



Approaches to formalization of the informal waste sector into municipal solid waste management systems in low- and middle-income countries: Review of barriers and success factors

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Approaches to formalization of the informal waste sector into municipal solid waste management systems in low- and middle-income countries: Review of barriers and success factors

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ABSTRACT

Background and goal: The Municipal Solid Waste Management (MSWM) sector represents a major challenge for low- and middle-income countries due to significant environmental and socioeconomic issues involving rapid urbanization, their MSWM systems, and the existence of the informal waste sector. Recognizing its role, several countries have implemented various formalization measures, aiming to address the social problems linked to this sector. However, regardless of these initiatives, not all attempts at formalization have proved successful due to the existence of barriers preventing their implementation in the long term. Along with this, there is a frequent lack of knowledge or understanding regarding these barriers and the kind of measures that may enable formalization, thereby attaining a win-win situation for all the stakeholders involved. In this context, policy- and decision-makers in the public and private sectors are frequently confronted with the dilemma of finding workable approaches to formalization, adjusted to their particular MSWM contexts.

Building on the review of frequently implemented approaches to formalization, including an analysis of the barriers to and enabling measures for formalization, this paper aims to address this gap by explaining to policy- and decision-makers, and to waste managers in the private sector, certain dynamics that can be observed and that should be taken into account when designing formalization strategies that are adapted to their particular socioeconomic and political-institutional context. This includes possible links between formalization approaches and barriers, the kinds of barriers that need to be removed, and enabling measures leading to successful formalization in the long term.

Method: This paper involved a literature review of common approaches to formalization, which were classified into three categories: (1) informal waste workers organized in associations or cooperatives; (2) organized in CBOs or MSEs; and (3) contracted as individual workers by the formal waste sector. This was followed by the identification and subsequent classification of measures for removing common barriers to formalization into five categories: policy/legal, institutional/organizational, technical, social, and economic/financial. The approaches to formalization, as well as the barrier categories, were validated through the assessment of twenty case studies of formalization. Building on the assessment, the paper discussed possible links between formalization approaches and barriers, the 'persistent' challenges that represent barriers to formalization, as well as key enabling factors improving the likelihood of successful formalization.

Results: Regardless of the type of approach adopted to formalization, the review identifies measures to remove barriers in all five categories, with a stronger link between the approaches 1 and 2 and the existence of measures in the policy, institutional, and financial categories. Regarding persistent barriers, the review identified ones arising from the absence of measures to address a particular issue before formalization or due to specific country- or sector-related conditions, and their interaction with the MSWM context. 75% of the case studies had persistent barriers in respect of policy/legal issues, 50% of institutional/organizational, 45% of financial/economic, and 40%, and 35% of social and technical issues respectively.

Conclusions: This paper concludes that independently of the formalization approach, the lack of interventions or measures in any of the five categories of barriers may lead formalization initiatives to fail, as unaddressed barriers become 'persistent' after formalization is implemented. Furthermore, 'persistent barriers' may also appear due to unfavorable country-specific conditions. The success of a formalization initiative does not depend on a specific approach, but most likely on the inclusion of country-appropriate

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measures at the policy, economic and institutional levels. The empowerment of informal waste-workers is again confirmed as a further key success factor for their formalization.

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1. Introduction

Managing municipal solid waste is a big challenge. Inappropriate municipal solid waste management not only causes critical environmental impacts (climate change, environmental and human health damage, biodiversity loss, soil erosion) (Hoorweg and Bhada-Tata, 2012; Cleary, 2009), it also has negative economic and social impacts (Cointreau, 2006; Scheinberg et al. 2010; Lohri et al., 2014). The challenge is greater in low-and middle-income countries, which share several similarities regarding their socio-economic conditions, in particular in having waste management systems that operate to low standards (Wilson et al., 2006, cited by Aparcana et al. 2012; Hoorweg and Bhada-Tata, 2012).

This situation creates the need for alternative ways to handle and dispose of the waste, which has led to the emergence of informal waste activities (called the ‘informal waste sector’). The informal sector contributes significantly to the recycling rates of many cities in low-and middle-income countries, thus reducing the volume of waste deposited in landfills, environmental pollution, creating at the same time local added value through the recycling market and informal employment opportunities (Scheinberg et al., 2010; Wilson et al., 2012). However, despite these benefits, the informal sector is also associated with negative social and economic conditions, such as poverty, bad working conditions, exploitation, discrimination, child labor, social rejection, and lack of education (Wilson et al., 2006; Medina, 2000).

In light of this situation, policy-and decision makers have identified the need to recognize the contribution of the informal sector, while improving their working conditions and socioeconomic situation. For this reason, a variety of formalization approaches have been devised and implemented in recent years. However, the road to successful formalization is not always free of difficulties. Policy-and decision-makers, as well as waste managers in the private waste sector face a variety of barriers to formalization, when designing formalization approaches according to their specific country contexts. There is a lack of understanding regarding the type of barriers arising before and after formalization, the possible measures to eliminate those barriers in the long term, and the

options to structure these enabling measures as formalization strategies. As a result, decision-makers may decide to copy the ‘modernization’ trends applied in high-income countries (Scheinberg et al., 2006; Gutberlet, 2011) or formalization experiences from other countries, without considering the potential differences between their MSWM systems and the situations in those countries, nor the interaction with the informal sector.

The purpose of this paper is to shed light on policy- and decision-makers, and to waste managers in the private sector on the aspects that should be taken into account when designing formalization strategies, including the types of barriers that may be encountered before and after formalization and the enabling measures adopted to address them. Furthermore, it is expected to provide further insights regarding approaches to formalization, associated barriers, and enabling measures; answering the question of whether the occurrence of certain barriers is linked to specific approaches to formalization, or not.

The current paper starts by providing general background information about the informal waste sector in low-and middle income countries, social issues and waste governance towards the informal sector. This is followed by a review of different approaches to formalization, including a categorization of common barriers to formalization. This is subsequently validated through a review of twenty case studies, which are grouped according to their approach to formalization. The barrier categories are used as the criteria for identifying enabling measures applied by the selected cases, towards the elimination of barriers. Based on this assessment, this paper discusses how the enabling measures were conceptualized and combined in each formalization approach, as well as their effectiveness. Furthermore, it identifies the ‘persistent’ barriers that remained as ‘challenges’ to be overcome by formalized MSWM systems, and discusses the feasibility of their removal.

2. Methodology of the review

The study involved a literature review looking at common formalization approaches that have been implemented in low-and

middle-income countries. Based on this, the approaches to formalization were classified according their tendencies to establish organizational structures and in accordance with other characteristics. The paper continued with a literature-based research for the identification and subsequent classification of typical barriers to formalization, as well as measures for removing them.

The approaches to formalization and the barrier categories were validated through the review of twenty case studies, which were selected based on the organizational structures implemented in the formalization processes, the availability of information in public secondary sources, and their geographical location (covering Africa, Asia, and South America). The paper analyzed and discussed their common characteristics, according to the type of formalization approach applied, types of barriers encountered before and after formalization, the enabling measures applied, and the outcomes. Building on this, the review identified problems that represent 'persistent' barriers that remain after formalization, as well as discusses key enabling factors that may remove them in the long term. The [supplementary material](#) in this paper provides a summarized description of the case studies.

3. Results of the review

3.1. The informal waste sector in low-and middle- income countries

The informal waste sector consists of individuals, groups and micro-enterprises performing informal waste services and/or informal valorization "but are not sponsored, financed, recognized or allowed by the formal solid waste authorities, or who operate in violation of or in competition with formal authorities" ([Scheinberg et al., 2010](#), cited by [Velis et al., 2012](#)). Their main motivation is to earn an income through service fees or by selling valuable materials extracted from waste ([Gunsilius et al., 2011a](#)).

These individuals or groups are known by many names, depending on the local language, but they are usually known as recyclers, scavengers, waste-pickers or rag-pickers ([Gutberlet, 2011](#); [Medina, 2000](#); [Wilson et al., 2006](#)). Different informal sector activities have been observed in low-and middle-income countries: itinerant waste-buyers, who go from door to door and collect and buy recyclable materials; street waste-pickers, who recover recyclable materials from mixed waste on the streets; municipal waste collection crews, who recover recyclable materials while transporting them to disposal sites; and finally waste-picking at dumping places. After picking and sorting, informal waste-workers sell the recyclable materials to earn a livelihood ([Scheinberg et al., 2006](#)).

Downstream in the value chain are the middlemen or informal traders/small junkshops. Typically, small traders buy collected recyclable materials from the informal waste-workers and sell the materials to recycling processors companies. As a general rule, the junk shops disappoint the informal waste-workers by paying them very low prices for the materials, as they capacity of adding value to the collected secondary materials is limited ([Wilson et al., 2006](#)).

Despite being socially marginalized and working under poor conditions, informal waste-workers contribute significantly to recycling rates in low-and middle-income countries. As a result of an extensive literature review, [Linzer and Lange \(2013\)](#) report informal recycling rates of up to 45% of the generated waste (in some cases even more), while [Linzer and Salhofer \(2014\)](#) estimate informal recycling rates of between 17% and 38% of the municipal solid waste generated in urban China. Furthermore, [Wilson et al. \(2012\)](#) report that in Bamako, Mali, the informal sector carries out up to almost 100% of total recycling activities. Other cities with an important presence on the part of the informal sector are

Quezon City (Philippines), Varna (Bulgaria), Delhi (India), Managua (Nicaragua) and Dhaka (Bangladesh).

3.2. Benefits of informal sector

The positive contribution of the informal sector is also reflected through the financial contribution they make to the formal waste management sector. Several studies point to the cost reductions to formal waste management systems as a direct consequence of the informal waste activities. The quantity of waste that the formal sector has to collect is significantly reduced, which means lower labor, transport and infrastructure costs. Also, landfilling is optimized through the reduction of volume use ([Wilson et al., 2006](#)). As reported in an assessment of six cities carried out by [Gunsilius et al. \(2011b\)](#), informal collection and recycling contribute to the high avoided costs related to waste collection amounting to 14 million EUR/year in Lima (Peru), 12 million EUR/year in Cairo (Egypt) and 3.4 million EUR/year in Quezon City (Philippines). In Lusaka (Zambia) the net cost of informal waste collection is only 1.6 USD/ton, or 10.4 USD/ton less than in the formal sector. [UNEP \(2010\)](#) mentions the cases of Jakarta, Delhi and Bangalore, where informal recycling prevents around 30% (in Jakarta) and 15% of waste going to landfill (Delhi and Bangalore). Informal recycling represents savings on waste collection and disposal costs of around 13,700 USD/day for the Delhi and Bangalore municipalities. Regarding job creation, [Linzer and Lange \(2013\)](#) estimate that informal waste management systems generate between ten and forty times more jobs than systems in a high-income country.

3.3. Problems related to the informal waste sector

Despite the positive economic and environmental impacts of the informal waste sector, several studies have also identified serious social problems, such as poor working and living conditions, child labor, school absences and incomplete school education for adults ([Medina, 2000](#); [Wilson et al., 2006](#); [Scheinberg et al., 2006](#) and [ILO, 2004](#)). Frequently, informal waste activities involve families working with their children, who can be found picking in the streets or working at dump sites ([ILO, 2004](#); [Scheinberg et al., 2006](#)). The main factors driving child labor are their economic contribution to their families through unpaid work, family poverty, a lack of skills and educational opportunities, and the high costs of schooling, among other things ([ILO, 2004](#)). Another main issue is health. Informal waste-workers work without protective clothing or equipment, being more likely to be injured by sharp objects (needles, broken glass, metal, etc.) and animals (dog bites, rat bites, etc.) ([UNEP, 2005](#)). Further studies have reported increased risk of musculoskeletal problems ([Cointreau, 2006](#)), ophthalmological and respiratory infections ([UNEP; 2005](#)), and work-related respiratory gastrointestinal and skin problems [Rushton \(2003\)](#). Exacerbating this situation is the lack of water and sanitation infrastructure for informal waste-workers and their families, who often live in poor areas close to dump sites ([Cointreau, 2006](#)).

Citizens, as well as the authorities, are often hostile to informal waste-workers ([Medina 2000](#)). They generally suffer the social stigma of being associated with waste. Informal waste-workers are often subjected to harassment by officials, exploited by middlemen and despised by society generally, and it is hard to find citizens who appreciate their work, or partners at the political and legal levels who are prepared to defend their interests ([Gunsilius et al., 2011a](#)). [Nas and Jaffe \(2004\)](#) point out the attitude of self-hatred and lack of self-confidence adopted by informal waste-workers, who consider themselves to be associated with 'sub-human characteristics'. However, this self-perception may vary depending on their position in the value change. Individual

waste-workers are more vulnerable due to their not having an organized supportive network, being more exposed to exploitation, social rejection, etc. (Wilson et al., 2006). Scheinberg and Savain (2015) present the case of informal waste-workers in Tunisia, Morocco, and Palestine, where they perceived themselves as abandoned and rejected, and wished to change their occupation. This self-perception was different when they were active in higher stages of the waste value chain, such as semi-professional or professional recyclers. They tend to have access to better resources and equipment, making it possible to collect more waste and trade with recycling companies directly or the public sector. In this case, they appear to be content with their jobs and look on themselves as business men and service providers (Scheinberg and Savain, 2015).

3.4. Current policies and waste governance regarding the informal sector

The perception of the informal sector's activities can vary depending on the country (Nas and Jaffe, 2004). The informal sector are perceived as negative, this being reflected in national policies and the relevant legal context. Medina (2000) and Wilson et al. (2006) mention repression, neglect and collusion in public policies, including aggressive measures to suppress these activities and sometimes exploitation by local authorities. Scheinberg and Savain (2015) cited the examples of Algeria and Jordan, where informal recyclers are arrested or fined.

As a result, informal waste-workers are seen as suspect, and the relationship between the formal and informal sector is frequently defined by mistrust and competition (Scheinberg and Savain, 2015). The authorities and the police are openly hostile towards them, as well as being subject to bribery to be given access to the waste (Ezeah et al., 2013; Katusiimeh et al., 2013; Baud et al., 2001). In Uganda, private waste companies rarely cooperate with the informal sector due to its perceived illegality. On the other hand, informal waste-workers are reported as having to pay bribes to the local authorities in order to avoid being arrested for dumping in illegal sites, and they also accuse the formal sector of having taken advantage of their situation by paying at lower rates. Further conflicts are related to geographical competition and access to waste resources (Katusiimeh et al., 2013; Scheinberg and Savain, 2015). Furthermore, Baud et al. (2001) report that the local authorities in Chennai (India), Manila (the Philippines) and Lima (Peru) prefer to cooperate with NGOs and large waste management enterprises rather than trade with the informal sector. They are only prepared to engage with the latter after its formalization, e.g. through NGOs or community-based organization (CBO) mediation.

3.5. Experiences with formalization

Despite the conflicts and rejection policies, low- and middle-income countries have started to recognize the need to resolve environmental, social and economic issues related to their MSWM systems, changing their previous attitude of opposition and indifference into one of active support or "stimulation" (Medina, 2000; Wilson et al., 2006; Kashyap and Visvanathan, 2014). Governments are acknowledging the positive contribution of the informal sector, and have begun considering its inclusion in formal waste management systems (Nas and Jaffe, 2004; Marelló and Helwege, 2014). This change can be observed in recent waste policies and legal frameworks of countries such as Brazil, where the National Solid Waste Policy recognizes informal recyclers as important stakeholders of the MSWM system, pointing out the need to include recycling associations and cooperatives in separate collection and recycling programs, and making their inclusion in the reverse logistic mandatory (Gutberlet, 2011; Dias, 2010).

Likewise, the Colombian waste policy framework includes a 3R waste hierarchy and enables the participation of marginalized or discriminated groups in bidding processes (Terraza and Sturzenegger, 2010). In Peru, Law N 29419 supports the formalization of informal recyclers and requires local governments to support the creation of associations, cooperatives and MSEs and to include them in separate public collection and recycling programs. In Kingston, Jamaica, informal recyclers working in CBO activities are stimulated through their inclusion in the National Solid Waste Management Reorganization Scheme, which aims to improve their economic and health security (Nas and Jaffe, 2004).

Similar changes are taking place in India, the Philippines and Bangladesh too. In India, national policies such as the National Action Plan for Climate Change of 2009 and the National Environment Policy of 2006 recognize the informal waste sector as the core of the recycling system, thus highlighting the need for formalization, actively supporting the creation of cooperatives and involving organized recyclers in door-to-door collection. The National Framework for the Informal Sector in Solid Waste Management in the Philippines aims to integrate the informal sector by providing it with a favorable policy environment, skills development, and access to secure livelihoods, employment and social services. Further, in Bangladesh, the National 3R Strategy supports the participation of the informal sector in recycling (Kashyap and Visvanathan, 2014).

Unlike the examples mentioned above, countries such as Indonesia, Jordan, Yemen, Algeria, Egypt and Lebanon are in a different stage of development regarding their recycling goals and formalization strategies. While the role of waste management is recognized by these countries as a driver of climate change and related social issues, they still lack policy instruments for including the informal sector in their waste management systems (Scheinberg and Savain, 2015; GIZ, no date). Morocco is the only country in the Africa and Middle East region with a national policy that recognizes the informal sector as part of the private sector and authorizes it to collect recyclables (Scheinberg and Savain, 2015; PNDM, 2007).

Policies and legal changes allowing the formalization of the informal sector are key aspect. However, as an important stakeholder of waste management systems, the informal sector also plays an important role the success or failure of formalization initiatives. The literature regarding the willingness and interest of informal recyclers to be formalized is not extensive, but some studies indicate the unwillingness and reluctance of informal recyclers to be formalized, due to their perception that they would lose their work flexibility and autonomy (ESCAP, 2015; Burcea, 2015; Coffey and Coad, 2010). Other formalization experiences in low- and middle-income countries have shown the readiness of informal waste-workers to be formalized as long as this happens in a participatory way and based on a stakeholder consultation process that includes them, fulfilling their expectations and needs regarding working conditions, income, flexibility and empowerment, among other issues (Gutberlet, 2011, 2012; Terraza and Sturzenegger, 2010; Günsilius et al. 2011b; ESCAP, 2015; Scheinberg and Savain, 2015).

3.6. Current approaches to formalization

3.6.1. Based on organizing informal waste-workers in associations and cooperatives

In this model, municipalities and formalized waste-workers organized in associations or cooperatives establish contracts or cooperation agreements for performing collection services and recycling. Examples of this model can be found in the Philippines, Brazil, Colombia and Peru, among other countries, where informal waste-workers have been organized through the initiative of NGOs and municipalities (Wilson et al., 2009; Velis et al., 2012;

Gutberlet, 2012; Gunsilius et al., 2011a; Abarca et al., 2013; Aparcana and Salhofer, 2013; Terraza and Sturzenegger, 2010). Mostly, their income is not fixed but depends strongly on the quantity and quality of collected recyclable materials, which are sold in the local recycling market. However, in other cases, the economic sustainability of the model has been ensured through changes in waste policies and regulations. In Diadema and Londrina (Brazil), the incomes are the result of a combined approach: partially based on the sale of recyclable materials, the amount of waste not diverted to the landfill, and fixed waste fees paid by the municipality based on the area covered by the collection service (Yates and Gutberlet, 2011).

In addition to their role as initiators, NGOs may provide technical, financial and social assistance to associations in the form of social aid projects aiming to help informal waste-workers and alleviate their poverty. Some authors have criticized this aspect due to the focus on social problems, instead of recognizing the economic, social and political contributions of the informal sector (Scheinberg et al., 2006). Gutberlet (2012) proposes an alternative to this in the form of a 'Participatory Sustainable Waste Management' (PSWM) approach, which has been successfully implemented in some formalization processes related to associations and cooperatives in Diadema and São Paulo (Brazil). This approach aims at the implementation of 'solid waste recovery, reuse and recycling practices with organized and empowered recycling cooperatives supported with public policies, embedded in solidarity economy, targeting social equity and environmental sustainability'. PSWM is based on the achievement of collective goals in the direction of common economic development (the solidarity economy), the formulation of democratic waste management policies and participatory management (Gutberlet, 2012).

3.6.2. Based on organizing recyclers in CBOs (Community Based Organizations) or MSEs (Micro- and Small Enterprises)

CBOs are formed when individuals organize themselves to provide waste services in their communities. Here, people living in poor neighborhoods are often confronted with bad living conditions, high unemployment, low legal and social status, and a lack of basic sanitary services in the community, such as waste management. For poor community members (informal waste-workers, the elderly, the disabled and the unemployed), this situation often represents both an opportunity to exploit a possible source of income from providing waste services and recycling materials, and the need to create a clean environment for themselves and their community (WASTE, 2001).

In this approach the municipality plays a minor role, providing support through supplying regulations, equipment and infrastructure, awareness-raising activities, etc. The incomes of formalized waste-workers are mostly covered by waste collection fees (paid by users) and, in cases of recycling, from selling the recycled materials (SANDEC, 1996). Depending on need and the recycling market, CBOs can perform waste collection, sorting and recycling, composting and the cleaning of public areas, among others activities.

Informal waste-workers may also formalize their activities by forming themselves into micro- and small enterprises (MSEs) to provide waste services to their communities (waste collection, street sweeping, recycling). SANDEC (1996) describes this model as involving ordinary citizens as beneficiaries, with the local government or municipalities being the legally responsible entity contracting the MSEs. In the model described by SANDEC (1996), incomes are generated by waste fees collected by the municipality, which are paid on to the MSEs. NGOs play the roles of consultancies and technical assistance providers, especially during the implementation phase of the model. Further, in some cases, they might provide financial assistance in the form of starting capital together with local banks.

Baud et al. (2001) analyzed the functioning of the MSE model in metropolitan Lima, Peru, where pilot projects showed the technical feasibility of implementing this system for collecting and recycling waste, especially in poorly served and inaccessible areas. The model was initiated by the NGO IPES, which provided technical and financial assistance to start 140 MSEs, mainly run by women from poor communities. In this case, residents supervised the quality of the services and paid the local government, which in turn paid the MSEs. However, the authors point out the unsustainability of this model due to the irregularity of payments from the local authorities to the MSEs, leading to the latter collapsing. The same study described more successful results for a second MSE model, which envisaged closer interaction with the users (local communities). In addition to supervising the quality of the services, the community paid for the services direct to the MSEs, thus ensuring a continuous flow of income and permitting the MSEs to survive (Baud et al., 2001).

3.6.3. Based on adopting informal waste-workers as workers for the formal waste management sector

Informal waste activities may be also formalized through collaboration in performing certain activities, as they have the necessary capacities for it (experience, equipment, lower costs). Schmied et al. (2011) mention the "TransWaste" project, where formalization was proposed based on cooperation between the Austrian public waste sector, the private sector (represented by waste management social enterprises or re-use enterprises in Austria or Hungary), and informal Hungarian collectors. Gunsilius et al. (2011a) present the example of Wongpanit Co. Ltd in Thailand, which buys recyclable materials from households, waste pickers, collection crews, smaller junk shops, etc. and provides them with diverse social services and support programs, such as training in occupational health and safety among other things. The company also offers training for poor and disadvantaged people, employing some of them at the recycling facility (Sang-Arun et al., 2014).

The public and private formal sectors may also recruit informal waste-workers as formal workers performing waste collection or at recycling facilities. This approach can be classified as 'traditional', with informal recyclers typically being seen as 'poor people' with social problems, the aim being to 'help' them and 'alleviate their poverty'. This tends to ignore the importance of informal recyclers in the waste management system and tries to improve their situation, without addressing the social and political factors that influence it (Scheinberg et al., 2006).

For example, Gunsilius et al. (2011a) mention the case of the extraction of alternative fuels and raw materials (AFR) from waste for cement production in Iloilo City (the Philippines). The project began by employing thirty waste pickers at the recycling plant, later increasing to sixty. In Indonesia, the recycling enterprise Banda Ache Plastic Recycling not only cooperates with junk collectors, itinerant buyers and waste pickers, which are registered members of a waste recycling association, but also employs seventeen former waste pickers at the recycling plant. Some social benefits included in this approach are free elementary schools, job security, holiday entitlements, and regular and steady salary (Kashyap and Visvanathan, 2014). In 2002, the city of Surabaya (Indonesia) implemented a new MSWM system based, where households separate their waste into "dry" and "wet" materials. The "dry" materials are collected by neighbourhood associations, who hire waste-collectors (former waste-pickers), provide push-carts, and pay salaries to them for their services in collecting and transporting waste from household units to transfer stations (Premakumara, 2012). Further examples of this approach can be found in India (Rathi, 2006; Baud et al., 2001), Peru (Aparcana and Salhofer, 2013), Indonesia (Zurbrügg et al., 2012) and Argentina (Parizeau, 2011), among others.

3.7. Barriers and enabling factors regarding sustainable formalization

Several studies have analyzed the factors or barriers that prevent MSWM systems in low- and middle-income countries from becoming sustainable. Abarca et al. (2013) grouped these barriers into the following categories: technical, environmental, financial/economic, socio-cultural, institutional/organizational and political/legal. Further research confirms this categorization and describes similar problems within each category (Ezeah and Roberts, 2012; Abarca et al., 2013; Troschinetz and Mihelcic, 2009; UN-HABITAT, 2010; Cointreau-Levine, 1994; Ogawa, 1996; Wang and Geng, 2012).

Research into the barriers affecting formalization has moved towards proposing different approaches to assessing formalization initiatives, aiming at identifying not only the typical barriers, but also the enabling factors that lead formalization initiatives to be successful and sustainable in the long term. For instance, Zurbrügg et al. (2012) propose three assessment criteria for formalization initiatives: (i) social mobilization and acceptance (social element); (ii) stakeholder, legal and institutional arrangements comprising roles, responsibilities and management functions (policy and institutional element); and (iii) financial and operational requirements, as well as cost-recovery mechanisms (economic element). Furthermore, Velis et al. (2012) developed an assessment tool called 'InterRa', which is based on a typology for classifying possible interventions to promote the integration of informal recycling systems in a city's SWM system. The authors consider three primary intervention categories (the SWM system, the materials and value chain, and society as a whole) underpinned

by the organizational and empowerment dimensions. The authors suggest that a balanced development of all four intervention categories would increase the chances of successful formalization. Moreover, they conclude that the organization and empowerment of informal waste-recyclers is a key factor enabling MSWM systems to change in the direction of more fully integrated systems (Velis et al., 2012).

Velis et al. (2012), Zurbrügg et al. (2012), Abarca et al. (2013) and some other authors show interesting similarities regarding their assessment criteria and their views of the factors that characterize successfully implemented formalization initiatives. These studies point out the importance of including policy, institutional, social and financial measures in maximizing the chances of a formalization process being successful.

Building on this, the present paper sorts interventions regarding formalization into five categories: (1) policy and legal arrangements; (2) economic/financial instruments; (3) institutional and organizational arrangements; (4) actions regarding welfare and social acceptance; and (5) technical/operational interventions. Table 1 presents some of the typical issues identified in each category, including common actions leading to successful formalization, regardless of approach.

3.8. Review of case studies

Table 2 presents a review of twenty case studies of formalization experiences, carried out with the aim of identifying first, the type of formalization approach implemented and its main characteristics according to the case study; and secondly, the presence

Table 1
Classification of common barriers to formalization and enabling measures for their removal.

Categories	Barriers to formalization (various authors)	Common recommended measures/interventions towards formalization (Adapted from Velis et al. 2012)
Policy and legal arrangements	<ul style="list-style-type: none"> – Absence of adequate policies, clear legislation and strong regulations (Abarca et al., 2013) – Waste legislation is fragmented into different laws, causing the lack of many important elements (technologies, cost-effective aspects, enforcement mechanisms) (Abarca et al., 2013; Troschinetz and Mihelcic, 2009; Ezeah and Roberts, 2012) 	<ul style="list-style-type: none"> – Favorable national policies, regulations, political support nationally and locally, law enforcement – Eco-efficiency: reductions in packaging, producer responsibility
Economic/financial instruments	<ul style="list-style-type: none"> – Budgetary constraints, lack of economic support from the central government, weak strategies for raising funds from residents, inappropriate economic and financial planning (Ezeah and Roberts, 2012; Abarca et al., 2013; Troschinetz and Mihelcic, 2009; UN-HABITAT, 2010; Cointreau-Levine, 1994; Ogawa, 1996) 	<ul style="list-style-type: none"> – Microcredit initiatives, expansion of capital basis, financial incentives – Entering of new service roles and niches (diversification of services); increase in bargaining power
Institutional/organizational arrangements	<ul style="list-style-type: none"> – Lack of organizational capacities and managerial skills (leadership) of local authorities (Abarca et al., 2013; Wang and Geng, 2012; Troschinetz and Mihelcic, 2009) – Perception that environment protection conflicts with national economic goals (Wang and Geng, 2012) – Sharing of similar roles and responsibilities, confusion regarding their delineation and distribution. Cross-agency collaboration rare (Wang and Geng, 2012) 	<ul style="list-style-type: none"> – Organization of the informal sector, formation of cooperatives/micro- and small enterprises, cooperatives and associations – Stakeholder involvement, collaboration and partnerships among stakeholders of waste management systems, good relationship with the receiving industries and the formal MSWM system, national initiative-participatory approach
Social acceptance and welfare	<ul style="list-style-type: none"> – Lack of educational and awareness campaigns regarding the importance of a proper waste management system and the role of citizens as waste generators (Abarca et al., 2013; Wang and Geng, 2012) – Social rejection: working as a recycler is associated with low status and considered undesirable. There is a general disrespect for the work, producing low working ethics of workers and poor quality of their work (Ogawa, 1996; Abarca et al., 2013) 	<ul style="list-style-type: none"> – Information and education campaigns, training and empowerment of the various stakeholders – Acknowledgment – and acceptance by authorities of benefits that informal recycling can provide, inclusion of informal recycling into waste management, political and legal recognition, acceptance by the public, change to policy makers' perceptions about informal recycling activities – Occupational safety practices, social and environmental health, improvement of working conditions and equipment
Technical/operational	<ul style="list-style-type: none"> – Unavailability of technology and/or human work force, lack of skilled personnel with technical expertise on waste management, lack of country appropriated technology, deficient waste equipment and structures (waste transfer stations, storages, old waste vehicles, etc.), poor roads, unreliable data and lack of information-sharing between stakeholders (Troschinetz and Mihelcic, 2009; Abarca et al., 2013; Wang and Geng, 2012; Ezeah and Roberts, 2012) 	<ul style="list-style-type: none"> – Assessing and documenting existing MSWM system, accurate data collection regarding waste and recycling markets, data quality – Pilot projects – Technical/operational requirements: access to adequate sorting and storage spaces, infrastructure, topographical considerations, improved quality of secondary raw materials – Appropriate technology, economic and technical assistance, technical capacity-building for waste workers

Table 2
Characterization of case studies of formalization.

Formalization approaches	Case study	Presence of interventions					Further characteristics				Barriers and success factors		Reference
		Policy	Economic/financial instruments	Institutional/organizational	Social	Technical	Initiator	Externally financed	Hiring scheme	Income	Success factors/enabling measures	Persistent barriers/challenges	
Recyclers' associations and/or cooperatives	Linis Ganda Programme, Metro Manila (Philippines)	Yes	Yes	Yes	Yes	Yes	NGOs, Municipality	Not mentioned	Association members	Variable (based on the amounts of sold recyclable material)	Diversification of products (eg. recycled purses; Alternative Refused Fuel in pellets instead charcoal); strong leadership of recyclers; support of public authorities	Corruption or illegal activities around waste services; power conflicts between some authorities and associations	UN-HABITAT (1998) - Ciudades para un Futuro mas sostenible; Bennagen et al. (2002)
	Iloilo City (The Philippines)	Yes	Yes (establishment of a capital-built-up through the associations' savings programme)	Yes	Yes	Yes	Municipality	Yes	Association members	Mixed (depending on the type of activity done by the association: based on the amounts of sold materials and some fixed incomes, e.g. security services, support personnel for landfill)	Development of capacities for providing local services and products; pilot projects for developing and testing new options for material recovering; diversification of products and services; active stakeholders involvement to identify demand of the local market	Further capacity building; technical support and awareness; need for exploring other materials for handcraft recycling (according the market development); lack of data regarding waste composition, quality, material prices, current situation of informal waste pickers	Paul et al. (2012)
	Joao Pessoa (Brasil)	Yes	Not mentioned	Yes	Yes	Yes	Municipality	Yes	Association members	Variable (based on the amounts of sold recyclable material)	Commitment of local government through investment and coordination; capacity building; awareness raise activities among citizens and recyclers; education programs for adults	Lack of awareness of the community; lack of management capacities in the public administration; low educational level and lack of information and trust of informal recyclers	UN-HABITAT - Ciudades para un Futuro mas sostenible (2004)
	Medellin (Colombia)	Yes	Yes	Yes	Yes	Yes	Recyclers	Not mentioned	Association members	Fixed	Diversification of services (in addition to collection and recycling: cleaning services, por public and private institutions)	Not mentioned	Web site: RECUPERAR; Medina (2000)

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Table 2 (continued)

Formalization approaches	Case study	Presence of interventions					Further characteristics					Barriers and success factors		Reference
		Policy	Economic/financial instruments	Institutional/organizational	Social	Technical	Initiator	Externally financed	Hiring scheme	Income	Success factors/enabling measures	Persistent barriers/challenges		
	Bogota (Colombia)	Yes	Yes	Yes	Yes	Yes	Recyclers	Yes	Association members	Fixed (for recyclers at the recycling plant)	Diversification of services (street sweeping, capacity building, and awareness raising services)	High percentage of rejected material	Terraza and Sturzenegger (2010) , WIEGO (2009)	
	San Vicente de Cañete (Peru)	Yes	No	Yes	Yes	Yes	NGO	No	Association members	Variable (based on the amounts of sold recyclable material)	Awareness and support from the population; increase of social inclusion	No diversification of products or services; lack of finance instruments for recyclers; lack of involvement and awareness of the municipality; conflicts and mistrust among recyclers; income depends on selling prices	Aparcana and Salhofer (2013)	
	Diadema (Brazil)	Yes	Yes (incentive in the national solid waste legislation)	Yes	Yes	Yes	Municipality	No	Association members	Mixed (revenues from selling materials and also a fixed payment for the collection services)	Waste fees partially based on area served; income does not depend on the market, representing an stable source of income for recyclers; strong legal support from the municipality; diversification (recycling and collection)	Not mentioned	Gutberlet (2011) ; Yates and Gutberlet (2011)	
	Pune (India)	Yes	Yes	Yes	Yes	Yes	Recyclers	No	Association members	Mixed: from user fees and the sale of recyclable materials	Diversification of services and products made of recycled materials; sorting and storage places for increasing volume to be sold, increasing bargaining power	Still low willingness to pay (citizens); health insurance and pension schemes Not implemented. It is expected to be paid by the municipality	Chikarmane (2012)	
	Mumbai (India)	Yes	No	Yes	Yes	Yes	NGO	Yes	Association members	Fixed	Decentralization of waste service delivery (for increasing coverage rate); user pay principle; municipality plays the role of monitoring instead of delivering waste	CBOs and NGOs face the problem of non-participation from some people in the community; problem with the revenue recovery from compost	Rathi (2006) , Mahadevia et al. (2005)	

Table 2 (continued)

Formalization approaches	Case study	Presence of interventions			Further characteristics						Barriers and success factors		Reference
		Policy	Economic/financial instruments	Institutional/organizational	Social	Technical	Initiator	Externally financed	Hiring scheme	Income	Success factors/enabling measures	Persistent barriers/challenges	
	Londrina (Brazil)	Yes	Yes (incentive in the national solid waste legislation)	Yes	Yes	Yes	Municipality	No	As association members	Mixed (the recyclers get revenues from selling materials and also a fixed payment for the collection services)	services; adequate policies allowing development of community based business Waste fees partially based on area served; fair payment system of the recyclers performing various tasks in recycling; high level of commitment of the local government; contractual relationship between government and recyclers; transparency; and stakeholder involvement	Bad infrastructure in recycling centres; logistic problems in integrating the system with the recycling industry; shortcomings regarding occupational health	Gutberlet (2011) , Terraza and Sturzenegger (2010)
Recyclers forming CBOs or MSEs (within low income communities)	MSEs in East Africa (Kenya, Zambia, Tanzania, and Uganda)	Yes (for participation of the private sector)	Not mentioned	Yes	Yes	Yes	ILO	Yes	As worker for the MSEs	Fixed (based on waste fees for collection service and contracts with the municipality)	Privatization	Lack of business capacities and strategy; no financial sustainability, depending on external grants; lack of support from the local authorities; poor working conditions; unwillingness to pay for the collection service; no possibility to pay for low income areas	UN HABITAT (2010) ; ILO (2003)
	CBOs in Nakuru (Kenya)	Yes (for participation of the private sector)	Yes	Yes	Yes	Yes	NGO, municipality	Yes	Recylers are part of the community and members of the CBO	Fixed (regarding waste fees for collection and transport)	User pay principle (for waste services), decentralization of provision of waste services, support and involvement of the public sector	Unwillingness to pay of the citizens; lack of awareness; lack of financing of investments; high costs of licenses for provision of waste services; lack of appropriate disposal sites	Mwanzia et al. (2013)
	MSEs in Comayagua	Yes (for participation)	Not mentioned	Yes	Yes	Yes	NGO	Yes	As worker for the	Variable (depending on	Cooperation and agreements with	Not mentioned	DANIDA - PREMACA

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Table 2 (continued)

Formalization approaches	Case study	Presence of interventions			Further characteristics						Barriers and success factors		Reference
		Policy	Economic/financial instruments	Institutional/organizational	Social	Technical	Initiator	Externally financed	Hiring scheme	Income	Success factors/enabling measures	Persistent barriers/challenges	
	(Honduras)	of the private sector)							MSEs	sales of recyclable materials)	waste generators, such as residents, private companies, schools, hotels. Raising awareness and support from the municipality		(2012)
	CBOs in Cairo (Egypt)	Not mentioned	No	Yes	Yes	Yes	NGO	No	Recylers (women) are part of the community and members of the CBO	Not mentioned	Product diversification: paper recycling and further paper derived products such as paper bags, cards, etc.	Protective approach; lack of empowerment of recyclers	GIZ (2010)
	CBOs in Mombasa (Kenya)	Still in process (At the time of the report). Some support from the municipality	Yes trust fund for recyclers)	Yes	Yes	Yes	NGO	No	Recylers are part of the community and members of the CBO	Not mentioned	Improved services	By-Laws allowing recyclers to provide waste services are still in process; lack of support by the Municipal Council in waste transport and providing waste transfers and sorting stations; corruption within the network; lack of commintment of recyclers to stay in ther organizations; weak leadership or recyclers; lack of technical capacities; lack of health schemes for recyclers	Kuria and Muasya (2010)
As formal workers (for private companies, municipalities, CBOs, or for MSEs)	Gianyar (Indonesia)	Yes (based on 3R hierarchy)	No	Yes (stakeholder consultation at the local level)	Yes	Yes	Rotary Club of Bali Ubud and a local NGO.	Yes	As waste workers at the composting plant	Not mentioned	Involvement of local stakeholders, reduced social conflicts	Difficulties in selling the compost to the agriculture sector, due to subsidized chemical fertilizers; lack of a good marketing strategy of the compost (for cost recovery)	Zurbrügg et al. (2012)
	Santiago de Surco (Peru)	Yes (not specific for supporting this model)	No	No	Yes	Yes	Municipality	No	As formal waste workers	Fixed	Municipality represents an stable finance source for the system, covering fixed and variable	Only short termn contracts with formalized recyclers; no full access to health services, therefore	Aparcana and Salhofer (2013)

Table 2 (continued)

Formalization approaches	Case study	Presence of interventions			Further characteristics						Barriers and success factors		Reference
		Policy	Economic/financial instruments	Institutional/organizational	Social	Technical	Initiator	Externally financed	Hiring scheme	Income	Success factors/enabling measures	Persistent barriers/challenges	
	Dhaka (Bangladesh)	Yes (based on 3R hierarchy)	Yes	No	Yes	Yes	NGO, international private sector	Yes	As formal waste workers for waste collection and at a compost plant	Fixed (similar to a local municipal waste worker)	costs. The system does Not depend on the recycling market and price fluctuations	no full elimination of social problems; low motivation and awareness of waste workers regarding their job, low job satisfaction	UN-HABITAT (2010), Sinha M (2012), IWPAR (no date)
	Banda Ache Plastic Recycling (Indonesia)	Yes (based on 3R hierarchy)	No	Yes (recyclers in associations,contracted as individual workers	Yes	Yes	Private company	No	As formal waste workers	Fixed (similar to a local municipal waste worker)	Collaboration of the public authorities, revenues based on compost sales and CDM certificates, creation of demand for compost, national policy supports use of compost for agriculture, strong marketing partners, interest of local banks, transparency and good governance through CDM	Lack of capacity building and information for stakeholders regarding the Clean Development Mechanism (CDM) process; difficulties to fulfil the compost regulation; difficulties in obtaining permits and licences	Kashyap and Visvanathan (2014)
	Chennai city (India)	Yes (not specific for supporting this model)	No	Yes, parcial (the local government is not involved)	Not mentioned	Yes	CBO Exnora	No	Recyclers are "adopted" as individual workers	Fixed	High level of commnity involvement; reduced waste tariff for households, the effectiveness of source separation, financial viability and increase in quality employment for the Street Beautifiers	Lack of coordination among stakeholders	Baud et al. (2001); Best Practices for Human Settlements: EX-NORA (UNESCO, no date)

and type of measure or intervention according to the five categories mentioned above (see Table 1). Beyond this, Table 2 presents some ‘challenges’ or ‘persistent’ barriers, which could not have been removed even after implementation of these measures; they thus remain as challenges to be overcome.

The review identifies measures to remove barriers in all five categories, regardless of the type of approach to formalization; however, it suggests a stronger link between the existence of measures in the policy/legal, institutional/organizational, and economic/financial categories and approaches 1 and 2. Without intending to establish any rule, this review shows that fixed salaries are preferred when applying formalization approach 3. Unlike this, approaches 1 and 2 tend to offer variable incomes or, in an effort to reduce economic uncertainty, a combination of variable and fixed salaries.

For the case studies in which informal waste-workers are organized as associations (approach 1) or as CBOs or MSEs (approach 2), policies and legal instruments support formalization specifically under these modalities, thus allowing recyclers to provide waste management services (e.g. collection and recycling). In these cases, the formalization was initiated through bottom-up actions started by local stakeholders (recyclers, NGOs, municipalities), which were scaled up in the case-study countries and incorporated into their national policies (Peru, Brazil, Colombia, Kenya, India). However, the existence of such policies does not ensure formalization. In addition, it is important to implement legal instruments to enforce these policies and to facilitate formalization process (Abarca et al., 2013; Velis et al., 2012; Günsilius et al., 2011b).

In the case of the formalization approach based on contracting informal waste-workers as formal workers (approach 3), the initiatives emerged in countries with waste management policies promoting sustainable waste management practices, for instance, integrated waste management, 3R and other policies. Such strategies would drive the implementation of any measure enhancing the operational aspects of waste management, such as recycling rates, without necessarily being focused on how informal waste-workers are incorporated into the waste management system. Therefore, it is important to enhance the focus of such policies, redirecting them towards the recognition of the contribution of informal sector and empowering them through MSWM policies and favorable regulations. As pointed out in the literature review (see Section 3.7), this aspect should be included as a basic component of any waste management strategy that is considering formalization, regardless of the approach applied.

The existence of institutional/organizational measures is also linked to the type of formalization. Organizing informal waste-workers to form associations, CBOs or MSEs implies intensive participatory decision-making processes, with stakeholder engagement, partnerships, synergies and communication among stakeholders (e.g. municipalities, NGOs, formalized informal waste-workers) (Günsilius et al., 2011a; Gutberlet, 2012; GIZ, 2010). The third formalization approach proposes contracting informal waste-workers as formal workers, frequently without close interaction with other stakeholders in the waste management system. Unlike the previous two formalization approaches, recyclers frequently do not participate in decision-making processes, nor do they cooperate with other relevant stakeholders.

This review also identifies the inclusion of financial and economic measures in formalization approaches 1 and 2. The absence of finance instruments in the third approach may be explained by the type of employment arrangement between informal waste-workers and the waste service provider as their employer. Measures along the technical and social dimensions are common in all three formalization models, regardless of the formalization approach. This is due to the fundamental goals, which usually include improving the socioeconomic situation of recyclers, as well

as eliminating environmental problems related to waste management.

Regarding the kinds of persistent barriers, the most frequent were observed in the policy/legal, institutional/organizational, and economic/financial dimensions. 75% of the case studies reported problems in the policy/legal category. The most relevant barrier in this category appears to be the lack of empowerment of formalized waste-workers. Mostly, cities consider them to be a socially vulnerable group, instead of engaging them as important stakeholders, who contribute positively to the environment and local economy (Medina, 2000; Wilson et al., 2006; Scheinberg et al., 2006). The fact that a country or city has policies or strategies supporting formalization does not guarantee that formalized waste-workers are considered suitable providers of waste management services or valorization activities. This may cause formalization initiatives stumbling or even failing in the medium or long term due to a lack of political support on the part of national and local authorities, as in the cases of San Vicente de Cañete, Peru; MSEs in East Africa; Cairo, Egypt; Mombasa and Nakuru, Kenya; and Comayagua, Honduras). Policies that treat formalized waste-workers as poor victims and disadvantaged may affect their status as important stakeholders, thus reducing their empowerment and bargaining power, and leading to them not being seen as waste management professionals (Scheinberg et al., 2006). This may lead municipalities to support private-sector initiatives (Gianyar, Indonesia; Dhaka, Bangladesh; Banda, Indonesia). The cases of Colombia (Medellin and Bogotá) and Brazil (Londrina, Diadema, João Pessoa) represent good examples of how governments have incorporated formalized waste-workers as a key relevant component of their waste management policies and strategies.

50% of the case studies were affected by institutional or organizational issues after formalization. The most persistent barriers at this level are related to conflicts between public authorities and associations (metropolitan Manila, the Philippines), mistrust among waste-workers (San Vicente de Cañete, Peru, João Pessoa, Brazil), and corruption and illegal activities surrounding waste services (metropolitan Manila, Philippines, Mombasa, Kenya). Conflicts of interest and competition among stakeholders in the formal and informal sectors respectively, a lack of trust and corruption are problematic issues pointed out in the literature review, ones that are relevant even before formalization approaches are implemented (Medina, 2000; Wilson et al., 2006; Scheinberg and Savain, 2015; Ezeah et al., 2013; Katusiimeh et al., 2013; Baud et al., 2001).

Possible drivers for these problems after formalization may include the lack of transparency in institutional and organizational formalization processes, a lack of clarity in the policy and legal framework regarding formalization and in the distribution of roles and responsibilities between the formal sector and formalized waste-workers, and the lack of information and poor coordination among stakeholders (Wang and Geng, 2012). Also, weak leadership on the part of the formalized waste-workers and a lack of management capacities in the public administration may be the source of the most persistent institutional barriers (Abarca et al., 2013; Wang and Geng, 2012; Troschinetz and Mihelcic, 2009).

Transparency and good governance for formalization processes can be stimulated through a participatory approach based on stakeholder communication and involvement in the formalization project (Günsilius et al., 2011a; Gutberlet, 2012; GIZ, 2010). This has been a success factor in João Pessoa, Diadema and Londrina (Brazil) and Nakuru (Kenya). Active stakeholder involvement was also mentioned in the cases of Iloilo City (Philippines), Dhaka (Bangladesh) and Gianyar (Indonesia), all of which achieved not only a high level of commitment and participation on the part of the public sector, but also active cooperation between recyclers and the government, as well as other stakeholders, such as waste producers.

With regard to persistent financial and economic barriers, 45% of the case studies reported at least one financial or economic-related issue after the implementation of formalization, especially in cities applying formalization approaches 1 and 2. The case studies reported the lack of financial instruments for supporting formalized waste-workers in investing in their activities. Fluctuating revenues of formalization initiatives based on approaches 1 and 2 may also represent a significant persistent barrier to their financial sustainability. In this case, waste-workers' incomes are very variable and vulnerable due to local recycling market conditions such as prices, demand, and sales volumes (San Vicente de Cañete, Peru; metropolitan Manila, Philippines; Comayahua, Honduras; Mumbai, India), or the lack of business capacities and strategies (MSEs in East Africa: Kenya, Zambia, Tanzania and Uganda). The barriers mentioned existed even before formalization in these cities, being mentioned as very common in the literature on barriers to formalization (Ezeah and Roberts, 2012; Abarca et al., 2013; Troschinetz and Mihelcic, 2009; UN-HABITAT, 2010; Velis et al., 2012). Future formalization initiatives in low- and middle-income countries should thus focus on the inclusion of financial mechanisms for supporting formalized waste-workers, the development of payment schemes, and the strengthening of their business capacities.

Compared with the issue of fluctuating incomes and instability, the alternative of establishing fixed payment schemes seem to be the solution, though this is not always the case. Formalization based on waste collection mostly envisages fixed salaries from waste fees paid by residents. In this case, an unwillingness to pay for waste services may negatively affect the economic stability of formalized waste-workers, representing also an important barrier for formalization projects, as mentioned by Abarca et al., 2013; Cointreau-Levine, 1994; Coffey and Coad, 2010; Ogawa, 1996; and USAID (2014) and as reported in the cases of MSEs in East Africa (Kenya, including Nakuru, as well as Zambia, Tanzania and Uganda) and Pune (India).

To address the problem of income instability, some cities have introduced collection and storage centers aimed at increasing sales volumes and enhancing bargaining power regarding fluctuating prices (Medellin and Bogotá, Colombia; Pune, India; Londrina and Diadema, Brazil). This measure may also be combined with a mixed income structure based on fixed waste fees (for collection and other cleaning services) and variable revenues from the sale of recycled materials, as implemented in Londrina and Diadema (Brazil); Iloilo City (Philippines) and Pune (India). This may represent an adequate solution that compensates for the risks of both income schemes and may be used by other countries with similar situations pre-formalization. A low level of willingness to pay can be tackled by reducing waste tariffs for households (Chennai, India), implementing the 'user pay principle (for waste services)' (Nakuru, Kenya; Mumbai, India) or linking waste fees to water or energy supply fees, which is proposed by some studies, such as Lohri et al. (2014) and PAHO (2010). A key factor for designing measures is to formulate them through a consultative process, taking into account the MSWM context.

Although the lack of diversification of products and waste services offered by formalized waste-workers is not expressly mentioned as a strong barrier, some case studies have included several measures in the direction of the diversification of waste services, embedding this as an important aspect of formalization strategies since the development phase. This measure has been included in the Philippines (metropolitan Manila and Iloilo City), Medellin and Bogotá (Colombia), Diadema and Londrina (Brazil), Pune (India), Cairo (Egypt) and Dhaka (Bangladesh), which have all reported positive results, especially in strengthening the financial sustainability of these initiatives. Diversification is also widely recommended in the literature and mentioned as an

important success factor for formalization (Velis et al., 2012; Wilson et al., 2009; Scheinberg et al., 2006 and 2010).

Regarding social and behavioral barriers, the assessment identified persistent barriers in 40% of cases, for instance, the lack of awareness of communities and municipalities regarding their role in MSWM systems, and the positive socioeconomic and environmental impacts of formalized waste management activities (João Pessoa, Brazil; Nakuru, Kenya; San Vicente de Cañete, Peru). There is also a lack of awareness on the formalized waste-workers' side regarding the importance of their jobs, which is reflected in low job satisfaction (Santiago de Surco, Peru) and the lack of commitment on the part of recyclers to stay in their organizations (Mombasa, Kenya). This issue may be due to still existing negative self-perceptions, probably due to the focus of the formalization on victimizing waste-workers, instead empowering them through participatory policies and consultation processes (Scheinberg et al., 2006; Gutberlet, 2011, 2012; Terraza and Sturzenegger, 2010; Gunsilius et al. 2011b; ESCAP, 2015; Scheinberg and Savain, 2015). Furthermore, this may reduce the readiness of informal recyclers to stay in their organization, due to their perception that they would be losing work flexibility and autonomy.

Other reported persistent social barriers are related to the shortcomings of health insurance and pension services (San Vicente de Cañete and Santiago de Surco, Peru; Pune, India; Londrina, Brazil), poor working conditions (Kenya, Zambia, Tanzania and Uganda, East Africa,) and fluctuating incomes for formalized waste-workers that cause economic insecurity and poverty. Regardless of the kind of formalization strategy, decision-makers should redirect their focus from isolated "poverty-alleviation" measures to a policy that integrates socially inclusive measures to policy and financial instruments, taking into account the interactions among categories of interventions or measures (Velis et al., 2012; Scheinberg et al., 2006). The cases of Diadema and Londrina (Brazil), Medellin and Bogotá (Colombia), and Chennai (India) show the good results of a participatory approach, where communication and cooperation among stakeholders, and the high level of community involvement and awareness, have led to a progressive reduction of social issues.

Among the persistent technical barriers (30% incidence), the lack of capacity and technical skills was the most reported issue (Mumbai, India; Mombasa, Kenya; Iloilo City, Philippines; Dhaka, Bangladesh). Furthermore, problems related to bad infrastructure were reported in the cases of Nakuru (Kenya) and Londrina (Brazil). Also, the lack of data regarding waste composition, quality, material prices and the current situation of informal waste-workers was mentioned as an important barrier in the case of Iloilo City (Philippines).

Compared to persistent barriers in the previous categories, technical barriers are easier to detect and frequently require straightforward solutions specific to the technical context of the MSWM. For instance, some cities have implemented capacity-building programs for formalized recyclers aimed at developing and reinforcing technical capacities (Chennai, India; João Pessoa, Brazil). Other cities have focused on the development of capacities for providing diversifying local services and products (Iloilo City, Philippines) or capacity-building for designing strategies based on the decentralization of waste services (Mumbai, India; Nakuru, Kenya).

One limitation of this review was the data collection and assessment of the case studies, based only on secondary sources (papers and reports), which may present out-of-date or incomplete data. As a result, it was not possible to confirm with certainty whether a specific measure was actually applied or not. One way to counteract this was to compare different sources where possible. In the absence of primary data collection, it is recommended to use updated local studies wherever possible. This may help to confirm

the presence of measures and their effect on the current status of the formalization initiatives. Therefore, further research is required to provide reliable updated evidence of the effectiveness of interventions or measures in enabling formalization in the long term.

4. Conclusions

This review was carried out with the aim of orienting policy- and decision-makers in the formal sector on the aspects to consider when designing formalization strategies, including the kinds of barriers that need to be removed and the enabling measures that increase the chances of successful formalization in the long term. The review concludes that the lack of interventions in any categories of barriers may lead formalization initiatives to fail, thus making barriers 'persistent' even after formalization has been implemented. Furthermore, it concludes that 'persistent barriers' may also appear due to the lack of awareness of policy- and decision-makers concerning the close interaction between interventions or measures.

Finally, no conclusion is possible regarding which formalization approach has the greatest chance of success in the long term. Nevertheless, the inclusion of country-appropriate measures at the policy, economic and institutional levels represents a key factor in formalization strategies, increasing the chances of success. Moreover, the empowerment of formalized waste-workers is again confirmed as a further key success factor, though it is influenced by how governments design policies and strategies for the sector that acknowledge the contribution of formalized recyclers and view them as relevant stakeholders in their waste management systems. Further research is needed regarding the impacts of the enabling measures on the current status of formalization experiences, especially their inclusion in policies and national MSWM strategies.

Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.wasman.2016.12.028>.

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