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CASE STUDY

Solid waste management in Bogotá: the role of recycling associations as investigated through SWOT analysis

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Abstract In emerging economies, recycling provides an opportunity for cities to increase the lifespan of sanitary landfills, to reduce the costs of solid waste management, to decrease environmental problems from waste treatment by reincorporating waste into the productive cycle and to protect and develop the livelihoods of citizens who work as informal waste pickers. However, few studies have analysed the possibilities of and strategies for integrating the formal and informal sectors in solid waste management for the benefit of both. This integration is the key, especially in developing countries, to understanding how the recycling population can develop a business despite their social and economic limitations. The aim of this study was to perform a strength, weakness, opportunity and threat (SWOT) analysis of three recycling associations in Bogotá with the aim of examining and understanding the recycling situation from the perspective of members of the informal sector in their transition to becoming authorised waste providers. This issue has rarely been studied in the context of developing countries. The data used in the analysis are derived from multiple sources, including a literature review, Bogota's recycling database, focus group meetings, governmental reports, national laws and regulations and interviews with key stakeholders. The results of this study show that as the primary stakeholders, the formal and informal waste management sectors can identify the internal and external conditions of recycling in Bogotá. Several strategies were designed based on the SWOT analysis. The participation of recycling associations is important in the design and application of waste policy, the consolidation of recycling through an effective business model, promotional programmes for social inclusion and the development of new transformation processes and technologies to valorise recycling

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materials. In conclusion, recycling associations can become authorised waste providers through a profitable business that increases recycling rates to create a productive process from waste during the generation of new materials and to decrease environmental problems while improving the welfare and living conditions of recyclers. These findings are important for Bogotá to advance and promote recycling as a key strategy for integrated sustainable waste management in the city.

Keywords Recycling · SWOT analysis · Solid waste management · Bogotá

1 Introduction

Cities in developing countries show increases in the amounts of waste produced due to a number of factors: (i) the increased number of people who live and work in cities; (ii) the increased waste quantities generated per capita due to increases in wealth; (iii) increases in the amount of waste produced by business and service activities; and (iv) increasing diversity and complexity of the materials in this waste. These facts indicate that solid waste management (SWM) is one of the most substantial challenges for cities and one of the key responsibilities of governments (UN-habitat 2010).

The foundations of integrated and sustainable (solid) waste management (ISWM) integrate the physical elements (public health, environment and resource management) and governance features (inclusive system, financially sustainable waste system and consolidation of institutions and proactive policies) that are key to delivering a system that functions well and provides waste governance (UN-habitat 2010). Moreover, the concept of Participatory Sustainable Waste Management (PSWM), a project developed between the Canadian International Development Agency (CIDA) and the Faculty of Education at the University of Sao Paulo (USP), demonstrated that the application of an action-oriented and participatory methodology that includes the knowledge of recyclers is fundamental to the design of waste management policies that increase effectiveness, strengthen the solidarity economy, and aim for social equity and environmental sustainability (Gutberlet 2010).

In the cities of developing countries, waste management is characterised by an active informal sector system for recycling, reuse and repair that contributes to an increase in recycling rates. It is important to develop strategies to formalise this sector as a social inclusion policy. The recycling sector offers livelihoods to important numbers of the urban poor. Furthermore, this sector has the potential to save 15–20 % of its waste management budget by decreasing the quantities of waste that would otherwise have to be collected and disposed of by the city (UN-habitat 2010).

Reducing, reusing and recycling materials are key aspects within waste management planning because high levels of separate collections and improvements in sorting and recycling technologies generate advantages such as reduced landfill volumes, reduced negative impacts of waste and beneficial reuses (Arena and Gregorio 2014; Loughlin and Barlaz 2006). Moreover, recycling has several advantages. It enables the valorisation of waste and its return to the value chain. Activities such as the collection, sorting and cleaning of material are labour intensive and require little capital equipment, which promotes the inclusion of vulnerable populations. Furthermore, investments can be scaled up as technical processes to transform waste and low-cost raw materials are increased (Vogler 1981).

Recycling has been studied from the following perspectives: (i) *public policies*, for which studies have demonstrated that regulations and instruments such as public funds and new technologies can encourage or induce recycling; an example is the acceptance of a wide range of recycling materials as raw material for industries, which is more effective for improving recycling behaviour than policy instruments that are intended to penalise disposal, such as bag limits and fees (Starr and Nicholson 2015; Mueller 2013; Kaciak and Kushner 2009); (ii) the role of recycling in integrated SWM as fundamental for modernising and balancing waste treatment in cities to implement the most effective method for reducing environmental problems and cost (Marshall and Farahbakhsh 2013; Menikpura et al. 2013; Hoornweg and Bhada-Tata 2012); (iii) the benefits of recycling, which include the reduction of landfilling in favour of increased recycling to generate lower environmental impacts, lower consumption of energy resources, lower economic costs, promotion of the efficiency of waste management operators, upgrading the living and working conditions of waste pickers and other marginalised groups and contributing to a closed loop material system (Sharholy et al. 2008; Ohnishi et al. 2012; Ferreira et al. 2014); (iv) the praxis of inclusive waste management, which has been analysed especially in developing countries such as Brazil and Indonesia, where local recyclerś' organisations and/or informal recycling providers are active stakeholders in SWM; this approach focuses on an inclusive society through a solidarity economy that implies the creation of enterprises or cooperatives that strengthen the work of these communities (Gutberlet 2015a, b; Sembiring and Nitivattananon 2010). These studies demonstrate the importance of recycling to achieve sustainability and an inclusive society in cities. The valorisation of waste as raw materials that promote this activity is a key to environmental protection.

Studies have addressed different aspects of the informal recycling sector and waste management. For example, Sasaki et al. (2014) analysed the social situations of waste pickers in Indonesia through quantitative surveys to determine several social, health and environmental problems among these populations. These authors found that waste laws and regulations should be appropriately applied to facilitate a socialisation process for waste pickers and to prevent child labour in informal recycling. Matter et al. (2013) evaluated the production of household waste and how its segregation conserves the value of recyclable materials, facilitating the accessibility of the recycling sector and reducing the overall waste streams in the context of Dhaka, Bangladesh. These authors used several descriptive methods and concluded that segregation by category is essential for increasing the value of waste, and the integration of stakeholders is fundamental to establishing their needs and perceptions to determine the best public interventions. Sembiring and Nitivattananon (2010) analysed the role of informal recycling in SWM in Indonesia by applying a material flow method and questionnaires to identify the positive and negative aspects of informal recycling within SWM. They suggested that policy makers should seek to include the informal recycling sector in the SWM as an alternative strategy to achieve an inclusive society. Nzeadibe (2009) evaluated the situation of the informal recycling sector in the city of Enugu in Nigeria in terms of SWM planning by using direct observation, interviews with stakeholders and a review of relevant legislation, policy documents and reports related to SWM. That study established that, from different perspectives throughout the city, the informal recycling sector contributes to a reduction in environmental problems, creates jobs and alleviates poverty. However, this sector has not been considered in SWM reforms, which is important to empower the people involved in this activity. Ojeda et al. (2002) analysed how to achieve sustainable SWM systems in Mexicali, Mexico by considering four types of actors (the municipal government, the formal private sector, the informal sector and communities). These authors described the system and the possibilities for

recovering recycled materials and generated a proposal to improve waste management. Gutberlet (2015a) explained the operations of recycling cooperatives and their contributions to a sustainable society using metropolitan São Paulo, Brazil, as a case study. They found that the organised recycling sector is fundamental in efficient material separation and has an impact on the social and solidarity economy and the ecological economy.

These studies have demonstrated the importance of the informal recycling sector and its inclusion in the formal sector as a strategy to reduce poverty and improve the quality of life and environmental sustainability through ISWM.

In the context of Colombia and, especially, in Bogotá, recycling has been analysed by accounting for the production of waste and the potential to increase the recycling rate, waste management and urban sustainability, the role of waste pickers and their work to defend their rights and guarantee their work and improve conditions through their inclusion in SWM policies, and educational strategies to achieve a recycling culture and to evaluate different public policy instruments to create an effective recycling programme in Colombian cities (DANE and UAESP 2004; Betancourt 2005; District Planning Secretary of Bogotá 2012; Alfonso and Pardo Martínez 2016).

In Colombia, the commercial and industrial establishments dedicated to the buying, pre-transformation, transformation and selling of material with recycling potential are called economic units of recycling (UERs) and are classified as formal and informal (DANE and UAESP 2004).

The formal UERs are characterised as incorporated companies and legal organisations such as commercial companies, cooperatives, limited companies, simple limited partnerships or limited partnerships with share capital. These UERs carry out accounting by calculating the overall balance, daily records and profit and loss accounts, have business registers and include at least ten remunerated employed persons. In contrast, the informal UERs are natural persons or societies hold companies that operate unincorporated enterprises. These UERs do not perform accounting (therefore, they do not calculate the overall balance and profit and loss accounts), although they may record revenues and expenses. They do not have business registers and include fewer than ten remunerated employed persons (Ocampo 2009).

The aim of this study was to analyse the possibilities and strategies related to integrating the formal and informal sectors of SWM using a strength, weakness, opportunity and threat (SWOT) analysis with three Bogotá recycling associations as a case study. The primary contribution of this research is to identify the primary advantages and disadvantages of these associations in the transition from the informal to the formal sector. Studies in this area are limited, and research in Latin America is beginning to act as a strategy for social inclusion and sustainability development and as a tool for policy makers to improve the design of policies and instruments that have enhanced recycling within SWM, especially in developing countries.

Thus, this study provides a more accurate description of the situation of recycling in developing countries, especially in Bogotá; contributes to the literature on recycling; and provides novel possibilities for the integration of waste pickers into integrated sustainable waste management. The study also contributes to the limited analysis of recycling associations and options to decrease poverty through the valorisation of waste.

The remainder of the paper is organised as follows. Section 2 describes the research methods applied in this study; Sect. 3 describes solid waste and recycling in Bogotá; Sect. 4 shows the primary results and features of a SWOT analysis of three recycling associations that were selected within Bogotá; Sect. 5 explains potential strategies for improving integrated sustainable waste management through the integration of the

informal sector as authorised waste providers in the city; and finally, the primary conclusions are presented.

2 Research methods to analyse recycling in Bogotá from a SWOT analysis

The SWOT analysis tool is a strategic method that is used to analyse recycling in Bogotá. This method has been widely applied in different fields related to environmental management. For example, Pesonen (2007) developed a sustainability SWOT as a systematic tool that includes a traditional SWOT tool, a strategic business planning and life cycle analysis to determine product sustainability in the framework of business decision-making in the case of biodiesel, demonstrating that this tool is easy for green business to use and presents the overall product or life cycle process, including the principal sustainability aspects. Nikolau and Evangelinos (2010) used a SWOT analysis to evaluate environmental management practices in the Greek mining and mineral industry to identify important policy implications related to state support with specific financial funds, regulations and environmental training programme for which these practices could involve a high cost in the long run. In the case of waste management, Srivastava et al. (2005) applied a SWOT analysis to a community to formulate strategic action plans for municipal SWM in Lucknow (India) to improve waste management and to create better collaboration between the community and the municipal company. Zamorano et al. (2011) described industrial waste generation and management in Granada (Spain) with a SWOT analysis to generate various recommendations to improve industrial waste management. Uddin et al. (2014) applied a SWOT model to evaluate the integration of a safe water supply and a sustainable sanitation system and to define the opportunities and challenges of grey water treatment and reuse in the Mongolian context.

These studies have demonstrated that the SWOT tool is adequate for analysing waste management from several perspectives by integrating and incorporating different stakeholders with the aim of providing better decision-making capabilities to analyse problems from a strategic perspective. However, this tool can only be used to assist in decision-making. It is an initial approach to a situation and should be used as a comprehensive and qualitative method (Pesonen and Horn 2013; Klöpffer 2008).

This study included the key stakeholders related to recycling activities in Bogotá, such as policy makers, public employees related to waste management, industry representatives, workers in recycling associations and waste pickers. The research was developed in the following four stages (see Fig. 1): (i) evaluate the situation of waste generation and recycling in Bogotá from different sources, such as the compilation of statistics,

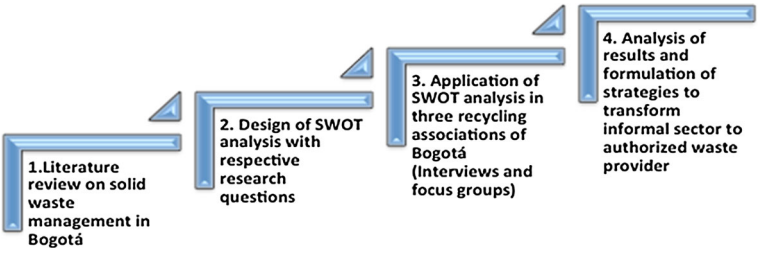

Fig. 1 Steps of the research process

government reports, laws and regulations related to recycling and interviews with representatives of public offices, such as the UAESP (Special Administrative Unit of Public Services); (ii) design a set of research questions formulated to apply the SWOT analysis and to define the strengths, weaknesses, opportunities and threats of the three recycling associations in Bogotá; (iii) execute a specific SWOT analysis based on research questions that were designed with the aim of determining the possibilities for these associations to become authorised waste providers. The answers to these questions are summarised by studying information that was obtained from a series of focus group meetings and interviews (two per association and one with government offices); and (iv) according to the results of the identified SWOTs, generate a number of recommendations to improve the possibilities of including the informal recycling sector in the formal waste management programmes in Bogota based on the principle of maximising strengths and opportunities, changing weaknesses to strengths and minimising threats.

Three recycling associations were selected for the study, taking into account the following criteria: (i) the location included representative associations in the most populated zones of the city (downtown, north and south); (ii) the number of recyclers included associations with more than twenty recyclers so that the study would include large associations (more than 200 recyclers), medium associations (more than 40 and fewer than 100 recyclers) and small associations (more than 20 and fewer than 30 recyclers); (iii) average rate of recycling in a range between 50,000 and 100,000 kg/month per recycling warehouse,[1] which guarantees representativeness, taking into account that the survival of these associations depends on a rate of recycling defined as a minimum of 50,000 kg/month (Cempre 2011); (iv) representativeness in the recycling sector in Bogotá, which implies participation in the recycling market, operation time (more than 5 years) and recognition of key stakeholders in waste management; (v) recycling associations that are in the process of consolidation as formal UERs. With these criteria, the selected associations allow us to determine the primary features of the SWOT analysis and establish opportunities for inclusion as authorised waste providers. Table 1 shows the primary features of the selected recycling associations.

This study included eight focus group interviews (see Table 2). The lead researcher asked questions and facilitated the dialogue with the recycling associations. The groups consisted of the following five people: the head of the association, the financial coordinator, a worker and two recyclers. In the case of the government offices, the focus group consisted of the following three people: a policy maker, a recycling supervisor and a facilitator. The answers were subsequently reviewed to minimise any inconsistency, and then, the information was compiled and analysed by accounting for the SWOT analysis perspective. This method allows the participants to express their opinions in their own language, provides a multidimensional view of participant knowledge, attitudes and self-reported behaviour and shows the level of emphasis the participants place on a particular issue (Bonnett and Williams 1998).

2.1 Formulation of research questions to apply SWOT analysis

The primary research questions that were developed for the focus group meeting are presented and explained below. These questions were designed with the aim of providing information about the situation and the perspectives of recycling associations to analyse the

[1] In this study, Ecoalianza and APREAM have only a recycling warehouse, whereas Give me your hand has six recycling warehouse that cover one the most populated areas in Bogotá.

Table 1 Features of selected recycling associations

Recycling association	Location	Number of recyclers	Average rate of recycling (kg/month)	Primary objectives
Give me your hand	Northwest zone of the city	269	86,886[a]	Organisational strengthening and economic consolidation
Ecoalianza	Downtown of the city	48	97,390	To become self-sustaining and to improve the welfare of recyclers
APREAM	South of the city	27	66,098	To attach a value to the waste

[a] The association *Give me your hand* has six recycling warehouse, and the average rate of recycling is per recycling warehouse

Table 2 Features of focus groups

Organisation	Type	The number of focus groups	Participants	Total participants
Give me your hand	Recycling association	2	Head or manager of association, financial coordinator, administrative employment and two recyclers	5 per focus group = 10
Ecoalianza	Recycling association	2	Head or manager of association, financial coordinator, administrative employment and two recyclers	5 per focus group = 10
APREAM	Recycling association	2	Head or manager of association, financial coordinator, administrative employee and two recyclers	5 per focus group = 10
UAESP[a]	Public sector	1	Two policy makers, coordinator of recycling and a public employee	4
CEMPRE[b]	Industry representatives	1	Director of CEMPRE, an employee and two industry representatives	4
Total		8		50

[a] UAESP: special administrative unit of public services

[b] CEMPRE: entrepreneurial commitment for recycling

possibility that they could become authorised waste providers. Moreover, the questions were formulated based on a literature review and legislation related to waste management in Colombia and Bogotá.

Question 1: What are the strengths of the recycling association in terms of becoming and being maintained as authorised waste providers in Bogotá?

This question allows for the recognition of the major strengths of recycling associations in their transition from the informal to formal sectors within the waste management framework. In the focus group meetings, the participants were asked for their ideas with respect to questions such as the following:

- What are the advantages of being in the formal sector as a recycling association?
- What are the factors that would assure the long-term viability of the recycling associations as authorised waste providers?

Question 2: What are the weaknesses of recycling associations in terms of achieving consolidation as an authorised waste provider?

The aim of this question is to determine the weaknesses that recycling associations may face when being consolidated into the formal sector. In particular, the participants might be asked questions such as the following:

- What could be improved in the transition?
- What barriers prevent the consolidation of recycling associations?
- Which aspects should be improved or strengthened in the process of moving from the informal to the formal sector?

Question 3: What are the opportunities that recycling associations can exploit to develop as authorised waste providers?

This question is proposed to obtain information about which opportunities the recycling associations might face externally in becoming a formal sector of waste management. Related questions include the following:

- What possibilities would be available to recycling associations during the transition to the formal sector?
- What benefits would be associated with being part of the formal sector within the waste management system?

Question 4: What are the threats that recycling associations might face as authorised waste providers?

This question addresses the threats that would prevent recycling associations from improving their inclusion in the formal sector. This theme can be further described by the questions that follow:

- What are the external obstacles that recycling associations might face in the formal sector?
- Are there supporting facilities available to create an improved recycling association?

3 Solid waste and recycling in Bogotá

Bogotá, which is the primary city in Colombia and has a population of approximately 7,878,783 inhabitants, was selected as a case study. This city contributed 26 % of the gross domestic product of Colombia over the last decade. Its primary economic activities are in the construction sector, the manufacturing and service industries, the commercial sector, the mining and quarrying sector and utilities (DANE 2012a). The population of Bogotá has grown over the last decade by an average of 1.39 % annually, which has a direct relation to the generation of solid waste (DANE 2012b).

During the last decade, Bogotá has produced an average of 2,167,129 tonnes of waste per year, with household waste generating the highest percentage at 69.3 % (JICA and

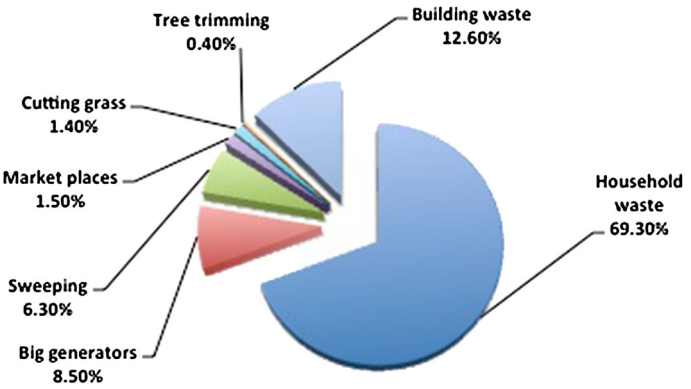

Fig. 2 Categories of waste generated in Bogotá and disposed of in the landfill. *Source*: Based on JICA and UAESP (2013). *Note*: Market places are defined as sites where goods, especially food products, are bought and sold and that produce high quantities of organic waste

UAESP 2013). Figure 2 shows the categories of solid waste generated in the city that are disposed in their totality in a landfill called Doña Juana.

Table 3 shows the waste production per sector in Bogotá. On average, the production of solid wastes is as follows: household sector, 234,566 kg/day; commercial sector, 77,771 kg/day; institutional sector, 560 kg/day; and big generators (especially the manufacturing sector), 505 kg/day. Of this waste, approximately 67.7 % is organic waste and 32.2 % is inorganic waste. The waste generation per capita in this city is lower than the global average, which is between 0.8 and 1.6 kg/person/day (JEM 2013), indicating that it is important to develop adequate instruments to maintain or slow the growth of waste generation.

In Bogotá, recycling activities involve the extraction of recyclable and reusable materials from mixed waste. This sector is characterised by labour intensive, low wage, low-capital investments, unrecorded and unregulated work and low technology, and the work is often performed by marginal populations of society. This city recycles 357 tonnes/day, although the calculated potential is approximately 1000 tonnes/day (JICA and UAESP 2013; Alfonso and Pardo Martínez 2014), indicating the importance of this activity for waste recovery, to increase the useful lives of landfills, to include marginal populations, to decrease poverty and to generate integrated sustainable waste management.

Table 3 Waste production in Bogotá per sector

Sector	Waste production
Generation per inhabitant	0.32 kg/person/day
Generation per household	1.66 kg/person/day
Generation per commercial sector	1.36 kg/establishment/day
Generation per institutional sector	0.604 kg/establishment/day
Generation of organic waste	83102 tonnes/month
Generation of inorganic waste	39613 tonnes/month

Source: Based on JICA and UAESP (2013)

4 Results and discussion of SWOT analysis for three recycling associations in Bogotá

The primary results of the SWOT analysis are shown in this section. The tool selected for application in the three recycling associations in Bogotá helps to increase understanding of the external and internal conditions that recycling associations face when converting to authorised waste providers. Principally, the internal conditions are related to the strengths and weaknesses, and the external conditions refer to the opportunities and threats. Table 4 summarises the SWOT analysis from the primary results of the focus group meeting.

4.1 Strengths

Recycling associations show several strengths, especially with regard to the features of this population, which has achieved recognition and value for their work by the government and society. Furthermore, the processes required to achieve the capture, recovery and valorisation of different recyclable materials have been strengthened by the attempt to consolidate recycling as a profitable business to achieve the elimination of the poverty trap.

Recycling associations are composed of waste pickers who have been very active in defending and fighting for their labour rights as recyclers. These individuals aim to improve their working conditions to achieve recognition and inclusion in the waste management system in the city. Waste pickers have demonstrated leadership, perseverance and high levels of organisation that have facilitated the formulation of policies, strategies, programmes and local and national laws to recognise the recyclers' labour, wages,

Table 4 Results of the SWOT analysis on transforming from the informal to the formal sector for recycling associations in Bogotá

Internal conditions	External conditions
Strengths	Opportunities
Leadership, empowerment and potential for inviting and intervening in political decisions related to waste management and to defend the rights of recyclers	Recognition of recycler work
Improvements in labour conditions and in the recycling process	Potential to increase the recycling rate
Application of accounting processes from inputs and outputs	Alliances with industrial sector for the sale of recycling materials with value added
Recycling of different materials	
Weaknesses	Threats
Recycling associations do not have working capital	New private companies should provide recycling service
Limited investments for improving the process to valorise recycling materials	Lack of awareness of the importance of separation and recycling at the source among the people of Bogotá
The recyclers come from a marginal population	Legal instability
Low and insecure labour conditions	Failure to eliminate the poverty trap from these vulnerable populations

possibilities of becoming authorised waste providers and participation in the design of the Integral Solid Waste Management Plans of cities. However, for the recycling association, the government and policy makers that engaged in the practice and application of these public policy instruments are challenged to include this vulnerable population. The participants expressed these elements during focus groups in the following manner[2]: (i) *We seek to defend the recycling profession, which has the same labour rights as any work*; (ii) *The recyclers have created or made or generated the recycler profession, and it is important to achieve recognition of our work by the population and the local government of the city*.

In Colombia, different legislative measures have been implemented to promote recycling. In some cases, these measures have been promoted by the recycling population through their associations to achieve recognition of their labour rights, such as a ruling by the Constitutional Court C741/2003, protection ruling T724/2003 and court records 268/2010 and 275/2011. These legislations have recognised remuneration in the "recycling for recyclers" component and as a complement to the income of recyclers for the selling of materials that can be collected and classified. The main rights obtained are the following: (i) the obligation to separate waste at the source; (ii) remuneration to recyclers that demonstrates that recycling is their employment; (iii) operative and administrative organisation of recycling activities; (iv) direct payment that is proportional to productivity efforts determined by the quantities of materials (kg) collected and reported, where the value is based on the parameters of waste management regulations; (v) regularisation of recycling associations with the aim of controlling and verifying the remuneration of recyclers; (vi) incorporation of recyclers through associations into the value chain and selling the materials to industries to guarantee that the recyclers will be included in the value chain of waste management.

The zero waste programme seeks to exploit and return solid waste to the productive cycle through the promotion of the utilisation culture based on responsible consumption, waste separation, reuse, reparation and recycling of consumer goods. This programme has generated the inclusion of recyclers through associations and remuneration by their jobs provided that they belong to formal recycling associations that are considered economic units of recycling (UAESP 2012).

Recycling association members understand that recycling is a business that requires a range of processes to valorise and process different materials to sell raw materials from recycling to industry. It is important to improve the technology and to maintain accounting books to determine the viability of the business and to achieve profitability, which would allow for improved living conditions for recyclers and their families. In focus groups, the main comments that supported this point were the following: (i) *Recycling is good business, and recyclers should begin to build associations with an entrepreneurial approach*; (ii) *Recycling associations should valorise materials where wholesale points become recycling industries that sell raw materials to the production sector.* Figure 3 shows the profit percentage by collected material.

4.2 Weaknesses

The primary weaknesses identified by the recycling associations are related to financial resources, the cultural patterns of the population and labour conditions, which could undermine the consolidation of recycling as a business and a strategy for social inclusion.

[2] The authors provided the translations of the focus groups.

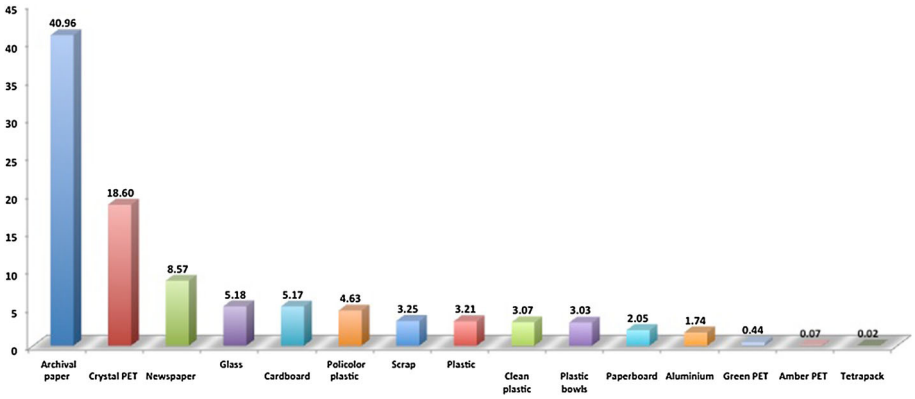

Fig. 3 Profit percentage according to the material collected by selected recycling associations. *Note*: Plastic includes high-density polyethylene (HDPE), polyvinyl chloride (PVC) and low-density polyethylene (LDPE)

Recycling associations should overcome the obstacles that constrain their growth and sustainability. In general, waste pickers have low levels of education, insufficient financial resources or limited access to credit and minimal or no business experience. Private and public sector support is important to help overcome these weaknesses. Comments from focus group participants related to this point were as follows: (i) *For associations of waste pickers, obtaining seed capital is difficult due to a lack of credibility in this vulnerable population*; (ii) *The public sector should promote the inclusion of waste pickers through financial support to consolidate recycling activities as a business in this vulnerable population.*

At this time, it is fundamental that waste management systems recognise the work and effort of recyclers through financial remuneration that improves labour conditions and recognises recycling as much as any type of work. For example, a participant in a focus group commented, *The constancy, resistance, endurance and force of leaders and members of recycling associations to achieve remuneration for recyclers recognised by the State—this was a long process because the judicial mechanisms as legal guardianships have spanned more than 10 years.*

Other limitations for legal recycling associations include the cultural patterns of recyclers, which generate problems in the conformation, development and consolidation of associations due to power struggles and anxieties about leadership among recyclers. To overcome this situation, it is necessary to train this population in conflict resolution and communication skills.

Today, every waste picker receives 10 cents on the dollar per kg of recycling material as a wage. This is a low wage that is paid by the local government. Recycling associations often lack the liquidity and resources to pay their expenses and to make investments to improve their businesses through increased capacity, new technology and transport equipment. These elements would help these associations to survive by reaching the break-even point and would even allow them to achieve profitability in the near future. Recyclers made the following comments: (i) *Not having working capital and a fixed income due to the volatility of material prices and taxes are the main weaknesses in consolidating recycling associations in Bogotá*; (ii) *The salary of a recycler is lower than that of a worker.*

4.3 Opportunities

There are multiple opportunities for recycling associations to become authorised waste providers. In Bogotá, recycling work has begun to be recognised, and some programmes have been designed to increase recycling rates through separation at the source by the population and to generate a recycling culture. Recycling associations have achieved consolidated alliances with the industrial sector to sell recycled materials as raw materials for use in different industrial processes. A recycler made the following comment in a focus group: *The recycling associations have multiple opportunities, such as increasing the collection of material and developing mechanisms to transform and valorise recycling material as raw materials for industry*.

Through legal battles, the recycling sector has gradually achieved recognition from public authorities and civil society, decent working conditions and inclusion in the waste management system. However, wages for recyclers remain low, and greater support is still required for these associations with the aim of growing a profitable and effective business. The salary of recyclers, which is lower than minimum wage, in most cases, depends on the quantities of material collected and sold and the support of local government. Focus group participants commented, (i) *Recycling associations must be capable of sustaining and achieving productive business. Today, the association is at a break-even point; there is no gain, but there is no loss*; (ii) *New programmes and legal instruments are achievements by waste pickers who seek to generate new business opportunities through recycling as a strategy for social inclusion*.

Bogotá has a low recycling rate. It is fundamental to promote waste separation and a recycling culture among citizens with the aim of reducing the amount of garbage that arrives at landfills to alleviate the health risk to waste pickers when sorting reusable or recyclable materials from loads of mixed waste and to decrease the environmental problems related to inadequate waste management processes, exploitation and the valuation of residual waste.

Recycling associations have created alliances with the industrial sector with the aim of reducing intermediation in the sale of recyclable waste, stabilising the prices of materials and obtaining better incomes that improve the conditions of businesses and recyclers. These alliances have been built based on the requirements of the productive sector by using recycling materials as raw material. Various companies seek to support formal recycling associations through grants to process recycling materials, the direct purchase of materials, training in company start-ups and material processing. These industries indicate that recycling associations can consolidate recycling as a productive business by analysing the management, cash flow, situation of recyclers and general results with the aim of continuing to support and purchase materials. A focus group participant commented, *It is fundamental to have the support of the productive sector in the purchase and use of recycling materials as a strategy to promote recycling associations and care for the environment*.

4.4 Threats

According to the SWOT analysis, the incursion of private companies into recycling services, the lack of a recycling culture in the population, legal instability and the failure to eliminate the poverty trap are the primary threats to recycling associations.

Private companies have found a business opportunity in recycling, which provides an option for the public sector to create recycling activities within society. These companies understand the business, have working capital and technology and have opportunities to create marketing materials. However, this option works to the disadvantage of waste pickers who continue to live at the margins and fail to be included in this population, which is the key to eliminating the poverty trap. For this reason, it is important to grow recycling associations, to seek new alliance alternatives within the private sector and to help waste pickers become employees of private companies that guarantee decent work for the recycler population. A recycler commented in a focus group, *More companies support the recycling activities of associations. However, private companies with resources could begin new recycling companies that would eliminate these associations as businesses because the competition would be very difficult*.

The formulation of waste policy and laws has been unstable in Bogotá, which has generated mistrust among recycler populations. However, policy makers have formulated policies that require the inclusion of waste pickers as associations become authorised as the waste providers of the future. A participant in a focus group commented, *The new legal instruments have been important for recycling associations. However, in most cases, the application is very slow and requires many procedures*.

Recycling culture in Bogotá is limited, which decreases the possibilities to collect and process materials with the potential for reuse. This situation presents a threat to recycling associations because they cannot collect enough material to guarantee profitable businesses. In the city, environmental problems are increased by inadequate disposal of waste that could have been returned to the productive chain.

5 Strategies to promote the integration of informal sector members as authorised waste providers

Based on the SWOT analysis above, critical strategies for the transition from the informal recycling sector to authorised waste provision should adhere to the basic principle of improving inclusion in the recycling sector, such as by including *maximizing strengths and opportunities, transforming weaknesses to strengths and minimizing threats*.

To achieve the effective inclusion of the recycler population into the waste management system, the following factors are important: (i) supporting social acceptance, (ii) developing adequate policies that respond to the needs of stakeholders, (iii) mobilising and integrating recycling associations, (iv) creating strategic alliances with the industrial sector and (v) providing training in the techniques and tools of management, negotiation and conflict resolution, among others (Ezeah et al. 2013). These aspects should be flexible and should account for local conditions and contexts to develop and empower the recycler population.

According to research by King and Gutberlet (2013) and Gutberlet (2015a) in Brazil, legal and organised cooperative recycling generates multiple benefits for communities, governments, recyclers and the environment (such as the reduction of greenhouse gas emissions). Thus, it is crucial to promote the following: (i) remuneration for recycling activity; (ii) promotion of public policies that support the social and solidarity economy of solid waste with the participation of the recycler population; (iii) promoting access among recyclers to formal education, skill development and capacity building; (iv) implementing adequate technology and infrastructure in cooperatives to collect, separate and transform

materials for introduction into the value chain through their commercialisation. It is also important to improve logistics and management to achieve efficiency and quality in recycling; (v) recycling cooperatives that allow for a sustainable, inclusive, integrated municipal SWM service. These elements concur with the results of the SWOT analysis in this study and are taken into account in the following strategies.

To achieve the inclusion of recycling associations and to help them become authorised waste providers, the following strategies should be employed in the Colombian context:

- *Trade union management* allows for the participation of recycling associations in the design and application of waste policy and recycling with the aim of inclusion through laws, regulations and programmes. This management will promote recycling culture and adequate labour conditions for the waste picker population as a strategy to decrease poverty and the environmental problems associated with waste management. This strategy is consistent with Murakami et al. (2015) in the Brazilian context, who suggested that public policies should concentrate on community awareness campaigns to promote the importance of recycling and provide attention to waste pickers through training to increase alternatives for waste sorting, improvements in income and new recycling technologies. Moreover, in countries such as Colombia and Brazil, recycling associations of waste pickers have achieved high visibility, and pickers participate in the formulation of public policies. For example, in Brazil, waste pickers have participated in the integration of recycling associations at different levels (Tavares 2014). In Colombia, especially in Bogotá, recycling associations have won recognition for the work of waste pickers and changes in vehicles from animal-drawn carts to motor vehicles.
- *Business management* is important to achieve economic consolidation through a business model that is more productive and allows for the increased collection of materials and the valorisation of waste via their reinstatement into the value chain. At this time, it is essential to promote a recycling culture and separation of garbage at the household level, which generates multiple benefits for the environment, recyclers and the recycling business model. Recycling as a business to collect, separate and transform waste from raw materials allows for the creation of jobs, the provision of economic opportunity, the generation of revenues and the conservation of energy and natural resources. Furthermore, the business aspects of recycling are important to facilitate the integration of supply and reverse-supply chain members by using appropriate economic instruments that promote new technologies to transform recycled materials and improve products with an eco-friendly design (Batool et al. 2008; Sheu and Chen 2014). Vogler (1981) demonstrated that waste is one of the world's largest industries and provides a good employment opportunity for the following reasons: (i) waste is plentiful (it is generated every day by the population); (ii) waste is free or very cheap (to protect the environment, it is necessary to return it to the value chain); (iii) waste is flexible (recycling material can be processed into something more valuable as raw material or can be sold to be transformed by another link in the value chain); and (iv) waste is labour intensive (recycling in developing countries requires people to collect and sort materials). It is important to understand these features of recycling to strengthen the recycling business as an inclusive, environmental and economic strategy for development.
- *Social management* is a key factor in empowering recyclers and achieving their integration as associations to facilitate the recycling business and teamwork. To improve the welfare and quality of life of recyclers, programmes should be available to

promote education (training in communication abilities, conflict resolution, high school and waste technology, among others), health, household, recreation and labour conditions that allow the human development of this population through better interpersonal relationships, and the development of strategic alliances between the public and private sectors that support recycling associations. This strategy concurs with several studies that have demonstrated that the work of waste pickers is not recognised within SWM because, in general, this population lacks education, self-organisation and knowledge of their civil rights for an effective social participation process. These aspects are fundamental to promote social innovation initiatives that foster greater social inclusion and decrease poverty (Nzeadibe and Anyadike 2012; Paul et al. 2012; Ezeah et al. 2013).

- *Process and technology management* is a strategy that generates the possibility of seeking new transformation processes and technologies to valorise recycling materials for the productivity and sustainability of recycling associations. Moreover, it is important to design and apply selective recycling routes to increase recycling rates and promote a culture of source waste separation and recycling in the population. The government and private sector should promote financial programmes and instruments that allow recycling associations to access credit or financing possibilities for their productive undertakings to make recycling an effective business. Moreover, different methods of development should be made available to improve waste management and to produce valuable end products from waste as a complex resource (due to its diversity and variability). At the same time, a variety of innovative solutions and alternatives should be offered through advanced valorisation strategies in which waste is used as raw material for new products and applications. These approaches are key technologies that will help to make recycling associations successful in the long run through the commercialisation of materials from waste (Arancon et al. 2013; Mirabella et al. 2014). However, in developing countries such as Colombia, it is important to consolidate recycling associations and improve the livelihoods of recyclers through remuneration to waste pickers by the local government. This has begun in Bogotá, where it is necessary to achieve remuneration comparable to the legal minimum wage, as demonstrated by Gutberlet (2015a, b) in the Brazilian context.
- The following policy suggestions by Acosta and Ortiz (2013) for a SWM plan concur with the results of this research: (i) the recognition of waste pickers and recyclers as important actors in the reclamation of recyclables should be included in all public policies related to waste management in Colombia; (ii) the structural base of public policy should include guaranteed access to recyclable materials from waste, security for professional recyclers to remain in the profession, incentives to move upwards in the value chain and recognition of a payment system for cleansing and environmental services that must include actions for the recognition and social, technical and economic inclusion of this population; (iii) actions should be developed to make recycling activity visible and measurable, which would gradually lead to a greater level of formalisation of this occupation; (iv) to decrease impacts related to fluctuations in the recyclables market, recycling associations should generate their own value recycling processes with the aim of achieving more equal redistribution of the revenues obtained in the value chain. Hence, recycling associations should work to engage industry directly to raise the sale prices of materials and to obtain other benefits that the industrial sector can offer for sustainability and the maintenance of the business; (v) public awareness should be raised regarding the importance and contribution of the recycler population to social and environmental issues with the aim of decreasing

public discrimination based on this work; (vi) recycling associations should continue to seek remuneration for public and environmental services rendered based on cleansing services and indicators of their contributions to the environment; (vii) the combination of remuneration for environmental services and the sale of materials will allow recycling associations to achieve good business that promotes social inclusion, environmental protection and economic consolidation.

The findings of these studies are important for determining good strategies and policies that promote the inclusion of waste pickers in the integrated sustainable waste management of the city and that allow these populations to eliminate the poverty trap through an effective business in recyclables. The business of recycling generates benefits for society by decreasing environmental problems and reintegrating raw material into the productive process through innovative solutions and strategies. Moreover, citizens in other cities in Colombia or Latin America should understand the possibilities of employing recycling associations as authorised waste providers, which is essential to eliminating poverty and dignifying the work of the street waste pickers as well as guaranteeing better labour conditions and fewer health risks.

6 Conclusions

This study performed a thorough SWOT analysis and presented the internal and external conditions of the transition from the informal sector to authorised waste provision in Bogotá. It is important to understand the possibilities for waste pickers and recycling associations to continue as recyclers with adequate labour conditions or through a profitable business from recycling. The results suggest that the primary strengths of recycling associations are their leadership, their capacity to organise and their mechanisms for improving the process and labour conditions of recyclers, whereas the primary weaknesses are a lack of economic resources, the cultural patterns of waste pickers and low and insecure labour conditions.

The external conditions of the SWOT analysis indicate that the primary opportunities for recycling associations are the recognition of recyclers' work, the potential to increase the recycling rate in Bogotá and alliances with the productive sector to stabilise the prices of recycling material and improve incomes. In contrast, the primary threats are the possibilities that private companies will provide recycling services, the lack of a recycling culture and separation at garbage sources by Bogota's citizens and the failure to eliminate the poverty trap in these vulnerable populations.

The findings also present some major opportunities that recycling associations can exploit to become authorised waste providers. These associations can build integrated sustainable waste management in Bogotá through a profitable business that increases the recycling rate, integrates waste into a productive process for the generation of new materials and decreases environmental problems while improving the welfare and living conditions of recyclers.

Based on the identified SWOTs, some strategies for improving the transition from the informal sector to authorised waste provision have been proposed. It is important to guarantee legal stability and promote improvements in trade union management, business management, social management and process and technology management. These strategies will allow recycling associations to achieve a business model that allows the recycler

population to have decent work and to be recognised by society for their labour, which contributes to their welfare and to environmental protection.

The results of this study are important for understanding the actual situation of recycling associations in Bogotá with the aim of designing new instruments and programmes that allow these associations to be integrated and recognised for their labour within the integrated sustainable waste management of the city. Other cities in Colombia and Latin America should determine possibilities for integrating the recycling population into business models that allow the creation of recycling associations or the integration of waste pickers into private recycling companies as a strategy to decrease poverty.

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