Chapter 9

Waste in the City: Challenges and Opportunities for Urban Agglomerations

Jutta Gutberlet

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.72047

Abstract

Worldwide cities are rapidly expanding, creating visible environmental and social challenges. The generation of waste is one of the central concerns in urban agglomerations, particularly in the global South, where inadequacies, absences and weaknesses shape the local waste management system. Uneven geographic development has created obvious spaces of exclusion and neglect. In response, informal and organized waste pickers engage in selective waste collection and recycling, serving their community and the environment. These contributions are still mostly unrecognized and unaccounted for. This chapter begins with emphasizing the challenges of urban growth, consumption, poverty and waste. In the global South, every day millions of informal waste pickers reclaim recyclables from household waste to earn their living. In doing so they make an important contribution to reducing the carbon footprint of cities, recovering resources, improving environmental conditions and health creating jobs and income among the poor, particularly in low-income residential areas. This chapter discusses the organization of these initiatives into networks and examines the challenges and benefits of such practices that promote grassroots resilience and contribute to reducing both the adverse impacts of cities on climate and environmental change (UN sustainable development target # 11.6) as well as urban poverty (Goal # 8).

Keywords: urban growth, global South, urban development, waste management, sustainability

1. Introduction: rapid urban growth, waste and inequality

Since 1950 the world's urban population has grown from 746 million to 3.9 billion in 2014 [1]. In the global South, most cities, particularly the metropolitan areas are rapidly expanding into

large urban and suburban agglomerations, with so called "in-between cities," where some of the rural characteristics are still mixed into the urban fabric. Cities attract people for many reasons, and most often unemployment and the prospect of a better life with improved and safer living conditions is the key driver to urban growth. Migration, particularly from rural to urban, but also different forms of population movement from other cities, regions and even from other countries are responsible for rapidly changing the urban population [2]. In some parts of the world natural population increase is still on the rise and coupled with higher average life expectancies, population sizes are still becoming bigger. This dynamic urban growth can generate significant stress on city administrations who need to provide the necessary basic infrastructure and public services to expanding neighborhoods and new settlements. As a result of the incapacity to provide these, part of the population lives in extreme poverty and under critically neglected living conditions, often causing sever health challenges to their families and surrounding community [3].

This chapter draws on many years of research and outreach experience with informal and organized waste pickers in different cities of the world. I have learned through participatory action research lenses and in community based research approaches focusing on everyday praxis in the city in the global South, with a particular eye on waste. This reseach practice uncovers post-colonial contexts of waste and value, including gender, class and race perspectives, urban transformation and infrastructure impacts or related challenges in the global South. I am informed by feminist theory, which uncovers power relations and embraces the concepts of equality and equity as crucial in the outcomes of urban development. The research seeks to empower vulnerable populations and value their knowledge grounded in everyday experiences and takes into consideration masculinist power and representation. I acknowledge that the local expertise and understanding cannot be fully realized from the outside [4]. Political Ecology is relevant to urban analysis, because it is inclusive of these multiple layers and actors that shape urban landscapes over time.

Section 1 of the chapter introduces the concept global South and the Urban Political Ecology (UPE) framework. Then, in Section 2 I provide a brief contextualization of waste management in urban agglomerations in the global South, in terms of characteristics of waste and prevailing forms of dealing with waste. I present some of the current social and environmental challenges linked to waste. Section 3 presents the idea of social grassroots innovations, coming from waste pickers. The UPE lens situated in the global South context looks at household waste and some of the grassroots actors, the processes and transformative practices they bring to waste management. There are concrete livelihood opportunities attached to collecting, separating, trading, adding value, and in performing environmental education and technical training in waste management. The final Section 4, highlights some of the insights gained from waste pickers and their organizations that contribute to a place-based understanding of working with waste, grounded in their concrete experiences. The key recommendation in this chapter underlines the important role of public policies in stimulating grassroots development and to address the serious challenges waste and disposal pose in urban agglomerations.

http://dx.doi.org/10.5772/intechopen.72047

1.1. Contextualizing the global South

The global South is a spatial and historical concept used to facilitate the understanding of commonalities and differences between countries. However, as a category of places, there is the risk of presenting a rather dualist perspective on development, opposing the South with the North, or even interpreting the term as geographic location, which of course is not the objective. The term recognizes the shared characteristics related to the historical processes experienced under colonialism and imperialism, which have strongly shaped their economies and cultures. The term recognizes situated differences in the multi-scalar processes and transformative practices observed among countries, regions and places. Global South is a term that provides a telling difference from countries we call the global North. Yet, the lived experiences in these locations (both in the North and in the South) are multiple, temporal and place specific. Cities differ immensely from each other and cannot be put together under the same banner. Therefore, a dichotomous division between two worlds would not be tenable empirically and also not desirable politically. It is a contested term, but yet it helps us grasp common causes and consequences of unequal power relations, manifested in everyday urban politics with high levels of inequality and persistent poverty.

Conceptualizing the global South brings to life the specific historical social, economic and political processes unfolding, that find their epicenter in urban experiences in the global South. The bulk of urban growth is now happening in that part of the world and we see urban imaginations, based on processes that are primarily taking place in the global North shifting to patterns that evolve from the global South, as becoming more relevant [5, 6].

With urban growth consumption rates are also on the rise globally. Worldwide cities generate over 720 billion tons of wastes every year [3]. In cities people mostly rely on industrialized and heavily packaged food, significantly adding to the quantity of household waste generated every day. Waste is not yet perceived as a critical challenge, as a socio-ecological issue of highest priority to city administrators nor to the community, and waste is treated mostly with "end of pipe" measures, rather than pro-actively curbing generation and discard of waste, thus reducing the use of virgin resources and stimulating circular resources flows. Yet, in many cities waste is an obvious and visible problem, with uncollected waste amounting in public space, affecting the water quality and environmental health in the city. Waste collection services are often unequally provided within cities, with observable patterns of social and environmental injustices related to waste accumulation and availability of waste infrastructure and services. Those services that are provided usually focus primarily on collection and disposal [3].

1.2. Taking a Situated Urban Political Ecology lens

Situated Urban Political Ecology (UPE) is a detailed framework to better understand the ways in which society, politics and cultural behavior influence the city's metabolic processes, such as flows of resources and outputs as well as the related actors in the city [7]. It recognizes the fact that cities are built with resources from nature and that in turn cities also shape nature into urban landscapes. Waste flows and those actors that work with waste and in waste management, for example, bring to life the combination of natural and societal forces involved in

urban metabolic processes that create urban landscapes and geographies of inequality in terms of social and environmental justice. In such a framework, the challenges and opportunities that come with the recovery of recyclable materials from waste become obvious. The situated UPE lens helps us understand how the legacies of colonialism have shaped who benefits and in which ways they benefit from the urban environment. Power structures manifest in urban development and urban policies equally define who has access to resources and services. Waste management is increasingly becoming one of the greatest challenges, particularly for a highly urbanizing world. It is closely connected to physical *and* social processes taking place in the city, but also in the expanding suburbia and in the "in-between city" [8].

UPE sees urbanization as a political process of socio-ecological change, which can also be studied as a process of socio-metabolic transformations [9]. The metaphor of *urban metabolism* sees the city as a living organism with flows of resources going in and out of the city, actors intervening in the transformation and consumption of these recourses, and with related services and product outputs. This is a systems perspective of the city, where social processes, spatial form, and the material and energy metabolism are equally connected and interwoven [10]. The analogy helps us identify and map waste flows and key actors involved in the collection, transformation and final destination of the resources embedded in waste. We can, for example, recognize social relationships and power relations that underpin activities related to waste under different forms of "waste regimes" and waste management systems. The concept of "waste regime" seeks to understand the economic, political, and material dynamic through which waste is produced, conceptualized, and politicized [11]. Waste regimes are bound to specific historical, cultural and geographic contexts. Waste management systems involve different forms of technology, automatisation and practices in waste collection, transformation and final destination.

How is it, that certain values prevail, whereas others are undermined, and, how do these "value regimes" [12] operate in different ontological, cultural, material, and political settings? Urban metabolism analysis studies the entry, transformation and storage of materials and energy and the discharge of any kind of waste and unwanted products. Here, infrastructures and services play crucial roles in maintaining cities and providing for the residents. Cities surely are complex systems. With a dynamic and cyclical perspective applied to planning and development, this approach shows where cities are not livable, are unhealthy and unsustainable or are unjust and inequitable [13].

The UPE focus directs attention to social power relationships and how these produce historically specific social and physical natures. Related to waste management different actors, with more or less levels of inclusion and power can be mapped. The scope of those dealing with waste is wide, ranging from small to large and even multinational contractors, government officials, recycling businesses, middlemen (scrap dealers), organized recycling cooperatives and associations to informal waste pickers. In addition, there are the everyday experiences with waste of ordinary people, governmental and non-governmental actors, contractors, developers, and so on. What are the values embedded in the roles played by the diverse institutions and actors? Where do they locate and where do they position themselves, in the local and global processes of treating, sorting, trading, and recycling waste? There are apparent and hidden social justice issues related

http://dx.doi.org/10.5772/intechopen.72047

to control, ownership, and appropriation of waste management resources and technologies. As already hinted, there are uneven geographical processes at play, inherent to the production of urban environments. In the formal part of the city waste is regularly collected, while in the informal neighborhoods these services are neglected. Sometimes the infrastructure and service gap is filled by grassroots initiatives. The following section will describe some of the key challenges city dwellers in the global South are currently facing.

2. Waste challenges in the global South

Waste constitutes a key developmental and environmental issue. It is an almost unavoidable consequence of human activity. Today humans generate more waste than ever before, not only because of dramatic population increase over the past centuries, but also because of the changed nature of consumption and the different composition of solid waste. A shift toward waste minimization and away from depositing it at landfills is important. Per capita consumption of packaged goods and consumer products has skyrocketed after World War II, with the rapidly expanding adoption of growth and consumption oriented economic development. This is when material consumption gained momentum on a global scale [14]. Waste in the city is a transversal theme; it affects water quality, causes flooding (e.g., urban storm waterlogging due to trapped waste in water drainages), generates public health issues by hosting disease vectors, affects the perception of public space (e.g., as a space of neglect and lack of citizenship) and furthers the sense of exclusion. But waste also has other social, economic and environmental facets, which will be discussed further on.

Post-consumer waste generation has more than doubled worldwide, between 1971 and 2002. In the global South, growth in municipal solid waste generation has become exponential from the 1980s onwards, and it continues to steadily grow in most of the global North, except for Central and Eastern European countries and the Former Soviet Union [15]. While Western Europe and North America on average already experienced municipal solid waste (MSW) rates between 1.4 and 1.8 kg/capita/day over the past decade, the population in many large cities in the global South is now also reaching values between 1 and 1.4 kg/capita/day [16]. The urban lifestyle contributes to higher waste generation not only in people's homes but also outside. Particularly the food service industry thrives on disposables. Today, people consume more in the streets and their consumption leaves more disposable waste in public waste bins. In 2012, urban residents globally generated about 1.2 kg/capita/day of MSW, compared to 0.64 kg in 2002 [17]. In Brazil, the average daily quantity of MSW generated per person is currently about 1.1 kg. For major cities in Africa MSW generation is estimated to range from 0.3 to 1.4 kg/capita/day [18]. Differences in waste generation can be large, as demonstrated by data for Bamenda and Yaounde (the capital) in Cameroon, which generate 0.5 and 0.8 kg/capita/day, respectively [18]. Population size and growth rates are important factors that influence municipal solid waste management. There is a positive correlation between population size and both, the rate of waste produced and the percentage of households enjoying regular waste collection. Yet, it is clear that rapidly growing cities have a hard time in providing consistent waste collection services.

Under the current era, industrial production of consumer goods is characterized by a reduction in product life spans, growing product variety, material component diversity, and increased packaging. All these characteristics are drivers for increased use of natural resources and are responsible for generating waste and producing water, soil and air contaminants. The rise in solid waste is linked to increased levels of urbanization and wealth. Between 1997 and 2007, the Gross Domestic Product (GDP) in India has increased by 7%, while estimates indicate a rise in municipal solid waste over these 10 years by 45%, from a total of 48 million to 70 million tons [19]. The figures for Brazil demonstrate a similar correlation between wealth and solid waste generation. From 2009 to 2010, GDP rose by 7.5%, while MSW increased by 6.8%. In the following year, GDP slowed down with an increase of 2.7%, and MSW generation increased only by 1.8% [20].

Population growth comes with an increase in consumption and waste. More affluent segments of the population consume more and generally their consumption also produces a larger environmental impact. China, India and Brazil alone have added another 509 million new consumers between 1990 and 2000, with an average purchasing power of 839 billion US$ [21]. These "new consumers" are defined as *"people within typically four member households with purchasing power of at least PPP $10,000 per year, i.e., at least PPP $2,500 per person … (PPP dollars are between 1.3 and 5.3 times higher than conventional dollars in 20 countries* - 17 developing and 3 transitional countries)" [21], p. 4963. Increased income enables consumers to purchase household appliances, electronics, cars, and other items that mark affluent lifestyles, including the consumption of more packaged food items and meat. *Our current waste regime is characterized by an exponential increase in volume and material diversification of discarded objects and substances, as a consequence of increases in packaging, shorter product durability, programmed obsolescence, economic growth logic, consumerism, and mass consumption* [22], p. 58. All these factors are responsible for driving solid waste generation. Consequently, cities have to cope with large quantities of solid waste. This includes household waste, construction waste, industrial waste organic waste (e.g. from public parks and other green spaces), and often also diverse forms of toxic waste produced in the city. Of particular concern is the waste that is not collected and that accumulates in illegal dumps, in streets, riverbeds or unoccupied spaces, often following certain patterns delimiting distinguished formal and informal spaces in the city.x

2.1. Composition of household waste

Waste composition reflects cultural and technological trends and varies greatly between different continents and regions over time. There are many technical aspects involved in creating more sustainable and equitable waste management services. While ashes from heating and cooking, e.g., were reported as large components of household waste in North America until the middle of the last century, plastic appears only since the 1970s as a separately recorded substance [23]. Urban waste in the global North currently contains more recyclable goods and electronics, while municipal waste in the global South still has a larger biodegradable fraction and less recyclable material content. Often these valuable materials have already been reclaimed by the household or by informal recyclers for reuse or trading.

In African cities, the organic content of household waste is still much higher and tops 70% [18]. The household waste composition in Brazil is still typical for the global South, with large

fractions of organic (51.4%) and recyclable (31.9%) materials (metals, paper and cardboard, plastics, and glass), and a small proportion classified as other materials (16.7%) [24]. Yet, here the amount of electronic waste is quickly growing, increasing the demand for E-waste recycling.

2.2. Characteristics of waste management

Most municipal solid waste generated worldwide is still deposited at landfills and waste dumps (70%), while 19% is officially recycled or treated by mechanical or biological treatments and a small proportion is incinerated (11%) [25]. Landfill technologies differ from open dumping to sanitary landfills, with methane capturing. The burning of waste is common, particularly in and around informal settlements and in rural areas. Although worldwide many countries are upgrading their landfills to sanitary landfills, as has happened, for example, in South Africa, Uganda, Ghana and Egypt a decade ago, at the time raised the concern that most landfills in Africa are *"owned and operated by the very body that is supposed to enforce standards. The philosophy of getting waste out of sight and consequently out of mind seems to be the overriding consideration of these authorities"* [18], p. 17. As a consequence, most resources which are limited are spent only on the removal of waste, particularly in formal neighborhoods, and little investment is done in the infrastructure for more sustainable waste management.

Some cities in the global South also adopt expensive waste management models, e.g., mechanized separation systems for recycling or high tech *Waste to Energy* incineration. These waste management options generate very little employment and are not financially sustainable; often locking governments into long-term waste management contracts, preventing the use of more appropriate technologies. Yet, policy makers are increasingly interested in the social aspects of waste. They have learned through experience that not considering the social aspect of waste compromises the implementation of their policy goals and often results in detrimental and costly social effects, particularly for vulnerable social groups.

Informal collection of recyclable and reusable materials is widespread in the global South and significant amounts are recovered. At the same time formal recycling programs are still rare and are most often insignificant in terms of the percentage of recovered materials. There are environmental (and health) impacts as well as benefits of various degrees involved in the act of informally collecting, separating, redirecting and recycling materials contained in waste. Organized door-to-door selective collection of recyclable materials, in particular, embodies opportunities for environmental education in the community; helping shift attitudes and values away from current wasteful consumption patterns and habits, toward reuse and informed, educated consumption and disposal.

In the case of Brazil, 80% of the country's household waste is regularly collected, and the primary final destination for it is sanitary landfills (58.1%) and controlled landfills (24.2%). The rest gets deposited at unprotected waste dumps (17.7%) [24]. In 2016, only 927 municipalities (17%) in Brazil had some sort of official selective waste collection in place [26]. As in most countries in the global South, selective waste collection happens primarily through informal waste collectors. They have historically been stigmatized and denied epistemic agency. It is crucial that research interrogates how shifts in the waste and recycling systems can change how society perceives waste pickers and also how waste pickers construct themselves and their praxis, in order to build up an efficient and inclusive waste management system.

2.3. Impacts from waste infrastructure

Landfills are still necessary, but when uncontrolled they are a source for environmental impacts on soil, water and air. They are located close to urban agglomerations, sometimes competing with environmentally protected areas. Landfills and dumps generate significant greenhouse gases (GHGs), primarily methane (5–10% of global methane is emitted by landfills) and carbon dioxide, as microbial communities decompose the organic matter contained in the waste [27]. Converting open dumping and burning to sanitary landfills implies *"control of waste placement, compaction, the use of cover materials, implementation of surface water diversion and drainage, and management of leachate and gas"* [15], p. 595, thus improving the carbon footprint of waste disposal. Ironically, the landfill upgrading process now creates a shift from mostly CO_2 emissions from aerobic decomposition and burning to CH_4 emissions, which continue for several decades after waste disposal. However, methane emissions from landfills can be stabilized with gas recovery technology, as is already widely implemented in the global North and beginning to be adopted in many countries in the global South. Landfills further impact the soil and groundwater with leachate produced as water percolates intermittently through the refuse pile. Leachate can contain high levels of nutrients (nitrogen, phosphorous, potassium) heavy metals, toxins (such as cyanide) and dissolved organic compounds. One of the big challenges in most cities is to ensure that all operating landfills are designed properly and are monitored once they are closed. For that, local governments need to access funding programs that seek to improve the condition of landfills.

Mismanaged and uncollected waste is a public health hazard. Abandoned waste attracts disease vectors (including rats, mosquitoes) and if carried into waterways leads to storm waterlogging, causing inundations [28] and consequent public health hazards. When burned, a number of toxic substances are emitted, impacting local neighborhoods.

Waste incineration (including *Waste to Energy*) and other thermal processes are local sources of air pollution, constituting additional health risk factors to city dwellers, who often already have to cope with serious air contamination issues. These installations produce CO_2 from fossil carbon sources and generate other contaminants such as dioxins, furans, polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), mercury (Hg) and many other GHGs. Particularly, the fly ashes and slags become a hazardous output [16, 29]. *Waste to Energy* is attractive as a quick solution addressing the growing solid waste generation and increasing energy requirements in the city. It is an expensive technology often only viable through public private partnerships (PPPs). Waste management is a multibillion dollar industry. One of the leading waste technology corporations worldwide is *Veolia*. This company's main new activity is *Waste to Energy*, generating many billion dollars of revenue every year. According to their forecast the global market in this sector will be worth about 30 billion euros in 2020. They already have contracts in 33 countries and are recently expanding in the global South [30]. In many countries waste incineration has become a threat to waste pickers, for whom household waste is a resource. The city's commons make their livelihoods from collecting recyclable materials and feeding them into the circular economy. Yet, even in cities where organized waste pickers perform this service, waste incineration is under consideration, funded through PPPs.

Morris [31] argues that recycling mixed solid waste saves more energy than generated by *Waste to Energy* facilities. His findings underline that recycling conserves energy that would be used to extracting natural resources and transforming them to produce goods that can also be manufactured from recycled materials. Mining, extraction, transportation and transformation of natural resources, generates environmental impacts (often in pristine environments) and also emits greenhouse gases (GHG), affecting the global climate. Recycling values the resources and energy incorporated in the making of these products, often allowing for new goods to be manufactured from the recovered materials. It is global consensus that *"the climate benefits of waste avoidance [reuse] and recycling far outweigh the benefits from any waste treatment technology, even where energy is recovered during the process"* [32], p. 1. Recycling values labour and generates income to the many different actors along the value chain. With well-designed and functioning recycling operations, all resources can be recovered from the waste stream for re-use and often for up-cycling in the generation of new products.

Another urban environmental issue relates to the fact that waste and recyclable materials often travel long distances. De-regulation and globalization re-shape the movements of these materials. Transportation uses energy and adds to air pollution, traffic and noise in large urban agglomerations. Worldwide, half of all plastics, paper and scrap metals are exported to South East Asia. China is leading dealing with recyclable material, with importing over 7.4 million tons of plastic waste, 28 million tons of waste paper and 5.8 million tons of steel scrap; mostly treated in backyard shops or small-scale industries [25]. More recently, particularly the trans-continental shipping of electrical and electronic equipment waste (WEEE) has become a serious challenge, especially as it is shipped to global South cities. 70% of the global WEEE ends up in Chinese cities [33]. While the rough dismantling of E-waste (recovering plastics, copper and other metals, etc.) happens in the global South, reclaiming the high value components (rare earths) happens in the global North, who is in possession of the specific recycling technology. Waste trafficking is often illegal and *"has become institutionalized practice among certain corporations that pollute, dump toxic waste and make environmental crime victims of various global minorities"* [34], p. 103. This section has outlined a serious of challenges that can be avoided or addressed in good waste governance, as will be discussed further in this chapter.

3. Resource recovery and social grassroots innovation

The bulk of material recovery in the global South is informal, grassroots and involves a wide spectrum of domestic reuse of bottles, cans, plastics, paper, cardboard and many other discarded materials. Yet, its role is largely unrecognized in waste management and by city authorities. In Delhi, India 15–20% of the MSW (daily 1,275 to 1,700 tons) is collected by informal recyclers. The waste pickers also redirect 200 tons per day of separated organic material to a large-scale composting plant. They collect organic waste from households in the affluent neighborhoods, where they compost it in a series of community composting pits [35]. Often, the lack of local markets for recyclables is still a prevailing limitation for the recycling activity to further flourish [18].

A well-known example for informal grassroots recycling is the work of the *Zabaleens* in Cairo, recovering approximately 6,000 tons of MSW per day (up to 80% of the waste generated in the city) of the material entering the solid waste system, compared to 11% formal recycling [36]. In many cities around the world a large number of workers recover significant quantities of recyclable material from the waste stream, generating savings of around 20% or more to the municipal waste management budget, which in large cities can represent many millions of dollars per year [37]. The city of Lima, Peru has no formal recycling program and relies entirely on the local *recicladores*, including informal service providers, street collectors and dump pickers, to divert 20% of the MSW into recycling, as a report by GIZ/CWG found [14]. These examples illustrate a common situation in waste management in urban agglomerations in the South.

The study by GIZ/CWG has translated the environmental benefits associated with informal material recovery as reduced negative externality costs, expressed in Euros. According to their studies the informal recyclers generate 97.6% of these externality costs in the case of Lima, Peru and 83.4% in Cairo, Egypt [38], p. 21. There is evidence in most big cities that informal workers perform a service that saves city expenditures.

Innovations in waste management from the grassroots level bring many social and environmental benefits that tackle the UN sustainable development target # 11.6, *making cities and human settlements inclusive, safe, resilient and sustainable*, as well UN sustainable development target # 8, *promoting sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all* [39].

Several questions remain prominent for a paradigm shift in waste management. One of these questions is how we can get the true recognition for the creation of jobs and improvement of livelihoods from informal and organized recycling. Particularly organized waste pickers are a grassroots source of innovation.

Another question addresses how we can stimulate behavioral change toward prevention, reuse and recycling. Informal sector recycler are those individuals or enterprises that are involved in private sector recycling and waste management activities which are not sponsored, financed, recognized, supported, organized or acknowledged by the formal solid waste authorities, or which operate in violation of or in competition with formal authorities [40]. Waste pickers are carriers of grassroots innovations and have many lessons to share that can help improve municipal waste management systems. In many countries waste pickers have organized in cooperatives, associations, networks or social movements. *"Grassroots innovation movements seek innovation processes that are socially inclusive towards local communities in terms of the knowledge, processes and outcomes involved"* [41], p. 114.

3.1. Place based informal and organized recycling

Amid the pressures of climate change, population growth, industrialization and urbanization, one of the major challenges faced in global communities is the sustainable and equitable access to infrastructures, services and resources. There is usually a complex network of actors in waste governance, including residents, waste pickers, waste managers, engineers, bureaucrats,

consultants, businesses, but also activists, journalists and scientists. These actors often do not agree on how waste related problems are defined or get solved, nor do all of these actors unanimously recognize that different sources of knowledge are needed to solve these problems. There might even be divergence on what type of knowledge to use, how it is produced and communicated across different societal sectors and actors.

People's relationships to waste and the meanings attributed to waste reveal about culture and society. In order to achieve a fundamental shift in how we see, generate and manage material waste we need to involve other stakeholders and their knowledge. Waste pickers contribute to developing, understanding and solving waste management problems. Innovative governance models can potentially emerge from a dialog with organized waste pickers creating collaborative relationships in providing waste services. Transdisciplinary understanding of waste encompasses this collective approach, bringing together the formal and non-formal actors for creation, communication and use of waste-related knowledge.

In this chapter, I have provided diverse examples for informal recycling activities, highlighted within different situated contexts. *"Waste picking is a key occupation in solid waste management in most cities in the global South. Waste pickers can range from poor people rummaging through garbage in search of food, clothing and other basic, daily needs to informal private collectors of recyclables for sale to middlemen or businesses, as well as organized collectors/sorters of recyclables linked to unions, cooperatives or associations"* [42], p. 6. Waste picker contribute environmentally, by reclaiming resources and channeling these into the circular economy. In their work, they are constantly challenged by everyday life decision-making and the daily challenges shape them as grassroots innovators. They work locally in the community, with high levels of participation in decision-making and flat hierarchies [43]. Despite, often being dismissed, this population hosts key actors in waste management.

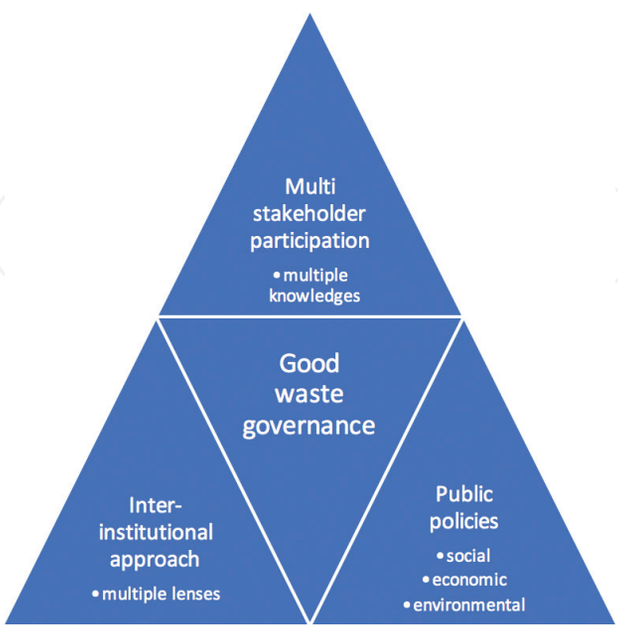

Figure 1. Major components of good waste governance.

Social aspects of waste management, or the socio-economic advantages of recycling, as highlighted by [44–46], are not yet widely recognized and comprehensive social indicators demonstrating the social contributions of organizing waste pickers are yet to be developed, in order to be able to clearly measure the benefits deriving from that work to society. From practice, we know that inclusive waste management generates positive contributions to democracy. During the negotiation process between recycling cooperative and local government for waste management service contacts, e.g., waste pickers as citizens affirm their rights to have a voice and to participate in these decisions, thus strengthening democracy. Waste governance decisions can also undermine democratic relations between citizens and the state and even further deepen inequality and poverty. In contrast, good waste governance embraces the following building blocks, as shown in **Figure 1**.

4. Final considerations

Waste constitutes a major challenge to city administrators and urban populations at large. However, waste is not perceived as an "issue" yet. Waste is treated through the engineering lens rather than from an interdisciplinary perspective. We need to move beyond seeing waste as a merely technical issue and move towards a complex socio-environmental-technical understanding of waste. Learning from the praxis of a wider range of stakeholders (including waste pickers, elected officials, waste managers, private companies and middlemen or scrap dealers) is critical to either facilitating or hindering transformations in the waste and recycling systems.

Urban communities have a say in what happens to their waste and who has access to waste. They must have a say in the decision-making whether to invest in expensive waste management technology, without prioritizing job creation or whether to support labor intensive, inclusive forms of waste management and resource reclamation. Cities can promote a shift towards waste minimization and resource recovery. Waste governance decisions need to also be based on "good governance" principles, including democracy and consensus orientation, participation, accountability, transparency, responsiveness, equity and inclusiveness, be effective and efficient and following the rule of law [1]. These guiding principles should also be applied to waste governance and specifically applied in waste management.

When it comes to deciding over which waste management process and technology to favor and the design of specific policies, the following questions are relevant for local governments.

(1) Who should be involved in policy and decision-making (key stakeholder, e.g., waste picker organizations, local business associations, educational sector, NGOs, experts)?

Participation is not without challenge and stakeholders have to ask what is their mandate? What are the local political realities? What is the available budget? What are the priorities within the city? and so on.

(2) What technology is most appropriate in terms of:

- environmental concerns (air pollution, water and soil contamination)

- poverty reduction and employment generation
- economic sustainability (cost – benefit, short to long term)
- environmental sustainability (resource savings and reclamation, reduction in GHG emissions, etc.)

According to the Intergovernmental Panel on Climate Change (IPCC), solid waste and its management are considered key contributors to climate change. Greenhouse gases are emitted or avoided in the upstream and downstream stages in the life cycle of municipal solid waste management systems [47]. Upstream emissions can be avoided when recycled resources replace virgin resources in the fabrication of metal, glass, plastic and paper products. In addition, landfill gas (CH_4) and deforestation represent other upstream impacts that are reduced with recycling [48–51]. Fossil fuel greenhouse gas emissions are of course also associated with recycling operations, as energy and some virgin resources are consumed during the collection and transportation of materials, processing, and re-manufacturing [52]. With recycling, however, both methane (CH_4) and carbon dioxide (CO_2) emissions are avoided through the diversion of resources from landfills, through resource recovery and recycling of paper, cardboards and other biodegradable material [47, 53], and through reducing the amount of waste to be deposited at landfills.

Research underlines the need to redefine clean development mechanisms (CDMs) to allow for the recognition of resource recovery for reuse and recycling as measures to reduce GHG emissions, save natural resources and energy [54]. Recycling has not yet been considered a CDM, while *Waste to Energy* and Methane to Energy projects, associated to landfills, are already funded under this mechanism [55]. These shortcomings need to be addressed by including a social development agenda within CDM policy frameworks. Taking a social perspective on thermal treatment of solid waste the outcome is aggravated by the fact that this form of waste management destroys the resources in waste and thus, the source of income for waste pickers and recyclers.

There are challenges and limitations related to recycling (down-cycling, up-cycling) which governments should discuss and act on. There are often not enough down-cycling alternatives for many waste materials and waste flows. Here too, cities can become drivers for innovative forms of reuse and recycling. Not to forget is the fact that collection, transportation and processing of waste and recyclables also generate fossil-derived carbon dioxide and other pollutants from the fuel used in transportation, and therefore also needs to enter the equation.

Millions of informal waste pickers collect household waste daily in cities around the globe to earn a living. In doing so they contribute to reducing the carbon footprint of cities, recover resources, improve the environmental conditions and health in the city. The research discussed in this chapter points towards a radical economic and social shift away from growth centered urban development and *end of pipe* waste management; towards steady state development, embracing de-acceleration, stability, sufficiency and sustainability. Recovering materials for reuse or recycling is a step towards that direction and helps avoid

natural resource extraction. Inclusive recycling addresses poverty and unemployment issues. The work of informal recyclers, as resource reclaimers—for recycling and reuse—and the role they play as environmental educators can be extended to gradually recover more of the materials that are still wasted in landfills or incinerators, progressing towards more resilient and healthy communities; this implies a different, participatory waste governance. Waste management is an important field of urban governance. The success or failure of governments is linked to how they deal with waste and with the responses society is already producing. Waste governance is more than just having the right laws and policies in place and having institutions enforce the policies. It is also about levels of democratic participation, recognizing other forms of knowledge, and understanding the links between waste, value and society in order to tackle broader social, political, cultural and economic issues that affect the urban agglomerations. Inclusive waste management has the potential of bridging a social gap. Finally, weak urban governance (government that lacks participation, democracy, transparency, equity and inclusiveness) is probably the major impediment to proper solid waste management.

Author details

Jutta Gutberlet

Address all correspondence to: gutber@uvic.ca

University of Victoria, Victoria, B.C., Canada

References

[1] United Nations-Economic and Social Commission for Asia and the Pacific. What is Good Governance. Bangkok: UNESCAP; 2014. http://www.unescap.org/search/node/good%20governance [Accessed: 10-10-2017]

[2] WBGU (German Advisory Council on Global Change). Humanity on the Move: Unlocking the Transformative Power of Cities. Berlin: WBGU; 2016

[3] UN-HABITAT (United Nations Human Settlements Programme). State of the Art of the World's Cities 2012/2013 - Prosperity of Cities. Nairobi: UN-Habitat & New York: Routledge; 2013

[4] Hesse-Biber S, Yaiser M. Feminist Perspectives on Social Research. New York: Oxford University Press; 2004

[5] Arabindoo P. Rhetoric of the 'slum': Rethinking urban poverty. City. 2011;**15**(6):636-646. DOI: 10.1080/13604813.2011.609002

[6] Parnell S, Robinson J. (Re)theorizing cities from the global South: Looking beyond neoliberalism. Urban Geography. 2012;**33**:4

[7] Heynen N, Kaika M, Swyngedouw E, editors. In the Nature of Cities: Urban Political Ecology and the Politics of Urban Metabolism. London: Routledge; 2006

[8] Keil R, Young D, Wood PB, editors. In-Between Infrastructure: Urban Connectivity in an Age of Vulnerability. Kelowna, British Columbia: Praxis (e) Press; 2011

[9] Rapoport E. Interdisciplinary Perspectives on Urban Metabolism. A review of the literature, UCL Environmental Institute Working Paper. Development Planning Unit, UCL; 2011

[10] Swyngedouw E, Heynen NC. Urban political ecology, justice and the politics of scale. Antipode. 2003;**35**(5):898-918

[11] Gille Z. From the Cult of Waste to the Trash Heap of History: The Politics of Waste in Socialist and Postsocialist Hungary. Bloomington: Indiana University Press; 2007

[12] Appadurai A. Introduction: Commodities and the politics of value. Appadurai, A. (Ed.). In: The Social Life of Things: Commodities in Cultural Perspectives. Cambridge: Cambridge University Press; 11th Edition; 2013

[13] Newman P, Jennings I. Cities as Sustainable Ecosystems: Principles and Practices. Washington, DC: Island Press; 2008

[14] United Nations Human Settlement Program (UN-HABITAT). Solid Waste Management in the World's Cities. London, UK: Gutenberg Press; 2010

[15] Bogner J, Abdelrafie AM, Diaz C, Faaij A, Gao Q, Hashimoto S, Mareckova K, Pipatti R, Zhang T. Waste management. In: Metz B, Davidson OR, Bosch PR, Dave R, Meyer LA, editors. Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press; 2007

[16] Vergara SE, Tchobanoglous G. Municipal solid waste and the environment: A global perspective. Annual Review of Environment and Resources. 2013;**37**:277-309

[17] Hoornweg D, Bhada-Tata P. What a Waste: A Global Review of Solid Waste Management. Urban Development Series Knowledge Papers. Nr. 15. Urban Development & Local Government Unit. Washington DC: World Bank; 2012. https://siteresources.worldbank.org/INTURBANDEVELOPMENT/Resources/336387-1334852610766/What_a_Waste2012_Final.pdf [Accessed: 10-10-2017]

[18] Achankeng E. Globalization, urbanization and municipal solid waste management in Africa. In: African Studies Association of Australasia and the Pacific 2003 Conference Proceedings - African on a Global Stage; 2003. http://wiego.org/sites/wiego.org/files/publications/files/Achankeng_Globalization_Urbanization_MSWMgmt_Africa.pdf [Accessed: 10-10-2017]

[19] United Nations Environment Programme (UNEP). Waste Investing in energy and resource efficiency. Green Economy. Online report; 2011. http://sawic.environment.gov.za/documents/3636.PDF [Accessed: 10-10-2017]

[20] BNDS (Banco Nacional de Desenvolvimento Social). Relatóriofinal do perfil institucional, quadro legal e políticas públicas relacionados a residuos sólidos urbanos no exterior e no Brasil. Fundação de Apoio ao Desenvolvimento da Universidade Federal de Pernambuco – FADE. Pesquisa Científica BNDS FEP No 02/2010 (report); 2012

[21] Myers N, Kent J. New consumers: The influence of affluence on the environment. Proceedings of the National Academy of Sciences, USA. 2003;**100**:4963-4968. DOI: 10.1073/pnas.0438061100

[22] Gutberlet J. Urban Recycling Cooperatives: Building Resilient Communities. London, New York: Routledge Taylor & Francis Group; 2016. 183 pp

[23] Walsh DC. Urban residential refuse composition and generation rates for the 20th century. Environmental Science & Technology. 2002;**36**(22):4936-4942

[24] ABRELPE (Associação Brasileira de Empresas de Limpeza Pública e Resíduos Especiais). Panorama dos Resíduos Sólidos no Brasil 2011. São Paulo (report): ABRELPE; 2011

[25] International Solid Waste Association (ISWA). Globalization and Waste Management. Phase 1: Concepts and Facts. Vienna: ISWA; 2012. www.iswa.org/index.php?eID=tx_iswatfg_download&fileUid=36 [PDF Accessed: 10-10-2017]

[26] CEMPRE. CICLOSOFT; CEMPRE. CICLOSOFT; 2014. http://cempre.org.br/ciclosoft/id/2 [Accessed: 10-10-2017]

[27] Matthews E, Themelis NJ. Potential for reducing global methane emissions from landfills, 2000-2030. In: Proceedings Sardinia 2007, 11. International Waste Management and Landfill Symposium S. Margherita di Pula, Cagliari, Italy, 1-5 Oct. 2007; 2007. http://www.necec.org/files/Matthews_Themelis_Sardinia2007.pdf [Accessed: 10-10-2017]

[28] Akter A, Mohit SA, Chowdhury MAHC. Predicting urban storm water-logging for Chittagong city in Bangladesh. International Journal of Sustainable Built Environment. 2016;**6**:238-249

[29] Porta D, Milani S, Lazzarino A, Perucci CA, Forastiere F. Systematic review of epidemiological studies on health effects associated with management of solid waste. Environmental Health. 2009;**8**(60):1-14

[30] Reuters, FEBRUARY 10, 2015. https://www.reuters.com/article/veolia-strategy/update-1-veolia-to-get-half-of-revenue-from-industrial-clients-by-2020-idUSL5N0VK4RG20150210 [Accessed: 24-10-2017]

[31] Morris J. Recycling versus incineration: An energy conservation analysis. Journal of Hazardous Materials. 1996;**47**:277-293

[32] United Nations Environment Program (UNEP). Waste and Climate Change: Global Trends and Strategy Framework. United Nations Environmental Programme Division of Technology, Industry and Economics International Environmental Technology Centre Osaka/Shiga; 2010. http://wedocs.unep.org/handle/20.500.11822/8648 [Accessed: 10-10-2017]

[33] Bartl A. Ways and entanglements of the waste hierarchy. Waste Management. 2014;**34** (1):1-2

[34] Simon DR. Corporate environmental crimes and social inequality: New directions for environmental justice research. In: White R, editor. Environmental Crime: A Reader. UK: Willan Publishing; 2000, 2009. pp. 103-116

[35] CHINTAN. Cooling Agents: An Analysis of Climate Change Mitigation by the Informal Recycling Sector in India. Report prepared in association with The Advocacy Project, Washington DC; 2009

[36] Fahmi W, Sutton K. Cairo's contested garbage: Sustainable solid waste management and the Zabaleen's right to the city. Sustainability. 2010;**2**:1765-1783. DOI: 10.3390/su2061765

[37] Wilson DC, Velis C, Cheeseman C. Role of informal sector recycling in waste management in developing countries. Habitat International. 2006;**30**:797-808

[38] Scheinberg A, Simpson M, Gupt YE, et al. Economic Aspects of the Informal Sector in Solid Waste. Eschborn, Germany: GTZ; 2010

[39] UN Sustainable Development Goals. http://www.un.org/sustainabledevelopment/sustainable-development-goals/ [Accessed: 20-10-2017]

[40] Scheinberg A, Wilson DC, Rodic-Wiersma L. Solid Waste Management in the World's Cities. London; Washington, DC: Earthscan for UN-Habitat; 2010

[41] Smith A, Fressoli M, Thomas H. Grassroots innovation movements: Challenges and contributions. Journal of Cleaner Production. 2014;**63**:114-124

[42] Dias S, Samson M. Informal Economy Monitoring Study Sector Report: Waste Pickers. Cambridge, MA, USA: WIEGO; 2016

[43] Grabs J, Langen N, Maschkowski G, Schäpke N. Understanding role models for change: A multilevel analysis of success factors of grassroots initiatives for sustainable consumption. Journal of Cleaner Production. 2016;**134**:98-111

[44] Baumann H, Tillman AM. The Hitch Hiker's Guide to LCA. An Orientation in Life Cycle Assessment Methodology and Application. Lund: Studentliteratur; 2004

[45] Reddy BS, Assenza GB. Climate change - A developing country perspective. Current Science. 2009;**97**(1):50-62

[46] Rogger C, Beaurain F, Schmidt TS. Composting projects under the Clean Development Mechanism: Sustainable contribution to mitigate climate change. Waste Management. 2011;**31**(1):138-146

[47] United States Environmental Protection Agency (US EPA). Solid Waste Management and Greenhouse Gases. A Life-Cycle Assessment of Emissions and Sinks; 2006. http://purl.access.gpo.gov/GPO/LPS76916 [Accessed: 10-10-2017]

[48] Bogner J, Pipatti R, Hashimoto S, Diaz C, Mareckova K, Diaz L, Kjeldsen P, Monni S, Faaij A, Gao Q, Zhang T, Ahmed MA, Sutamihardja RT, Gregory R. Mitigation of global greenhouse

gas emissions from waste: Conclusions and strategies from the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report. Working Group III (Mitigation). Waste Management Resources. 2008;**26**(1):11-32

[49] Chester M, Martin E, Sathaye N. Energy, greenhouse gas, and cost reductions for municipal recycling systems. Environmental Science & Technology. 2008;**42**:2142-2149

[50] Pimenteira CAP, Pereira AS, Oliveira LB, Rosa LP, Reis MM, Henriques RM. Energy conservation and CO_2 emission reductions due to recycling in Brazil. Waste Management. 2004;**24**:889-897

[51] Thorneloe SA, Weitz KA, Nishtala SR, Yarkosky S, Zannes M. The impact of municipal solid waste management on greenhouse gas emissions in the United States. Air & Waste Management Association. 2002;**52**:1000-1011

[52] ICF Consulting. Determination of the Impact of Waste Management Activities on Greenhouse Gas Emissions: 2005 Update, Final Report. Submitted to: Environment Canada and Natural Resources Canada. Toronto: ICF Consulting; 2005. https://www.rcbc.ca/files/u3/ICF-final-report.pdf [Accessed: 20-10-2017]

[53] Morris J. Comparative LCAs for curbside recycling versus either landfilling or incineration with energy recovery. International Journal of LCA. 2005;**10**(4):273-284

[54] King M, Gutberlet J. Contribution of cooperative sector recycling to greenhouse gas emissions reduction: A case study of Ribeirão Pires, Brazil. Waste Management. 2013;**33**(12):2771-2780

[55] Forsyth T. Building deliberative public – Private partnerships for waste management in Asia. Science. 2005;**36**(4):429-439