D) mandate (I) waste pickers integration (B) following national SWM policy agenda (C)
S3		Ministry of Environment, Forest and Climate Change (A) be reluctant about (I) waste pickers integration (B) if different SWM policy agenda
S4		National policymakers (A) include (I) legal recognition of IWS (B) in SWM Rules 2016 (C) & for waste pickers integration (C)
S5		National policymakers (A) not consider (I) scrap shops (B) in legal recognition of IWS (C)
S6		National policy makers (A) consider (I) legal recognition of waste pickers (B) in legal recognition of IWS
S7		National policymakers (A) aim (I) waste pickers integration (B) by means of waste pickers legal recognition (C) & in Material Recovery Facilities (C)
S8		National policy makers (A) aim (I) waste pickers protection (B) by waste pickers integration (C)
R4	SWM Agenda II	State policymakers (A) must (D) formulate (I) state SWM policy (B) in accordance with national SWM Rules (C)
R5		State government (A) must (D) follow (I) waste hierarchy (B) for SWM policy agenda (C)
S9		State policymakers (A), Experts (A), NGOs (A) represent (I) waste pickers' interest (B) in SWM policymaking (C)
R6		Municipality (A) must (D) formulate (I) municipal bylaws (B) based on SWM Rules 2016 (C) & from state SWM policy (C)
S10		Municipality (A) pursue (I) visual cleanliness and efficiency (B) in local SWM policy (C) & following Swachh Bharat Mission (C)
R7		Municipality (A) must (D) establish however deemed appropriate (I) waste pickers integration (B) in municipal bylaws formulation (C)
S11		Municipality (A) not discuss (I) waste pickers integration (B) in municipal bylaws formulation (C)
R8		State government (A) must (D) monitor (I) municipality's SWM rules implementation (B) for waste pickers integration (C)
S12		State government (A) not monitor (I) municipality's SWM rules implementation (B) for waste pickers integration (C)
R9		Municipality (A) must (D) prioritise (I) waste pickers integration (B) with other municipal duties (C) & as mandated by national policy (C)
S13		Municipality (A) prioritise (I) privatisation of SWM services (B) if different agenda (C) & if deal with private company (C)
S14		Municipality (A) prioritise (I) capital-intensive SWM solutions (e.g., waste-to-energy) (B) over waste pickers integration (C)
R10	Municipal Integration Obligations	Municipality (A) must (D) ensure (I) waste pickers job recognition (B) if individual waste picker (C) & if PW organisations (C) & by establishing a system (C)
S15		Municipality (A) not ensure (I) waste pickers job recognition (B) if individual waste picker (C) & if PW organisations (C) & by establishing a system (C)
R11		Municipality (A) must (D) ensure (I) waste pickers integration (B) in SWM services (C) & when recognised waste picker (C)
S16		Municipality (A) not ensure (I) waste pickers integration (B) in SWM services (C) & when recognised waste picker (C)
R12		Municipality (A) must (D) ensure waste pickers with (I) access to high-value recyclables (B) if informal waste picker (C) & if integrated waste picker (C)
R13		waste pickers (A) must (D) participate in (I) SWM activities (incl. door-to-door waste collection) (B) when integrated and authorised (C)
R14		Municipality (A) must (D) provide waste pickers with (I) SWM training (B) when waste picker integrated (C)
S17		Municipality (A) not provide waste pickers with (I) SWM training (B) when waste picker integrated (C)
S18		waste pickers (A) mistrust (I) awareness activities and trainings (B) if given awareness program (C) & by Municipality or NGOs (C)
S19		waste pickers (A) gradually accept (I) benefits of formalisation (B) if trust in awareness programs (C)
R15		Municipality (A) must (D) provide waste pickers with (I) ID cards (B) if waste pickers not registered (C)
S20		Municipality (A) not provide waste pickers with (I) ID cards (B) if waste pickers not registered (C) & in case misuse (C)
S21		waste pickers (A) make (I) misuse of ID card (B) when registered (C)
S22		waste pickers (A) obtain (I) social recognition (i.e., dignified job) (B) if ID card (C)
S23		waste pickers (A) face (I) more vulnerability (B) if not ID card (C)
R16		waste pickers (A) must (D) access (I) social security schemes & government benefits (incl. Loan) (B) if ID card (C)
R17		waste pickers (A) must (D) not lend to others (I) money from loan (B) if loan given (C)
S24		waste pickers (A) lend to others (I) money from loan (B) if loan given (C) & if misbehaving (C)
S25	IWS & society	NGOs (A) belong to (I) high caste (B) most times (C)
S26		NGOs (A) not address (I) caste stigmatisation (B) if high caste (C) & in awareness programs (C)
N1		Citizens (A) must not (D) engage in (I) waste picking (B) if not low caste (C)
S27		NGOs (A) raise (I) awareness about waste pickers (B) among citizens (C)
R18		Citizens (A) must (D) give waste pickers (I) respect (B) if not aware (C) & if waste pickers low caste (C) & if waste pickers transient or Muslim (C)
S28		Citizens (A) not give waste pickers (I) respect (B) if not aware (C) & if waste pickers low caste (C) & if waste pickers transient or Muslim (C)
S29		Citizens (A) give waste pickers (I) respect (B) if aware (C)
S30		Citizens (A) sell to waste pickers (I) high-value recyclables (B) if respect (C)

(*continued on next page*)

Table. B.1 (*continued*)

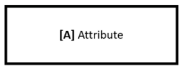
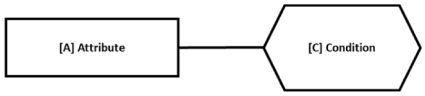
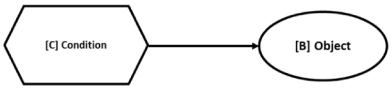
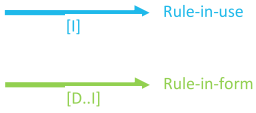
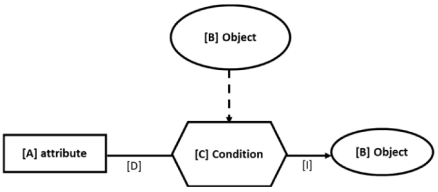
Statement ID	Action Situation	Statement
S31		Citizens (A) ignore (I) waste pickers existence (B) if no respect (C)
N2		waste pickers (A) must not (D) come to (I) private houses (B) asking for recyclables (C) & if no respect (C)
N3		Waste aggregators (A) may (D) come to (I) private houses (B) asking for recyclables (C) & if no respect (C)
N4	Informal waste supply chain	waste pickers (A) may (D) access (I) landfill (B) if open site (C)
R19		waste pickers (A) must (D) not live in (I) landfill buffer zone (B) if working at landfill (C) & in 500m radius (C)
S32		waste pickers (A) live in (I) landfill buffer zone (B) if working at landfill (C) & in 500m radius (C)
S33		waste pickers (A) extract (I) high-value recyclables (B) from landfill (C) & from transfer stations (C) & from roadside bins (C)
S34		waste pickers (A) sell to small aggregator (I) waste (B) if high-value recyclables gathered
S35		Small aggregators (A) sell to big aggregator (I) segregated waste (B) if waste bought from waste picker (C) & if enough volume (C)
S36		Big aggregators (A) sell to processor (I) aggregated waste (B) if segregated waste bought from small aggregator (C)
S37		Processors (A) sell to manufacturer (I) recycled material (B) if aggregated waste bought from big aggregator (C)
S38		Processors (A) keep (I) informal operations (B) if more profitable informally (C)
S39		Processors (A) not pay worker (I) compensation (B) if accident (C) & if informal (C)
R20		Processors (A) must (D) pay worker (I) compensation (B) if accident (C) & if formal (C)
S40		Small aggregators (A) expect (I) waste picker loyalty (B) if regular business (interaction) (C)
S41		Small aggregators (A) make (I) verbal contract (B) if expect waste picker loyalty (C)
N5		waste pickers (A) must (D) comply with (I) waste quality requirements (B) as agreed with scrap dealer (C)
S42		Small aggregators (A) find (I) new waste picker (B) if not satisfied (C) & if personal disputes (C)
S43		Small aggregators (A) give (I) money advance (B) if loyal waste picker (C)
S44		Small aggregators (A) ensure (I) material input (B) by giving money advance (C)
S45		Small aggregators (A) do (I) better business (B) if loyal waste picker (C)
S46	Market and IWS	Processors (A) change (I) recycled materials' price (B) if virgin materials' price change (C)
N6		Processors (A) must (D) inform big aggregator about (I) price for aggregated waste (B) if recycled materials' price change (C)
S47		Processors (A) not inform big aggregator about (I) price for aggregated waste (B) if recycled materials' price change (C) & if favourable (C)
N7		Big aggregators (A) must (D) inform small aggregator about (I) price for segregated waste (B) if aggregated waste's price change (C)
S48		Small aggregators (A) absorb (I) price change (B) if price for segregated waste change (C) & if drastic change (C)
S49		Small aggregators (A) change (I) price for high-value recyclables (B) if price for segregated waste change (C)
S50		Small aggregators (A) give (I) fixed price (B) as set by the market (C)
S51		waste pickers (A) accept (I) price (B) as given by scrap shop (C)
S52		Small aggregators (A) lend waste picker (I) loan (B) if waste picker has sudden needs (C)
S53		waste pickers (A) accept (I) low price (B) if borrowed money from aggregator (C)
S54		waste pickers (A) not have (I) redressing mechanism (B) if given low price (C)
S55		waste pickers (A) change (I) scrap shop (B) if bad pricing (C)
R21		Municipality (A) must (D) ensure (I) waste pickers integration (B) in SWM services (C)
R22		Municipality (A) must (D) employ waste pickers (I) SWM services (B) following national SWM policy (C)
S56		Municipality (A) not employ waste pickers (I) SWM services (B) following national SWM policy (C)
R23		waste pickers (A) must (D) do (I) door-to-door waste collection (B) if hired as conservancy workers (C)
R24		Municipality (A) must not (D) end (I) waste picker's contract (B) when publicly hired (C) & if waste picker doesn't follow rules (C)
S57		waste pickers (A) take for granted (I) job (B) if contract with Municipality (C)
S58		waste pickers (A) receive (I) minimum wage (B) if publicly contracted for SWM services (C)
S59		waste pickers (A) earn (I) lower income (B) if state minimum wage
R25		State government (A) must (D) update (I) state minimum wage (B) with national wage (C)
S60		State government (A) not update (I) state minimum wage (B) with national wage (C)
S61		Municipality (A) expect (I) rise of responsibilities (B) if integrates waste pickers in SWM services (C)
S62		Municipality (A) delegate to tender (I) waste pickers integration (B) as contractor's responsibilities (C)
R26		Contractors (A) must (D) employ waste pickers (I) SWM services (B) as per tender clause (C)
S63		Contractors (A) not employ waste pickers (I) SWM services (B) as per tender clause (C)
R27		waste pickers (A) must (D) follow (I) companies' rules (B) if privately contracted for SWM services (C)
R28 (O)		Contractors (A) must (D) end (I) waste picker's contract (B) if rules are not followed (C)
N8		waste pickers (A) must (D) do (I) more intense work (overload) (B) if privately contracted for SWM services (C)
S64		Municipality (A) have no control on (I) waste picker working conditions (B) if privately contracted (C) & if work overload (C)

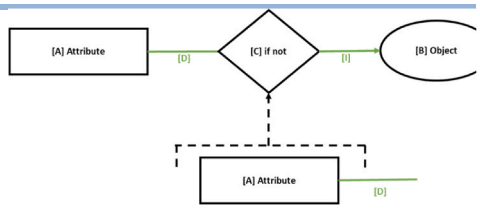
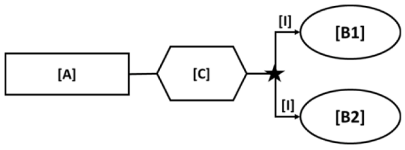
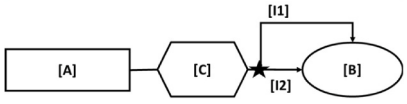
Appendix C. Drawing Institutional Network Diagrams

In the network diagrams, the components of the ABDICO syntax are represented visually to form an institutional statement. The visual representation of each component, and the protocols for connecting various statements together are explained in Table C1.

Appendix D. Institutional Network Diagrams

The diagrams are read from the top left corner following the connections between institutional statements (dashed lines). For readability reasons, the action situation of SWM Agenda is separated into two network diagrams: SWM Agenda I and SWM Agenda II. Agenda I presents institutions at the national level. Agenda II presents the institutional context on the state and local levels.

Step		Concept in ABDICO syntax	Visual representation in the diagram
1.	Define action arena for the basis of the diagram.	-	Title of the diagram
2.	Determine institutional statements that belong to the action arena.	-	-
3.	Per institutional statement, a rectangle represents an attribute [A] which can be single or multiple.	Attribute(node)	
4.	The link between the attribute and the condition of a statement captures the deontic type [D] of that statement. In case of shared strategy, this link does not have a name.	Attribute(node) Deontic(link) Condition(node)	
5.	The link between the condition and the object of a statement captures the aim [I] of that statement.	Condition (node) Aim (link) Object (node)	
6.	The links are colour coded to distinguish between rules-in-form (ABDICO rules), and rules-in-use (ABDICO norms and shared strategies) (between attribute and condition(s), between condition(s) and object).	ABDICO ABDIC ABIC	
7.	Connecting two statements: If the object of one institutional statement influences the condition(s) of another institutional statement, draw a dotted arrow from the object of that institutional statement, to the condition(s) of the other institutional statement.	Object Condition	

8.	Sanctions are defined as special types of institutional statements with an "if not" condition. In the presence of a sanction, the (potentially) non-conforming attribute is connected to the condition of the sanctioning statement..	Or else	
9	Points of concern occur in two situations: 1- When the attribute, the aim and the condition of two statements are the same, but the objects are different 2- When the attribute, the condition and the object are the same	-	
	but the aims are different. This is depicted with a black star.		

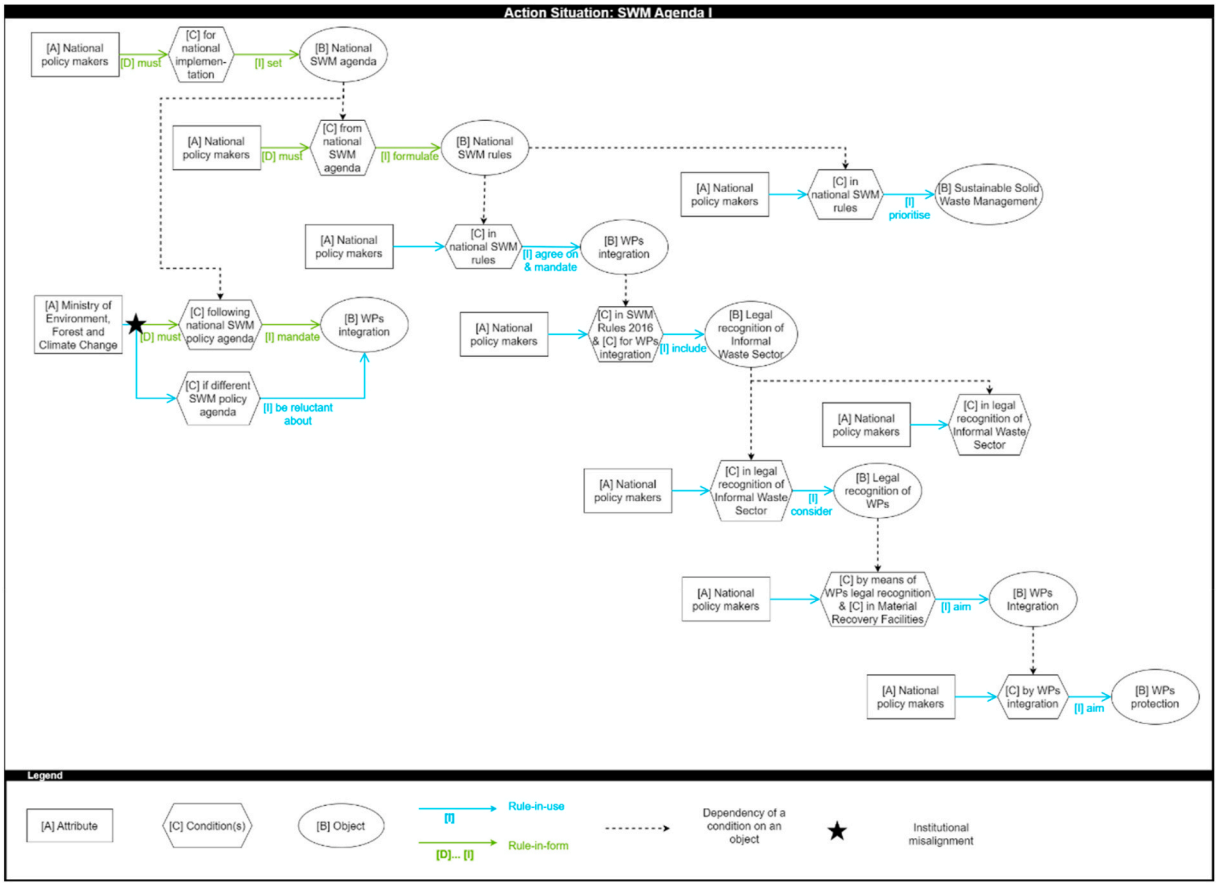


Fig. D.1. Network diagram: action situation SWM Agenda I.

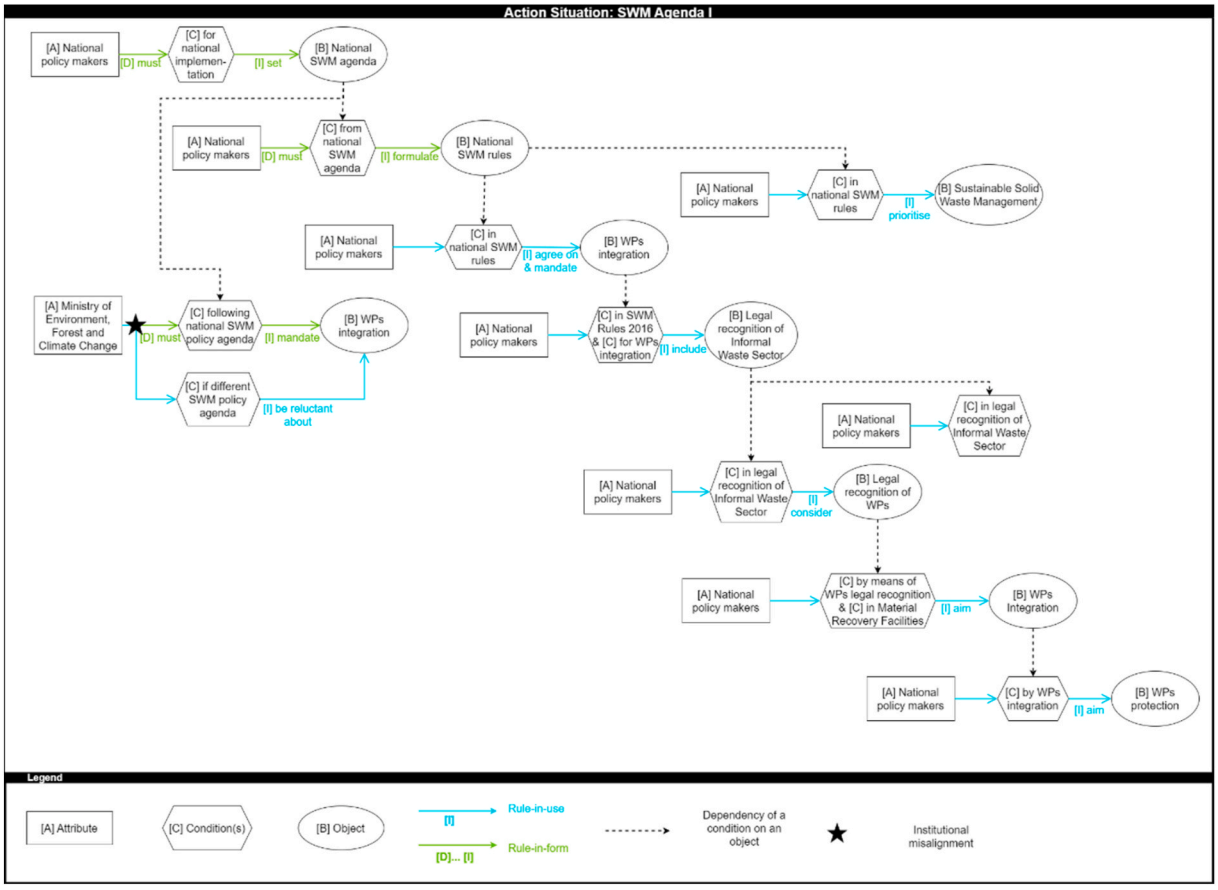


Fig. D.2. Network diagram: action situation SWM Agenda II.

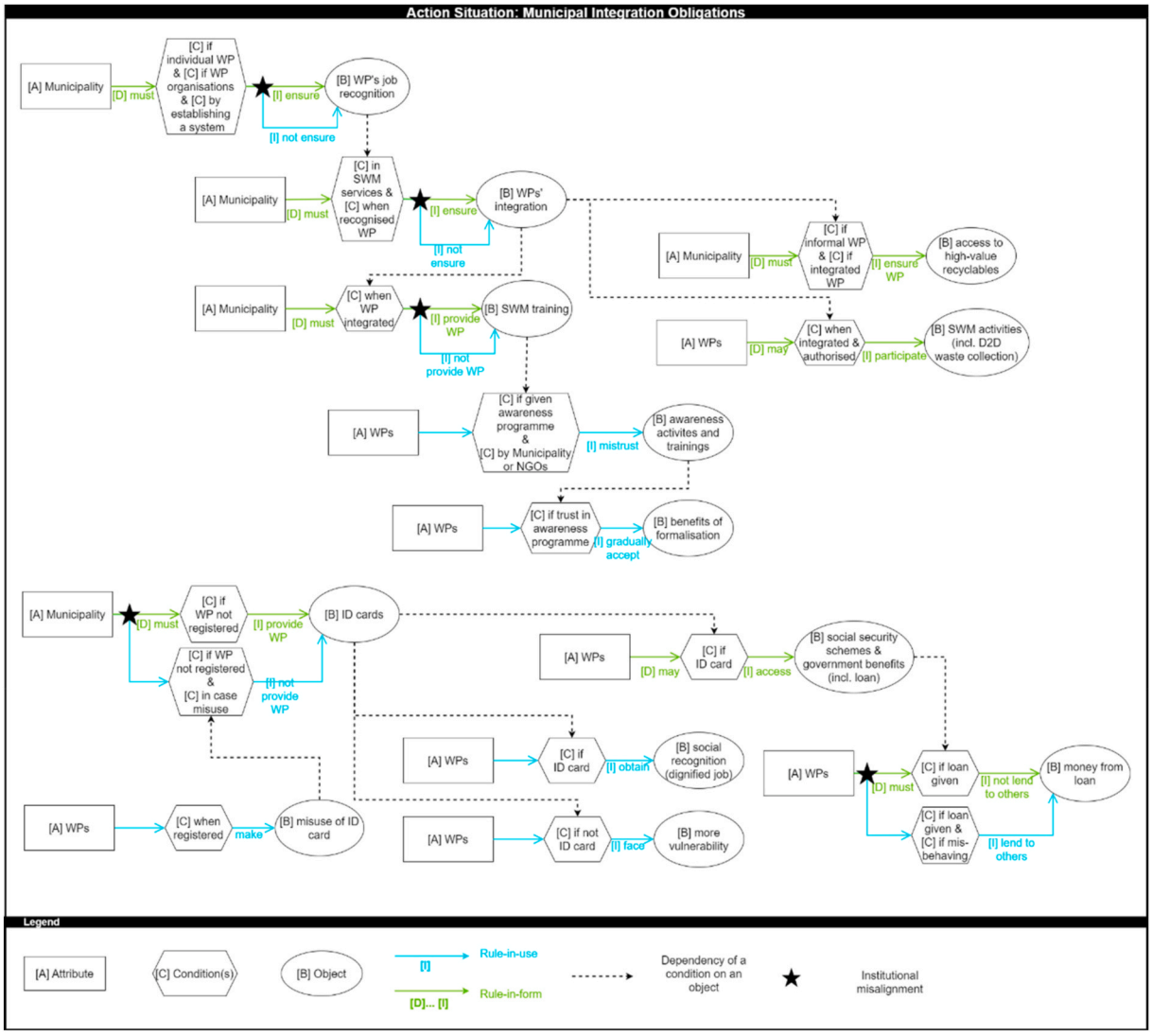


Fig. D.3. Network diagram: action situation Municipal Integration Obligations.

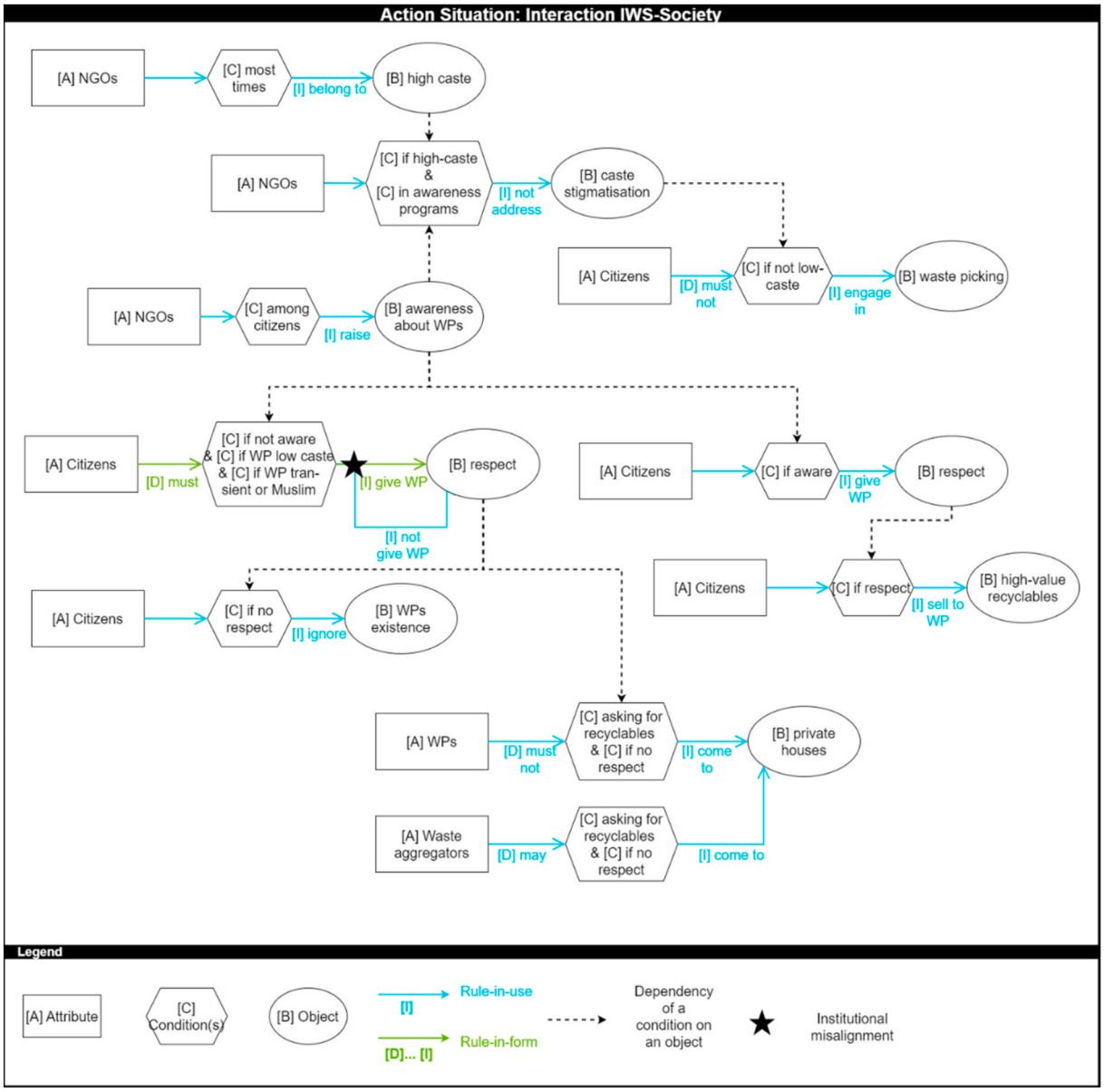


Fig. D.4. Network diagram: action situation IWS and Society.

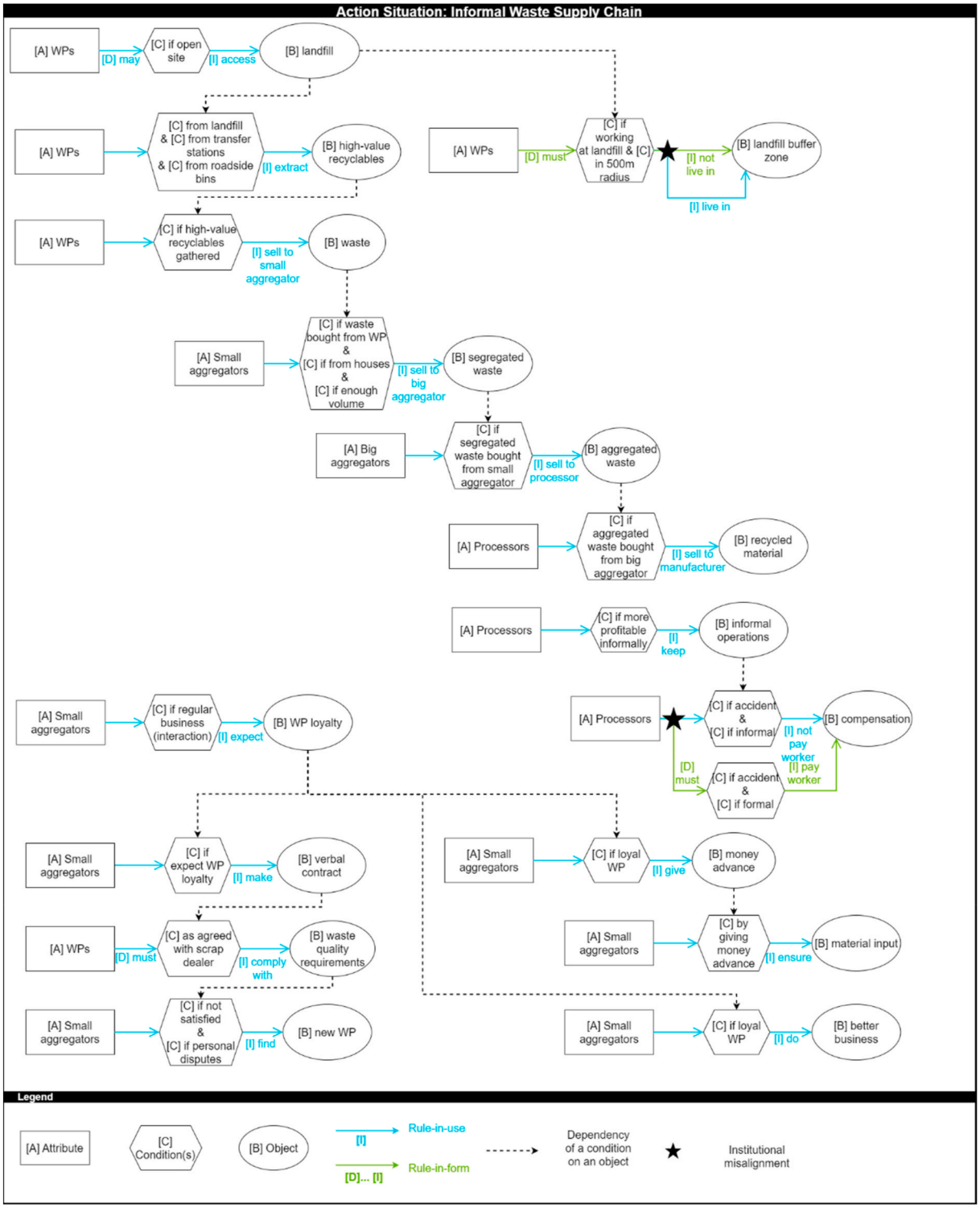


Fig. D.5. Network diagram: action situation Informal Waste Supply Chain.

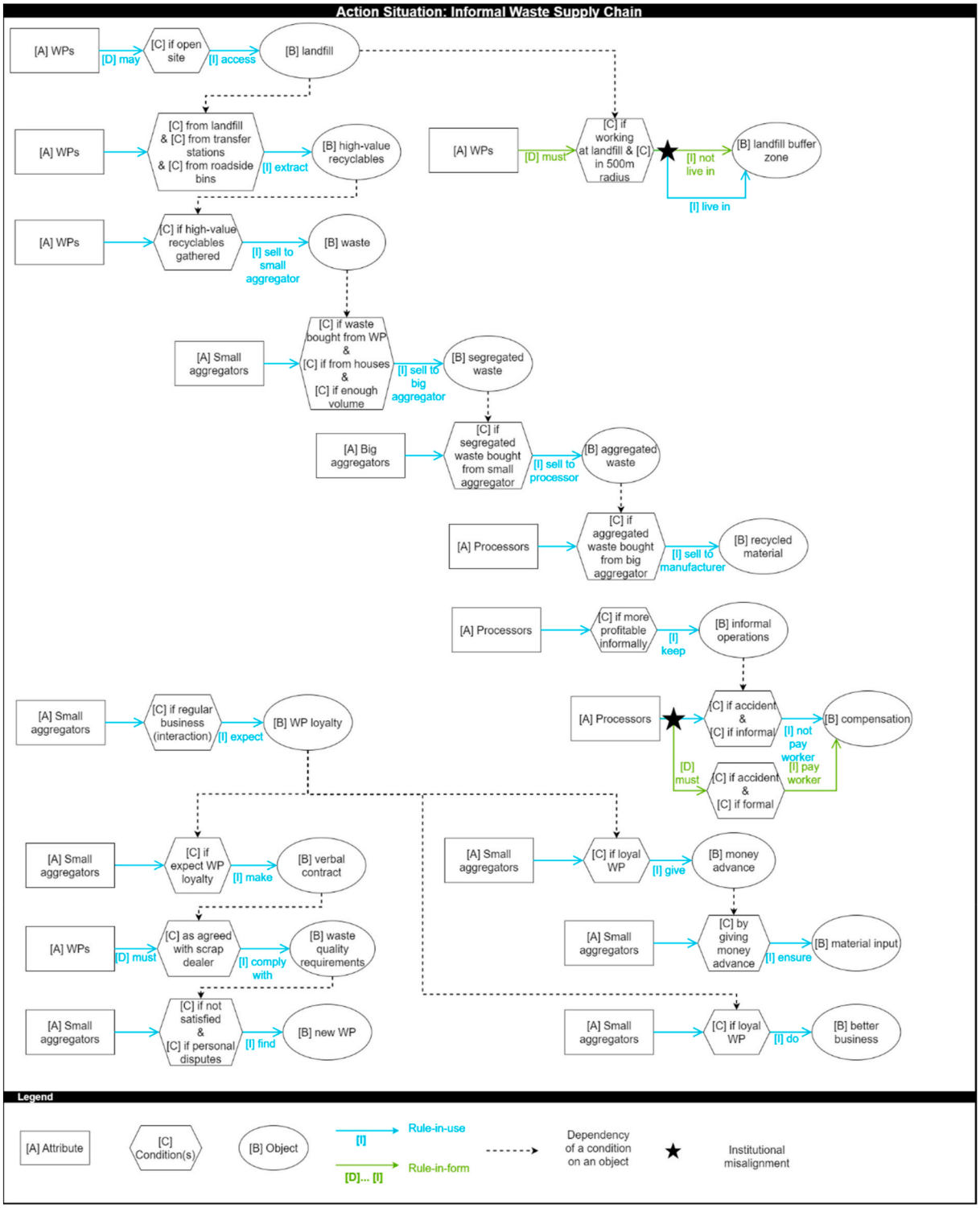


Fig. D.6. Network diagram: action situation Market and IWS.

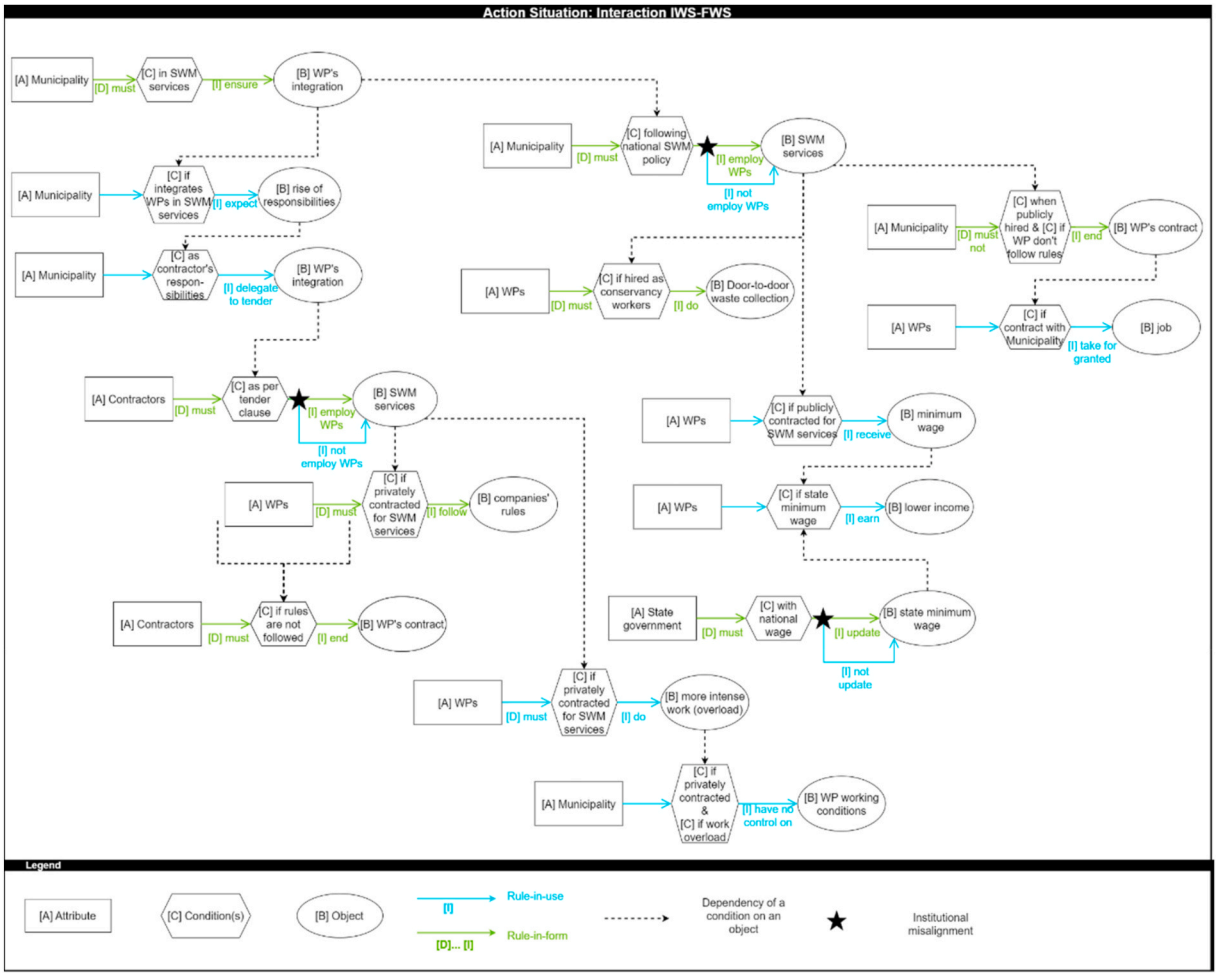


Fig. D.7. Network diagram: action situation IWS and Formal Waste Sector.

Appendix E. Calculation of measures

Centrality

The centrality of every actor or attribute present in each action situation is calculated.

Table E.1
Centrality of the attributes for each action situation or diagram.

Action Situation: Informal Waste Supply Chain	
Attribute [A]	Centrality
Waste pickers	1,25
Small aggregators	1,75
Big aggregators	0,25
Processors	0,75
Average	1,00
Action Situation: Market and IWS	
Attribute [A]	**Centrality**
Processors	0,73
Big aggregators	0,36
Small aggregators	1,45
Waste pickers	1,45
Average	1,00
Action Situation: Interaction IWS and Formal Waste Sector	
Attribute [A]	**Centrality**
Municipality	1,60
Contractor	0,53
Waste pickers	1,60

(*continued on next page*)

Table E.1 (*continued*)

Action Situation: Informal Waste Supply Chain	
Attribute [A]	Centrality
State government	0,27
Average	1,00
Action Situation: Interaction IWS and Society	
Attribute [A]	**Centrality**
NGOs	1,20
Citizens	2,00
Waste pickers	0,40
Waste aggregators	0,40
Average	1,00
Action Situation: SWM Agenda I	
Attribute [A]	**Centrality**
National policy makers	1,80
Ministry of Environment, Forest and Climate Change	0,20
Average	1,00
Action Situation: SWM Agenda II	
Attribute [A]	**Centrality**
State policy makers	1,00
State government	1,00
Experts	0,50
NGOs	0,50
Municipality	2,00
Average	1,00
Action Situation: Municipal Integration Obligations	
Attribute [A]	**Centrality**
Municipality	0,77
Waste pickers	1,23
Average	1,00

Embeddedness

The embeddedness of every object present in each action situation is calculated.

Table E.2
Embeddedness of the objects for each Action Situation or diagram.

Action Situation: Informal Waste Supply Chain	
Object [B]	Embeddedness
Landfill	0,67
Landfill buffer zone	0,00
High-value recyclables	0,50
Waste	0,50
Segregated waste	0,50
Aggregated waste	0,50
Recycled material	0,00
Informal operations	0,50
Compensation	0,00
waste picker loyalty	0,75
Verbal contract	0,50
Waste quality requirements	0,50
New waste picker	0,00
Money advance	0,50
Material input	0,00
Better business	0,00
Average	0,34
Action Situation: Market and IWS	
Object [B]	**Embeddedness**
Recycled materials' price	0,50
Price for aggregated waste	0,33
Price change	0,00
Price for segregated waste	0,67
Price for high-value recyclables	0,50
Price	0,67
Fixed price	0,50
Loan	0,50
Low price	0,50
Redressing mechanism	0,00
Scrap shop	0,00
Average	0,38

(*continued on next page*)

Table E.2 (*continued*)

Action Situation: Informal Waste Supply Chain	
Object [B]	Embeddedness
Action Situation: Interaction IWS and Formal Waste Sector	
Object [B]	**Embeddedness**
waste pickers integration	0,60
Rise of responsibilities	0,50
SWM services	0,56
Companies' rules	0,00
waste picker's contract	0,33
More intense work (overload)	0,50
waste picker working conditions	0,00
Job	0,00
Door-to-door waste collection	0,00
Minimum wage	0,00
Lower income	0,00
State minimum wage	0,33
Average	0,24
Action Situation: Interaction IWS and Society	
Object [B]	**Embeddedness**
High caste	0,50
Caste stigmatisation	0,50
Waste picking	0,00
Awareness about WPs	0,75
Respect	0,50
WPs existence	0,00
High-value recyclables	0,00
Private houses	0,00
Average	0,28
Action Situation: SWM Agenda I	
Object [B]	**Embeddedness**
National SWM agenda	0,67
National SWM rules	0,67
WPs integration	0,33
Sustainable Solid Waste Management	0,00
Legal recognition of IWS	0,67
Scrap shops	0,00
Legal recognition of Waste pickers	0,50
waste pickers protection	0,50
Average	0,42
Action Situation: SWM Agenda II	
Object [B]	**Embeddedness**
State SWM policy	0,75
Waste hierarchy	0,00
waste pickers' interest	0,00
Municipal bylaws	0,67
Visual cleanliness and efficiency	0,00
waste pickers integration	0,33
Municipalities' SWM rules implementation	0,00
SWM privatisation	0,00
Capital-intensive SWM solutions	0,00
Average	0,19
Action Situation: Municipal Integration Obligations	
Object [B]	**Embeddedness**
waste picker's job recognition	0,33
waste pickers integration	0,60
SWM training	0,33
Access to high-value recyclables	0,00
SWM activities	0,00
Awareness activities and trainings	0,50
Benefits of formalisation	0,00
ID cards	0,60
Misuse of ID card	0,50
Social recognition	0,00
More vulnerability	0,00
Social security schemes and government benefits	0,50
Money from loan	0,00
Average	0,26

Institutional Dependency Rate (IDR)

Table E.3
IDR for each action situation or diagram.

Action Situation	IDR
Informal Waste Supply Chain	0,10
Market and IWS	0,15
Interaction Informal and Formal Waste Sector	0,12
Interaction IWS and Society	0,15
SWM Agenda I	0,16
SWM Agenda II	0,11
Municipal Integration Obligations	0,10

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