E-waste management in Ecuador, current situation and perspectives

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20.1 Introduction

With an annual growth of 2 million tonnes, E-waste is one of the fastest growing waste streams globally (Ignatuschtschenko, 2017; United Nations University, 2014). The global amount generated in 2016 was estimated at 44.7 Mt, from which, 4.2 Mt were generated in Latin America accounting 6.62 kg/inh/year. The top three generators in this region were Brazil (1.5 Mt), Mexico (1 Mt), and Argentina (0.4 Mt). Furthermore, the countries with the highest E-waste generation per capita were Uruguay (10.8 kg/inh), Chile (8.7 kg/inh), and Argentina (8.4 kg/inh). In this context, Ecuador has values below these regional averages, with 90 kt and 5.5 kg/inh, respectively (Baldé et al., 2017). These estimations do not consider undocumented flows of electric and electronic equipment (EEE), that is, smuggling or the so-called "invisible entries," which represents a high percentage of devices entering the region (Cruz-Sotelo et al., 2017), and "aparatos viajeros" (small and middle devices introduced by travelers) (Blaser, 2009) that eventually become E-waste. Latin America faces several challenges toward an integrated sustainable E-waste management, according to Boeni et al. (2008). The most relevant are the lack of specific regulatory frameworks, inappropriate activities performed by the informal sector, and weak E-waste management systems (Boeni et al., 2008).

A crucial element for developing adequate E-waste management strategies, at national and regional levels in Latin America, is the development and implementation of specific regulatory frameworks (Torres et al., 2015; Baldé et al., 2017). Latin American countries have different levels of development on E-waste regulation. Brazil (Veit and Bernardes, 2015), Colombia (MINAMBIENTE, 2017), Costa Rica (Ministerio de Salud, 2018), and Peru (Ministerio del Ambiente, 2012) have aligned their regulatory frameworks with the principle of extended producer responsibility (EPR). However, the adoption of the EPR principle as state policy has faced

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difficulties due to particularities of the countries, varying in terms of scope, range, type, and funding mechanisms (Boeni et al., 2008; Torres et al., 2015). Chile approved the law 20920 in 2016, which mandates the application of EPR for waste management, but without a specific law on E-waste (Congreso Nacional, 2016). El Salvador has published a technical guide for E-waste management (Monge et al., 2017). Mexico mentioned E-waste in two general waste management laws (Torres and Accurso, 2015), and Nicaragua presents a general policy where E-waste management is identified as a strategic axis (MARENA, 2018). On the contrary, Argentina (Torres and Accurso, 2015; Escobar, 2017), Guatemala (MARN, 2018), Honduras (MIAMBIENTE, 2018), Panamá (MINSA, 2018), Bolivia (MMAyA, 2017), and Venezuela (Minea, 2018) do not have specific regulations on E-waste enforced. As for Ecuador, it counts on constitutional dispositions about environmental issues, a specific environmental law (Asamblea Nacional, 2017) which incorporates normative of EPR, and ministry agreements on E-waste (MAE, 2013b,c).

In Latin America, initiatives on E-waste management have become social imperative; particularly in the collection phase that represents job opportunities for vulnerable groups in growing economies (Magalini et al., 2015). E-waste collection is typically performed at municipal level, and in most cases, it is left in part to the informal sector (Boeni et al., 2008) which is constituted by groups of collectors, scrap dealers, and traders (Fernández Protomastro, 2013). Informal collectors receive different names, such as "recicladores de base"—base recyclers—(IRR, 2015), "segregadores" (Espinoza et al., 2008), "cachineros," "recicladores" (IPES, 2014), or "recuperadores" (Uribe et al., 2010); in this work the term base recyclers is used. Generally, base recyclers are neither registered nor count on a license to operate. They work under precarious environmental and safety conditions (Magalini et al., 2015), and very often their activities take place on illegal sites (Cruz-Sotelo et al., 2017). There are also semiformal schemes, where base recyclers work under the radar of municipal governments (Solíz Torres, 2015). The activities of the informal sector derive in producers not exercising their legal responsibility (EPR), and consumers getting rid of their EEE without considering the dispersion of pollutants (Fernández Protomastro, 2013). Furthermore, economic interests trigger a fragmentation process, causing the informal sector to collect only valuable items and discarding others with little or no economic value (UNESCO and Plataforma RELAC, 2010; Magalini et al., 2015).

Following collection, base recyclers perform dismantling steps and sell valuable parts to intermediaries, who in turn resell them to E-waste recycling companies. If not sold, these parts are stored inside houses, sharing space with other domestic activities (Uribe et al., 2009, 2010). Typically, the unusable fractions end up on sidewalks, wastelands, or illegal landfills (Cruz-Sotelo et al., 2017). There are also emerging recycling companies with limited capacities, performing mainly dismantling processes (UNESCO and Plataforma RELAC, 2010). Few examples of larger recycling companies also exist in the region. Brazil, Costa Rica, and Mexico have facilities with the R2 certification (Baldé et al., 2015) that deals with protection of people and the environment, protection of data and preservation of resources

(SERI, 2018b). Recently, R2 certified recycling facilities have started operations in Chile, Colombia, and Ecuador (SERI, 2018a). These facilities perform dismantling steps and mechanical treatment of EEE. Final metal refinement is performed at international level by large companies due to its complexity (Hagelüken, 2018), and because of the lack of specialized facilities in the region. In this chapter, the integrated and sustainable waste management (ISWM) framework is used to analyze the E-waste management in Ecuador and to formulate the key challenges and perspectives for the country. Finally, conclusions are drawn highlighting the main findings.

20.2 Integrated and sustainable waste management

In this work, the Ecuadorian E-waste management system is analyzed under the lens of the ISWM framework (Wilson et al., 2015; Ignatuschtschenko, 2017). This framework has been typically used to analyze waste management systems. For instance, Wilson et al. apply the ISWM framework to examine how cities in developing countries have been tackling waste management issues (Wilson et al., 2013). The work of Ignatuschtschenko performs a comparative assessment of the E-waste sector in China, Japan, and Vietnam by examining how those countries comply with the ISWM framework (Ignatuschtschenko, 2017).

The ISWM framework considers the links and overlaps between the three stages of waste management: generation, collection, and disposal. Furthermore, it takes into account the interdependency of these stages with other economic subsystems, for instance, manufacturing, transportation, urban growth and development, and public health (Ignatuschtschenko, 2017). This framework corresponds to three main questions concerning an E-waste management system: Who should be involved?, What should be done?, and How should it be done? (Ignatuschtschenko, 2017). These questions determine the three dimensions of the framework: the *stakeholders*, the *elements*, and *sustainability aspects* of a waste management system.

The *stakeholders* include national and local governments, NGOs, academia, and public or private companies involved in the collection and treatment of waste, as well as formal or informal sectors involved in the waste handling process, and also producers and consumers as waste generators (Anschütz et al., 2004; United Nations Human Settlements Programme, 2010). The *elements* of a waste management system comprise the technical components and the processes relating to removal and safe disposal of waste (generation, collection, and treatment), as well as the actions relating to the valorization of resources (reuse, recycling, and recovery). Finally, the *sustainability aspects* of a waste management system refer to factors that facilitate efficient and sustainable waste management activities, for example, political environment, regulatory frameworks, socio-cultural conditions, environmental and health aspects, as well as financial and economic factors (Anschütz et al., 2004; United Nations Human Settlements Programme, 2010). Fig. 20.1 depicts the ISWM framework proposed by van Klundert and Anschütz.

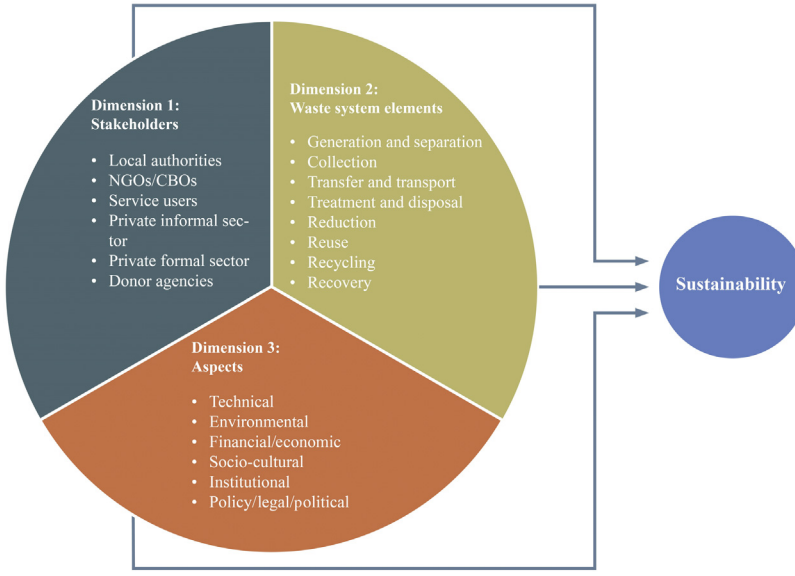

Figure 20.1 The ISWM framework.
Sources: Adapted from van de Klundert, A., Anschütz, J., 2001. Integrated Sustainable Waste Management-The Concept. In: A. Scheinberg (Ed.). Gouda. doi: 90-76639-02-7 and Anschütz, J., IJgosse, J., Scheinberg, A., 2004. Putting Integrated Sustainable Waste Management into Practice - Using the ISWM Assessment Methodology.

20.3 E-waste management in Ecuador

The Republic of Ecuador has an area of 283,561 km^2; it is located in South America, bordering by land with Colombia and Peru, and sharing maritime space with Costa Rica (Nations Online, 2018). Fig. 20.2 shows the location of Ecuador on the American continent. The Ecuadorian population stands at 17.1 million inhabitants in 2018 (INEC, 2018), and presents an annual growth rate of 1.31% (IndexMundi, 2017). According to the last census, 62.77% of people live in urban areas and 37.23% in rural areas (Villacís and Carrillo, 2012). Administratively the country's territory is divided into 24 provinces and 221 cantons. The provinces are grouped into nine Administrative Zones according to their geographical proximity, cultural, and economic characteristics.

The country has a GDP of USD 107.27 billion and a GDP per capita of USD 6300 (IMF, 2018). The Ecuadorian economic activity mainly relies on exports of crude petroleum, bananas, and crustaceans. The primary destinations of these products are the United States, Vietnam, Peru, Chile, and Russia. On the other hand, imports mostly consist of machines (mainly computers and telephones), refined petroleum, coal tar oil, and chemical products (OEC, 2018). According to the STEP initiative, the amount of EEE put on the market in 2012 was 7.2 kg/inh with a total of 110 kt (StEP, 2019). Regarding E-waste, it is estimated that Ecuador generates 5.5 kg/inh, adding up 90 kt in 2016 (Baldé et al., 2017).

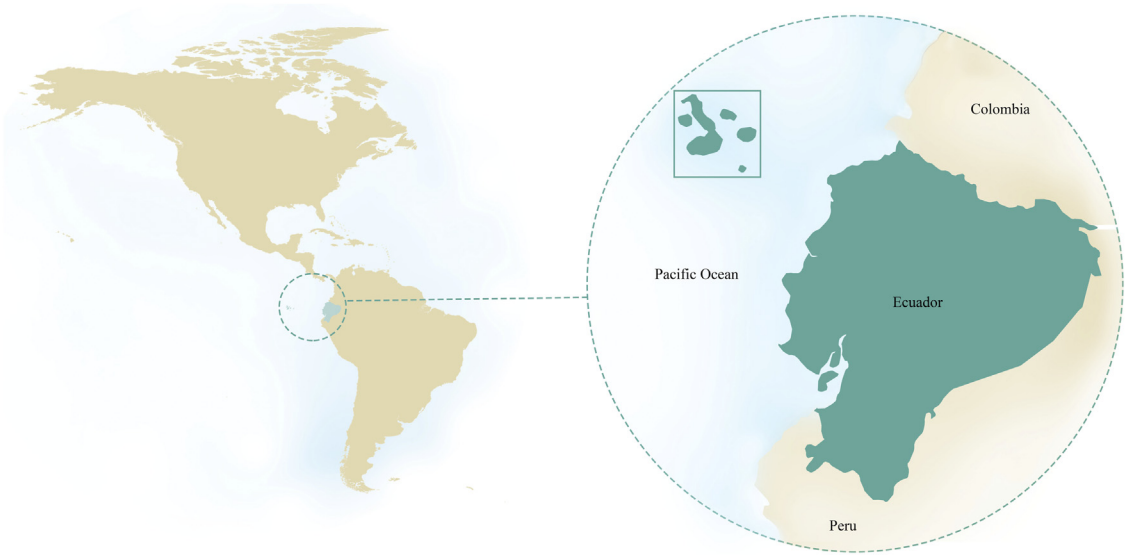

Figure 20.2 Geographical location of Ecuador.
Source: Map generated based on material from Porto Tapiquén, C., 2015. Shapefiles (*.shp) de América. Available at: <https://tapiquen-sig.jimdo.com/descargas-gratuitas/américa/> (accessed 08.01.19.).

20.4 ISWM: stakeholders

In this chapter, a stakeholder is defined as any group or individual who can affect or is affected by a decision-making processes (Grimble and Wellard, 1997). A stakeholder analysis, which included an in-depth literature analysis and multistakeholder workshops (Reed et al., 2009), was performed to understand the E-waste management system in Ecuador (Grimble and Wellard, 1997; Mushove and Vogel, 2005).

The key stakeholders and their roles were identified considering the last three stages of E-waste management proposed by UNEP: collection, preprocessing and end-processing (Schluep et al., 2012). Next, the stakeholders were categorized according to their type, that is, the nature of the organization that each one represents (Hare and Pahl-Wostl, 2002). Finally, to understand the importance of each stakeholder, their roles were analyzed in detail. Fig. 20.3 illustrates the set of stakeholders' type identified. Most stakeholders play a role within a specific phase of the life cycle. Nevertheless, some of them such as national government, consumers, NGOs, and academia, are present in more than one stage or are not part of a

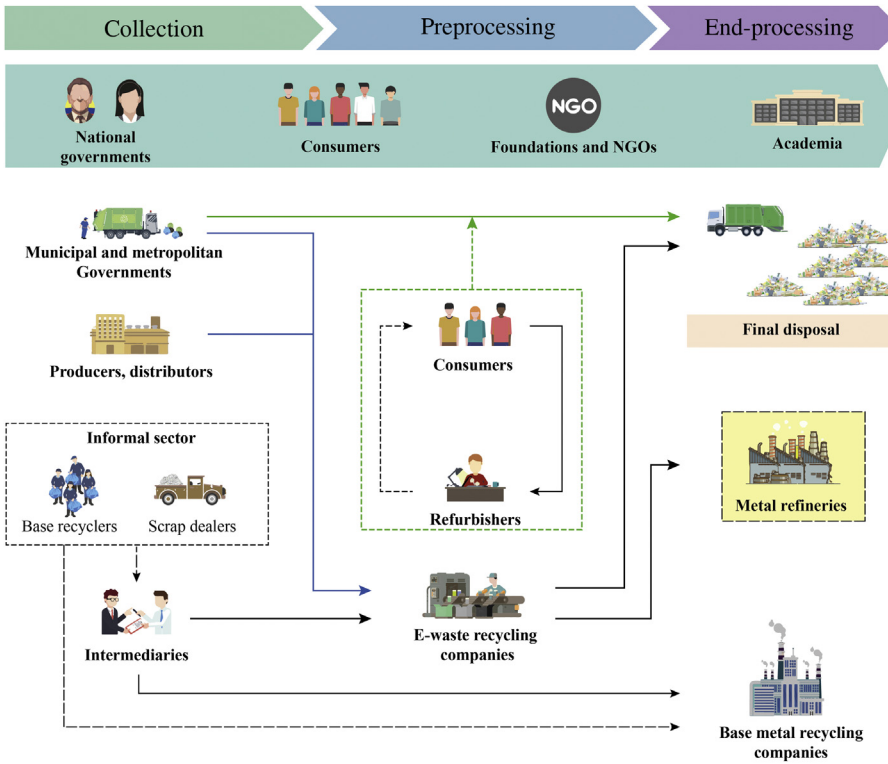

Figure 20.3 Identified stakeholders in the E-waste management system in Ecuador.

specific stage but they are relevant for the entire EEE life cycle. In this work, these stakeholders are referred to as transversal.

20.4.1 Transversal stakeholders

- *The National Government* plays a vital role across the entire EEE life cycle; it is responsible for coordinating, facilitating, and establishing regulations for waste management activities. Ecuador is a unitary state with decentralized administration, so competencies are assigned to different governmental bodies (Asamblea Constituyente, 2008). For instance, the Ministry of Environment(MAE) has the competencies for establishing national policies and developing regulations for waste of electric and electronic products (WEEE/E-waste—RAEE in Spanish) management (Asamblea Nacional, 2017). Besides, this Ministry grants operating permits to E-waste recycling companies (MAE, 2018a) and must promote the formalization, association, strengthening, and capacity building of recyclers at the national and local level (Asamblea Nacional, 2017). Additionally, there are a number of government bodies responsible for activities with a direct impact on E-waste management. For instance, the Council of Foreign Trade and Investments and the Ministry of Production, Employment and Competitiveness led, in 2010, the establishment of regulation to control the export of steel, aluminum, and copper-tin (bronze) scrap (MIPRO, 2010; IRR, 2015). This is relevant because in the country some E-waste, such as refrigerators and stoves, are traded together with scrap metal (Beltrán, 2013). Besides, the Ministry of Industries and Productivity has fostered recycling and scrap dealing initiatives.

  Since E-waste is not yet seen as a critical issue in the country, most of the funding for projects and research on this topic comes from international organizations. For instance, in 2018, the United Nations Industrial Development Organization (UNIDO) and the Global Environment Facility (GEF) in cooperation with the Ministry of Environment of Ecuador launched the program "Strengthening of National Initiatives and Enhancement of Regional Cooperation for the Environmentally Sound Management of Persistent organic pollutants (POPs) in Waste of Electronic or Electrical Equipment (WEEE) in Latin-American Countries" (GEF, 2018; UNIDO, 2018). This project aims to strengthen national and regional E-waste management systems in 13 countries through policies and consumers' involvement (Cueva, 2018).
- *Consumers* in Ecuador do not have a clear and defined role in the waste management system. Moreover, their awareness of the environmental relevance of E-waste is low. The awareness that they are responsible for the generation of E-waste and that should be part of the financing system to treat it properly is rare among consumers. On the contrary, there is the perception that discarded EEE has monetary value, so a regular practice is to trade these devices to informal door-to-door waste collectors. If not traded, EEE at the end of life typically remain at home or are donated to persons with fewer economic resources.
- *Foundations and NGOs* provide support to vulnerable groups involved in waste management activities. There are a number of organizations that support projects focused mainly on social and organizational aspects. For instance, the nonprofit organizations (NPO) "Avina" and "Fundación Alianza en el Desarrollo" supported the creation of the "Red Nacional de Recicladores del Ecuador"—National Network of Recyclers of Ecuador—(RENAREC) in 2008. RENAREC started with 18 associations and currently counts on 40 from 14 municipal governments (IRR, 2015). Other examples are the NPO "Hermano

Miguel" that, through the project "Yo reciclo" collects around USD 15,000/month from sales of recycled products (La Hora, 2018). Additionally, the "Fundación Ecuatoriana para la Protección y Conservación de la Naturaleza" NATURA, within its Solid Waste Management Program, carries out the project Fondo Reciclar. This project focuses on investment models for the recovery of recyclable materials from waste, creating green job opportunities and improving people's living standards (Fundación NATURA, 2018). Other NPOs such as "Fundación ESQUEL," OIKOS, "Fundación para la Gestión de Residuos" (FUNGERES), "Fundación para la Gestión Ambiental" (GEA), have also done relevant work for recyclers (Ojeda, 2009). These NGOs also promote the development of waste management regulation. For example, in the city of Cuenca, the organization "Cuenca, Ciudad para Vivir," together with the municipal waste management company, and the participation of recyclers' associations, academia, and public and private institutions presented a bill on solid waste management and inclusive recycling at the end of 2018 (El Tiempo, 2018).

- In Ecuador, *academia* is perceived by other actors as unbiased and positioned to convene stakeholders. Although E-waste has not yet gained enough traction at Universities there have been a number of related studies. Most of these works center on technical and economic aspects of the end of life treatment of E-waste (Espinoza Echeverría, 2010; Padilla Torres, 2017; Vargas Torres, 2017) or the implementation of recycling facilities (Rojas Matovelle and Román Quevedo, 2012). There are few studies on E-waste generation (Delaunay and Montero, 2013) and on the environmental and social aspects involved in E-waste management. These investigations are mostly undergraduate and master thesis rather than scientific publications. In 2018 KU Leuven, Universidad Andina Simón Bolívar and Universidad de Cuenca launched the research project "Enhancing the Social Value of the Circular Economy in Latin America". This project studies opportunities for incorporating informal recyclers in the circular economy, focusing on two waste streams: PET bottles and E-waste (VLIRUOS, 2018). The research focuses on two case studies in Ecuador, Cuenca, and Portoviejo, in close collaboration with the informal recyclers and other stakeholders. Academia is an important actor that has the capability for performing investigations and technical studies on E-waste management; as well as incorporating related topics in the curriculum, which influences future professionals, thus society.

20.4.2 Stakeholders: collection

- In Ecuador, *municipal and metropolitan governments* operate in a decentralized manner. They are in charge of providing the public service of solid waste management, and developing programs to reduce, recycle, and guarantee the adequate treatment of solid waste (Asamblea Constituyente, 2008; Asamblea Nacional, 2012, 2017). The 221 municipalities perform solid waste management activities under four modalities depicted in Table 20.1. It is worth mentioning that each municipality has its particularities and level of development. Most of them (56.6%) are in transition from open dumps to landfills (INEC, 2017). Special and hazardous solid waste, including E-waste, is not part of the competences of municipal governments but of the Ministry of Environment (Asamblea Nacional, 2017). Nevertheless, 24 municipalities report collection of E-waste (INEC, 2017), and some of them have carried out local initiatives to collect E-waste. For instance, the municipality of Ambato started a collection campaign in 2017, gathering 3.8 t of E-waste until May 2018 (GAD Ambato, 2018). In November 2017 the municipality of Cuenca implemented one E-waste collection point (EMAC, 2017), but no data are yet available on the amounts retrieved.

Table 20.1 Municipal waste management.

Modality	Number of municipalities	Percentage
Direct municipal management	161	73
Public municipal company	14	6
Association of municipalities	22	10
Association of public companies	24	11
Total	221	100

Source: Data from INEC, 2017. Base de Datos de Gestión Integral de Residuos Sólidos 2016. INEC, Quito. Available at: <http://www.ecuadorencifras.gob.ec/documentos/datos/Estadisticas_Ambientales/Municipios_Consejos_Provinciales/Gestion_Integral_Residuos_Solidos_de_Municipios/BaseCSVResiduos2016.zip>.

- One of the most important stakeholders for E-waste collection are *base recyclers*, who make a living by retrieving recyclable materials from discarded products. They usually work under substandard sanitary and environmental conditions, and frequently their activities are restricted or even criminalized. This situation poses a great challenge for the government. In 2014 it was estimated that roughly 20,000 base recyclers operated in the country, of which only 6% was associated (IRR, 2015). In 2015 the presence of base recyclers was reported in 101 out of 221 (46%) municipalities (Solíz Torres, 2015), and the four biggest cities (Quito, Guayaquil, Cuenca, and Manta) counted on 8865 base recyclers. The vast majority, 90%, of base recyclers do not have access to social security, and their average monthly income in 2015 was USD 218, while the national basic income for the same year was set at USD 354 (Ministerio del Trabajo, 2015). Only base recyclers from Quito and Cuenca report having support from municipalities or NGOs (IRR, 2015).

  Base recyclers work under two modalities: in the first one, they walk through the city collecting items of their interest directly from consumers, or containers and garbage bags outside the houses. Base recyclers move in reduced areas due to difficulties of transporting the collected waste (Mentefactura, 2017), most of the time walking or biking. In the second modality, base recyclers separate materials at landfills or dump-sites. There are also *scrap dealers*, who travel by truck across the city, or even provinces, buying items directly from EEE consumers (La Hora, 2008). Following collection, E-waste is sold to intermediaries at a range of USD 0.33 to USD 0.41 per kg (IRR, 2015). In some cases, base recyclers dismantle products to separate components or to recover materials. These operations are often performed without personal protection equipment at streets or at home. Practices such as burning cables, breaking lamps, and recovering of metals through artisanal methods are frequent. These practices are learned by experience and without any awareness on the health and environmental impacts caused by hazardous elements present in E-waste.
- *Intermediaries* constitute the bridge between the informal sector and E-waste recycling companies. They gather whole items, components or materials provided by base recyclers or scrap dealers. Once the amount of E-waste gathered is representative, it is sold to recycling companies. There are no data on the number or location of intermediaries in the country, which hinders E-waste traceability.
- According to the art. 233 of the Environmental Organic Code (CODA) and the Ministry Agreement No. 190, *producers/distributors* are responsible for treating their products at the end of life via a formal management channel (MAE, 2013c; Asamblea Nacional, 2017). To this end, producers/distributors are compelled to be registered as "hazardous waste generators." However, there is little control to enforce this requirement and not all

the companies comply with it. Few producers/distributors have collection points or offer transportation for large volumes of devices, such as the cases of Xerox and HP, which work in a business to business (B2B) model (HP, 2018; Xerox Corporation, 2018) and Samsung and Computrón that collect electronic waste from public and private companies (Granda, 2014). Most of these initiatives do not keep publicly accessible records.

20.4.3 Stakeholders: preprocessing

- In Ecuador, consumers still tend to send their EEEs to *refurbishers* for extending their lifespan; and there are regulations that ease the importation of spare parts for EEE (e-Comex, 2017; SENAE, 2017). Across the country, there are electrical and electronic product service centers for, among others, refrigerators, TVs, computers, and mobile phones. Typically, these centers are small businesses, while few are authorized centers of international firms. There are no data on the fate of broken components and unusable EEE on the web pages of the refurbishment centers. Although international firms such as Xerox, HP, Samsung, and LG provide refurbishment services, there are no online reports on their E-waste flows.
- In the country, there are 11 private E-waste *recycling companies* with official permits to operate (MIPRO, 2018). They work with the input provided by producers/distributors registered as "hazardous waste generators" and intermediaries of the informal sector. These companies perform storage, primary dismantling and mechanical comminution of discarded EEEs. Following, the valuable fraction of E-waste, containing precious metals and copper, is exported to metal refineries treating WEEE (Wang et al., 2012). For instance, the Ecuadorian company, Vertmonde, reports that 95% of E-waste is sent to further treatment abroad (Vertmonde, 2018, personal communication, 25th September) and the company ReciclaMetal sends Printed Wired Boards (PWBs) to the metal smelter UMICORE in Belgium (Recicla Metal 2019, personal communication, 17th January). There are no data available on the fate of the fractions with low or no value, so it is assumed that they end up at municipal landfills.

20.4.4 Stakeholders: end-processing

- Due to the diversity of elements present in E-waste, there is also a great variety of treatment processes and technologies available for recovering materials (Wang et al., 2012). In the country there are *base metal recycling companies*; for instance, the iron and steel companies ADELCA and NOVACENTRO have implemented smelting processes for treating secondary materials (Visser, 2014; IRR, 2015). ADELCA has supported the creation of storage facilities (about 300 warehouses) (El Telégrafo, 2011) and transport networks (Visser, 2014), and has strengthened the cooperation among base recyclers, as well as supporting the improvement of their working conditions (IRR, 2015).
- *Metal refineries* are International Companies that refine and detoxify outputs from preprocessing through chemical, thermal and metallurgical processes targeting mainly precious metals and copper. In the case of two Ecuadorian E-waste recycling companies, INTERCIA sends preprocessed E-waste to Global Electric Electronic Processing in Canada (El Telégrafo, 2012); and VERTMONDE sends memory modules to Canada for end-processing (Granda, 2014). E-waste that is not treated by metal refineries or base metals recycling companies is sent to municipal waste management systems and disposed of in landfills, controlled dumps, or open dumps.

20.5 ISWM: elements

20.5.1 Generation and separation

In Ecuador, the generation of municipal solid waste (MSW) corresponds mostly to households, accounting for 70%, followed by the commercial-institutional sector with 16%, industry with 8%, and the hospital and healthcare sector with 6% (IRR, 2015). There is an increasing trend in household waste separation and classification; official reports state that in 2010, 25.16% of the Ecuadorian population classified their waste, rising to 41.46% in 2016 (Grupo Técnico DEAGA, 2016). This process considers four categories: organic, paper and cardboard, plastic, and glass (Arias and Seilles, 2014; Seilles, 2015; Grupo Técnico DEAGA, 2016). Regarding municipalities, 82 out of 221 (37.1%) have implemented separation at source (INEC and AME, 2017). Records on E-waste generation are available for the years 2013 (56.46 kt), 2014 (73 kt), and 2015 (76.5 kt), see Table 20.2 (MAE, 2018b).

In the particular case of mobile phones in Ecuador, a recent estimate calculated the number of mobile phones that became E-waste from 2012 to 2018 based on average lifespan, historical records on imports and exports, and stock data from official sources. On average, for the analyzed period, roughly 2 million units become E-waste annually. Considering an average weight of 129 g/device, this quantity represents approximately 0.28 kt of E-waste per year (Sucozhañay and Vidal, 2019).

20.5.2 Collection and transport

The collection service has a 90.9% coverage in urban areas and 57.4% in rural areas (IRR, 2015; Mentefactura, 2017). In 2016 the amount of MSW collected was 4.6 Mt with an *urban* per capita generation of 0.58 kg/inh/day (INEC and AME, 2017), which represents an increment of 0.5 Mt compared to 4.1 Mt documented in 2014 (IRR, 2015). From the collected amount, the organic fraction corresponds to 62%, whereas the inorganic fraction is subdivided as follows: plastics 11%, paper and cardboard 9%, glass 3%, scrap 2%, and "others" 13% (IRR, 2015; Mentefactura, 2017). Although E-waste as such does not appear within this subcategorization, some municipalities retrieve this stream through a differentiated

Table 20.2 Details on imports of EEE, E-waste generation and collection.

	2013	2014	2015
EEE imports (kt)	188.7	194.1	154
E-waste generated (kt)	56.5	73	76.5
E-waste collected (kt)	5.1	6.1	5.9
E-waste collected (%)	9	8	7

Source: Data from MAE, 2018b. Fortalecimiento de Iniciativas Nacionales y Mejora de la Cooperación Regional para el Manejo Ambientalmente Racional de los COPs en Residuos de Aparatos Eléctricos y Electrónicos (RAEE) en los Países de América Latina. Quito, Ecuador.

collection. Specifically, in 2016, 24 municipalities collected 75.6 t of E-waste (INEC, 2017). However, some categories, such as large and small household appliances are typically classified as scrap (Beltrán, 2013; Donoso Carrillo, 2017), so these devices are exported or sold locally as scrap metal, which hinders E-waste traceability. In addition, according to the National Survey on Employment, Unemployment, and Underemployment (ENEMDU), only a small fraction, on average below 5%, of consumers send E-waste to a special container or storage center for further treatment (INEC, 2013; Grupo Técnico DEAGA, 2016). For year 2014, the amount of collected E-waste reached 6.14 kt (MAE, 2018b). In this year the "Iniciativa Regional para el Reciclaje Inclusivo" (IRR) reported data on the quantities of E-waste (5.99 kt) collected by the informal sector in the three biggest cities: Quito, Guayaquil, and Cuenca, which accounted for 98% of the total as depicted in Fig. 20.4 (IRR, 2015). Therefore considering the official quantities reported by MAE, only 8% of the E-waste generated in 2014 was collected. Available records on E-waste collection from 2013 to 2015 are presented in Table 20.2.

There has been only one initiative to set collection targets for E-waste in the country. In 2013 the collection target of 3% of the number of mobile phones placed on market in the previous year was linked to the importation quotas for these devices (MAE, 2013a,c; COMEX, 2012a). From 2013 to 2015, the collection highly surpassed this target (Fig. 20.5). However, in December 2015 the national limit for imports of mobile phones was established in 2,663,762 units regardless of the collected units (PNGIDS, 2018). As a result, collection rates dropped drastically, for example, in 2014 the national collection rate was 14.01%, and in 2016 it reached 3.81% (MAE, 2018b).

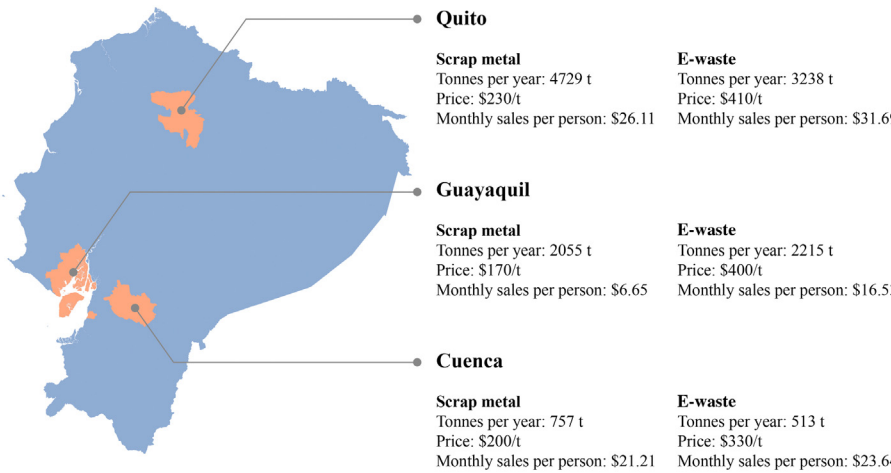

Figure 20.4 Scrap metal and E-waste collected by the informal sector.
Source Data from IRR, 2015. Reciclaje Inclusivo y Recicladores de Base en el Ecuador. Ecuador. Available at: <https://reciclajeinclusivo.org/wp-content/uploads/2016/04/Reciclaje-Inlcusivo-y-Recicladores-de-base-en-EC.pdf>.

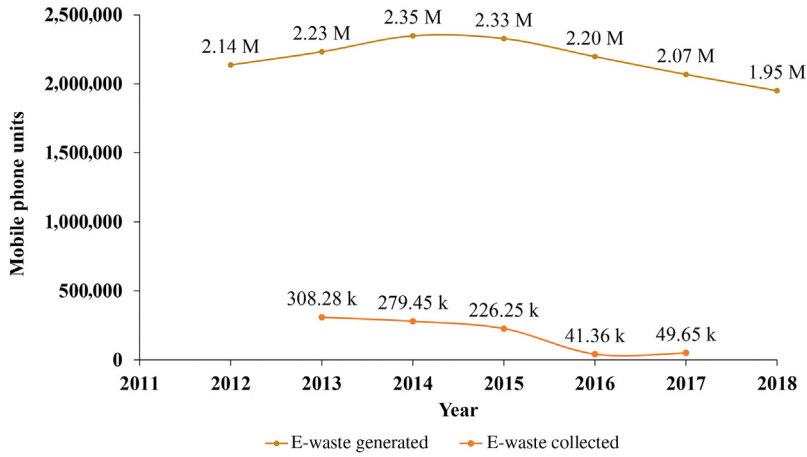

Figure 20.5 Estimations on E-waste generated and collection of E-waste. Case: mobile phones.
Sources: Data from PNGIDS, 2018. Recolección de teléfonos celulares. Quito and Sucozhañay, G., Vidal, I., 2019. Análisis del flujo de materiales y evaluación del impacto ambiental de los residuos de aparatos eléctricos y electrónicos. Caso de estudio: Teléfonos celulares en el cantón Cuenca. Cuenca.

Regarding E-waste transportation, this stage can occur in different ways since this activity can be covered by intermediaries, producers, or by E-waste recycling companies as part of their services. It is worth mentioning that there is a specific procedure for the environmental licensing of hazardous waste transportation. This procedure requires specific elements such as driver certifications, declaration of transportation capacity, and environmental management plans (MAE, 2018a).

20.5.3 Treatment and disposal

The E-waste collected, both formally and informally, is expected to reach an E-waste recycling company, which locally can cover activities such as storage, dismantling, and shredding, and then export components and fractions with precious metals for further treatment (Torres et al., 2015). For 2014, the processing capacity was estimated in 13 kt (MIPRO, 2014, 2016). Assuming that all the E-waste collected in this year reached to these recycling companies, it is noticeable that they work at less than half of the capacity. Following local treatment E-waste is exported to metal refineries, plastic recyclers and base metal recovery companies (Vertmonde, 2018, personal communication, 25th September). Additionally, due to the local demand of recycled scrap, estimated in 588 kt/year (IRR, 2015), recycling processes for base metals take place within the country. For instance, in 2013 MIPRO and the iron and steel company ADELCA signed an agreement with MIPRO to handle 330,000 old refrigerators collected by the National Government and transform them back into steel products (El Telégrafo, 2013; Centrosur, 2016). In compliance with this agreement

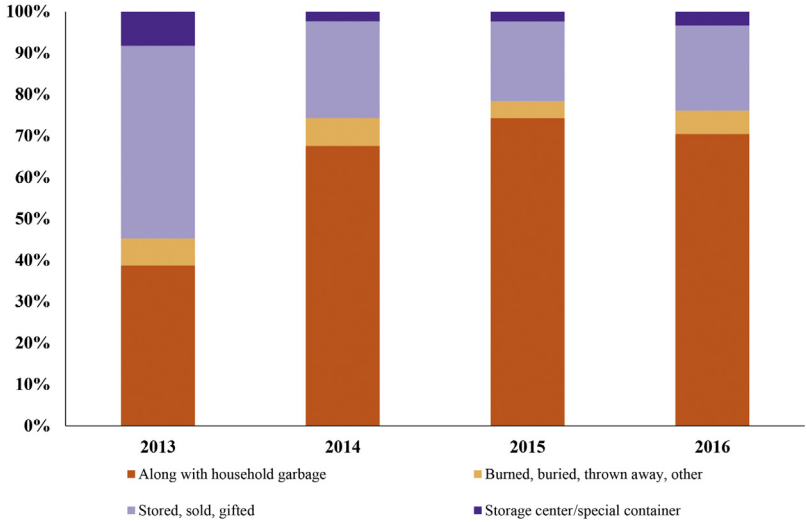

Figure 20.6 E-waste disposal in Ecuadorian households. In 2017, 76% respondents disposed of their E-waste along with household garbage. Other disposal methods were not mentioned. *Sources*: Data from INEC, 2013. Módulo de Información Ambiental en Hogares ENEMDU - Diciembre 2013. Available at: <http://www.ecuadorencifras.gob.ec/documentos/web-inec/Encuestas_Ambientales/Hogares-2013/201401_EnemduAmbientePresentacion.pdf> (accessed 03.12.18.), Grupo Técnico DEAGA, 2016. Información Ambiental en Hogares. Available at: <http://www.ecuadorencifras.gob.ec/documentos/web-inec/Encuestas_Ambientales/Hogares/Hogares_2016/Documentotecnico.pdf> (accessed 03.12.18.), and Benavides, R., et al., 2017. Módulo de Información Ambiental en Hogares - Diciembre 2017. Available at: <http://www.ecuadorencifras.gob.ec/documentos/web-inec/Encuestas_Ambientales/Hogares/Hogares_2017/DOC_TEC_MOD_AMBIENTAL_ENEMDU.2017.pdf> (accessed 03.12.18.).

the program is still ongoing and reports that from 2013 to 2016 the number of refrigerators treated was 92,000 (ADELCA, 2016).

Although disposal is viewed as the last measure in the waste management hierarchy (Ignatuschtschenko, 2017), it is a recurrent practice in Ecuador. On average, from 2013 to 2016, 62.8% of Ecuadorians reported mixing E-waste along with household garbage, see Fig. 20.6 (INEC, 2013; Grupo Técnico DEAGA, 2016). Thus, a high amount of E-waste ends up in final disposal sites such as landfills, emerging cells or open dumps. Furthermore, initiatives encouraging E-waste reduction are rare in the country. As a consequence the amount of E-waste generated in Ecuador has increased from 73 kt in 2014 (Baldé et al., 2015) to 90 kt in 2016 (Baldé et al., 2017).

20.6 ISWM: aspects

Following the ISWM framework, the third dimension comprises the factors that influence the whole waste management system and have impact in terms of

efficiency and sustainability (Ignatuschtschenko, 2017). Those factors include political, legislative, and institutional frameworks, socio-cultural conditions, financial and economic factors, as well as technical and environmental aspects.

20.6.1 Socio-cultural conditions

Culture and consumption have an unprecedented relationship in the globalized world. Appadurai (1988) defines consumption as the function of a variety of social practices and classifications, and not so much as a mysterious emanation of human needs. Therefore consumption always assumes cultural forms. In this context, understanding the Ecuadorian culture is important to analyze E-waste management.

Latin American societies have been described as heterogeneous or culturally hybrid, this means, the flow of material and symbolic goods (Brünner, 1988) and the complex articulation of modernities and traditions (Bauman, 1998; García Canclini, 1990). Furthermore, they have been characterized by been moderately collectivistic, this means that social relationships are group-centered; and strongly polychromic, this means that time is seen as cyclical. People in Latin America are strongly relationship-based meaning that there is emphasis on interpersonal relationships and trust; and moderately harmony-oriented which means that focus is on living in harmony with nature and adjusting to the natural and social environment (House et al., 2004; Steers et al., 2010).

Even though in recent years, Ecuadorians have perceived profound changes in their consumer attitudes and practices, it is difficult to compare them with a consumer society such as the North American or European. Ecuador has half of the population living in poverty or extreme poverty. This implies that consumption is not carried out in the same intensity or with the same characteristics as in more affluent societies. For example, low-income populations generally buy second hand or repair appliances for their homes such as refrigerators, TV sets, kitchen appliances, as well as computers and cell phones. Repairing and selling used or refurbished products is an important part of the informal economy. Thus, it is easy to find someone who can repair electronic artifacts and, generally, this service is offered at a competitive price.

20.6.2 Political, legislative, and institutional frameworks

This section focus on policy and legal aspects analyzing the environmental normative in Ecuador related to E-waste management. It describes the Ecuadorian constitutional development according to the international regulatory framework, the secondary normative on solid waste management, and the regulation of the integrated management of hazardous and special waste. Fig. 20.7 shows the constitutional development of the environmental law in Ecuador.

In conformance with the ISWM framework, national legislations should integrate and implement international rules and standards. In this regard, Ecuador participates in most of the international environmental agreements and has formulated its legislation accordingly. The Basel Convention on the Control of Transboundary Movements

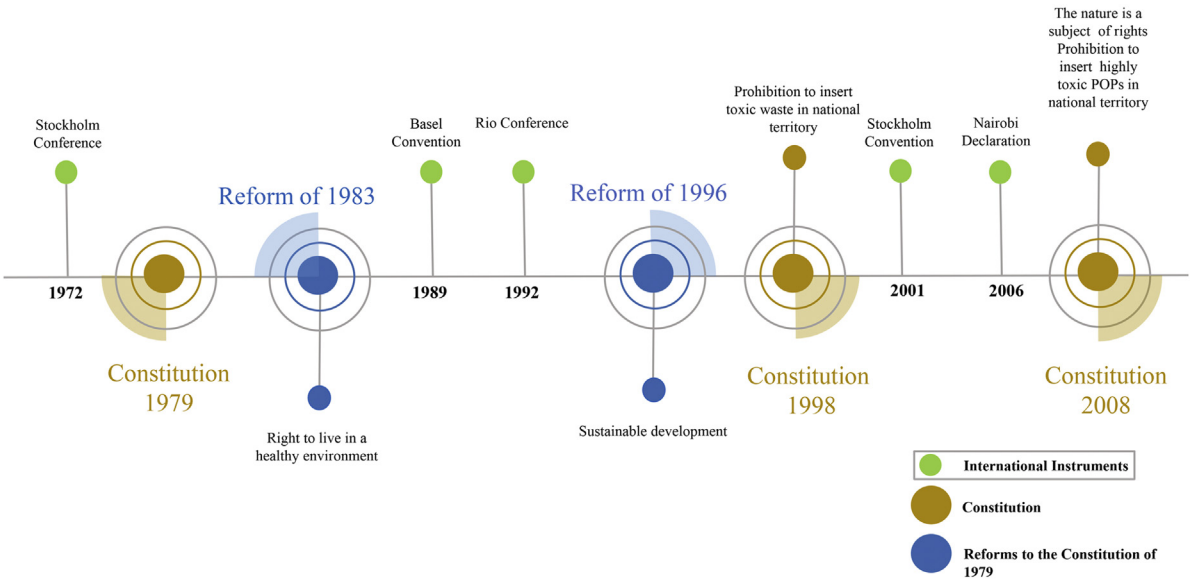

Figure 20.7 Constitutional development of the environmental law in Ecuador.

of Hazardous Wastes and their Disposal (United Nations, 1989) and the Stockholm Convention on Persistent Organic Pollutants (United Nations, 2001) are the most important ones related to E-waste management which influenced the Ecuadorian normative. In addition, there are other international instruments that have shaped the Ecuadorian constitutional development regarding environmental issues and waste management, the most relevant being the Stockholm Conference (United Nations, 1972), the Rio Conference of 1992 (United Nations, 2017), and the Nairobi Declaration on the Environmentally Sound Management of Electrical and Electronic Waste (United Nations, 2006).

The constitution of Ecuador after its return to democracy, established in 1979, along with the reforms of 1983 (Congreso Nacional del Ecuador, 1984) and 1996 (Congreso Nacional del Ecuador, 1996) incorporate the citizen's right to live in a healthy environment free of contamination and the State obligation to guarantee sustainable development. After that, the Constitution of 1998 made the protection of the environment a fundamental duty of the State, the concept of sustainable development turned into a transversal idea and the prohibition to insert toxic waste in the national territory was established (Asamblea Nacional Constituyente, 1998). Later, the Ecuadorian Constitution of 2008 prohibits the development, production, commercialization, importation, transportation, storage, and use of persistent organic pollutants (Asamblea Constituyente, 2008). Moreover, this novel Constitution recognizes the indigenous vision of the relation humans—nature reflected in the concepts of "Pachamama" and "Sumak Kawsay" which are native terms that mean "Mother Earth" and "good living," respectively. In this way, Ecuador changed the traditional anthropocentric view on environmental rights that considers nature as an object (Ávila Santamaría, 2016). Instead of that, a biocentrist perspective is developed in which the "Pachamama" is recognized as a subject of rights to be respected, preserved, and restored according to its life cycle (Asamblea Constituyente, 2008).

Moreover, the Constitution of 2008 and the Environmental Organic Code (CODA) establish a vast list of environmental principles, see Appendix A and B (Asamblea Constituyente, 2008; Asamblea Nacional, 2017). The rights and principles recognized in the Ecuadorian Constitution could be applied directly without the necessity of a secondary normative (Asamblea Constituyente, 2008). Regarding E-waste, two key environmental principles are considered in the Ecuadorian regulations: the *precautionary principle* and the *extended producer responsibility (EPR)*. The former implies that if there is a risk of severe or irreversible harm, the lack of scientific certainty will not be a reason to postpone the measures to prevent the environmental degradation. EPR is related to the duty that the producer or the importer has along the whole life cycle of the product. It includes the impacts related to the selection of the materials, the production process, the final disposal, and the use of them at the end of their useful life (MAE, 2013b; Asamblea Nacional, 2017).

The CODA was enacted in 2018 aiming to unify environmental laws in the country. In this sense, the CODA establishes the general policies for the integral waste management considering EPR and the promotion of the development,

exploitation, and appreciation of waste as an economic good with a social purpose. In this sense, the hierarchical principle in waste management must respect the following order: (1) prevention; (2) minimization of the generation in the source; (3) appreciation; (4) elimination; and (5) final disposal (Asamblea Nacional, 2017). In Ecuador E-waste is considered as a hazardous waste (MAE, 2012). The CODA determines that generators and managers of hazardous and special waste must receive an administrative authorization. Then, in agreement to EPR every natural or juridical person that is defined as a generator of special and hazardous waste, is responsible for the environmental management of these waste streams starting from their generation until their elimination and final disposal, according to the hierarchical principle mentioned above. Moreover, the people hired by the generators to manage special and dangerous waste, will share responsibilities in case of accidents that could produce contamination or environmental damage (Asamblea Nacional, 2017).

Most of the fundamental environmental laws are integrated in the CODA; nonetheless, the regulation of special and hazardous waste is still described in a secondary normative. In the case of E-waste, the Ministry of Environment established in 2013 a *National Policy for the Post-consumption of Unused Electric Equipment* that focuses on EPR of importers and producers (MAE, 2013b). In the same way, the Ministry Agreement No. 191 to *Prevent and Control the Contamination by Chemical Dangerous Substances, Dangerous and Special Waste*, regulates the situation of unused cell phone equipment (MAE, 2013c); the Resolution No. 67 of 2012 of the Ministry of Foreign Affairs Commerce that restricts the importation of cell phones (COMEX, 2012b); and the Resolution No. 100 of the same institution of 2012 that establishes a maximum capacity that the importer of cell phones can bring (COMEX, 2012a). Furthermore, there are other vital norms in the field that regulate used batteries (MAE, 2013d) and integral management of plastics (MAE, 2014). In this regard, the Unified Text of Environmental Secondary Normative (TULSMA) regulates the integrated management of dangerous and special waste, which is composed by the following phases: (1) generation; (2) storage; (3) collection; (4) transportation; (5) recover; and (6) final disposal, as shown in Fig. 20.8 (MAE, 2003).

The Ecuadorian legislation recognizes environmental incentives as economic instruments to promote compliance with the environmental law. Mainly two norms regulate this topic: the CODA and the Ministry Agreement No. 140 of 2015 that regulates the institutional chart for environmental incentive. In this sense, the Ministry of Environment has a leading role in this area with the support of the decentralized governments in their territorial division (Asamblea Nacional, 2017). The environmental incentives pretend to promote the sustainable exploitation of biological resources, the culture of prevention and reduction of contaminants and compliance with the environmental law (Asamblea Nacional, 2017). These incentives could be (1) economical or noneconomical; (2) tax or fiscal ones; (3) honorary; and (4) others established by the authority. The environmental incentives promote the implementation of cleaner technologies and integral waste management in the framework of a circular economy. They aim at stimulating sustainable development which

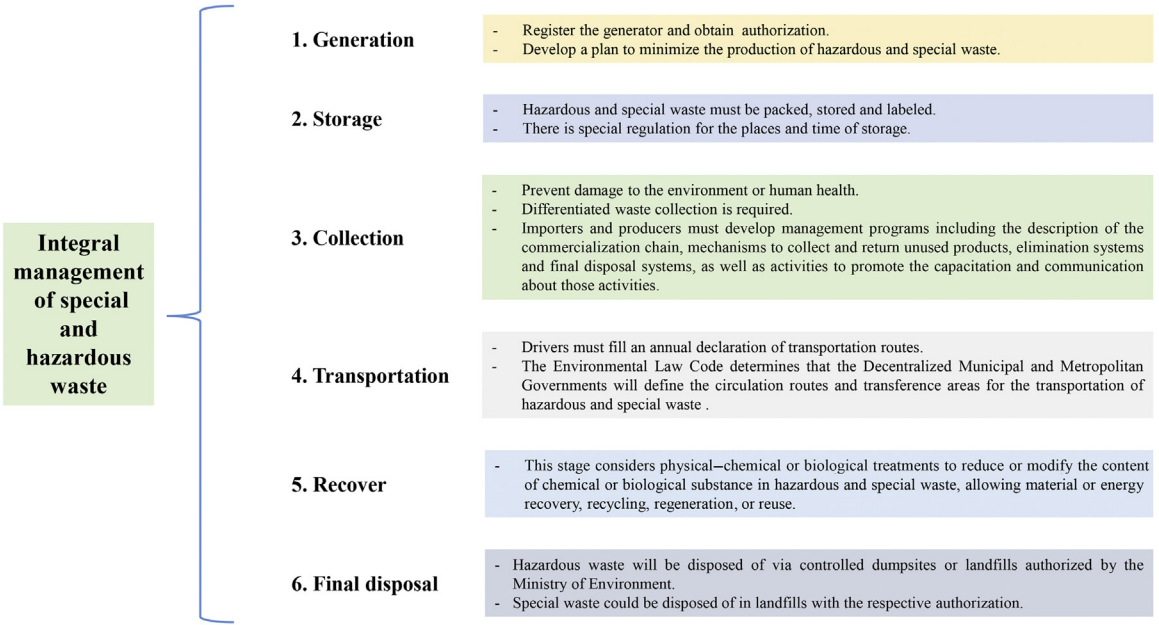

Figure 20.8 Phases of the integral management of special and hazardous waste.
Source: Text of Environmental Secondary Normative, art. 78-147 (MAE, 2003. Texto Unificado De Legislacion Secundaria De Medio Ambiente (TULSMA). Registro Oficial Edición Especial 2 de 31-mar.-2003. Ecuador. Available at: <http://www.silec.com.ec/Webtools/LexisFinder/DocumentVisualizer/FullDocumentVisualizerPDF.aspx?id = AMBIENTE-TEXTO_UNIFICADO_DE_LEGISLACION_SECUNDARIA_DE_MEDIO_AMBIENTE>).

objective is to produce goods and services while reducing the consumption and waste of raw materials, water, and energy (MAE, 2015; Asamblea Nacional, 2017).

20.7 Challenges and perspectives

This section presents the main challenges of the Ecuadorian E-waste management system toward compliance with the ISWM framework. Those challenges were identified in a National Workshop on E-waste management, held in July 2018. This workshop was conducted using the Systemic Design of Solutions (Méndez-Fajardo et al., 2017), previously used to frame the current E-waste National Policy in Colombia (MINAMBIENTE, 2017). The exercise included 51 actors representing most of the interested parties defined in the section of stakeholders. For instance, National and Municipal Government representatives, Manufactures/Importers (e.g., Claro, Indurama), Recycling Companies (e.g., CTIP, Vertmonde), Base Recyclers, Academia (e.g., Universidad de Cuenca, ESPOCH), and International Organizations such as the Swiss Federal Laboratories for Materials Science and Technology (EMPA), the Swiss Resource Centre and Consultancies for Development (Skat), and the United Nations Industrial Development Organization (UNIDO). This broad stakeholder participation contributes to a holistic insight into the E-waste situation in Ecuador.

The absence of E-waste management on the political agenda at the national and local level, together with the lack of budget assignment for this topic are the leading causes that impede the creation of an ISWM system in the country. Only few initiates dealing with E-waste exist, mainly founded by international bodies. The prime limitation associated to the political and legal aspects is the lack of a robust and coherent legislative and regulatory framework, adapted to the dynamics of the management system, which is also easy to understand and operationalize for the actors involved. The regulatory framework for the E-waste management system is composed of Constitutional Norms, the CODA, Ministry Agreements and Resolutions. Hence, the gaps encountered in the Ecuadorian legislation are the result of a dispersed secondary normative and the need for specific E-waste regulation. Aligned with the extended producer responsibility, the country obligates generators of special and hazardous waste to register, obtain authorization, and present a management program including mechanisms to collect and return, elimination systems, and final disposal. However, this normative is not specific for E-waste, but for special and hazardous waste. As a result there is a lack of a technical guide that could recognize the special features of E-waste along their integral management (StEP, 2018). The new "Reglamento al CODA—CODA bylaw" which is currently being analyzed by the President is considered as an opportunity to consolidate the legal framework to regulate WEEE in Ecuador. In this regulation, a special chapter for the Integral Management of Hazardous and Special Waste is considered.

Regarding stakeholders involvement, the main limitation is that their roles and responsibilities are not well-defined. Such uncertainty does not propitiate an environment where stakeholders could assume and develop their roles effectively. The

Ecuadorian environmental competences model is a big challenge because there is too much responsibility of the Central Government. In addition, the country has an enormous financial problem due to an institutional crisis, which derived in a reduction in the number of Ministry Offices from 27 to 20. As a result, the Ministry of Environment was merged with the Ministry of Water (Presidential Decree, 533). This new structure ended up with a Ministry with too many competencies, and fewer resources for the course of action, for example, contracting studies and planning strategies.

Currently the informal sector represents most of the workforce of the E-waste management chain. However, its work is not recognized by the government or society; even an operative model for its socio-economic inclusion does not exist in the country. One way to tackle this informality is guaranteeing a fair price for the provided service and recognizing the critical role the informal sector plays. According to Aparcana (2017) there are different formalization strategies, one of them is to organize waste collectors in associations or cooperatives. Another strategy is to organize waste collectors in community-based organizations or micro and small enterprises and eventually, or to contract them as individual workers by the formal waste management sector (Aparcana, 2017). Formal recognition of their role could decrease the volume of E-waste that goes through an inappropriate channel, that is, ending up at final disposal sites.

In addition, the improvement of the technical capacity of E-waste recycling companies should be considered a priority. For improving their capacities, these companies should aim at complying with technical standards to obtain international certifications. These developments would lead to a higher valorization of the E-waste processed. Currently, only one recycling company complies with an R2 certification. Another point for improvement is the service coverage, considering that the current eleven recycling companies registered by MIPRO have their facilities only in four cities: Quito, Guayaquil, Ambato, and Machala.

In terms of generation and separation, most users in Ecuador do not separate E-waste, and it is most likely to end up in final disposal sites along with household garbage. Therefore it is imperative to support initiatives for classification at source and the implementation of a differentiated collection system to enhance the next steps in waste management. For example, in the urban areas of Cuenca, about 60% of households do not classify their waste, and 35% of them mention that the main reason is the absence of collection points or containers destined for their use. Another 20% mention that they do not have the interest to perform this practice (Mentefactura, 2017). Another critical element for the development and improvement of the Ecuadorian E-waste management system are data. Data contribute with the understanding of E-waste flows and thereby allows the local and national government to take the corresponding actions for the correct treatment of E-waste. However, registered operators do not make data available, neither the amount of E-waste processed nor their processing capacity. Furthermore, E-waste operators and institutions are required to document the flows of unusable state goods received and delivered, but such data are not readily available. Therefore one of the main challenges is to design a proper plan for data collection at municipal and national

level. In this regard, StEP (2014) indicates that recycling companies require to document the inputs they receive from their suppliers. Besides, StEP mentions the necessity of stating what information is expected from each participant within the E-waste management chain. Finally, the exchange of information and knowledge, open access data, and well-documented processes are essential. One option to achieve this is by developing a multistakeholder platform that ensures the implementation of a proper E-waste management system where strategic decisions are jointly taken based on an open dialogue and are accepted by all participants.

20.8 Conclusion

This work presents an analysis of the current situation of the Ecuadorian E-waste management system. The assessment is performed under the lens of the Integrated and Sustainable Waste Management framework. It assesses the Ecuadorian situation with respect to the three dimensions proposed in the ISWM, that is, stakeholder's involvement, political and socio-cultural aspects, and the technical elements and procedures that constitute the E-waste management system in Ecuador.

The analysis of the Ecuadorian situation, regarding E-waste management, revealed the shortcomings that hinder the creation of a National ISWM system. The most relevant being, E-waste in Ecuador is not part of the political agenda neither at national nor at local level. The national government should lead the develop of an integral policy and an effective E-waste management system with the participation of key stakeholders. Furthermore, the Ecuadorian regulatory framework has dispersed secondary normative, which lacks coherency and it is not robust. Most of E-waste regulation are built on Ministry Agreements and Resolutions related to Hazardous and Special Waste. This exhibits a need for specific E-waste regulation. Nevertheless, there are ongoing governmental initiatives to consolidate this legal framework in the CODA bylaw.

Roles and responsibilities of stakeholders involved in E-waste management are not well-defined so there is uncertainty on the competences that each one has to assume. In addition, the current financial and institutional situation of the country hampers a proper management, only few resources are assigned to develop new projects on environmental topics. A couple of initiates dealing with E-waste are presently carried out, mainly founded by international bodies. The implementation of formalization strategies for the informal sector needs to be addressed by the government. There exist several alternatives to include the informal sector in the E-waste management chain, which will contribute to improve their well-being as well as to increase the recycling rate of this waste stream. These initiatives should go along with the improvement of E-waste recycling companies. The government should encourage international certifications to assure that best available techniques are in place.

Furthermore collection systems and data gathering schemes must be deployed through alliances between the central government and municipalities. The reverse

logistic, statistics and proper treatment can be financed via the EPR system. Currently EPR is mentioned at different levels of legislation but it is not implemented for E-waste. In addition, the limited awareness about E-waste in Ecuador is another problem that limits its proper treatment. National and municipal government must develop actions to increase environmental awareness. They must promote the reuse of EEE, inform consumers about the prohibition to dispose E-waste together with household waste, and create authorized collection points through municipal governments.

Despite the current flaws and challenges in the Ecuadorian E-waste management practices, the country has a strong chart of fundamental rights and principles that enforces the duty of the State to guarantee, through public policies and normative, the creation of an integrated and sustainable E-waste management system.

List of abbreviations

Abbreviations	Spanish	English
AM	Acuerdo Ministerial	Ministry Agreement
AME	Asociación de Municipios del Ecuador	Association of Municipalities of Ecuador
Basel Convention		Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal
CCCV	Cuenca, Ciudad para Vivir	
CE	Constitución del Ecuador	Constitution of Ecuador
CODA	Código Orgánico del Ambiente	Environmental Organic Code
COMEXI	Consejo de Comercio Exterior e Inversiones	Council of Foreign Trade and Investments
COOTAD	Código Orgánico de Organización Territorial, Autonomía y Descentralización	Organic Code of Territorial Organization, Autonomy and Decentralization
EMPA		Swiss Federal Laboratories for Materials Science and Technology
E-waste		Electronic waste
e-Comex	Comercio Exterior	Foreign Trade
EEE		Electric and Electronic Equipment
EMAC	Empresa Pública Municipal de Aseo de Cuenca	Municipal Cleaning Company of Cuenca.
ENEMDU	Encuesta Nacional De Empleo, Desempleo Y Subempleo	National Survey on Employment, Unemployment and Underemployment

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Abbreviations	Spanish	English
EPR		Extended Producer Responsibility
FUNGERES	Fundación para la Gestión de Residuos	Foundation for Waste Management
GEA	Fundación para la Gestión Ambiental	Foundation for Environmental Management
GEF		Global Environment Facility
IMF		International Monetary Fund
INEC	Instituto Nacional de Estadística y Censos	National Institute of Statistics and Census
IRR	Iniciativa Regional para el Reciclaje Inclusivo	Regional Initiative for Inclusive Recycling
ISWM		Integrated and Sustainable Waste Management
MAA	Ministerio del Ambiente y Agua	Ministry of Environment and Water
MARENA	Ministerio del Ambiente y los Recursos Naturales de Nicaragua	Ministry of Environment and Natural Resources of Nicaragua
MARN	Ministerio de Ambiente y Recursos Naturales	Ministry of Environment and Natural Resources of Guatemala
MEER	Ministerio de Electricidad y Energía Renovable	Ministry of Electricity and Renewable Energy
MIAMBIENTE	Secretaría de Recursos Naturales y Ambiente de Honduras	Secretariat of Natural Resources and Environment of Honduras
MICPEC	Ministerio de Coordinación de la Producción, Empleo y Competitividad	Ministry of Production, Employment and Competitiveness
MINAMBIENTE	Ministerio del Ambiente de Colombia	Ministry of Environment of Colombia
Minea	Ministerio del Poder Popular para Ecosocialismo y Aguas de Venezuela	Ministry of People's Power for Ecosocialism and Waters of Venezuela
MINSA	Ministerio de Salud de la República de Panamá	Ministry of Health of the Republic of Panama
MIPRO	Ministerio de Industrias y Productividad	Ministry of Industries and Productivity
MMAyA	Ministerio de Medio Ambiente y Agua de Bolivia	Ministry of Environment and Water of Bolivia
MSW		Municipal Solid Waste
Nairobi Declaration		Nairobi declaration on the environmentally sound management of electrical and electronic waste

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Abbreviations	Spanish	English
NATURA	Fundación Ecuatoriana para la Protección y Conservación de la Naturaleza	Ecuadorian Foundation for the Protection and Conservation of Nature.
NGOs		Non-Governmental Organization
NPO		Non-Profit Organizations
OEC		The Observatory of Economic Complexity
PNGIDS	Programa Nacional para la Gestión Integral de Desechos Sólidos	National Program for the Integral Management of Solid Waste
POM		Placed on Market
POPs		Persistent organic pollutants
RELAC	Plataforma Regional de Residuos Electrónicos en Latinoamérica y el Caribe	Regional Platform for Electronic Residues in Latin America and the Caribbean
RENAREC	Red Nacional de Recicladores del Ecuador	National Network of Recyclers of Ecuador
SENAE	Servicio Nacional de Aduana del Ecuador	National Customs Service of Ecuador
SERI		Sustainable Electronics Recycling International
SKAT		Swiss Resource Centre and Consultancies for Development
SRI		Sustainable Recycling Industries
Stockholm Convention		Stockholm Convention on Persistent Organic Pollutants
TULSMA	Texto Unificado de Legislación Secundaria de Medio Ambiente	Unified Text of Environmental Secondary Normative
UNEP		United Nations Environment Programme
UNESCO		United Nations Educational, Scientific and Cultural Organization
UN-Habitat		United Nations Human Settlements Programme
UNIDO		United Nations Industrial Development Organization
VLIR-UOS		Flemish Interuniversity Council—University Development Cooperation
WEEE	Residuos de Aparatos Eléctricos y Electrónicos	Waste of Electric and Electronic Products

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Appendices

Appendix A Constitutional environmental principles in Ecuador

Principle	Content	Constitutional norm
Sustainable Development	Find a balance between environment and development as linked concepts.	Art. 395.1
In Dubio Pro Natura	In case of doubt about the environmental normative, it must be applied in the most favorable sense to the protection of the nature.	Art. 395.4 Art. 71 in relation with art. 11.5
Precautionary	The authorities must adopt measures to protect the environment, even though the cause-effect relation between the activity and the harm have not been scientifically proven.	Art. 396, 73
Prevention	It takes place when there is certainty about the harm or the danger of the activity.	Art. 396.1
Solidarity and Integral Responsibility	It links everyone who is part of the production, commercialization and consume chain with the environmental responsibility. It is also known as "cradle to grave."	Art. 396
Integral Regulation	Environmental management policies must be applied integrally, and those will be mandatory for the authorities in general and every person.	Art. 395.2
Effective Judicial Protection and the Inversion of the Burden of Proof	The possibility to claim to authorities and judges to obtain effective judicial protection in environmental issues. It includes preventive measures that could stop the threat or the environmental damage, invert the burden of proof that is an exception of the principle of the presumption of innocence, so who has to proof is the person that alleges that there was not environmental damage.	Art. 397.1 Art. 87
Actions and Sanctions for Environmental Damage are Imprescriptible	The actions or sanctions never lapse.	Art. 395

(*Continued*)

(Continued)

Principle	Content	Constitutional norm
Prior Consultation	Every decision or governmental authorization that could affect the environment will be consulted to the community.	Art. 398 Art. 424

Appendix B Environmental principles in the environmental organic code of Ecuador

Principle	Content
Integral Responsibility	Who promotes the activity, generates or could generate environmental impact must be responsible.
Best Available Technology and Environmental Practices	The State must promote the development and use of clean environmental technologies and low impact alternative no contaminative energies.
Sustainable Development	The process in which the economic, social, cultural, and environmental aspects are linked to satisfy generational necessities.
Who Contaminates Must Pay	Who contaminates is obligated to integrally repair and to compensate those adversely affected.
In Dubio Pro Natura	In case of doubt about, it must be applied in the most favorable sense to the protection of nature.
Access to Information, Participation And Justice In Environmental Issues	Every person, community, nationality or collective, according to the law, has the right to the opportune and adequate access to information related with the environment.
Precautionary	If there is no scientific certainty of the environmental impact, the State must adopt opportune and effective measures to eliminate, avoid, reduce, mitigate and stop the affectation.
Prevention	If there is scientific certainty of the harm, the State must require to whom it corresponds measures to eliminate, avoid, reduce, mitigate and stop the affectation.
Integral Reparation	Group of actions, processes and measures to revert the impacts and environmental harm, to avoid their recurrence and facilitate the restitution.

(*Continued*)

(Continued)

Principle	Content
Subsidiarity	The State must intervene in a subsidiary and opportune form to repair the environmental damage, when the person that promotes the activity does not assume the responsibility about the integral reparation.