Waste Management 33 (2013) 2509–2519

Contents lists available at SciVerse ScienceDirect

Waste Management

journal homepage: www.elsevier.com/locate/wasman

Review

Emerging trends in informal sector recycling in developing and transition countries

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ARTICLE INFO

Article history:
Received 6 March 2013
Accepted 24 June 2013
Available online 22 July 2013

Keywords:
Informal sector recycling
ISR
Solid waste management
Developing countries

ABSTRACT

Optimistic estimates suggest that only 30–70% of waste generated in cities of developing countries is collected for disposal. As a result, uncollected waste is often disposed of into open dumps, along the streets or into water bodies. Quite often, this practice induces environmental degradation and public health risks. Notwithstanding, such practices also make waste materials readily available for itinerant waste pickers. These 'scavengers' as they are called, therefore perceive waste as a resource, for income generation. Literature suggests that Informal Sector Recycling (ISR) activity can bring other benefits such as, economic growth, litter control and resources conservation. This paper critically reviews trends in ISR activities in selected developing and transition countries. ISR often survives in very hostile social and physical environments largely because of negative Government and public attitude. Rather than being stigmatised, the sector should be recognised as an important element for achievement of sustainable waste management in developing countries. One solution to this problem could be the integration of ISR into the formal waste management system. To achieve ISR integration, this paper highlights six crucial aspects from literature: social acceptance, political will, mobilisation of cooperatives, partnerships with private enterprises, management and technical skills, as well as legal protection measures. It is important to note that not every country will have the wherewithal to achieve social inclusion and so the level of integration must be 'flexible'. In addition, the structure of the ISR should not be based on a 'universal' model but should instead take into account local contexts and conditions.

Contents

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http://dx.doi.org/10.1016/j.wasman.2013.06.020

1. Introduction

The urban economy is supported by two pillars; the formal and informal sectors (Zia et al., 2008). The formal sector is modern and industrialised, made up of public and private enterprises which are legally and financially backed by government agencies. In contrast, the informal sector lies out of state control. Despite this however, formal and informal enterprises are often dynamically linked; be it through production, distribution or consumption (Katusiimeh et al., 2013). Gutberlet and Baeder (2008) believe that in 'poor countries' the informal sector gives an invaluable 'front-line' service to large sections of society and often determines the direction of the whole economy. Informal Sector Recycling (ISR) is a term used to describe individuals or enterprises involved in the extraction of recyclable materials from mixed Municipal Solid Waste (MSW). As will be seen throughout this review, the trading network of the informal recycling sector is more comprehensive and efficient than it is first taken to be (Chi et al., 2011).

In most cases, informal waste recycling is carried out by poor, disadvantaged, vulnerable and/or marginalised social groups (for examples gypsies, rural migrants, disabled, elderly, the illiterate and religious minorities) who often resort to scavenging as an adaptive response (income) (UN HABITAT, 2010). The socio-economic and socio-demographic characteristics (level of income, gender, age distribution, marital status) of scavengers differ from location to location (Asim et al., 2012). Medina (2007) reported that as much as 2% of the population in some developing countries depend on waste picking for everyday survival. This figure is however difficult to corroborate since the informal sector is not usually included as a census category, so reliable data on the number of individuals engaged in scavenging are difficult to obtain (Medina, 2001; Zia et al., 2008). The informal sector is characterised by small-scale, labour-intensive, adapted technology, low-paid, unorganised/unplanned, and unregistered/unregulated work (Wilson et al., 2006; Monirozzaman et al., 2011). Chi et al. (2011) describes their activities as being part of a self-sufficient, shadow economy. Individuals and family groups within the sector do not usually possess trading licences, do not pay taxes, and are not included in the government insurance, social welfare or funding schemes. Having said this, Wilson et al. (2006) believe that the informal sector collect a variety of indigenous materials and process them into a variety of intermediate and final products; the skills to do so are often acquired outside the formal school system. This is reinforced by Ojeda-Benitez et al. (2002) who stated that through the high degree of creativity and flexibility they possess, the sector could respond instinctively to the needs and demands of the market. In other to better appreciate the current status of informal sector recycling in developing and transition countries (also called less-developed countries (LDCs), i.e. countries with low living standards, underdeveloped industrial base, and low Human Development Index (HDI) relative to other countries), we have reviewed the situation in a few representative countries/regions:

1.1. Overview of informal sector recycling in Africa, Asia and Latin America

1.1.1. Egypt

In Egypt, the Zabbaleen constitute the singular most important organised group involved in informal sector recycling. They are a discrete Christian minority group with an estimated population of 60,000 (Fahmi and Sutton, 2006). It is reported that they have collected and sorted nearly 50% of the household waste produced across Cairo, Egypt, since the 1930s (Wilson et al., 2006). Zia et al. (2008) is of the view that through the implementation of an NGO-led support program the group were able to organise themselves and so have been able to upgrade their services from waste collection to recycling and treatment. In fact, in 2006 a recycling rate of 74.3% was achieved by the informal sector compared to 10.6% by the formal sector (Wilson et al., 2009). Formal recognition by the state government has resulted in improved living and working conditions for the workers i.e. settlement improvements and the provision of basic infrastructure (i.e. school, health care, water supply). Notwithstanding, Integration into the society continues to face many challenges with official attitudes still hostile. In 2002, the city authorities decided to privatise the entire municipal solid waste management system so as to 'drive for a modern city'. A lack of coordination and collaboration amongst stakeholders (Zabbaleen, NGOs, private contractors and authorities) led to controversies and delay of planned improvements (Wilson et al., 2009).

1.1.2. China

Resource scarcity, rapid industrialisation and urbanisation are the main drivers for increased local demand for secondary raw materials in China. Itinerant buyers play a fundamental and highly efficient role in the separation, collection and utilisation of all reusable waste materials. The transition of Chinese economy from communist to a market based economy and the opening of borders to trade has however shown that it was more lucrative to import heavily subsidised source-separated recyclables from Europe than buy locally produced recyclables. Though the informal sector continues to recycle materials from municipal sources, with little support, recycling rates are declining (Wilson et al., 2009). Chi et al. (2011) is of the opinion that instead of focusing on household municipal solid waste the informal sector in China has turned to WEEE recycling. This is due to sufficient supplies brought by illegal imports, low labour costs, low treatment costs (albeit using backyard and highly polluting methods), lack of quality control, a steady downstream demand for secondary materials, and a comprehensive and efficient trading network (Chi et al., 2011).

1.1.3. India

There are an estimated six million informal waste pickers in India (Bonner, 2008). However, the informal sector is not included in any census category and so there is no reliable data available at

city, state or national levels (Zia et al., 2008). So far, organised recycling does not form a part of the local or state governments' waste management policy (Zia et al., 2008). Having said this, a number of partnerships exist in Indian cities that deal with the problem. These include public–private, public–community and private–private. Public–community partnerships (between Local Authorities and NGOs) are prevalent in the metropolitan cities of Bangalore, Chennai and Delhi. Furthermore, in Madras the NGO EXNORA created a waste collection program for low-income neighbourhoods where residents pay $0.30 per month for refuse collection. This has increased the earnings of the sector whilst also dignifying the activities, reduced littering and increased collection rates (Medina, 2000). Private-private partnerships flourish in areas such as Kanpur city where a network of waste pickers, dump pickers, itinerant buyers, dealers, wholesalers exist. A mixture of migrant Hindus (pickers) and Muslims (traders and dealers) work interchangeably, although the socio-economic status of both religious groups varies significantly. In India, waste pickers could be expected to earn Rs 1527 per month whilst wholesalers could earn up to Rs 10,700 per month (Zia et al., 2008). Wilson et al. (2009) state that like in Egypt, the Indian informal sector is continuously under threat from government's 'modernisation programme'.

1.1.4. South America

Compared with other regions of the world, the organisation of informal sector recycling is most advanced in Latin America with their recognition and inclusion as workers in MSWM systems more common than elsewhere. They are often organised into worker cooperatives or associations, which have combined into national movements in some countries (Bonner, 2008). A wide variety of stakeholders are involved, including activists, academics, waste picker organisations, NGOs, financial institutions, service providers, and federal, state, and local governments (Medina, 2008). Brazil for instance has one of the largest and best established national movements of waste pickers (Bonner, 2008). The organisation strives for collective recognition, legitimisation, self-empowerment and social inclusion, aiming to build a better and more dignified working life for its estimated 300,000–1 million Catadores (scavengers) who are involved in recycling activities (Gutberlet and Baeder, 2008). It is reported that Brazil alone has about 500 waste pickers' cooperatives (Medina, 2008). Coopamare, one of the most successful, collects and sells around 100 tonnes of recyclables a month in Rio (Medina, 2000). In addition to resource utilisation, members earn around $300 a month, which is twice the minimum wage in Brazil (Medina, 2008). Just as in Brazil, as many as 40,000 waste pickers are reported to be involved in recovering cardboard and other recyclables on the streets. Their economic impact is estimated at $178 million a year (Medina, 2008). A study in three Mexican cities found that nearly 3000 informal refuse collectors collect 353,000 tons of waste a year, earning up to five times the minimum wage (Medina, 2007).

1.1.5. South Africa

In South Africa, there are community-based organisations (CBOs), Co-ops and associations setup or supported by NGOs. However, few attempts have been made to build organisation beyond the local level. The Slum/Shack Dwellers International (SDI) recently began engaging with livelihood issues (service provision, infrastructure, housing) in order to support groups that have put some of their savings into recycling projects (Bonner, 2008).

1.2. Why does the informal recycling sector exist?

Specific physical and socio-economic conditions, including urbanisation, mass migration, rapid population growth, low-skilled labour forces, ageing infrastructure, economic poverty, and a lack of affordable services, are dominant in many metropolitan areas in developing and transition countries (Wilson et al., 2006; Sembiring and Nitivattananon, 2010). Such features present a huge problem for governments and local authorities who are responsible for the management of solid waste (from initial point of collection to final processing) (Damghani et al., 2008; Matter et al., 2013). In many areas the systems are poorly run, operate to a low standard, and provide inadequate collection and coverage (Asim et al., 2012). Optimistic estimates suggest that only 30–70% of the refuse generated in cities of developing countries are collected (Ezeah and Roberts, 2012). As a result of reported inadequacies in waste collection and disposal, waste is often disposed of into open dumps, on the streets, into rivers or on vacant lots. This can induce soil degradation, intensive flooding, water/air pollution, and acute sanitary and hygienic threats (Matter et al., 2013). However, such activity also makes refuse readily available for waste pickers (Asim et al., 2012). Sembiring and Nitivattananon believe that waste is a subjective issue; to some waste is a public health and environmental risk, whilst to others it has a 'use' or a 'value'. There is no question that to the informal recycling sector waste is perceived as a resource. By extracting materials; employment is generated, littering is reduced, the lifespan of the local landfill is prolonged, resources and energy are conserved, pollution is abated, aesthetic value is maintained, and the overall flow of waste is reduced (Damghani et al., 2008; Monirozzaman et al., 2011). Recycling also helps society 'move up the waste hierarchy' and supplies secondary raw materials to industry (Wilson et al., 2006; Asim et al., 2012). In certain cities, such as New Delhi and Cairo, the informal sector provides waste collection services where no formal systems exist (Wilson et al., 2009). It should be noted that, even here, the prime economic motive is very often not the fee charged for the service, but the income from selling collected waste (Wilson et al., 2006).

In the study "Solid Waste Management in Developing and Transition Countries" (UN Habitat, 2010), the authors argue that ISR results from and is sustained by a failure of the governance system. This point is re-echoed by Nzeadibe and Anyadike (2012) and Adama (2011) who contend that urban governance processes and politics including the nature and extent of state regulation, nature of state civil society relations and linkages are significant drivers of the informal sector recycling phenomenon in most developing countries. Though much of current discourse on informal sector recycling in developing countries have been framed within a poverty reduction and economic survival point of view (Nzeadibe and Anyadike, 2012), the reality remains that Informal sector workers do not operate in a vacuum. Informality could therefore be looked at from the point of view of overall failure in governance (Adama, 2011). All said, to better understand the politics of informal sector recycling in developing countries, there is a need to answer

Fig. 1a. Itinerant waste picker, Abuja Nigeria.

Fig. 1b. Traders at a dump site, Nyanya, Nigeria.

fundamental questions such as who are the actors and how are ISR activities shaped by place specific conditions (Adama, 2012).

2. Informal sector recycling hierarchy and networks

In most cities with informal, municipal waste collection and disposal systems, at least six categories of informal waste recycling are known to exist. Together, they form a recycling network hierarchy (Wilson et al., 2006). With every higher level of waste buying, the price and profit increases. It is important to note that despite socio-economic, political and cultural variations, scavenging patterns do exist around the world (Wilson et al., 2009).

2.1. Household waste collector

In several countries the informal sector directly provides waste collection services (Asim et al., 2012). This involves individuals or groups going from door-to-door collecting waste (from households, institutions, functions etc.) using a donkey cart, hand cart, bicycle or small vehicle. The prime economic motive is very often not the fee charged for the service, but the income generated from selling on the reusable/recyclable fraction of the collected waste (Wilson et al., 2006). After collection, materials deemed valuable are segregated, cleaned, washed, dried and classified. The remaining residual waste is often used as feed stock for domestic animals such as pigs or as a soil supplement for agricultural production. Some waste collectors work for employers and contractors as they cannot afford to buy the necessary equipment to undertake the activity. In exchange they are given a wage, shelter and mobility (Asim et al., 2012).

2.2. Street pickers

Street pickers gather secondary raw materials from mixed waste in markets, streets, garbage bins, drains and transfer stations all over the urban fabric (Wilson et al., 2006; Zia et al., 2008). Asim et al. (2012) noted that street pickers work an average of 10 h a day and cover an area of 10–15 km. Those who do not have hand carts are forced to carry the materials, usually in a big sack (see Fig. 1a) (Ezeah et al., 2009). As if this was not tough enough, they are sometimes assaulted by street gangs, the police and members of the public.

2.3. Itinerant waste buyers

Itinerant waste buyers (IWB) go from door-to-door of households (Figs. 1a and 1b), institutions and commercial centres collecting, trading or purchasing recyclable materials/items that people consider of no value (Ojeda-Benitez et al., 2002; Wilson et al., 2006; Zia et al., 2008). Cans, glass bottles, paper, newspaper, old mattresses and old furniture are often targeted (Ojeda-Benitez et al., 2002), although they tend to specialise in one or two kinds of materials (Wilson et al., 2006). The activity is often undertaken by individuals and so is labour intensive. It also involves capital investments in order to purchase bicycles, hand carts or wheelbarrows (Wilson et al., 2009). Asim et al. (2012) believe that the number of itinerant buyers is on the increase as householders are realising the economic benefit of selling materials.

2.4. Municipal waste collection crew

Secondary raw materials are recovered and segregated from vehicles transporting MSW to disposal sites (Wilson et al., 2006). Collection crews later sell the materials to scrap dealers and divide the income amongst themselves (Sembiring and Nitivattananon, 2010). Although there are time constraints, it has been known that the activities can double their income. This form of resource recovery is prolific in Thailand, Columbia, Mexico and the Philippines (Medina, 2001).

2.5. Dumpsite pickers

Whenever a truck full of solid waste arrives at the open dump/landfill the waste pickers pick out the useful material prior to it being covered. These materials are often deemed undesirable by other scavengers due to their poor quality (contaminated, damaged or soiled). This activity is mostly carried out by females, the elderly and children (prevents them from having a formal education) (Wilson et al., 2006). The recovered items are then sold to

Fig. 2a. Dumpsite waste picker, Gosa, Nigeria.

Fig. 2b. Collected items ready for bagging.

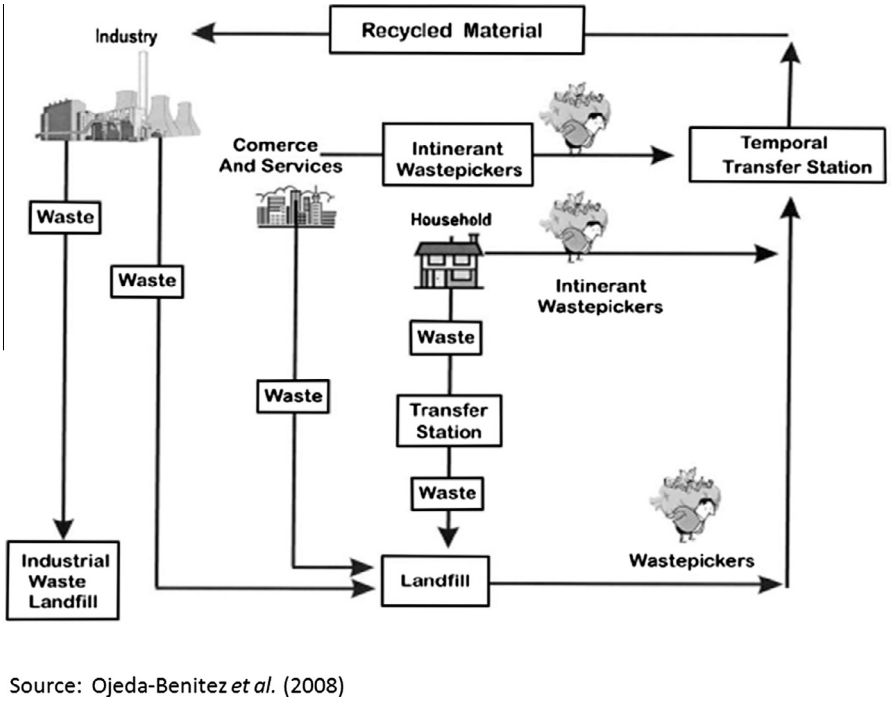

Fig. 3. Typical flow diagram of recyclable materials by the informal sector.

Table 1
Major recovered and recycled materials in Enugu urban area, Nigeria. *Source:* Nzeadibe (2009).

Materials	Quantity (kg/person/month)
Plastics	14,400
Non-ferrous metals	550
Ferrous metals	18,120
Glass bottles	8005
Total	41,075

temporary junk shops that are located on edge of dumps (see Fig. 2a). Asim et al. (2012) noted that in some cases the waste pickers have to pay to access the waste and then have to sell the materials to the same organisation at a price much lower than market value. However, group or family-organised activities reduce individual vulnerability and exploitation by providing a level of social/economic support (Wilson et al., 2006). The pickers live in temporary shacks which, as a whole, make up a squatter settlement/community (Zia et al., 2008). Here, living conditions are poor, there is limited infrastructure and amenities, no provision of urban services (i.e. sanitary facilities, clean water) and an absence of social safety networks (Wilson et al., 2006; Gutberlet and Baeder, 2008). These communities are frequently situated along railway lines, in disaster prone areas (such as steep slopes, flood plains or river beds) (Wilson et al., 2006), or on or near the dumps (widespread in Cape Town, Manila and Mexico City) (Wilson et al., 2006). By occupying the land near dumps, scavengers minimise transportation costs, occupy undesirable land, and use discarded materials for the construction of their home (for example tin, old textiles, bamboo, polythene and mud). These settlements are constantly expanding as more and more peasants come to the city looking for work (Sembiring and Nitivattananon, 2010). It is fair to state that the recycling activities here take place in a very dirty environment (see Figs. 2a and 2b) which can be detrimental to public health (Monirozzaman et al., 2011). Conflict between the informal workers and the formalised municipal crews can occur

Fig. 3a. Truck load of recovered metal scrap from Abuja, Nigeria.

at the site as scavengers can interfere with vehicle movements which results in reduced efficiency and increased turnaround times (Wilson et al., 2006).

2.6. Middlemen (Intermediate dealers)

Primary and secondary dealers, recycling SMEs, junk shops, intermediate processors, brokers and wholesalers constitute middlemen (Wilson et al., 2006). This group plays an important role in the recycling of materials. Industry demands an adequate volume of quality materials from their supplies and will not buy materials from individual scavengers. As a result, middlemen purchase items from 'scavengers' and then sell them to small industries, traders, main dealers, large scale enterprises and/or exporters who finally sell the recyclables to the manufacturing industry (private sector) (Sembiring and Nitivattananon, 2010).

This complex structure (Fig. 3) shows how the formal and informal sectors are explicitly linked (Wilson et al., 2009; Sembiring and Nitivattananon, 2010; Chi et al., 2011; Asim et al., 2012). In a

Table 2
Comparison of waste pickers monthly income and the minimum wage in Nigeria ($). *Source:* Nzeadibe (2009).

City	Ave. monthly income($)	Monthly minimum wage ($)
Port Harcourt	153.0	75
Nsukka	48.3	35
Enugu	99.3	35
Onitsha	84.9	35

monopolistic market (only one buyer), middlemen grossly take advantage of scavengers by paying low prices for the materials. Individual waste pickers or those who are relatively isolated on dumps are the most susceptible to exploitation as they do not have an organised supportive network.

3. Usually recycled materials

The informal recycling sector is highly skilled at identifying waste with a potential value, and locating customers within certain markets (Nzeadibe, 2009). The composition of solid waste produced, and therefore available to recycle, depends on dietary habits, culture/traditions, lifestyle, climate and income status of the community where the waste is produced (Damghani et al., 2008). The recyclable materials most frequently targeted are plastic, paper and cardboard, metal scrap (aluminium, steel, tin), glass, PET bottles, rubber, wood and textiles (see Table 1). Usually metal, paper and PET are preferred due to their incredible recycling potential and long life span (Fig. 3a). Conversely, bones are the least desirable material to recover (Suttibak and Nitivattananon, 2008; Monirozzaman et al., 2011). The degree to which a particular material is recycled depends on the price of virgin materials, existence of local markets, supply and demand for secondary materials, level of accessibility, convenience of transporting the materials, and the potential profit margin (Medina, 2001; Wilson et al., 2006). The price paid for an item depends on its quality and quantity, although waste pickers do not usually have control over what they get paid per kilogram of material (Ojeda-Benitez et al., 2002). Gutberlet (2008) suggests that there is an extreme fluctuation in the prices paid by small merchants, large merchants and the industry in different countries. Value can be added to the materials by cleaning, classifying, washing and drying, compacting, aggregating them into a commercial quantity, and altering their physical shape to facilitate transport (Wilson et al., 2006; Asim et al., 2012). Matter et al. (2013) believe that "the system is however not optimised to secure maximal value creation". This is because some pickers do not have the space to add value to the recovered materials and so these 'unclean' (fungi, bacteria, disease ridden) materials are sold at low prices (Gutberlet and Baeder, 2008). Since no control is exercised here, unsanitary recycled materials may enter society and result in irreversible health consequences (Damghani et al., 2008). Materials received from mixed waste will generally be contaminated and relatively low grade (Wilson et al., 2009). Waste therefore needs to be separated at source, possibly into biodegradable, non-biodegradable and recyclable components. The public will have to be sensitised towards the concept and educated about the benefits of resource recovery i.e. the contribution it brings to environmental health and elemental sustainability (Sembiring and Nitivattananon, 2010). This can be achieved through extensive and repetitive environmental education campaigns; using brochures, posters, and meeting/lectures in schools/religious institutions (Damghani et al., 2008). Careful planning is also necessary. Mor et al. (2006) suggest that a characterisation and composition analysis of the MSW stream would allow for an accurate estimation of its recycling potential and for effective management of the entire system.

4. Socio-economic, health and environmental impact of informal sector recycling

4.1. Estimating the economic impact of informal sector in SWM

Informal sector recycling allows new enterprises and trading networks to evolve and investments to take place (Gunsilius, 2012). Furthermore, the activity delivers a steady, reliable supply of valuable secondary raw materials to local industries (such as recycled plastic pellets) (Matter et al., 2013). This can substitute the importation of new materials and thus stimulate the manufacture of low-cost, affordable products for the local community (Wilson et al., 2006). This scheme also cuts the cost of formal waste management systems as the quantity of waste for collection is reduced (Matter et al., 2013). Gunsilius (2012) argues that most informal waste management operations achieve a net benefit while formal waste management operations have a net cost. This view is reinforced by Nzeadibe and Chukwuedozie (2011) who are of the opinion that the average earnings of waste pickers can be significantly more than the prevailing minimum wage (see Tables 2). However, Wilson et al. (2006) argue that because the informal sector workers do not pay taxes, the income generated does not immediately re-enter the economy. Although the sector is well adapted to prevailing conditions, lean seasons (i.e. monsoons, extreme winter and summer) can severely hinder the quantity/quality of collected material, thus reversing the positive impacts felt during periods of prosperity (Zia et al., 2008; Monirozzaman et al., 2011).

Gunsilius (2012), on behalf of The German Society for International Cooperation (GIZ), measured the economic costs and benefits of informal activities across two closely related sub-sectors, the informal service sector (who provide waste removal, transport, and disposal services and are paid a wage) and the informal recovery sector (who extract, process, transport, and sell reusable and recyclable materials in the recycling value chain and who are paid per Kilogramme weight delivered. The study covered six major cities around the world: Cairo (Egypt), Cluj-Napoca (Romania), Lima (Peru), Lusaka (Zambia), Pune (India) and Quezon City (Philippines).

The authors constructed two modelling scenarios which have the potential to aid in future decision making. On the one hand, they focused on the impact if the activities of the informal solid waste sector ceased to exist or was drastically restricted (subtraction scenario). And, on the other hand, they investigated the impact if the activities were recognised and integrated into the formal solid waste system (addition scenario). The exercise indicated that a stronger integration of the informal sector in the solid waste system had the potential not only to increase the informal sector revenues, but also to reduce the total solid waste system costs in a city and particularly the costs to formal sector. In the addition scenario, the net costs go down for Lima, and the net benefits rise significantly for Cairo, Cluj, and Quezon. In Lusaka, the addition scenario shows slightly higher costs than the subtraction scenario; whilst in Pune the subtraction scenario results in significantly higher costs than the addition scenario. It was found that the informal sector in the six cities together make a net profit of about 130 million Euros. The large profit is able to provide valuable income to around 73,000 informal sector workers. In fact, in five of the cities the informal waste sector provides more livelihoods than the formal waste sector (all but Lusaka). Average earnings in the informal recovery sector in Pune, Lima, Cluj, and Lusaka, are between 110% and 240% above the legal minimum wage level. The earning

Table 3
Estimation of the economic impact of informal sector recycling. *Source:* Gunsilius et al. (2011).

City/indicator	Cairo	Cluj	Lima	Lusaka	Pune	Quezon
Total number of livelihoods in informal waste sector (persons)	33,000	3, 226	17, 643	480	8,850	10, 105
Total employment in the formal waste sector (persons)	8,834	330	13, 777	800	4, 545	5, 591
Ratio of persons working in the informal sector to those in the formal sector	3.7	9.8	1.3	0.6	1.9	1.8
Average informal workers' earning (€/year)	2.721	2.070	1.767	586	1.199	1.667

Table 4
Risk causing factors related to solid waste: origin and examples.

Risk factor	Examples of possible risk
Composition of waste	Broken glass, sharp items, gas, dust
Organic decomposing waste	Bio-aerosols, gaseous emissions, leachate
Handling of waste	Lifting, accident, working in traffic
Processing of waste	Air and water emissions, fires, odour, noise
Disposal of waste	Odour, noise, vibration, explosion

Adapted from Wilson et al. (2006).

potential for individuals and families involved in full-time informal recovery almost always exceeds other individual or family livelihood options. It was also discovered that the informal sector saves the formal authorities a total of €39 million in the six cities. Most of the savings are related to avoided collection costs (€14 million per year in Lima, €12 million in Cairo, and € 3.4 million in Quezon City). The savings on transport depend on the point at which the material is removed from the waste stream for recycling (i.e. landfill or household). The average avoided costs per worker worked out at €571, which can be more than a worker earns in a year. (see Table 3 below for related statistics).

The authors took cognisance of the need to overcome major economic burdens, including bribery, criminalisation, the involvement of children, and the monopoly structures in the value chains. They conclude by providing some comprehensive recommendation, such as the advantages of developing carbon financing projects. These could become a supporting instrument for integration, but only if all relevant stakeholders invest heavily in the logistics.

4.2. Social issues

Recycling provides employment and a livelihood for impoverished, marginalised and vulnerable social groups. However, they have to survive in a very hostile social and physical environment. Governments and society do not recognise the activity as resource recovery (Ojeda-Benitez et al., 2002; Gutberlet, 2008) and so public policies towards the sector tend to perpetuate discrimination and prejudice; repression (bring shame and embarrassment on the area), neglect (often ignored and rarely supported), and collusion (exploitation) are all too common (Wilson et al., 2006; Sembiring and Nitivattananon, 2010). Those involved are often referred to as backward, unhygienic, disease-ridden, homeless, criminals, nuisances, unemployed, poverty-stricken, and generally incompatible with a modern waste management system (Wilson et al., 2006; Sembiring and Nitivattananon, 2010). In some instances the sector is viewed as suspicious and so authorities and the police are openly hostile. Apart from being harassed and facing abuse, for instance, sexual abuse, they are often subject to bribery (Wilson et al., 2006). If they refuse to pay the bribes they will not be able to work in the area. These attitudes, as well as the conceptual association with waste, reinforce the low social status of the scavengers (Gutberlet, 2008). The stigmatization and isolation as a result of social exclusion has, however, led to scavengers developing their own values, beliefs, habits, customs, and social networks (Wilson et al., 2006).

4.3. Health issues

Many health risks originate from the collecting, processing, recycling and disposing of waste. This is particularly true for the informal sector that is unaware or has little consideration for occupational health and safety (Ezeah et al., 2009). In fact, Gutberlet and Baeder (2008) argue that the sector is exposed to more biological, physical, chemical and social risks than workers in any other activity. Often they do not wear protective equipment such as gloves and boots (Monirozzaman et al., 2011) and so when manual handling the waste the scavengers are in direct contact with human and animal faecal matter, toxic chemicals and sharp items (broken glass, needles) (Wilson et al., 2006). Damghani et al. (2008) noted that in many developing countries there is limited or no rules surrounding the management of hospital waste. Often this waste is transported to landfill sites without any separation. If the waste is not separated and sorted carefully from non-hazardous waste the entire composition becomes potentially infectious (with human tissue for example). This may lead to the transmission of diseases like HIV and HBV (Table 4). Scavengers are also prone to inhale gaseous emissions, bio-aerosols and micro-organisms (i.e. automobile fumes, dust, mould, fungi and leachate). This can cause respiratory issues, dermatological problems, eye infections and low life expectancy (Wilson et al., 2006). Open dumps and landfills are breeding grounds for disease-carrying animals and so the communities who live on or near the dumps (often children, women and the elderly) are highly susceptible to dengue, leishmaniasis, diarrhoea, typhoid, anthrax, cholera, malaria and a variety of skin disorders. Other health risks associated with the occupation include flue, bronchitis, ulcers, high blood pressure, musculoskeletal injuries (i.e. chronic back ache and soreness in arms, legs and shoulders), fires (from burning of the waste), explosions, intense vibration, working in traffic, long working days, extreme whether events, malnutrition and bites from dogs and rats (Gutberlet and Baeder, 2008; Matter et al., 2013). If the collectors become sick or suffer from other health related issue then they lose their earnings due to a lack of medical facilities (Monirozzaman et al., 2011). As well as improving the living and working conditions of the sector (i.e. safety equipment, infrastructure, technology) it is evident that the proper packaging, storage, collection, transportation and disposal of waste is important so as to decrease the direct/indirect health risks to humans and the environment (Damghani et al., 2008; Gutberlet and Baeder, 2008).

4.4. Environmental

Wilson et al. (2009) suggest that the recycling rates achieved by the informal sector range from 20% to 50% in China, Pakistan, India and the Philippines, to up to 80% in Cairo (Egypt). This conserves natural resources, reduces the need for landfill areas and limits the output of greenhouse gas emissions (Suchada et al., 2003; Nzeadibe, 2009). However, environmental motivations appear to be unimportant and there is a reluctance to conform to environmental standards (Gunsilius, 2012). This is reinforced by Katusiimeh et al. (2013) who are of the opinion that scavengers respond to market demands and not environmental considerations

or regulations. Often, the desirable materials are separated and the remaining residual waste is indiscriminately dumped; causing widespread contamination and unaesthetic surroundings (Wilson et al., 2009). Integrating, organising and training informal workers on the negative effects of these practices is therefore crucial (Gunsilius, 2012; Ezeah and Roberts, 2012).

5. Emerging trends in informal sector recycling

5.1. WIEGO and the inclusive cities project

Between 1st to 4th March 2008 a number of representatives from waste picker organisations, including unions, cooperatives, associations, supportive NGOs, development agencies, governments and researchers, met in the city of Bogotá, Columbia, to attend a three world conference. The events, which were initiated by WIEGO (Women in Informal Employment: Globalising and Organising), the global action research-policy network and waste picker support organisations, consisted of the First World Conference of Waste Pickers, Third Latin American Conference of Waste Pickers, and the National Day of the Waste Picker in Colombia (Bonner, 2008).

The objectives of the conference were to; strengthen the organisation and connection of informal waste pickers globally, gather potential support from governments and international agencies, and build partnerships with committed activists. In order to do this it aimed to make visible their contribution to environmental protection, health, society, the economy, the formal solid waste management system (Bonner, 2008).

For waste pickers the conference represented a big step forward in their struggle for recognition, respect and civil liberty. It facilitated learning and sharing of experiences from different countries, and between waste pickers and other stakeholders. It also enabled the formation of cross-continent links and provided the basis for on-going exchanges and networking. Furthermore, it emphasised the need to work for the social and economic inclusion of waste pickers in solid waste management systems through the implementation of improved laws and public policies which effectively strengthen their organisations.

5.2. The inclusive cities project

Launched in 2008, the 'Inclusive Cities Project' is a collaborative framework between membership-based organisations (MBOs) of the working poor and the international alliances that support the work of the organisations. These include WIEGO, Latin America Network of Waste Pickers, HomeNet (South Asia), Kagad Kach Patra Kashtakari Panchayat (KKPKP, India) and StreetNet International. The aim of the project is to "strengthen membership-based organisations (MBOs) of the working poor in the areas of organising, policy analysis and advocacy, in order to ensure that urban informal workers have the tools necessary to make themselves heard within urban planning processes" (WIEGO, 2013). In order to do so a number of significant activities have been undertaken. For example, education materials have been created to help organise informal workers, and technical, communication and logistical support has been provided to waste picker delegations as they make their voices heard at the highest levels of international delegations. Furthermore, an 'Informal Economy Budget Analysis tool' was developed so to enhance the understanding of how government budgets address the interests of informal workers, and to identify opportunities for informal workers to participate in the budget process (WIEGO, 2013). According to WIEGO (2013) significant progress has been made by partners and the workers they serve to influence municipal and national policies in order to secure legal recognition and access to public resources.

5.3. Integrating the informal sector into formal MSWM

The informal recycling sector is widespread in most developing countries, with numerous stakeholders and is linked by extensive market networks (Chi et al., 2011). It is likely to be more organised and vigorous than first thought, however this 'invisible' sector does not have legal structures and planned productions to enable the sector run and grow in scale. This is because they are not 'officially recognised' by the formal sector and general public (Wilson et al., 2009). Modern models of waste management systems are neither sustainable nor are they designed in a way that allows the informal sector access to waste as a resource (Wilson et al., 2009; Gunsilius, 2012). An abrupt abolishment of the current informal sector would be counterproductive due to the wide spread nature of the practice in most developing countries (Chi et al., 2011). Furthermore, prohibiting a local industry that feeds thousands of workers could result in social deterioration. However, breaking down the barriers so as to allow the utilisation and integration of the sector into the overall economy is a major challenge (Sembiring and Nitivattananon, 2010; Ezeah and Roberts, 2012). Without good data on the quantities of material diverted from the formal management system, officials may not be convinced that the informal sector has a place in modern waste management systems (Ojeda-Benitez et al., 2002). Political will can therefore be seen as one of the major factors defining the level of integration. Damghani et al. (2008) believes that a unique solution is needed in order to determine the best possible approach to informal sector integration. This should take account of the political, climatic, economical, religious, legal, cultural and social conditions of a given area (Gunsilius, 2012). The needs and interests of the different stakeholders involved should also be identified and taken into account. Medina (2000) suggests that in some countries (Brazil, Columbia, India) governments have begun to change their previous attitudes of indifference and intolerance to one of active support and positive engagement. By recognising the economic, social and environmental benefits that the scavengers bring, they have introduced stimulation policies, development interventions, and reform packages (legislative, financial, and institutional) (Nzeadibe, 2009; Wilson et al., 2009; Asim et al., 2012). Successful integration programmes should focus on providing legislative, financial and institutional support such as; legalising the activities, preparing educational toolkits, creating social support programmes, giving strategic advice and guidance, awarding contracts for collection, improving technical and management practices, and developing secondary material markets (Gunsilius, 2012). This can result in poverty alleviation, environmental protection and economic growth. Another possible approach could entail creating local inter-sectorial (public–private) partnerships, though this could be problematic due to conflict of interest on the side of both formal and informal enterprises (Martins et al., 2009). However, by creating ownership and commitment, establishing regular business relationships and organising the sharing of responsibilities, convergent interests and complementary action can be sought (Gunsilius, 2012; Matter et al., 2013). It is important to note that not every country will have the necessary financial, physical, human, public and social capital available to achieve social inclusion and raise prosperity and so the level of integration must be 'flexible' (Ojeda-Benitez et al., 200; Sembiring and Nitivattananon, 2010). Chi et al. (2011) argue that in order to ensure the sustainability of the practise, it is important to explore, conserve and build upon the vast practical experience the sector already holds.

5.4. Models and approaches for integrating the informal recycling sector in waste and resource management systems in developing countries

Persistent issues with the activities of the informal sector, such as child labour, uncontrolled pollutant flows, untaxed activities,

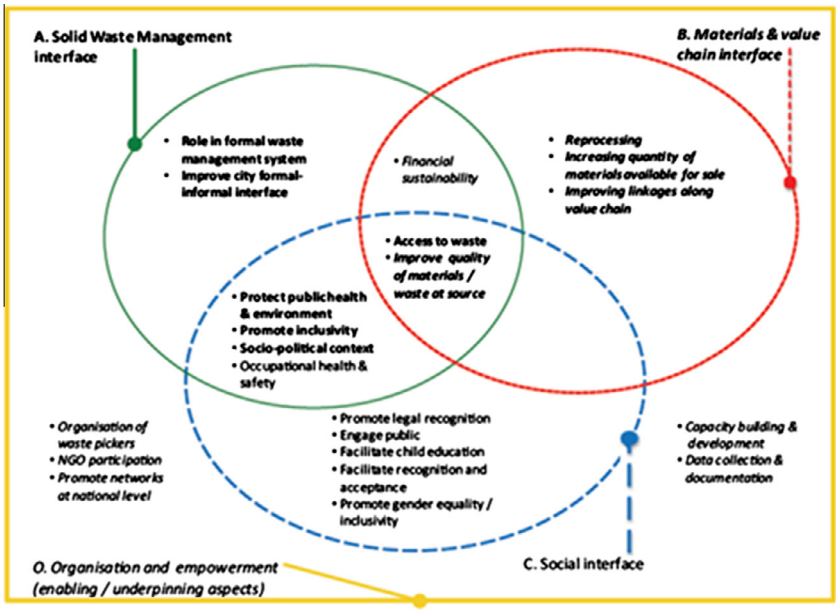

Fig. 4. Overall analytical framework and typology of interventions, showing the interdependencies (Velis et al., 2012).

association with crime and political collusion, and incompatibility with the image of a modern city continues to constitute a cog in the wheel of efforts towards the integration of informal recyclers into the formal waste management sector in many developing countries. Velis et al. (2012) in their recent study developed an Integration Radar or "InteRa", a state-of-the-art analysis of models and approaches for integrating the informal recycling sector in waste and resource management systems in developing countries. The study suggests that there is a major opportunity for win–win solutions (i.e. building recycling rates, improving livelihoods, enlightening occupational and environmental health, reducing costs to the city of managing its wastes) if the informal sector can be included successfully within an integrated and sustainable waste management (SWM) system (Velis et al., 2012).

In a nut shell, InteRa represents a systematic framework for classifying and analysing possible interventions to promote the integration of IRS in a city's SWM system. Three interfaces are identified; the IRS and the SWM system (access to waste, recognising the role of the informal sector, protecting public health and the environment, strengthening interfaces), the materials and value chain (improving the quality of the source material, adding value to the products sold, improving linkages along the value chain) and society as a whole (facilitating recognition and acceptance of the informal sector, work towards child education, gender equality and inclusivity, occupational health and safety). These were underlain by a fourth interface which is focused on organising and empowering the IRS into larger structured groupings by providing them with financial viability and capacity building opportunities (Velis et al., 2012).

The study modelled a rapid evaluation and visualisation tool (integration radar diagram) (see Fig. 4) which was designed to illustrate the degree to which a planned or existing intervention considers each of the four categories. This concise methodological framework was then applied to 10 case studies around the world. These include; Linis Ganda (The Philippines), Payatas Sanitary Landfill (The Philippines), Belo (Brazil), Curbside collection programme (Brazil), Cairo (Egypt), Guardianes del Riachuelo (Argentina), Unidad de reciclado de Rauch (Argentina), Programa Integral de Residuos Sólidos Urbanos Saladillo Saladillo (Argentina), General (Argentina), and Participatory waste management (Thailand) (Velis et al., 2012).

Results from the study suggest that there is wide scope for improvement when planning and implementing interventions aimed at the integration of the IRS into SWM. The authors therefore believe that any win–win solution needs to understand and act upon opportunities and challenges relating all three key interfaces. A necessary pre-condition to enable change is organisation and empowerment of the informal recyclers (key stakeholders need reliable partner organisations to work with, and organisation brings bargaining power and thus a better deal in the value chain). Therefore, any intervention should also be addressing this fourth category. The fundamental strength of the InteRa methodology framework is that it considers all key aspects of triple bottom line approach to sustainable development (environmental, social, financial capitals) and highlights the cross-cutting interventions in the central, cross-section area. This encourages a balanced approach between the different framework aspects. However, the selection of interventions will also depend on certain local needs and circumstances (Velis et al., 2012).

As the sample is not fully representative (most of the cases are from Asia and Latin America) results should not be used for drawing general conclusions about the IRS as a whole. Therefore, the application of the framework and InteRa tool to a wider set of case studies is needed to prove its practicality in designing balanced and comprehensive interventions (Velis et al., 2012).

5.5. The role of cooperatives

Cooperatives are a powerful means of promoting grassroots development of the informal sector. Strengthening of the organisa-

Table 5
Some examples of best practise cooperatives.

Country	Cooperative
Columbia	Cooperativa Recuperar, Cooperativa Reciclar
Brazil	Coopamare, CooperPires, Movimento Nacional dos Catadores
Mexico	Sociedad de Seleccionadores de Materiales (SOCOSEMA)
Argentina	Cooperativa El Ceibo
Philippines	Linis Ganda Program
Egypt	Zabbaleen

Adopted from Medina, 2000; Wilson et al., 2009.

tional structure of the informal sector into formalised groups dignifies the workers in the labour market (Martins et al., 2009). This allows them to negotiate as a discrete entity (Wilson et al., 2006). For example, they can act as a pressure group to demand regulated working hours and improved living conditions, as well as a level playing field for public healthcare (Gutberlet and Baeder, 2008). Networking and collaborating with NGOs and CBOs will add credibility to the role whilst opening channels of communication with the government, formal stakeholders, decision-makers, industry and the community (Damghani et al., 2008; Suttibak and Nitivattananon, 2008; Wilson et al., 2009). Their energy, creativity and familiarity with local conditions means that they can effectively establish goals, define action strategies, create structures and adopt targets (Medina, 2008; Martins et al., 2009). Qualified personnel within such agencies can help setup a monitoring committee which will deal with administration, accounting, consultancy and technical assistance (Damghani et al., 2008; Martins et al., 2009). Furthermore, they can help in accessing subsidies, grants and collateral-free loans to develop infrastructure (i.e. environmental education programs, skills development training, sorting and storage areas, social services etc.) and purchase adequate equipment (for example battery-driven handcarts, safety equipment, tools, uniforms) (Gunsilius, 2012). Wearing uniforms and carrying ID cards formalises their appearance and makes them 'visible' in society. This constructs a better relationship with the general public and builds self-confidence and self-esteem amongst the workers who could then feel they belong to a professional public service (Gutberlet and Baeder, 2008). Additionally, it is essential that legislations should be put in place at federal, state and municipal levels as a way to legalising and regulating the operations of the sector and other stakeholders. This will provide lawful protection and enhance the creations of partnerships with private companies (Martins et al., 2009). This could also provide opportunities of upward mobility as there is now an economic and social safety net.

Medina (2000) notes that when scavengers are supported they can earn higher incomes than unskilled, formal sector workers (see Table 5 for examples of best practice). Training programmes can educate the workers to efficiently and effectively add value to the recovered materials (i.e. to clean, bale, crush or sort recovered materials). Once they have become 'experts', they could have better market leverage and so may be able to circumvent the middle men in the trading network. Such levels of organisation will also allow for a diversification of their activities so as to enter new services and niches i.e. sweeping streets, pruning trees and bushes, weeding, and removing bulky objects and/or electrical waste (Gutberlet, 2008).

Society need to be informed of the projects that are occurring within the community in order to maintain support for the informal sector. Once a level of mutual respect, dialogue and social acceptance has been established (Sembiring and Nitivattananon, 2010), fundamental mentality shifts are needed by the public so that they instinctively source separate and dispose of MSW in a sanitary way (Gutberlet, 2008; Suttibak and Nitivattananon, 2008). Matter et al. (2013) believe that households have the capacity to reduce the amount of unwanted waste at a local level by segregating clean materials from mixed residual waste. Bottom up inclusive activities, such as conferences, workshops, community meetings, and awareness campaigns, are an effective tool to disseminate information and enhance the participation of various sectors of the population (businesses, schools, religious organisations) (Ojeda-Benitez et al., 2002; Gutberlet and Baeder, 2008). Martins et al. (2009) believes that with the backing of various stakeholders (private sector, government officials, politicians, waste dealers, NGOs, academic experts and residents), cooperatives can quickly become aware of environmental issues and standards. As such, they can make environmental performance improvements without sacrificing economic and social benefits (Asim et al., 2012). It can therefore be said that instead of being a nuisance, scavengers can form part of the solution to the inadequate management of solid waste in developing and transition countries.

6. Conclusion

The process of recovering recyclables from waste materials follows a complex structure of multi-level systems. In many developing and transition countries, the informal sector is the key factor in the recycling process. This situation is attributable to a combination of governance gaps, economic opportunities, industrial symbiosis, and the social realities that exist in such regions. Overall their impact upon the economic, social and environmental fabric of the urban system is positive. In some instances, they subsidise large areas of the formal sector; consequently, ignoring the informal sector could result in unsustainable interventions. This position is clearly backed by evidence from literature. Additionally, continuing to ignore the crucial role being played by the informal sector in planning new services, as is currently the case in some countries, is likely to result in delays and controversy; in extreme cases, it can result in the failure of planned improvements. It has been proven that integrating existing informal recycling structure into formal systems makes waste management sense as there is clear potential to strengthen formal-informal alliances. It can also provide employment, protect the livelihoods of some of the most disenfranchised sections of society, provide a supply of secondary raw materials, and enhance environmental protection. However, how to initiate the integration process is challenging, given that in most cases, informal workers have no structure, financial backing or adequate facilities. NGOs and CBOs can play an important role in organising the scavengers and strengthening the entire supply chain. By documenting, evaluating, understanding and building upon existing systems, a long term supportive policy framework can be introduced. This should cover a range of areas, including legal representation, political and social conflict resolution, health care, capacity building, knowledge enhancement, living and working conditions, basic facilities and technical support. These characteristics form the basis of successful recycling cooperatives. This done, those who were previously socially excluded would now become empowered citizens who are able to compete and negotiate as a discrete entity with private sector players in the labour market. The structure of the organisation should not be based on a 'universal' model but should instead take into account local contexts and conditions. The support of the community is integral to the success of the process and so the benefits associated with cooperatives (i.e. enhanced community health, environmental sustainability, valued partnerships and affordable local products) should be broadcast using a mixture of bottom up, and top down approaches. Newspapers and the mass media are effective tools for campaign promotion and so should be utilised. Solid baseline data surrounding the efficiency of waste collection and disposal will create dialogue and trust with multi-stakeholder and inter-institutional organisations. Overall, the general trend in most of the regions surveyed is that those factors that compel people to become scavengers are not foreseen to fade in the foreseeable future and so ISR activity is set to increase. Society therefore has two options; isolate the informal sector and allow for widespread social and environmental deterioration to articulate, or integrate the sector into the overarching recycling strategy and enhance the economic, social and environmental structure of the society.

7. Recommendations

Having reviewed a wide range of literature on informal sector recycling in developing and transition countries, a number of recommendations have become apparent.

- More research is required on the human health and safety risks associated with informal waste recycling in developing and transition countries. A better understanding of the needs of the informal population can influence legislation and public policies for better working regulations.
- More research is needed on estimating the economic importance of the activity on a local, national and regional scale. If successful, this would highlight the benefits the sector brings and, through this recognition, would drive greater integration within the formal municipal collection system.
- The barriers that face household source separation (additional effort, time and sorting space) should be addressed. Economic incentives could overcome this, however in some instances it may be social aspects that hinder achieving efficient recycling targets.
- The failures and successes of a variety of cooperatives should also be evaluated, with results incorporated into the development stage of other projects and programmes. This could be used as a 'learning curve'; helping to strengthen the structure and producing a more efficient collection and disposal system.

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