Closing the Circular Economy Loophole: on fair governance for European waste exports

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Closing the Circular Economy Loophole: on fair governance for European waste exports

Het dichten van het gat in de circulaire economie: over eerlijk beleid voor de Europese afvalexport

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Abbreviations

CE - Circular economy

DoC - Department of Construction

CRESTING – Circular Economy Sustainability Implications and Guiding Progress

DoNRE - Department of Natural Resources and Environment

DoSTE - Department of Science, Technology and Environment

EC - European Commission

EoL – End of Life

EPR - Extended Producer Responsibility

ESR – Early-Stage Researcher

ETRMA - European Tyre and Rubber Manufacturers Association

e-waste - Electric and Electronic Equipment Waste

EU – European Union

INGO – International Non-Governmental Organization

IPCC -Intergovernmental Panel on Climate Change

ISPONRE - Institute of Strategy and Policy on Natural Resources and Environment

LEP - Law on Environmental Protection

MARD - Ministry of Agriculture and Rural Development of Vietnam

MoC- Ministry of Construction of Vietnam

MoFA - Ministry of Foreign Affairs of Vietnam

MoF - Ministry of Finance of Vietnam

MoIT - Ministry of Industry and Trade

MoNRE - Ministry of Natural Resources and Environment of Vietnam

MoST - Ministry of Science and Technology

MPI - Ministry of Planning and Infrastructure of Vietnam

NGO - Non-Governmental Organization

OECD - Organisation for Economic Co-operation and Development

R&D – Research and Development

TD – Transdisciplinary

TDR – Transdisciplinary research

UEEE - Used Electric and Electronic Equipment

UPR – Ultimate Producer Responsibility

VEA - Vietnam Environment Administration

WEEE - Wasted Electric and Electronic Equipment

CHAPTER 1 Introduction

"When you get these jobs that you have been so brilliantly trained for, just remember that your real job is that if you are free, you need to free somebody else. If you have some power, then your job is to empower somebody else. This is not just a grab-bag candy game."

— Toni Morrison

Nobel Prize in Literature and professor of humanities

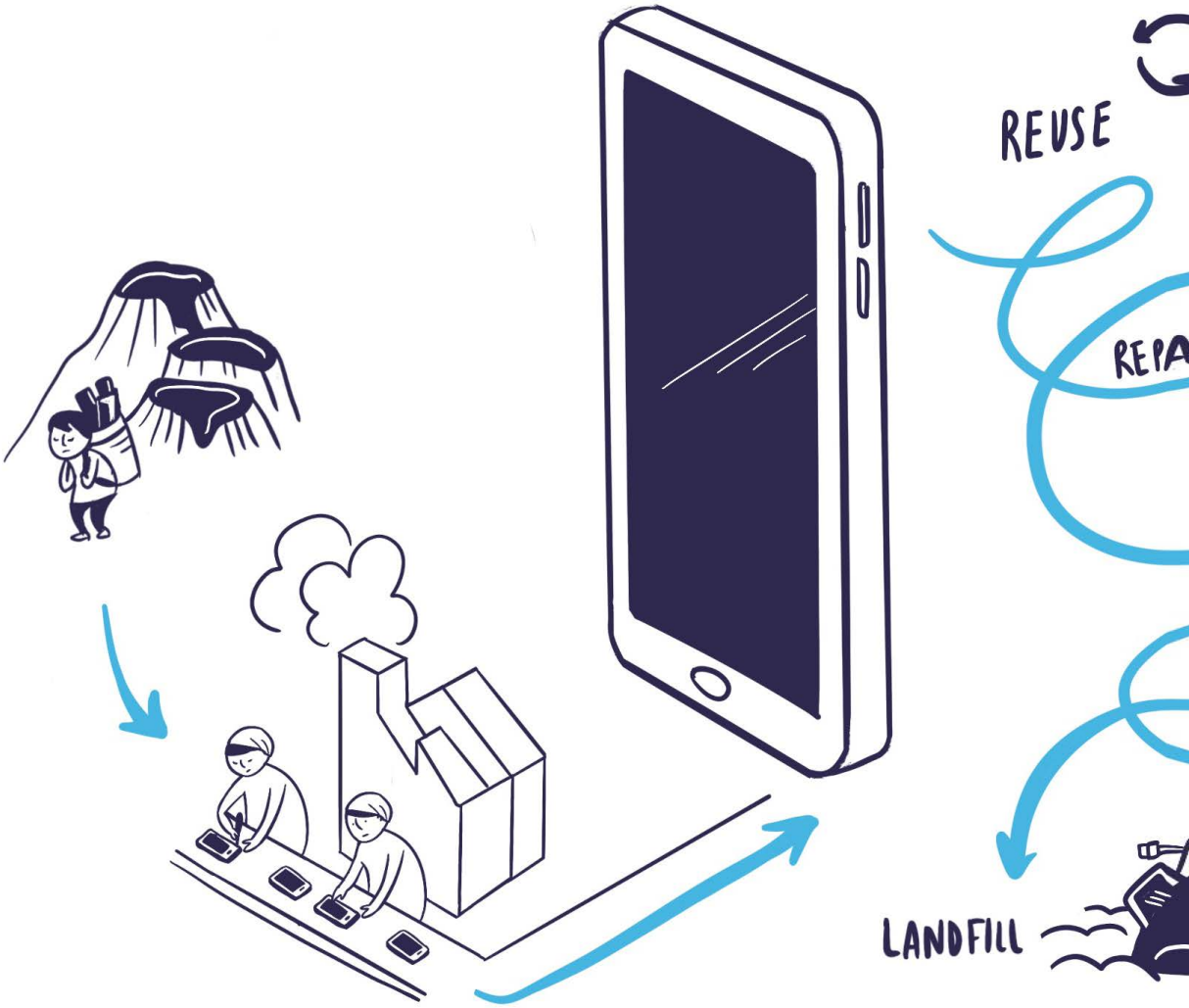


Illustration: Life of a cellphone

You do the right thing. You take time to separate and put plastic waste in a recycling bin; you trade-in or give back your old phone every three to five years. But what happens? Are they recycled? How often and where? Does it go to a state-of-the-art recycling facility? Or could a marginalised waste worker in Vietnam recycle your plastic waste in questionable work conditions? Could your phone end up in a landfill in Nigeria, leaking toxic elements after being reused for a short time and its valuable parts extracted? They are both likely, even if you did the right thing.

And have you thought about what it takes to recycle?

A factory, and some Euros in energy and labour costs? Or is it more? Can recycling and reusing, usually assumed sustainable, make this increasingly unequal world more unequal? If so, whose problem is it? Yours? The producers? Your government's? Everybody's? We are told that the recycling rate is increasing and that the circular economy has many promises for you and the planet. What does it mean in practice? This thesis will unpack some of these questions by following waste and used products shipped from the EU.

1.1 Need for Transition and Circular Economy

The latest Intergovernmental Panel on Climate Change (IPCC, 2022) recognises the interactions between humans, society, ecosystem and climate as the cause of climate change, ecosystem degradation and biodiversity loss. Yet these interconnections also offer hope to overcome such crises. Exploring the context and relationships between society, ecosystem and economics, sustainability research tries to explain increasingly complex challenges and proposes solutions. Building on such interconnected relationships from a system-thinking perspective, Meadows (2008) suggests leverage points to intervene effectively in a system for transformation. This thesis is a scientific exploration to find such leverage points in the global waste value chains to make it more sustainable, fairer and aligned with a just circular economy transition.

Humanity's current challenge is to navigate our common and shared future. In *Limits to Growth*, Meadows (1972) cautioned that unrestricted human activities would have an increasingly negative impact on planet Earth which they predicted to have catastrophic outcomes. Anthropocentric activities limit Earth's carrying capacity to supply its finite resources necessary for humankind and further restrict Earth's ability to function as a sink for the generated pollution. The book proposes human activities constrained to the limits of the Earth's biophysical capacities (Meadows, 1972). Some of these limits to the Earth's carrying capacities are now operationalised under the planetary boundaries. In 2022, out of the nine planetary boundaries considered vital for the flourishing of life in a safe space for humanity, we have crossed six (climate change, biodiversity loss, land-use change, toxic novel entities, freshwater change, and phosphorus and nitrogen cycles) (Persson et al., 2022; Wang-Erlandsson et al., 2022). Such exploitation of Earth's capacities by a few countries has a global impact and endangers human lives, livelihoods and other species (Hickel, 2017). Countries that have hardly contributed to climate change historically or currently are unfairly facing catastrophic effects of climate change (Hickel, 2017; Hickel et al., 2021). For example, the rapidly melting glacial snow in the Himalayas and climate change-induced extreme events in Nepal directly threaten the livelihood of women, children and marginalised people and further 750 million people in the Indian sub-continent region who depend on the water (Wester et al., 2019, Mani., 2021).

Such severe sustainability challenges for humanity are ongoing and even worsening, notwithstanding the introduction of the concept of sustainable development and its implementations. Sustainable development was introduced as a global transition framework focusing on the common challenges faced by humanity (World Commission on Environment and Development, 1987). There are multiple contending visions and criticism of sustainable development, including it being an oxymoronic concept primarily rooted in the problematic neo-liberal agendas of economic growth without any consideration for global environmental justice (Reclift, 2005). Nonetheless, numerous transformative sustainable development pathways are proposed and implemented. Besides sustainable development, diverse transition pathways that include a plurality of values, imaginaries, and aspirations are proposed. Transition pathways include Buen Vivir, Convivialism, Deep Ecology, Eco-Anarchism, Strong Sustainability, Eco-feminism, *Kyōsei*, *Tao* worldview, post-growth, *Ubuntu*, Ecomodernism, Geo-engineering, Neo-Extractivism and Green Growth (Kothari et al., 2019). These views are either in conflict or in harmony, but all promise to improve the world.

One such transformative pathway is the circular economy, whose discourse and policies have been increasingly popular in the EU and beyond (Chatham House, 2020; European Commission, 2015). Like many other transformative pathways, what a circular economy is or ought-to-be remains contentious, depending on the worldviews of the actor (Calisto Friant et al., 2020; Mann, 2018). A plurality of worldviews, values, access to finance, resource, knowledge and context(s) determine what a circular economy is in action and what it can or cannot achieve. However, its popularity globally in academia, governance, consulting, marketing, business models, and strategies remains uncontested. As one of the many testimonies to its popularity and academic uptake is this PhD project, which is part of a bigger Horizon 2020 project (CRESTING) with 15 PhD students who collectively dedicated at least 48 years to exploring various sustainability implications of the circular economy. Our project is not a stand-alone example: cities, countries, organisations, businesses, producers, and academia increasingly incorporate the circular economy in their rhetoric and action. The European Green Deal aims to mobilise €1 trillion in a decade, and the circular economy is a core part of it.

Since 2015, the circular economy has taken centre stage in the EU environmental policy discourse. The EU is historically and presently one of the most prominent regions globally in terms of consumption, production of waste, and contribution to climate change and biodiversity loss (Hickel,

2017; Hickel et al., 2021). This fact reflects systematic unsustainable practices in the EU and a need for transformation. Surveying the EU's policy documents' rhetoric, one quickly notices that circular economy discourse is integral to the EU's transformation narrative (Calisto Friant et al., 2020). With its economically and socially powerful Union with strong institutions, the EU aspires to transform and lead this global circular economy (European Commission, 2015). Yet, the EU ships its waste globally without accountability (European Commission, 2020). The EU embraces the circular economy as a green growth narrative that values strong economic growth while causing the least socio-economic harm within the EU. However, green growth, which hinges on the idea of decoupling economic growth from environmental harm, remains contentious (Parrique et al., 2019; Hickel and Kallis, 2020).

The transboundary movement of waste has been historically associated with exploitation, social and ecological injustices, and lack of value retention of resources (see chapter 2). Such unsustainable transboundary waste movement is not adequately discussed in the circular economy transition discourse. Despite the European Union shipping large volumes of waste beyond its territory, research and policy connecting transboundary waste movement and the circular economy are lacking. This thesis empirically examines the trends of shipping waste and discards from the EU to other countries and the sustainability implications of such practices. It connects the waste exporting trend to the European circular economy policy, focusing on waste governance. The research examines the EU's circular economy rhetoric, policies and actions by integrating multidisciplinary scientific knowledge with societal knowledge. Scientific knowledge includes multidisciplinary perspectives from sustainability science, governance, justice, ethics and epistemology. Societal knowledge consists of the plurality of ideas from the practitioners who are part of the waste value chain. Combining science with society guides us to find leverage points for policy intervention.

The EU views the circular economy as a green growth consumption and production model involving sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible to extend the life cycle of the product and material (European Parliament, 2021). The EU identifies multiple motivations and benefits to transitioning from the traditional take-make-consume-discard economic model to a circular "closing the loop". In the two Circular Economy Action Plans of 2015 and 2020, the EU views this sustainable green growth agenda as reducing waste and

creating value, securing crucial finite raw materials for increasing resource demand and reducing environmental impact from extraction (European Commission, 2020; European Parliament, 2021). The circular economy aims to boost economic growth, create jobs and help consumers within the EU while reducing the usage of raw materials, reducing emissions, and simultaneously leading the circular economy globally (ibid). For this, the EU wants to operationalise circular economy principles that sound similar to the proposals of other existing concepts like industrial ecology, bioeconomy and cradle-to-cradle, by refurbishing the old sustainability ideas into a new and appealing package (Rieke et al., 2018; Calisto-Friant et al., 2020). Scholars trace evolution by identifying three distinct historical phases: circular economy 1.0 as the emergence of waste management and recycling focused on the output side; circular economy 2.0 as eco-efficiency strategies for connecting input and output, and circular economy 3.0 focusing on maximising value retention in the era of socioecological crisis (Reike et al., 2018, see section 4.2.1). This PhD investigates some of the EU's abovementioned circular economy aspirations by researching its policies and practices related to transboundary waste.

To overcome socio-ecological crises, the EU states: "the EU needs to accelerate the transition towards a regenerative growth model that gives back to the planet more than it takes, advance towards keeping its resource consumption within planetary boundaries and therefore strive to reduce its consumption footprint and double its circular material use rate in the coming decade" (European Commission, 2020). The second Action Plan proposes circular economy as a "sustainable product policy framework" to guide key product value chains like electronics and ICT, batteries and vehicles, packaging, plastics, textiles, construction and building, and food, water and nutrients (European Commission, 2020). The EU assumes that being circular is sustainable in its narratives; however, such a co-relationship has not been established yet. The social, moral and ethical dimensions of sustainability are often left out of circular economy proposals and solutions (Schröder et al., 2020; Lemille, 2020; Gregson et al., 2015). Research also points out rebound effects, whereby circular economy practices can have unintended and harmful consequences (Zink and Geyer, 2017; Makov and Font Vivanco, 2018; Castro et al., 2022). In investigating the sustainability implications of the circular economy, this thesis also focuses on the often left-out social and ethical dimensions and intended and unintended global consequences of the European circular economy.

1.2 European waste shipment, waste governance and circular economy

The emphasis on waste in the EU's circular economy vision is represented in the policy mantra "less waste, more value", repeated in many policy documents. The circular economy advocates slowing, narrowing, and closing material and energy loops to shift from a linear to a more regenerative model (Geissdoerfer et al., 2017; Reike et al., 2018). To do so, various value retention options, or should we say 'loops' like refuse, reuse, resell, repair, refurbish, remanufacture, recycle, energy recovery, and remine, are suggested (Reike et al., 2018). These retention options aim to close the loop by retaining the value and functionality of a product as much as possible to prevent waste generation and use waste as resources when generated. Little attention is paid to closing the loop where waste or discards are shipped outside the EU. Lacking the international dimension obstructs the circular economy transition.

Contrary to the ambition of decoupling economic growth from resource use, increasing consumption continues to generate an increasing amount of waste in the EU (European Environmental Agency, 2021). Without the sufficient capacity to deal with the growing waste, the EU legally ships waste and discards outside the EU to 'reuse' and 'recycle' – shipping 33 million tons of waste to the non-EU country in 2020 (European Parliament, 2022). Despite pioneering in the field of waste governance by making waste producers responsible for its proper management in the EU using the policy instrument of the extended producer responsibility (EPR) since the 1990s, such responsibilities are limited within national jurisdiction. No accountability mechanism exists for the sound management of European waste shipped outside the EU. The EU acknowledges that such waste shipment was without proper accountability and caused harm in destination countries (European Commission, 2020), which is also observed by many scientists in the transboundary waste movement literature (see Chapter 2). The EU has recently revised various policies and directives, including waste shipment. These policy revisions are in line with recent changes in the international waste governance law of the Basel Convention and reflect some aspirations toward a circular economy transition. However, an explicit focus on reducing harm and adding circularity and sustainability to waste shipped outside the EU remains lacking in the circular economy action plans and practice and seems necessary to safeguard the transition.

The economic opportunities associated with trading waste and discards attract multiple actors in the value chain engaging in collecting, sorting, transporting, and treating waste. About 15-30% of such waste trade from the EU is illegal, costing the Union € 9.5 billion (European Parliament, 2022). The legal trade is also not transparent - the value chain, the waste's fate and sustainability remain obscure. Detailed trade data are either not publicly or easily accessible, and available data are limited to weight and economic value. They do not have information about sustainability and circularity. The current waste governance and data capture systems need urgent systemic intervention to make the international waste trade accountable, just and circular.

The economic, social, political, cultural and technological contexts of countries determine the capacity for sound waste management of waste and its circularity. Historically, the transboundary movement of waste to destinations which cannot manage waste is associated with social and ecological injustices. Seven years after the first EU Circular Economy Action Plan, very little attention has been paid to the EU waste shipment and its circularity (European Commission, nd). Waste out of sight of the EU seems out of the mind of the EU. Such challenges of transboundary waste shipment have been discussed in academia since the mid-1980s (see chapter 2) and frequently surface in the newspapers and Non-Governmental Organization (NGO) reports.

The NGO Basel Action Network (BAN) has advocated for justice in the transboundary movement since the 1990s. BAN continues highlighting equity and sustainability oversight in the European circular economy narrative and waste shipment (BAN, 2018). Similarly, other NGOs report shows the environmental and human harm associated with transboundary movement (CETIM, 2009; Greenpeace, 2022; Plastic Soup Foundation, 2022). Leading newspapers regularly raise the global sustainability problems of transboundary waste (The Guardian 2013; BBC 2018, 2019, 2022; New York Times 2018, 2019). According to a recent report, the EU is the world's largest exporter of plastic waste, and the Netherlands is the biggest exporter in the EU to non-western countries (Plastic Soup Foundation, 2022). Irresponsible plastic waste export and dumping are growing despite stronger international, European and Dutch regulations and circular economy action plans (Plastic Soup Foundation, 2022). Even though Indonesia lacks the capacity to recycle all plastic waste, the Netherlands's biggest plastic exports are to its former colony. The report suggests that the Dutch exploitation of Indonesia continues through this "neocolonial plastic scandal" (Plastic Soup Foundation, 2022). The Guardian called the UK the worst offender in shipping its e-waste to other countries, including its former African colonies (Guardian, 2019).

The EU engages in the trade of various categories of waste and discards for recycling or reuse. For example, to give a second life to used electric and electronic equipment (UEEE) discarded in the EU, they are traded mainly to West Africa. As labour-intensive waste management is expensive in the EU, the cheaper destination is identified as an important reason, often to places whose economic, legal, cultural and political contexts allow cost-minimisation (Bisschop and Huisman, 2018; van Wingerde and Bisschop, 2019). This waste trade often lacks transparency and accountability and thus opens economic opportunities for legal and illegal actors. Some actors in the waste value chain exploit structural inequalities to externalise waste-related harm, primarily in countries that depend on foreign investments for economic growth (Bisschop and Huisman, 2018; Wingerde and Bisschop, 2019). Both legal and illegal unequal exchange exploiting economic, social, political and technological asymmetries is responsible for furthering inequalities, uneven development and continuing ecological breakdown (Hickel et al., 2022; Hornborg and Martinez-Alier, 2016). Without an explicit focus on fixing these socio-ecological injustices in the waste trade, a just circular economy transition is impossible.

Research on more sustainable and ethical governance of transboundary waste, which this research undertakes, offers multiple benefits. Social and environmental harms associated with transboundary waste shipment can be minimised. Ethical governance reduces unethical and exploitative relationships in the value chain and contributes to justice and equity. As waste is resource in the circular economy, there will be more opportunities to maintain, retain and add value to the shipped waste. Just and circular waste governance ensures waste shipment destinations have the resources, infrastructure and knowledge to transform waste into a resource. Instead of exploitation, just and circular waste governance boosts the local economy and empowers workers in the waste value chain. Holistic policy intervention and enforcement can also address the increasing concern of waste trafficking. Better governance addressing critical challenges in the global waste trade value chain creates circularity, justice, equity and sustainability.

1.3 Research context, approach and outcomes

In this thesis, I investigate diverse and uncertain contexts of the transboundary waste and discard movement from the EU: different waste streams, various geographies of waste flow, obscure, complicated value chain, actors and their interactions, and pervasive lack of data. I intentionally frame a broad guiding research question to adapt to this complex and uncertain research context. Transdisciplinary research is a research approach suitable to investigate wicked problems like transboundary waste, characterised as "complex problems that lack definition, have multiple value judgements, lack solutions and resist all attempts to resolve them" (Brown et al., 2010, p. 4; see chapter 3 for research methodology). I aim to create solution-oriented contextual knowledge to find leverage points in the existing environmental governance of waste. For this, it was necessary to integrate a plurality of academic and societal understanding of the problems, challenges and opportunities for a systemic and synthesised 'bigger picture' understanding. To navigate uncertainty, I design research agile enough to adapt to changes and the needs of the local contexts without compromising scientific rigour. This broadness, openness and flexibility, in hindsight, served well. For instance, with little success in connecting with stakeholders after two months of fieldwork in China, the research focus was shifted to Southeast Asia. After the Chinese plastic waste import ban, the previously imported Chinese waste was diverted globally, including to Southeast Asia. Due to the uncertainties during the COVID-19 pandemic, most planned fieldwork was scrapped, and online research was adapted as needed.

This PhD dissertation makes three contributions by integrating policies, empirical evidence, academic literature on waste governance, circular economy, transboundary waste movement, just transition, and ecocentric ethics with societal knowledge. First, with the help of in-depth case studies in the Netherlands, Nigeria and Vietnam, it contextualises what is happening with European discards or waste sent to be reused or recycled. For example, both reuse and recycle are popular value retention options in the circular economy discourse, but the contextual understanding from the research demonstrates their lack of sustainability. Second, the research explores and shows the importance of the social dimension in the circular economy transition and waste governance. The research finds a need to

carefully and urgently connect spatial justice and equity, especially when trading waste and discards with countries that might not have similar waste management capacities as Europe. The research investigates policy interventions to include mutually beneficial relationships and fair governance and replace the exploitative neo-colonial relationship of shifting waste management responsibility or burden to the marginalised people of low-income countries. Lastly, the research explores the transdisciplinary methodology to navigate complex and uncertain sustainability challenges. It generates inclusive and relevant societal and scientific knowledge (discussed in Chapters 3 and 5) to enable implementable context-relevant interventions for sustainability challenges.

The main guiding question and the supporting sub-questions for the research are as follows:

What is the sustainability and circularity implication of Europe's current practice of shipping waste and discards to countries without existing sufficient waste management infrastructure?

1. What are the trends and practices of transboundary waste and discards shipment from the EU to low-income countries for recycling or reuse?
2. Who and what enables and drives these trends?
3. Which current policies govern these practices, and are these policies effective?
4. What policy interventions can make waste governance more sustainable and circular?

The research is situated in several European, African and Asian contexts (see Figure 1.1), which guide and shape the research process. The PhD project was part of CRESTING in the EU, where 15 PhDs worked at eight different universities, closely coordinating with 13 public and private organisations to explore sustainability implications of circular economy in policy making and governance, public and corporate sectors. Bi-yearly workshops, collaboration and other interacting opportunities between project teams ensured the cross-pollination of emerging knowledge in an important research context. At Utrecht University, the Circular Economy and Society Hub facilitated multidisciplinary interaction and collaboration opportunities for insights and policies towards circularity and sustainability. The researcher was embedded in the Nigerian context and engaged in organising the annual African Circular Economy Research and Policy Network in close collaboration with the University of Ibadan. In Vietnam, there was a close collaboration with the Institute for Circular Economy Development at the National University of Ho Chi Minh City.

A transdisciplinary research approach guided this research on the complex and non-transparent

waste value chain to co-create solution-oriented understanding. Chapter 3 explains the relevance of transdisciplinary knowledge in sustainability science from an early-stage researcher perspective. Chapter 5 focuses on the process of doing transdisciplinary research to make academic knowledge socially relevant and legitimate and co-creating policy intervention in depth. Apart from the broader transdisciplinary literature discussed in chapters 3 and 5, Hirsch-Hadron's (2008, p. 19) understanding and aims of transdisciplinary research fit the research context well and guide the research, its academic and non-academic outputs:

a. grasp the relevant complexity of a problem
b. take into account the diversity of the life-world and scientific perceptions of problems,
c. link abstract and case-specific knowledge,
d. develop knowledge and practices that promote what is perceived to be the common good.

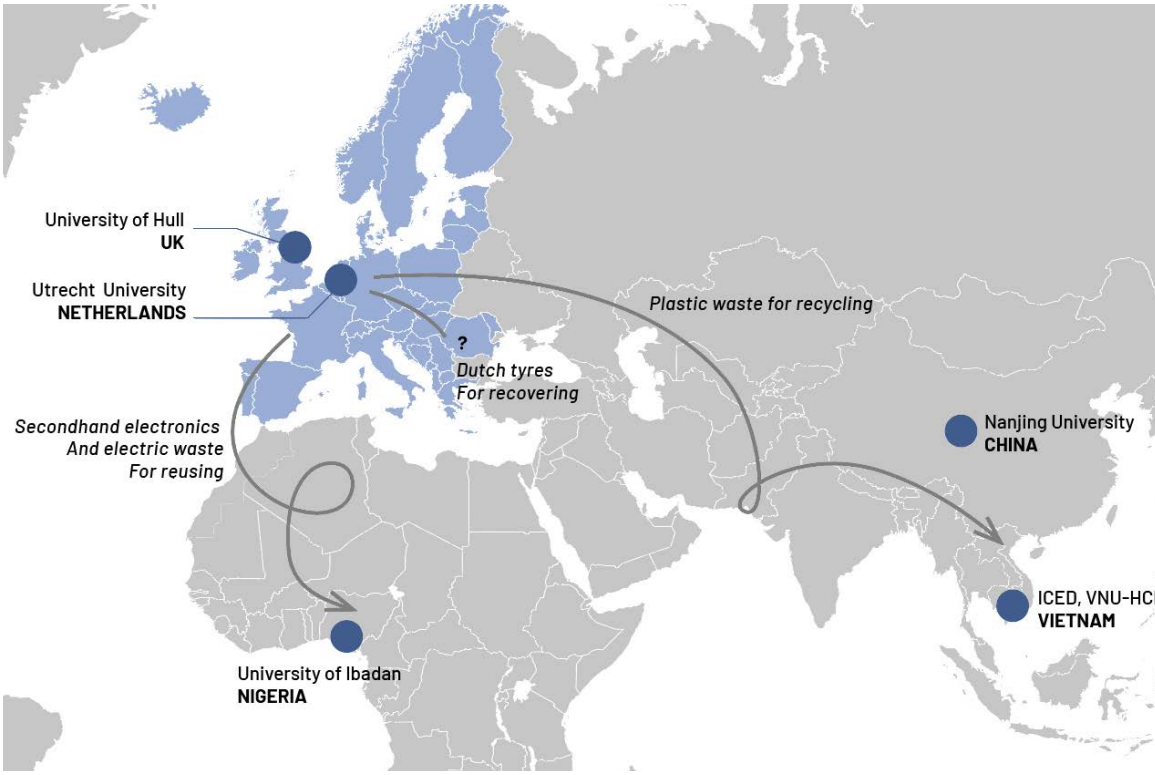


Figure 1.1 Research collaboration institutions marked with dots and waste stream flow

The social impact was deliberately designed in the research process during the PhD. Research outreach included include co-creating a science-based petition with a policy blueprint, popular science writing on various online and print platforms, creating research videos, writing press releases, following up and communicating with stakeholders during and after the research, engaging in podcasts, workshops, presentations in academic and non-academic settings and other engagements with stakeholders. Such active public engagement for research outreach in sustainability science is essential if one wants to promote the perceived common good from the research.

The thesis is divided into seven chapters, which include four published articles and one submitted for publication. The thesis primarily uses qualitative methods (complemented by a quantitative approach) for a contextualised and nuanced understanding. Detailed methods and the research process are discussed in individual articles, and the overall research approach is described in chapter 3. The PhD process was based on the case studies of the European Union and four countries: China, Nigeria, Vietnam and the Netherlands. Until 2018, China used to be the biggest plastic waste and e-waste importer, and Nigeria and Vietnam continue to receive significant European waste and discard. A case study of Dutch EPR gave insights into European EPR and its sustainability and circularity. All case studies include in-person fieldwork ranging from one to two months. We discuss three waste streams: car tyres in the Netherlands, plastic waste exported from the EU for recycling in Vietnam and used electric and electronic devices shipped from the EU to be reused in Nigeria. Relevant waste governance and circular economy policies and data were analysed, and stakeholders in the value chain were identified, interviewed and invited to workshops (if applicable). The case studies in Europe, Africa and Asia enabled the creation of relevant contextual solution-oriented knowledge. They highlighted the importance of shared principles like being inclusive, fair, transparent and just in waste governance for sustainability and circularity.

Just as transdisciplinary research integrates academic disciplines with societal knowledge, the various chapters reinforce and integrate each other to either fill a literature gap, provide contextual understanding or recommend interventions for a just and sustainable circular economy transition. Figure 1.2 shows the interconnected thesis chapters and how they integrate and resonate with theory and practice. Some chapters are theory focused but relevant to practice, while others are practice-oriented but rooted in theory. The chapters are briefly outlined below.

While recent literature reviews on circular economy (Geissdoerfer et al., 2017; Kirchherr et al., 2017; Meril et al., 2018; Sassanelli et al., 2019) and reverse logistics (Pokharel and Mutha, 2009; Agrawal et al., 2015) were available to guide our research, there were no current and relevant literature reviews on the transboundary movement of waste. Chapter 2 presents a literature review of the transboundary movement of waste that contributes to this scientific field of study and guides the rest of the research. This chapter presents findings from the last 35 years of literature around trends, geographical representation of created knowledge, problems of transparency and data availability, and policy gaps. Most previous knowledge was created in the context of the 'linear economy' focused on sound waste management. This research questioned some of the assumptions behind recurring themes and their limitations and validity in the present context. Now waste is increasingly seen as a resource and not necessarily as only harm to be dealt with. We found strong and opposing 'transboundary waste binaries', based on the assumption and understanding of waste with both usefulness and limitations. We argue for a nuanced and contextual understanding of the challenges of transboundary waste movement in the present context, where waste is increasingly seen more as a resource. This finding provides theoretical guidance for the rest of the research and the sub-RQs 1,2,3, and 4.

Chapter 3 addresses another literature gap by focusing on the challenges of doing transdisciplinary research from an early-stage researcher's perspective. While the transdisciplinary literature is diverse and rich, there was limited literature to guide early-stage researchers doing transdisciplinary research. This chapter shares early-stage researchers' experiences and reflections based on three transdisciplinary PhD research in sustainability sciences. It highlights six broad, transdisciplinary challenges and ways to navigate them. Integrating societal and scientific knowledge to co-create knowledge in sustainability sciences, chapter 3 guides chapter 5 and methodologically orients to answer sub-RQs 2 and 4.

Chapter 4 takes a critical look at the existing policy and practice to take stock of what works and what could be improved to add more circularity and sustainability in Dutch car tyre waste governance. Even though car tyres' collection and recycling rate portray a success story in the circular economy 2.0, we revisit it from an inclusive circular economy perspective. In-depth knowledge of how the current extended producer responsibility functions, its usefulness and limitations generated in this chapter shapes the rest of the PhD research. This research provided us with three key insights: i) how EPR waste governance functions in the EU, ii) the lack of transparency and data in the waste value chain once the

waste leaves the jurisdiction of the EPR either for recycling or to be reused and iii) lack of inclusion of circular economy actors in the current EPR structure primarily focused on recycling by downcycling is not necessarily sustainable. These insights became crucial for policy recommendations in Dutch tyre EPR and when researching the sustainability and circularity of exported EU waste streams and discards to Nigeria (chapter 5) and Vietnam (chapter 7). This knowledge integration help guide the theoretical framework and policy intervention for just and addressed sub-RQs 1, 2, 3 and 4.

About half of the collected plastic waste in Europe is exported outside for recycling. Chapter 5 explores the circularity and sustainability of plastic waste shipped to Vietnam for recycling. The waste value chain and its actors are obscure and function without accountability. In the case study of Minh Khai village, where the informal sector recycles imported plastic waste, unsustainable practices harm the individuals, society and the environment and only retain the lowest material value possible. While the EU pursues a higher plastic recycling rate, there is a lack of ethical and systemic consideration in waste trade and governance. The chapter highlights the need for fairness, ethics and transparency in the plastic waste trade for a just circular economy transition. Based on the findings, it proposes a framework for waste shipment for a just circular economy transition. This chapter addresses the sub-RQs 1, 2, 3 and 4.

Using a transdisciplinary methodology, chapter 6 expands on the insights of European waste governance and explores what happens to the exported electronic and electric equipment from the EU to Nigeria for reuse. Working closely with various stakeholders in Nigeria, the research integrates scientific and societal knowledge to understand the problems and challenges. Trade for reuse between asymmetrical social, economic, and political contexts without fair and transparent governance limits circularity. The responsibility of European e-waste management is transferred to the informal sector, which operates without proper infrastructure and knowledge, to process toxic and valuable e-waste. This unjust practice harms workers' health and their environment. A policy intervention, the ultimate producer responsibility, which extends the original producers' obligation to safely process their e-waste globally, is co-created in the research. This intervention acknowledges a lack of justice in the current transboundary waste governance and calls for a just circular economy transition. This chapter theoretically and empirically answers the sRQs 1, 2, 3 and 4. Some of the outreach from this chapter's output includes a policy blueprint (Thapa et al., 2022e), a petition (Thapa et al., 2021), a YouTube video (Faculty of Geosciences Utrecht University, 2021), press releases (Copernicus Institute of Sustainable Development at Utrecht University, 2022; Faculty of Geosciences Utrecht University, 2022), many engagements in social media and collaboration with organisations ranging from news media, NGOs and INGOs.

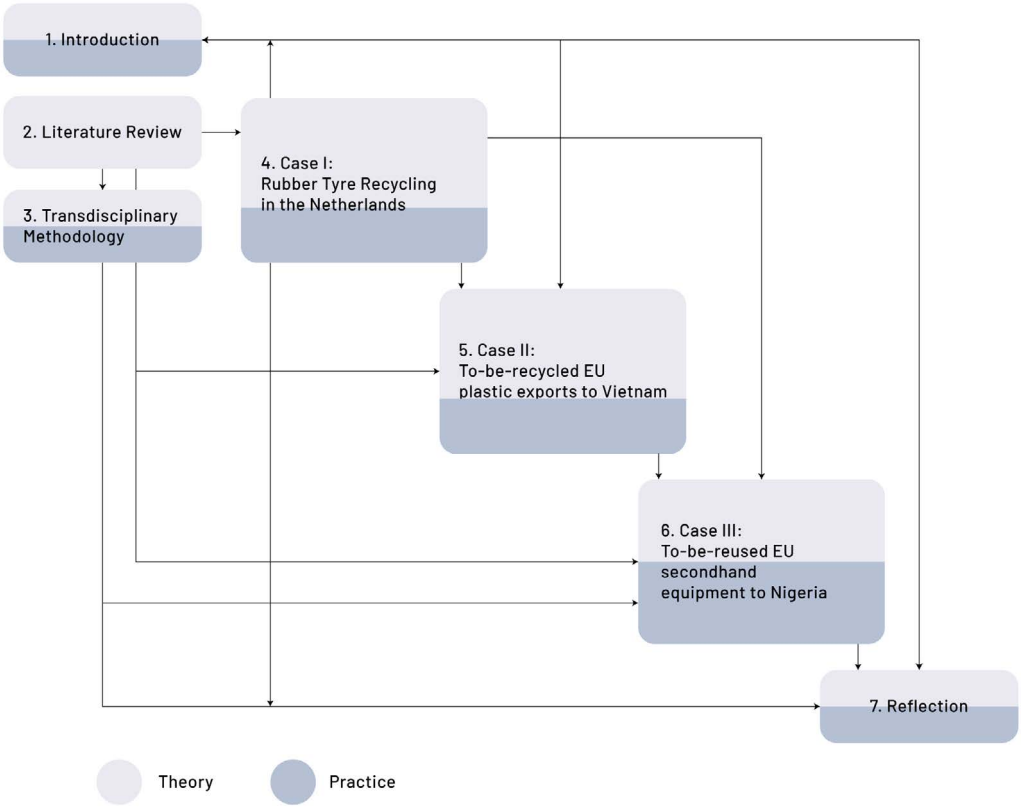


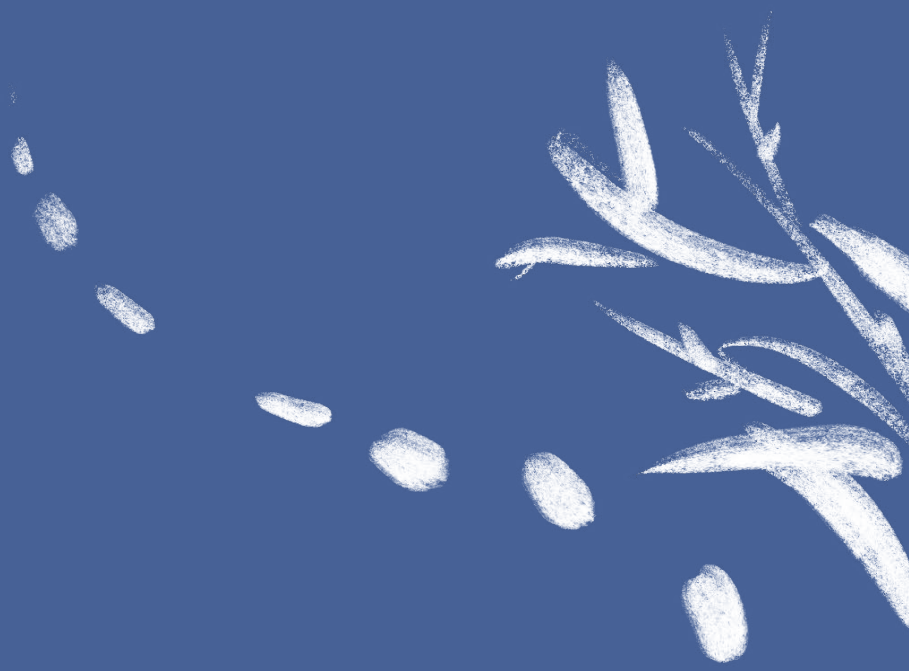
Figure 1.2 The interconnectedness of the thesis chapters and theory and practice allowed co-evolution and knowledge integration in this thesis.

Chapter 7 concludes with reflections on the research topic and the methodologies. First, it discusses waste governance as a wicked sustainability challenge and the role of transdisciplinary research in creating problem-solving knowledge. Second, it reflects on the vital need for just and ethical considerations in waste governance for sustainability and circularity. Thirdly, it reflects on designing critical policy interventions with examples of a just circular economy transition from the thesis. And lastly, it proposes topics for future research.

The PhD thesis uses an inclusive research methodology which enables an exploration of a plurality of epistemologies, understandings, and solutions. By integrating science with society, the thesis challenges the exploitative transboundary trade of waste, which limits circularity. The research aims to generate beneficial knowledge for advancing the European circular economy transition by incorporating justice and ethics in transboundary waste governance and circularity.

CHAPTER 2

Transboundary movement of waste review: From binary towards a contextual framing



"I am not against consumption.
I am against waste."

— Jose 'Pepe' Mujica

Former president of Uruguay (translated to English)

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Abstract

Multiple cases of toxic waste dumping from the Organisation for Economic Co-operation and Development (OECD) countries to non-OECD countries in the 1980s led to scholarly attention to transboundary waste movements. The Basel Convention was established to provide an international legal framework to tackle such problems in the early 1990s, focusing on hazardous waste. However, the transboundary movement of all waste, not just hazardous waste, remains a societal challenge globally, frequently surfacing as an ethical question on the one hand and a story of resource management/trade on the other. This phenomenon has been studied across disciplines resulting in diverse, scattered and often contested understandings. Despite previous and ongoing efforts, waste production, management and transboundary movements are increasing and are predicted to grow significantly with global social, environmental and economic implications. This literature review uses a research synthesis and problematisation approach to critically analyse the transboundary waste literature since 1985. The findings highlight research trends, the need for data reliability and policy coherence, and the sustainability implications of the phenomenon. One recurring theme in the literature is the reduction of the complex phenomenon involving multiple countries, policies, actors and waste streams into simple opposite narratives, which we call transboundary waste binaries. We have identified and then challenged assumptions behind transboundary waste binaries and discussed the implications of such assumptions on the broader discourse. We have concluded with future research recommendations to look past the transboundary waste binaries towards a nuanced and contextual understanding of transboundary waste flows.

2.1 Introduction

Like commodities, waste is imported and exported from one country to another (Cotta, 2020; Kellenberg, 2012; Lipman, 2015). This practice has social, environmental and economic implications and is a sustainability challenge at a global level (Cotta, 2020; Yang, 2020). The transboundary movement of waste consists of various waste streams governed by a patchwork of national, regional and international laws. United Nations Environment Programme (UNEP) estimates that 11.2 billion tonnes of solid waste is collected globally every year and estimates the global waste market sector, from collection to recycling, to be worth US$ 410 billion (UNEP, 2012, 2020). This estimate excludes the value added by the informal sector, which accounts for 80% of waste recycling in low-income countries (Rucevska et al., 2015). There is currently no reliable estimate for the amount of all waste categories that cross international boundaries for disposal. Notably, countries that lack the capacity for sound management of their own waste are included among the destinations of transboundary waste exports. More than half of the global population depends on active dumpsites for disposal, predominantly in low-income countries, posing health and environmental risk (UNEP, 2015). Waste generation and disposal contribute 5% of global greenhouse emissions, and sound waste management links to 12 of the 17 Sustainable Development Goals (UNEP, 2015).

Everyday human actions create various waste streams, some of which move internationally. Understanding the transboundary waste movement involves first understanding waste as a concept with varied socio-cultural, political and economic interpretations. Douglas (1966) argued that interpretations of waste are based on the cultural context of social classifications and their relationships, coining the phrase: 'dirt is matter out of place'. Reno attributed waste as 'a mirror of human culture' and as the 'signs of life' (Reno, 2014). Waste perceptions encompass deep cultural norms shaped by products, materials and contexts and waste is often stigmatised in many societies (van Ewijk et al., 2018). Waste 'out of sight' is often 'out of mind' and usually is desirable elsewhere but 'not-in-my-backyard'. UNEP remains vague about defining waste in their Global Waste Management Outlook report, acknowledging various usages of the word and views waste as 'the combination of four wrongs - a wrong substance, in a wrong quality, in a wrong place at a wrong time' and later refers to the colloquial understanding as 'stuff people throw away' (UNEP, 2015).

Like UNEP's, the waste definition from the Basel Convention on the Control of Transboundary Movement of Hazardous Waste and its Disposal leaves ample room for interpretation, thereby creating confusion. It defines waste as 'substances or objects which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law' (The Basel Convention, 1992). Despite, or because waste is essentially something that someone does not want, a legal definition is required to identify substances that need to be handled in specific ways to prevent harm to health or the environment. Sound waste management imposes costs, creating an incentive to seek an illegal solution, and the legal definition retains the contingent nature of the informal definitions. Discarded tyres for safety standards in one place might become secondhand tyres elsewhere with less stringent laws and then disposed of without guaranteeing sustainability (Campbell-Johnston et al., 2020). Like other waste, discarded tyres can either be recycled using sophisticated technology, incinerated, dumped or landfilled (locally or internationally), or used as secondary resources depending on the local socio-economic and environmental context. The potential for diverse interpretations of waste (even in cases with established legal definitions) is magnified more when waste moves from one national jurisdiction to another. Waste in one place can even be secondhand goods in others (such as dis- carded clothes or even a battleship) or raw material (such as plastic, paper and vehicle waste). Given the subjectivity of what is worth or safe to reuse and the capacity for reuse as raw material, there is a blurred line between trade in secondhand goods and a trade explicitly in waste. The same substance can be different things to different people and change its legal status in transit based on our assumptions of waste. This ambiguity of the waste definitions leading to multiple interpretations of waste has policy implications, influencing its sustainability implications (see section 'Policy gaps').

Among various socio-economic and political factors, the differences in disposal or recycling costs between places can drive the transboundary movement of waste with or without any regard for its sustainable management. A substance or item can become waste (which needs to be disposed of), end-of-life (which requires either to be disposed of or to be brought back to life) or resource (which is valorised) depending on its context. The processes applied (e.g. disposal or valorisation) are knowledge and technology-dependent, which depend on socio-cultural, political and economic realities. Moreover, something potentially hazardous can be treated without harm given appropriate technology and regulatory control, whereas it can cause harm elsewhere in the absence of one or the other. The identification of waste, then, is open to different interpretations in varied social, economic, political

and cultural contexts. These diverse contexts and interpretations become even more pronounced when factoring in various actors and their worldviews engaged in the transboundary waste movement. Academic scholarship in the transboundary movement of waste started in the 1980s following some notorious cases of hazardous or toxic waste dumps by the Organisation for Economic Co-operation and Development (OECD) countries to the non-OECD countries (Clapp, 2001). The Basel Convention entered into force in 1992 and is the foremost multilateral agreement governing transboundary hazardous waste. The three aims and provisions of the Basel Convention, when it entered into force in 1992, were: 'the reduction of hazardous waste generation and the promotion of environmentally sound management of hazardous wastes, wherever the place of disposal'; 'the restriction of transboundary movements of hazardous wastes except where it is perceived to be in accordance with the principles of environmentally sound management' and 'a regulatory system applying to cases where transboundary movements are permissible'. (The Basel Convention, 2011). Since the Basel Convention entered into force, volumes of hazardous waste generation have increased significantly and are predicted to increase further (The World Counts, 2021). Its transboundary movement remains an ongoing challenge (The Basel Convention, 2011). Overcoming the challenges is also technology and capital-intensive (Yang, 2020). It is worth noting that the Basel Convention only covers the transboundary movement of hazardous waste, which comprises a significant and important fraction of all waste. Non-hazardous wastes, such as textiles and paper, are openly traded globally as commodities following the World Trade Organization (WTO) rules (Grosz, 2016). Sound management of all forms of waste, hazardous or non-hazardous, and its transboundary remains a societal challenge. Even with several policy gaps (see section 'Policy gaps'), the Basel framework is the key international regulatory tool critiqued and debated in the literature.

This article reviews and critically analyses the existing transboundary movement of waste (both hazardous and non-hazardous waste) literature from 1985 to 2021. While some literature reviews on specific waste streams consider transboundary waste flows (see Fazzo et al., 2017; Maphosa et al., 2020; Pérez-Belis et al., 2014), a recent review dedicated to transboundary waste movements is lacking. We present an integrated review of the topic spanning the last 35 years and then identify the most prevalent assumptions in the literature. We use the 'problematisation approach' (Alvesson and Sandberg, 2011) to challenge some existing discourses and their implications. To problematise, we asked ourselves: what are the core assumptions in the discourse? Can we challenge these core

assumptions to create helpful problem-solving knowledge moving forward? This integration and problematisation of existing knowledge in this review can help future researchers frame their research to generate more contextual problem-solving knowledge, which might then translate to problem-solving policymaking and actions. This article first discusses literature review methods. We present findings showing scholarship trends, map geographical areas of academic publications, highlight data scarcity and policy gaps and establish linkages of transboundary waste movement to sustainability. In the section 'Analysis and discussion: Transboundary waste binaries', we focus on the concept of waste as both a resource and discard and examine the existing binary-dominated understanding (e.g. waste/not waste; legal/illegal). We explain these transboundary waste binaries, challenge some of their built-in assumptions and show their limitations. We then discuss recent work examining transboundary waste movements that consider the political, cultural, social and economic context and challenge these transboundary waste binaries. We highlight a need for a more contextual understanding of the transboundary movement of waste moving forward. Based on the findings and discussion, we conclude with five future research suggestions.

2.2 Methods

This section presents the frameworks used in this literature review, the literature review process and the limitations of the study.

2.2.1 Review methods

In this research, we used a combination of two frameworks. For the literature review, we used the framework developed by Cooper (2016) for research synthesis. The framework enables us to look at multiple studies on the same topic and draw conclusions about the research findings. Research synthesis includes the following steps: formulating the problem, searching the literature, gathering information from studies, analysing, integrating the outcome of the studies, interpreting the evidence and presenting the result (Cooper, 2016). We integrated previous works, sometimes by comparing and contrasting, and other times by connecting the literature. After this, we used the 'problematisation approach' of Alvesson and Sandberg (2011) for a critical analysis of the findings. This approach focuses particularly on spotting assumptions. The problematisation approach thus enables us to re-evaluate existing understandings and reimagine our ways of thinking about them. In the past, the primary focus of waste management was limited to collection and recycling. Now, there is a need to reduce and valorise waste – even before thinking of recycling. This view shift, drawing on the principles of the circular economy (Stahel, 2019), calls for re-examining ideas that shaped policies and practices, which had real-world implications. We utilised the problematisation method to spot assumptions reflexively, question them and explore the possibility of thinking differently. We analysed a set of similar assumptions in the literature, which we call transboundary waste binaries.

Given the diverse and context-dependent interpretations of waste and its transboundary movement, these two methods enable a new and integrated contextual understanding. Research synthesis primarily guides the result section (see section 'Results'), and the problematisation approach guides the analysis (and discussion) section (see section 'Analysis and discussion: Transboundary waste binaries').

2.2.2 Literature review process

The literature review process includes three phases: searching, filtering and data collecting. The first phase of the research involved searching academic literature for keywords and their combination in the Scopus database for papers published between January 1985 and January 2021. These keywords include 'waste', 'export', 'international', 'flow', 'movement', 'trade', 'transboundary', 'waste', and 'hazard', which were then refined by the phrases: 'waste flow', 'waste trade', 'waste movement', 'international waste', 'transboundary waste', 'global waste', 'transboundary movement', 'waste export' and 'transboundary waste movement'. These terms, phrases, and their combinations (inclusion criteria) were searched using the Boolean operators 'and', 'or' and 'and not' in 10 different searches that provided articles relevant to the transboundary waste movement. This process resulted in 1907 relevant articles, which were saved with their abstracts.

The second phase of screening and filtering followed the three-step process illustrated in Figure 2.1. Firstly, the title of the journal articles or book chapters from the 1907 articles were screened using keywords. Where the titles provided insufficient information, their abstracts were analysed. This filtering process resulted in narrowing it down to 695 articles. The next step was to analyse the abstracts of the articles and book chapters, applying excluding criteria. As the transboundary movement of solid waste is the subject of this research, the transboundary waste movement of air or water pollution was excluded. Publications that did not focus on the transboundary movement of waste as the primary subject were also excluded. For instance, if a paper focused on improving techniques for ship recycling and mentioned transboundary movements of end-of-life ships only briefly, the paper was discarded. In some cases, where the information in the abstract was not sufficient, the paper was scanned with attention to the above-identified keywords, and irrelevant articles were excluded. The process narrowed down the sample size to 218 articles. For this review, we analysed 218 full texts on the transboundary movement of waste between January 1985 and January 2021.

As most of the resulting articles focus on the transboundary movement of waste from OECD countries to non-OECD countries, this category of transboundary movement is the subject of this research. The academic focus on OECD and non-OECD countries most likely reflect the formulation of the Basel Convention itself. At the same time, other literature works with the Global North and South

terminology. There are important flows of transboundary waste within the countries in the Global North (see Bisschop, 2012; Obradović et al., 2014; O'Neill, 1997; Thomas and Fannin, 2011), within Global South (see Lepawsky, 2015a; Shinkuma and Huong, 2009) or from the countries in Global South to Global North, which is only discussed briefly in the literature and need more attention. The problems brought about by hazardous waste movement between economically and geographically distinct categories of countries, as tackled by the Basel Convention, remain.

2.2.3 Limitations

Before presenting the findings, it is important to discuss the limitations of the research. Firstly, as established in the introduction, understanding of waste is shaped by a socio-cultural vantage point, which inherently leads to biases of the researchers. Analysing the articles for the discussion section involved selecting issues to problematise, reflecting the authors' socio-cultural vantage point. For instance, the social scientist using a colonial lens might problematise the lack of decolonising discourse and note specific relevant elements. Precautions were taken to incorporate different points of view across academic disciplines by authors from three institutions with diverse academic backgrounds working in sustainability research. Secondly, only Scopus, a widely used database among social and natural scientists, was selected; incorporating other similar databases might have increased the number of articles analysed. Based on other similar literature reviews, 218 articles are deemed sufficient to capture the variety of discussions on the transboundary movement of waste. Non-academic sources, such as reports, whitepapers, documentaries and news articles, are not included as our purpose is to review academic perspectives. However, 36 years of academic publications include various relevant vantage points of understanding, including waste exporting/importing countries, the policy community, NGO, activist community, etc. Thirdly, the search keywords resulted in articles framed in the context of or relevant to transboundary waste movements. However, it could exclude broader waste literature (prevention, reduction, recycling, etc.) but is not explicitly linked to the transboundary movement. Lastly, only English language scientific publications were chosen, the majority of which are from institutions in OECD countries. Although the authors of those papers might be based in or originating from non-OECD countries, the resulting literature on transboundary waste might not reflect a globally diverse socio-cultural framing or a plurality of understanding.

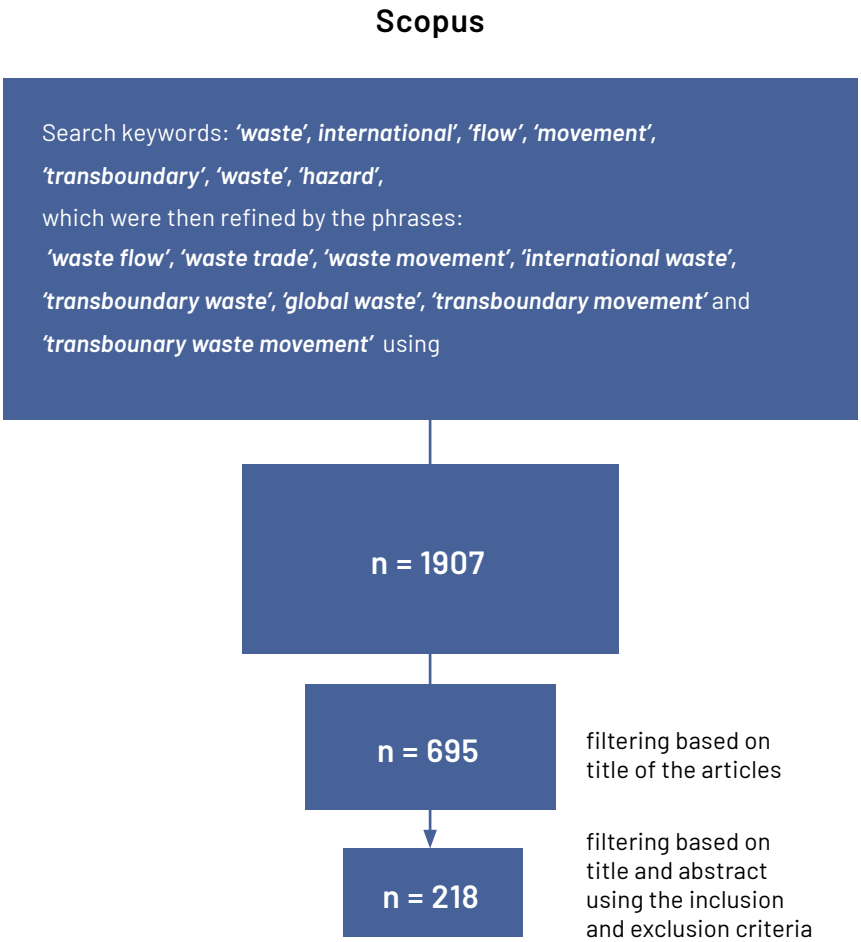

Figure 2.1. The process of screening and filtering was used in this study to reach 218 articles from January 1985 to January 2021.

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[1] *The Global North and South terminology stems from Brandt's (1980) map highlighting that the world's richer countries are largely, but not entirely, in the northern hemisphere. The Global North, thus, includes high-income southern hemisphere countries such as Australia and New Zealand. Notwithstanding the outstanding rates of economic development in parts of the world since 1980 (most notably China), the division retains validity. Although the Global North does not have a fixed membership in the sense of the OECD, both are largely economic in definition and, consequently, broadly similar in composition.*

2.3 Results

Firstly, we presented and discussed the research trends around the various waste streams and geographies of research. Secondly, we found that data scarcity and policy gaps remained a recurrent theme in the literature. Thirdly, we presented the sustainability implications of the transboundary movement of waste and the lack of discourse on reducing transboundary activity found in the literature.

2.3.1 Trends and waste categories

Between 1985 and 2000, most of the scholarship focused on transboundary hazardous waste movement (Figures 2.2 and 2.3) and/or the Basel Convention, which governs it. Stricter environmental regulations and increasing prices of environmentally and socially responsible waste management in the Global North often led to toxic waste dumping in countries without stringent laws at a fraction of the cost (Bernard, 2015; Kellenberg, 2012). Some of the many infamous dumping or attempts to dump toxic waste in several Global South countries in the 1980s and early 1990s include an Italian company dumping toxic waste in Nigeria to avoid European regulations, the Italian mafia dumping toxic waste in Lebanon during the civil war when the Lebanese government ceased to function, a U.S. company selling toxic waste mixed with fertiliser to the Bangladeshi government with assistance from Asian Development Bank, and the French government's deal to dump radioactive and industrial waste in Benin for helping national debt payment at a fraction of the actual disposal cost (Brownell, 2011; Clapp, 2001; Hägerdal, 2019). Several studies (Clapp, 2001; Paul, 2004; Swaney, 1994) cite a leaked 1991 memo from Larry Summers, then chief economist and vice president of the World Bank. He made a case for 'more migration of the dirty industries to LDCs [Least Developed Countries]', stating 'the economic logic behind dumping a load of toxic waste in the lowest wage country is impeccable' and 'I've always thought that under-populated countries in Africa are vastly under- polluted. . .'. This line of reasoning, described by various scholars as perverse economic rationality, combined with several high-profile cases of toxic waste dumping, led to an increased investigation and scholarship in the transboundary movement of hazardous waste, which has since dominated the field of research (Figure 2.2). These incidents, termed 'toxic colonialism', initially by Greenpeace, afterwards used in academic literature (Clapp, 2001; Kone, 2014; Okereke, 2006), captured the imagination not only of the academia but also

of the society at large, leading to the establishment Basel Convention (enforced since 1992) and several other regional conventions and agreements on transboundary movement of hazardous waste.

Around 2000, with increasing societal awareness of e-waste management and regulations in some parts of the world, the academic interest in e-waste increased (Figure 2.3). E-waste contains valuable substances like gold, silver, copper, etc. Some discarded electrical and electronic equipment can be disassembled to salvage these valuable metals for reuse and recovery. The Global E-waste Monitor, published by Global E-waste Statistics Partnership, estimates 53.6 million metric tonnes (mt) of e-waste generated in 2019 is worth an estimated 57 billion dollars, making it the most valuable waste stream, of which merely 17.4% was collected and recycled formally (Forti et al., 2020). E-waste generation globally is up 21% from 2015 and is estimated to increase to 74 mt by 2030 (Forti et al., 2020). E-waste contains toxic elements making its safe management difficult and expensive. Even though e-waste flow between OECD to non-OECD countries is illegal under the Basel Convention, the

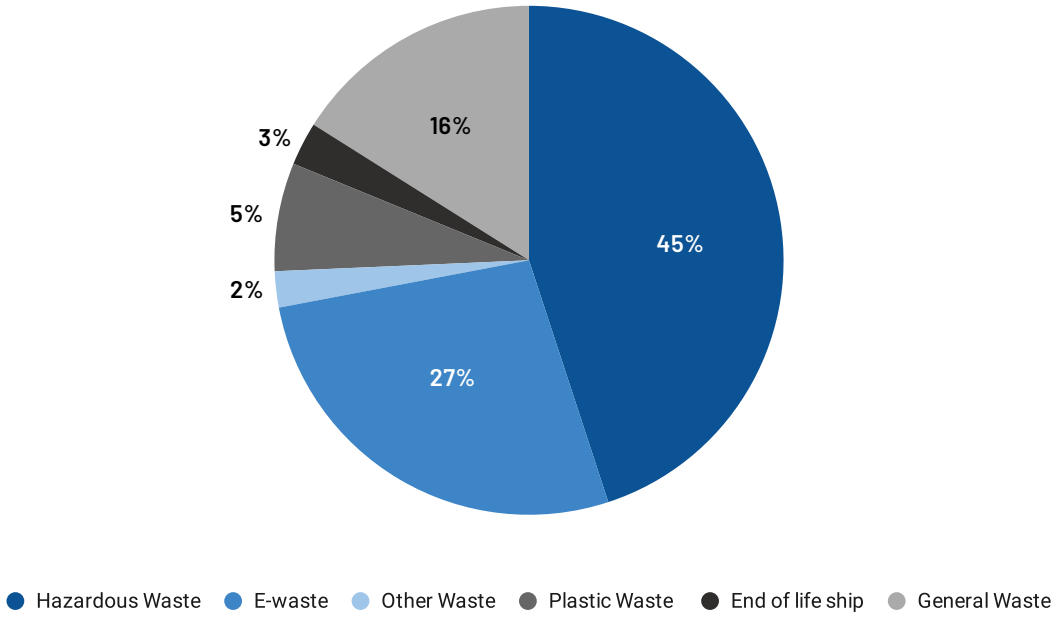


Figure 2.2. Distribution of attention to the various waste streams in the academic literature articles published between January 1985 and January 2021 (n = 218).

high disposal cost in high-income countries causes a flow to non-OECD countries (Bisschop, 2012). Its unsafe management causes health and environmental problems (Fazzo et al., 2017; Lipman, 2015). Because of the repair or reuse potential of some discarded electronic goods, e-waste is also disguised as useable or secondhand electronics, sometimes posing as humanitarian donations to circumvent international and national laws on hazardous waste (Bisschop, 2012). For all these reasons, research interest in e-waste has grown significantly since 2000 (see Figures 2.2 and 2.3).

Plastic has become another popular transboundary waste stream for research in recent years (Figures 2.2 and 2.3). Plastic research has gained momentum due to the rising plastic pollution problem, especially in the marine environment (Borrelle et al., 2020). When China, the biggest importer of plastic waste, stopped importing in 2018, it had a global effect. Since then, the research interest in transboundary plastic waste has been increasing (Figures 2.2 and 2.3). Articles that address all waste categories and focus on theory, governance, or management are an increasing academic research

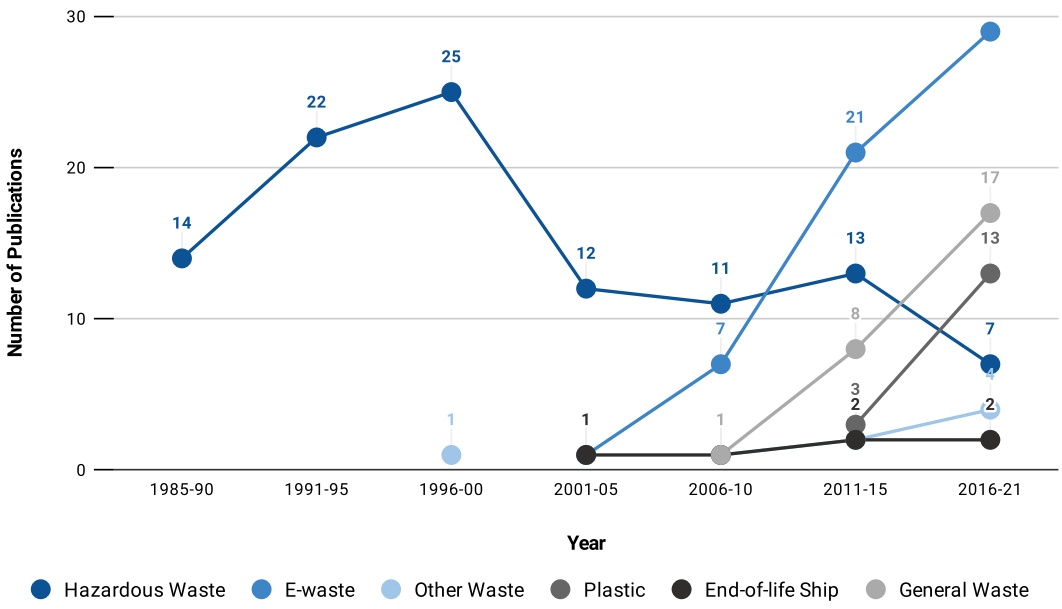


Figure 2.3. Various waste streams: and the number of academic articles published (n = 218).

interest and are depicted in Figure 2.3 in the 'general waste' category. Academic interest in the transboundary movement of waste categories, such as metal, paper, textile, vehicles, and batteries, remains low (shown as 'other waste' in Figure 2.3) thus far.

This review shows that researchers have often investigated contemporary societal trends of transboundary waste – hazardous waste since the early 1980s, e-waste since the early 2000s and plastic waste since the 2010s. The scholarship in the transboundary movement of waste is increasing as waste generation is projected to increase by 70% compared to 2018 levels by 2050 (World Bank, 2018). However, the analysis shows limited research on the transboundary movement of other waste streams such as paper, textile, rubber, wood, metal, batteries, photovoltaic and glass.

OECD (82.11%)	Number of Articles	Non-OECD (17.89%)
United States	58	
United Kingdom	25	
	16	China
Canada	15	
Australia	13	
Japan	10	
Germany	9	
Italy	7	
Switzerland	6	
Belgium, Sweden	5	
Spain	4	Nigeria
Ireland, Netherlands, Norway	3	Taiwan, India
Austria, Grece, Slovenia, South Korea	2	Hong Kong, Thailand, Philippines, South Africa
Czech Republic, Denmark, Finland, France, Portugal	1	Brazil, Coratia, Lebanon, Malaysia, Serbia

Table 2.1 Number of publications originated from institutions in various countries (n = 218).

2.3.2 Geographical representation and publication platforms

Academic institutions based in the United States, United Kingdom, China, Canada and Australia were the top five contributors to the transboundary movement of waste literature (see Table 2.1). The majority (82.11%) of publications were from researchers affiliated with institutions in OECD countries. In comparison, the non-OECD countries represented only 17.98% of the scholarship, predominantly from the institutions in China (16), Nigeria (4), Taiwan and India (2 each). As determined by the involvement of institutions in two countries or more, cross-country collaboration represents only 20% of the total publications. United States (32.40%) and the United Kingdom (13.97%) led among the OECD countries, whereas China (41.03%) led among the non-OECD.

In most of the reviewed literature, the non-OECD countries are the recipients of the transboundary movement of waste, yet scholarly contribution from the institutions based there remains low. At first glance, this could be attributed to the Scopus search being limited to English. However, Nigeria, India, South Africa and Hong Kong (4, 3, 2 and 2, respectively) have English as an official language as a legacy of colonialism, which is also a feature of numerous other non-OECD countries. A further explanation for the unequal geographic distribution of publications is likely to be the existing global inequalities, not only in economic conditions and access to higher education but also in the unlevel playing field in academic publishing (see Schipper et al., 2021 for similar inequity in climate scholarship and a manifesto for action). It is worth noting the majority of publications from the institutions in non-OECD countries discuss environmental and social injustice and advocate stricter policies, including the ban on the transboundary movement of waste (Gutierrez, 2014; Kim, 2006; Nnorom and Osibanjo, 2008a; Sonak et al., 2008; Sthiannopkao and Wong, 2013). The highest number of non-OECD country research output is from institutions in China (16), Nigeria (4) and India and Taiwan (3 each). Incidentally, China was the most prominent destination of plastic waste and e-waste imports until 2018, and Nigeria is currently one of the biggest e-waste destinations in Africa. This underrepresentation in the research contribution of the countries that also are popular destinations of transboundary waste and the lack of research collaboration with institutions in these countries could suggest a hegemonic discourse in the field.

The leading journals for publications in the field are Resources, Conservation and Recycling (20), Waste Management and Research (6), Environment (5), Environment Policy and Law (5), Journal of Cleaner Production (5), Environmental Law and Policy (4), Journal of Environmental Management (4) and Waste Management and the Green Economy: Law and Policy (4). Still, these represent only one-third of the articles reviewed. A wide variety of academic disciplines and sub-disciplines study the transboundary movement of waste, covering a total of 117 different journals. Most publications were from academic institutions of higher education, and only a handful was from not-for-profit organisations and consultancies.

2.3.3 Data scarcity

Uncertainty quantifying the flows and fate of transboundary waste is one of the most prominent challenges in researching the field (see Bisschop, 2012; Davis and Garb, 2019; Parajuly and Fitzpatrick, 2020 for e-waste; Thomas and Fannin, 2011 for toxic waste, Bishop et al., 2020 for plastic waste). Lepawsky (2016) created a case for data scarcity influencing the discourse by giving an example of how a non-peer-reviewed report, with questionable extrapolated anecdotal data, became the second most cited document in the academic literature for e-waste flows. Thus, extrapolated data on transboundary e-waste flows can be used to push certain worldviews in academia and policymaking (Lepawsky, 2016). Apart from flow, there is insufficient data to show what happens with waste after transboundary movement making it difficult to determine its sustainability impact. Early in the discourse, Schenkel and Skinner (1985) highlighted the need to close the information gap between scientific and technical experts, and government and practitioners. Thirty-six years later, these gaps remain and represent obstacles to understanding the transboundary movement of waste.

Several reasons contribute to data scarcity. Firstly, most countries lack robust data monitoring and recording systems, often leading researchers to make 'best guesstimates' to understand the phenomenon (Bisschop, 2012). Some countries lack the basic data management system (U.N. Environment, 2018). In cases of available data, the quality is limited. For example, most data on transboundary e-waste are collected in weight (and some- times economic value), which does not tell the properties and other values of the waste (Lepawsky, 2016). Two different compositions of the same weight of identical waste streams, such as plastics, e-waste or construction waste, can have varying

properties, toxicity and monetary, socio-economic and environmental values. Secondly, whatever data is collected lacks harmonisation across countries (Bisschop, 2012). This remains a challenge for comparison, even between locations with more sophisticated systems in place. For example, the variety of waste legislation also contributes to the lack of data harmonisation across countries (Lipman, 2015; Obradović et al., 2014). This problem can be seen in the data on waste exports provided by the Basel Convention and U.N. Comtrade database (Gregson and Crang, 2015), due to reporting gaps by individual countries (Lipman, 2015). Thirdly, various loopholes in the waste legislation (Barsalou and Picard, 2018; Lipman, 2015; Lucier and Gareau, 2016) make manipulation easier and data capture difficult. Illegal transboundary movement makes data gathering difficult, if not impossible (Bisschop, 2012). Fourthly, the engagement of the informal sector, which makes a valuable contribution to waste management (Millington and Lawhon, 2019), makes it difficult to capture data during the value chain of waste management. And lastly, there is a lack of prioritisation for rigorous data. Often port authorities lack the system, human resources, skills, software, language translation skills or funding to capture data (International Criminal Police Organization, 2017).

Given the unreliability of quantitative estimates of waste flows, it may be unsurprising that qualitative studies dominate the literature. Eighty-seven per cent of the 218 reviewed articles were qualitative using descriptive analysis. These studies included case studies, policy and legal reviews, historical analyses, text or literature reviews, etc. Quantitative articles (13%) involved mathematical modelling, survey and quantitative material flow analysis. In the reviewed literature, anecdotal data, expert interviews, surveys, estimates and modelling were frequently used to tackle the problems of unreliable data on waste flows. There are notable recent exceptions, which may be a sign of improvement. The Person in the Port Project (Odeyingbo et al., 2017), where researchers spent 16 months at two harbours in Lagos, Nigeria, inspecting 3622 import documents, 2184 vehicles and 201 containers in 2015 and 2016, provides some of the most robust data on reusable and end-of-life electric and electronic equipment movement to Nigeria from the rest of the world. Using U.N. Comtrade data, Bishop et al. (2020) show how the plastic waste shipment from the European Union for recycling elsewhere creates pathways for plastic debris in the ocean and showed that a significant (between 32,115 and 180,558 tonnes or 1%–7%) of the exported plastic waste was ended in the ocean in 2017. However, similar systematic data-intensive research remains infrequent, meaning that it is still only possible to estimate or guesstimate international movements of waste streams.

2.3.4 Policy gaps

Using comparative waste policy analysis in the E.U. and USA, Smith (1993: 91) identified the lack of a standard definition of waste and concluded it was a 'prerequisite to establishment of workable national and international waste management strategies'. This definition gap is still relevant now. For example, according to the Basel Convention definition, e-waste 'may or may not be considered waste in general or hazardous waste specifically', enabling the same e-waste to be hazardous in one country and non-hazardous or even functional equipment in another (Barsalou and Picard, 2018: 899), adding a geographical dimension to the discrepancies that can happen within one country. The export of used electronic and electric equipment, which can extend the lifespan of products, and minimise or even delay waste generation, becomes a loophole for transboundary movement of near end-of-life used equipment and e-waste if the export's functionality and durability are not guaranteed. Similarly, the export of waste for recycling to countries without sustainable recycling capacities creates a recycling loophole. Despite efforts to devise laws at national, regional and international levels, such loopholes allow the circumvention and manipulation of the law. These loopholes, combined with the high monetary value of waste and the increasing economic cost of environmentally sound management, create incentives for illicit and illegal activities. For e-waste, a high-value waste, the governance often involves actors engaged in white-collar crimes possibly benefit- ing from these loopholes (Bisschop, 2016).

As 45% of the reviewed literature is on hazardous waste (see Figure 2.2), the Basel Convention and its Ban amendment remain the most widely discussed policy in the reviewed literature. Various scholars question the effectiveness of the Basel Convention and the Ban amendment (Argüello Moncayo, 2016; Barsalou and Picard, 2018; Gutierrez, 2014; Krueger, 1999; Onzivu, 2013; Reis, 2016). The Basel Convention is the key multilateral international policy that has governed the transboundary movement of hazardous waste since 1992 and is often criticised. When framed, it aimed to regulate the transboundary waste movement of waste from the OECD to non-OECD countries. The Basel Ban Amendment, which makes the flow of hazardous waste intended for final disposal, reuse, recycling and recovery from OECD, E.U. and Liechtenstein to non-OECD countries illegal, took 24 years to ratify. Analysing the current global flows of e-waste not just limited to OECD to non-OECD, Lepawsky (2015a) questioned the relevancy of Basel's geographical division of non-OECD and OECD. Reis (2016) called for more dynamic rights-

based international law focusing on human, environmental and economic rights. Portas (2016: 79) compared the existing loopholes in the Convention to a tennis racket where 'there are more holes than matter' and argued for a need to modernise the Basel Convention to promote energy efficiency, sound recycling and sustainable material use. Khan (2016a) argued for greater transparency by implementing social labelling system for secondary commodities, adopting Extended Producer Responsibility at the national level, and incorporating sustainable production and consumption instead of merely waste management and cleaner production in the Basel Convention. Parajuly and Fitzpatrick (2020) advocated realistic, comprehensive and integrated policies that focused beyond mere economics and considered relevant policies internationally. The slow international political response to the urgent need to halt global flows of hazardous waste led to other international arrangements. The Bamako Convention, effective since 1998, prohibits the import of hazardous waste in Africa. The Stockholm Convention, effective since 2004, limits the transboundary movement of Persistent Organic Pollutants in certain waste. The Rotterdam Convention, effective since 1998, limits the transboundary movement of certain hazardous chemicals. This widening of the scope of the ban has not removed the underlying influences on transboundary waste shipments. Transboundary waste crime continues (Bisschop, 2016; Liddick, 2010; Rucevska et al., 2015; Walters and Loureiro, 2020) and is rising (Andreatta and Favarin, 2020; Dimitris and Alexandra, 2020; INTERPOL, 2020). Existing policies have loopholes that can be and have been manipulated or exploited.

In the cases of a waste stream not covered by the Basel Convention but which follows the WTO guidelines, policies monitoring the social, ecological and economic impacts of such trade remain in the legal grey area (Grosz, 2016). However, there are no international policies to guide the fate of most internationally traded waste (outside the Basel jurisdiction) to maximise the quality of value retention and minimise the associated potential socio-ecological harm (Grosz, 2016).

2.3.5 Sustainability implications of transboundary waste movement

Waste generation and its transboundary movement relate to the environmental, social and economic dimensions of sustainability. Improper municipal waste management contributes to greenhouse gas emissions (Šomplák et al., 2019). Improper waste management leads to ecosystem contamination and has adverse health effects (Orloff and Falk, 2003; Stebbins, 1993). Transboundary movement of waste

to destinations without the capacity for sound management causes harm by creating health problems, especially for people engaging in the informal sector of waste management and the marginalised people in the community (Bisschop, 2012; Fazzo et al., 2017; Lipman, 2015; Okereke, 2006). From this perspective, the transboundary movement of waste is unethical, viewed as exploiting the poor and the most vulnerable, and thus exacerbates inequalities (Little and Lucier, 2017; Orlins and Guan, 2016b). It is portrayed as harm inflicted by one society on another, a case of social injustice and toxic colonialism (Lipman, 2015; Lucier and Gareau, 2016; Müller, 2019). Apart from social injustice, transboundary waste flows are linked to environmental injustice and environmental racism (Clapp, 2001; Iles, 2006; Klenovšek et al., 2011; Lipman, 2006, 2015; Pellow, 2008; Sakai et al., 2011; Temper et al., 2015). These contrasts with earlier views of waste as a resource, an eco- nomic opportunity and an argument for a market mechanism to drive the transboundary movement (Alter, 1997; Kofi Asante- Duah et al., 1993; Montgomery, 1995). Kellenberg (2012) showed that waste trade to countries with sound recycling capacities can translate to environmental and economic benefits. China gains economically from imports of wastes such as plastics, cardboard, e-waste, etc. (Ma et al., 2020; Shinkuma and Huong, 2009), and Bangladesh gains economically from importing end-of-life ships (Alam and Faruque, 2014; Paul, 2004) but not without socio-ecological costs. In the absence of holistic, bottom-up solutions to tackle transboundary waste, Davis et al. (2019) showed concerns regarding the further marginalisation of the informal waste sector workers whose livelihood depends on (imported) waste. The transboundary movement of waste is thus closely related to ecology and health, social inequities and injustices, economic and resource benefits, good governance, etc., ultimately tied to various sustainability dimensions.

2.3.6 Reduction of transboundary movement of waste

Waste is a consequence of economic activity. In the reviewed articles on transboundary waste, consumption is acknowledged as a waste-producing activity that causes transboundary waste movements. Waste literature addresses concepts such as zero waste, cradle-to-cradle, circular economy, etc., which capture waste reduction. However, there is little discussion on waste reduction in transboundary waste literature. Notwithstanding that one of the objectives of the Basel Convention is to reduce the transboundary movement of hazardous waste, it focuses exclusively on managing the transboundary movement of hazardous waste rather than its reduction (Stebbins, 1993). O'Keefe (1988:

88), one of the earliest to call the transboundary movement of hazardous waste toxic terrorism, wrote, 'the only solution would be to develop new processes that produce as little waste as possible or failing that, to recycle or neutralise it'. Barsalou and Picard (2018: 890) are sceptical of current environmental conventions leading to waste reduction and argue that they are 'tools for the global distribution and management of disposable waste' by commodifying negative externality instead of reducing them. Bisschop (2012) identified the rapid growth and consumption of electric and electronic devices, which produces more e-waste, as a significant push factor for its illegal transboundary movement. Early results from the Chinese ban on plastic imports show environmental gains, especially when the previously exporting countries focus on local management and treatment of plastic waste (Wen et al., 2021). According to prevalent waste hierarchies that prioritise waste prevention, the principle of prevention (Duvic-Paoli, 2018) and proximity principle (Reese, 2018), reducing the volume of transboundary waste by first reducing waste production and then having sustainable value retention, maintenance and recovery options locally seems more sustainable. Reducing transboundary waste requires research on stewardship rather than management, adding and retaining value instead of trading and international disposing of waste, which appears lacking in the reviewed literature. Similarly, the reviewed academic discourse lacks discussions on local and regional waste management and its linkages to (reducing) the transboundary movement.

2.4 Analysis and discussion: Transboundary waste binaries

This section establishes the presence and dominance of transboundary waste binaries in the academic discourse, their usefulness and limitations and proposes a nuanced and contextual research approach moving forward. We used Alvesson and Sandberg's (2011) problematisation approach to spot assumptions and explore their implications. The primary aim of the problematisation method is to 're-evaluate existing understandings of phenomena, with a particular view to challenging and reimagining our current ways of thinking about them' (Alvesson and Sandberg, 2020: 1297). Since understanding waste and its movements are contingent on political, economic, social and cultural contexts, it is essential to look at their underlying assumptions. We spotted and challenged such assumptions to think differently than how and what we already know.

2.4.1 Waste or resource or both: Contextual and transitional

Thompson (1979) argued that waste is a socially defined construct that moves across the boundary between rubbish and non-rubbish, making the conception of waste contextual and transformational. Thus, transboundary waste can broadly be constructed either as discard or rubbish (something to get rid of) or resource or non-rubbish (something of value) or something in between based on the context. Brownell (2011) argued, 'as waste became an increasingly complex thing to buy and sell, its definition also became more politically, biologically, and economically contentious' (p. 264). These transformational and contentious conceptions of waste are compounded by the advent of ideas relating to the circular economy and industrial symbiosis/ecology, whereby waste is increasingly seen as a resource or value to be retained (Deutz and Frostick, 2009; Lacy and Rutqvist, 2015). Such views call to see waste as an input (see McDonough and Braungart, 2002) or even call for an 'end of waste' status (enabling a waste material to be legally treated the same as a new equivalent) (Deutz et al., 2020), bringing further contingencies.

The level of socio-political uptake of a circular economy, cradle to cradle, zero waste, or many similar concepts can thus influence waste characterisation: either as discard, resource or somewhere in between. However, the uptake of these concepts in one country can also have unintended consequences elsewhere. In the absence of transnationally harmonised standards for dismantling/recycling and regulatory enforcement, electronics sent overseas designated for reuse can be diverted as e-waste for profitability (Milovantseva and Fitzpatrick, 2015). Even though polyethylene terephthalate (PET) waste is globally discarded, seeing the economic value despite the ecological cost, China allowed the import of 40% of global plastic discards until recently (Ma et al., 2020). Bangladesh imports discarded end-of-life ships for economic reasons irrespective of the negative environmental and social implications (Alam and Faruque, 2014). Sometimes, the import of discarded secondhand products keeps them from being waste by extending their lives elsewhere, but they might be dumped and landfilled instead of being sustainably managed when it approaches their end-of-life. Importing waste to recycle for secondary materials can also thwart domestic traditions and innovations. Transboundary waste can be an economic 'resource' and simultaneously cause social, political or environmental harm even in the same context.

2.4.2 Transboundary waste binaries informing our understanding and shaping our practices

Based on assumptions, we established that waste perception is contextual and can be (harmful) discarded, (useful) resource or in-between. Questioning such assumptions (Alvesson and Sandberg, 2011) in the context of waste fluidity between waste and non-waste (Thompson, 1979) enables the emergence of transboundary waste binaries. Transboundary waste binaries describe the recurrent themes of strong opposing views prevalent in the literature primarily based on assumptions of waste. The most common transboundary waste binaries found in the literature are victim versus perpetrators, developed/rich versus under-developed/developing/poor and Global North versus Global South. This act of reducing complex interconnected phenomena involving diverse actors and their interests and varied politics into simple opposites represents a simplified approach to understanding the phenomenon. However, such binaries do not adequately represent the various contexts and how they interrelate. For example, the Global North is often characterised as a group of rich countries that dump waste onto the Global South for cost-saving reasons despite having the capacity to process waste. This

generalisation rightly brought awareness of frequent illegal dumping activities in the 1980s and the 1990s into the academic discourse but is still referred to without newer contextual realities of present times. Research shows such activities are often conducted by actors (legal or illegal) motivated by various push, pull or facilitating factors (Bisschop, 2012), not countries. Many national and international laws and policies make the transboundary movement of hazardous waste illegal. Thus, preventing illegal 'dumping' of waste is a shared responsibility of Global North and Global South authorities.

Transboundary Waste Binaries	Academic Source
Victims versus perpetrators (n = 7)	Bisschop and Vande Walle (2013), Brownell (2011), Johnson and Niemeyer (2008), Clapp (1994, 1998, 2002), Kohn (1995)
South versus North (n = 15)	Cotta (2020), Millington and Lawhon (2019), Müller (2019), E.U. (2019), Gregson et al. (2016), Khan (2016), Lucier and Gareau (2016), Bernard (2015), Crang et al. (2013), Marcoux and Urpelainen (2012), Brownell (2011), O'Neill (1998, Paul (2004), Montgomery (1995), Puckett (1994)
Illegal versus legal (n = 19)	Bakhiyi et al. (2018), Bisschop (2016), Efthymiou et al. (2016), Orlins and Guan (2016a), Bernard (2015), Kellenberg (2015), Obradović et al. (2014), Lawhon (2013), Bisschop (2012), Liddick (2010), Porter (2010), Benson et al. (2009), Moen (2008), Nnorom and Osibanjo(2008a), Lipman (2006), Soskolne (2001), Montgomery (1995), Sánchez (1994), Hilz and Radka (1991)
Developed (rich) versus Developing (poor) (n = 21)	Deshpande et al. (2020), Gollakota et al. (2020), Torrente-Velásquez et al. (2020), Hägerdal (2019), Müller (2019), Bisschop (2016), Lucier and Gareau (2016), Nnorom and Osibanjo(2008b), Okereke (2006), Yu-Jose (2004), Tsimplis (2001), Alter (2000), Krueger (1999), Ryland(1999), McKee (1996), Sánchez (1994), Kummer (1992), Anyinam (1991), Lipman (1990), Kohl and Sud (1989), Wynne (1989)

Table 2.2 Various transboundary waste binaries and their implicit or explicit usage in the academic literature are ordered from low to high chronologically.

Relying on such binaries without questioning them can introduce ambiguity in understanding rather than enhancing clarity, which in turn affects implementing potential solutions. The lack of reliable data on the transboundary movement of waste, the criminal nature of the hazardous waste trade and the lack of a common definition of waste in the law and policy realm further strengthens these binaries. Some of the more popular transboundary waste binary narratives, either explicitly or implicitly, found in the reviewed literature are listed in Table 2.2 and later illustrated in Figure 2.4.

2.4.2.1 Victim versus perpetrators transboundary waste binaries.

In the context of the socio-ecological justice discourse in the social sciences, victim versus perpetrators is one of the transboundary waste binaries that appear implicitly or explicitly following the cases of hazardous waste dump from OECD to non-OECD countries (see examples discussed in 'Trends and waste categories' Clapp, 1994; Favarin and Aziani, 2020; O'Keefe, 1988). This binary goes beyond hazardous waste and applies to other waste streams like e-waste, plastic and end-of-life ship, often associated with health and environmental harm if the destination country cannot manage imported waste well (Cotta, 2020). In this binary, waste is predominantly seen as discard and is 'discarded to' destinations without infrastructures and capacities. The social and environmental risks and burdens associated with the transboundary waste movement are distributed unequally, thus characterising the Global North as the perpetrators and Global South as the victims (Cotta, 2020; Favarin and Aziani, 2020). Using a quantitative model, Favarin and Aziani (2020: 372) confirmed their hypothesis that 'countries sharing a colonial relationship are more likely to exchange illicit waste'. This binary is motivated to showcase disregard for equity, fairness and distributive justice in the phenomenon of the transboundary waste movement and is characterised by toxic colonialism, garbage imperialism and environmental racism (Brownell, 2011; Lipman, 2015; Müller, 2019; Okafor-Yarwood and Adewumi, 2020).

The victim versus perpetrators binary is also present in environmental criminology. It is associated with fraudulent or illegal behaviour, where bad actors take advantage of legal and policy loopholes and cause socio-ecological harm. U.N. Environment (2018) estimates environmental crimes, including the transboundary movement of waste, as the fourth largest and most lucrative crimes after drugs, counterfeits and human trafficking. It further identifies most waste trafficking to originate in the so-called 'developed countries' and is driven by financial gains, weak enforcement systems and complexities in actors and policies (U.N. Environment, 2018). By sending discards as recyclables,

e-waste as used equipment, mixing discards in recyclables, etc., the perpetrators create victims driven by economic gains. While this transboundary waste binary highlights the socio-ecological injustices, it fails to interrogate the perpetrators and their actions in context. Global North as the predator is the underlying assumption, which can be challenged. While Global South remains unequal and global inequality is increasing due to systemic problems (Hickel, 2017), Global South countries also have sovereignty and agency to refuse waste coming from Global North and, in many cases, protected by international and national laws.

2.4.2.2 Legal versus illegal transboundary waste binaries

The contingent definition of waste and lack of harmonisation of laws and policies across jurisdictions create various loopholes and a thin line between legal and illegal transboundary waste. In a context

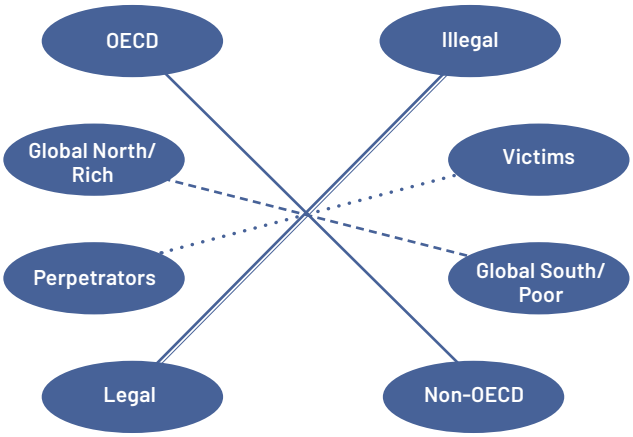


Figure 2.4 The variety of transboundary waste binaries present in the academic discourse of the transboundary movement of waste has roots in seeing waste either as a resource or discarded based on the socio-cultural, economic and political context.

where nations prohibit trading certain waste but liberalise others, Khan (2016) argued that the blurring between legal visions of waste and commodities is inevitable and confusing as commodities turn to waste and increasingly waste turns back into commodities. Bisschop (2012) identified actors and their varied relationships, global asymmetries in law, culture and economics and unharmonised policies to make a case for a thin line between legal and illegal in the worldwide movement of e-waste. Such a fine line can be crossed during waste transportation or during collection or disposal (Bisschop, 2016). Unlike other transboundary waste binaries, the law attempts to define legal/illegal yet remains prone to varied interpretations. Given the diversity of actors, their intentions, various stages and interpretation of the law, the legal–illegal binary shares the characteristic of being porous. International laws remain vague, and their interpretation is often shaped by socio-economic context. For example: used electronic and electric equipment is legal, whereas e-waste is illegal to ship from OECD to non-OECD countries, but what e-waste constitutes also depends on the socio-economic context, such as the ability and capacity of authorities to check for functionality. As environmental crimes become increasingly lucrative financially (Walters, 2013), the ambiguous assumptions between legal and illegal transboundary waste movements need more context and clarity.

2.4.2.3 Global North versus Global South transboundary waste binaries.

Global North versus Global South is another popular transboundary waste binary. This binary focuses on economic, social and geographic distinctions. It also captures a similar discussion in the (Developed versus Developing) and Rich countries versus Poor countries binary. Assumptions of geographies of waste movement in this binary are limited to flow from the North to the South and fail to consider other directional movements. Actors from the Global South, whose coordination facilitates such North-South movements, are not discussed. Quantitative research on e-waste shows illegal e-waste flow from higher-income countries to lower-income countries (Efthymiou et al., 2016). A 2-year study in Nigeria at the two import ports showed used electronic and electric (UEEE) devices imported in containers and roll-on/roll-off vehicles originating from the E.U., USA and China, of which 26% of the total 60,000 tonnes were estimated to be e-waste (Odeyingbo et al., 2017). Such UEEE flows were confirmed by follow-up research in Ireland, with 17,319 kg of UEEE exported on roll-on/roll-off vehicles (McMahon et al., 2021). Based on the customs paperwork, Nigerian research shows that most registered UEEE importers were Nigerians (Odeyingbo et al., 2017). Other research shows waste flow

other than the North-South direction, showing African countries as exporters of e-waste elsewhere (Lepawsky, 2015a), thus challenging the assumptions behind North-South flows.

Analysing the global PET plastic trade case study, Furniss (2015) showed similar assumptions and proposed reframing the transboundary waste movement beyond the North-South directionality. Limited data and the unreliability of existing data limit our ability to judge the veracity of assumptions in this binary. Some recent research challenges inherent assumptions and shows how adhering to North versus South binaries limits our understanding, which then can creep into the policy and action realm.

2.4.2.4 OECD versus non-OECD transboundary waste binaries.

The binary of OECD and non-OECD represents the international waste governance perspective and is present in the Basel Convention, especially in its Ban Amendment. Ban Amendment aimed to ban the movement of hazardous waste from OECD to non-OECD countries, but not flows from non-OECD to non-OECD or non-OECD to OECD countries. The transboundary waste binary assumes that all countries grouped in one of the two categories have the same waste governance and management capacity and fails to see the diversity within the groups. Such assumptions distort our understanding and limit effective policymaking. The pollution haven hypothesis predicts the pollution-intensive transboundary movement of waste flow to destinations with low environmental standards. It can also be traced back to the rich or OECD versus poor or non-OECD binary, where the former have sophisticated environmental health and safety standards. But when examined empirically, this hypothesis fails to capture the full context and complexities of the phenomenon (see Crang et al., 2013; Davis et al., 2019; Lepawsky, 2015a, 2015b; Moore et al., 2018).

Crang et al. (2013) highlighted that waste flows are influenced by supply and demand in global value chain networks and do not necessarily follow OECD to non-OECD or Global North to Global South. Both Davis et al. (2019) and Moore et al. (2018) suggested a shift of waste flow analysis from the macro scale to the micro to incorporate local communities and context, realities, opportunities, risks and vulnerabilities. Context-sensitive research challenges the dominating geographic assumptions of transboundary waste flows and shows limitations to assumptions behind these binaries.

2.4.3 Limitations of transboundary waste binaries narratives

The transboundary waste binaries in the literature demonstrate the unequal global context and the social and environmental injustices that arise from the transboundary waste movement. However, some binaries come with questionable assumptions, as discussed earlier. Thus, the widespread usage of these transboundary waste binaries, unless relevant from more contextual and empirical analysis, limits problem-solving discourses from the literature. Instead, these binaries, limited to problem identification and description, fail to capture the complexity of the global sustainability challenge of transboundary waste movement, whose socio-ecological impacts are not only limited within the narrow transboundary waste binaries imaginary of rich versus poor, North versus South, etc. but also the whole earth, humanity, present and future generations. Assumptions that form these binaries further restrict effective policymaking. A more nuanced and contextual approach challenges assumptions and shows limitations in these transboundary waste binaries. The following section highlights some research work that either challenges the existing binaries or adds context to these binaries.

2.4.4 Looking past the transboundary waste binaries: A nuanced understanding

Some research contributes to the body of knowledge by incorporating social, economic, cultural, historical and political contexts. In the literature, these contributions stand out as bringing nuanced approaches to understanding the transboundary waste movement and challenging assumptions of existing literature by adding layers of relevant context to the research. For instance, Millington and Lawhon (2019) proposed new epistemologies for research on the role of materiality and technology for insights into the distribution of costs and benefits. Their context-sensitive research agenda focuses on relational understanding to explore what enables and constrains value extraction for different actors in the waste value chain. Giving examples of compart- mentalised outlooks on waste, Barsalou and Picard (2018) proposed a legal framework of waste on a global scale that looks past the OECD (rich) and non-OECD (poor). They suggested that international laws should go beyond protecting the environment and be a guide to 'manage and externalise waste on a global scale' across international law (p. 905). Davis et al. (2019) proposed empirical research to guide theory and policy. They argued that its relevance is not only for data richness but contextual political narratives and their policy implications.

Müller (2019) advocated for connecting the existing macro-level discussions, characterised by often necessary generalisation on harm and toxic capitalism, with the micro-level focusing on actors and their environment. This author advocated for future research that 'aims to reinsert the human element while moving beyond anecdotal evidence and to provide personal insights into the business world of those trading' Müller (2019: 56). Barnes (2019) proposed research on long-term solutions with a mix of innovation, recycling and reducing production and consumption to prevent the tragedy of the commons. Moore et al. (2018) identified the disconnection of the health and environmental risk borne by locals with the nation-state discourse and advocated future research de-centring from the nation-state to the cosmopolitan notion of justice. Torrente-Velásquez et al. (2020) and Wilts et al. (2011) put a case for a global extended producer responsibility system for sustainably managing waste beyond the narrow geographical binaries discussed previously. Temper et al. (2015) called for understanding through collaboration and engaged research between academia and civil society. The researchers investigated multidimensional contexts, challenged existing geographic imaginaries and incorporated politicisation. The diversity of their research focus ranges from technology, social, legal, politics and governance, business and economy and t research. These research approaches seek contextual understanding and challenge inherent assumptions to solve our shared sustainable challenges.

2.5 Conclusions and recommendations

This literature review spanning 36 years demonstrates that sustainable waste management and its transboundary movement remain challenging at the local, national and international levels. Bakhiyi et al.'s (2018) comparison of e-waste management practices to 'opening Pandora's box' filled with unpredictabilities and complexities is equally true in the transboundary waste context. Our review reveals diverse characterisations of the phenomenon, often reduced to simple and opposing binaries. Depending on varied social, ecological, economic, political and cultural contexts, the binaries are predicated on the assumptions of waste stemming primarily as a resource or discard. Such simplification might serve our understanding but also can restrict or limit it. Lack of data and policy gaps underlie and reproduce these limitations. We argued for a need to look beyond binaries and instead call for a nuanced and contextual understanding of the issues underlying transboundary waste movements. We gave examples of research enabling a more contextual understanding, questioned the assumptions and showcased limitations in the binaries. Furthermore, the literature reviewed shows that the discussion is dominated by managing the transboundary waste movement but pays little attention to reducing it.

The transboundary movements of waste have substantial implications in all three dimensions of sustainability. Apart from the three sustainability dimensions of people, planet and prosperity (PPP), contexts of time and place are necessary for a nuanced and integrated approach (Vermeulen, 2018). With increasing waste generation, there is a need for a sustainable, ethical, just and impactful solution within the planetary and social boundaries. Being mindful of PPP, time and space dimensions and based on the findings, the prevalence of transboundary waste binaries and their limitations, we propose five interconnected areas of future research.

Firstly, we propose more collaborative research that brings academic disciplines, stakeholders and their contexts together. Geographical collaboration between the exporters and the recipient or importers of transboundary waste can bring an integrated and life cycle understanding of transboundary waste. Such under- standing can inevitably bring thoughts and ideas together across diverse socio-cultural and economic contexts to create inclusive understandings.

Secondly, we propose future problem-solving research, engaging various academic disciplines with society. One option is transdisciplinary research, which is increasingly recognised as a contextual solution-oriented approach to sustainability science. A transdisciplinary approach can bring together the informal waste sector with the formal, inspection workers, lawmakers, recyclers and other actors across countries in an equal participatory process to create problem-solving knowledge. This plurality of ideas can challenge assumptions behind transboundary waste binaries. Irrespective of the location and roles, waste indiscriminately affects the marginalised; their active voices are rare in the research field thus far, despite their service in waste management. A just transition focused research can start by giving them equal and empowering voices in future research.

Thirdly, the lack of reliable data, especially quantifying flows, and the fate of waste limits our understanding of transboundary waste movement. Research in developing data capture and harmonisation methodologies at a local and international level that enhances data transparency and availability is essential. Accurate data can give insights into less discussed waste flows within Global South, Global North or from South to North.

Fourthly, we recommend research on preventing transboundary waste movement in the first place. This also includes reducing the waste generation destined for transboundary movement. Strategies can include reducing or refusing consumption and value creation, addition, and retention of waste locally and regionally. Such sufficiency approaches are increasingly advocated by emerging research in degrowth, post-growth and sufficiency-based circular economy narratives.

Lastly, various finance, policy, regulation and law instruments need reform and rethinking to make them effective. However, research should also focus on making these instruments ethical and fair socially and ecologically.

CHAPTER 3

Science with society: Challenges of early-stage researchers engaging with transdisciplinary research in sustainability science

"A good scientist has freed himself of concepts and keeps his mind open to what is."

— Lao Tzu

Tao Te Ching, translated by Stephen Mitchell

This chapter is based on Thapa, K., Vermeulen, W. J. V., and Deutz, P. (2022). Science with society: Challenges of early-stage researchers engaging with transdisciplinary research in sustainability science. *Sustainable Development*. https://doi.org/10.1002/sd.2328

Abstract

The ongoing social and ecological crises create urgency in academia and elsewhere to devise actionable problem-solving knowledge to tackle sustainability challenges. Transdisciplinary research (TDR) represents a problem-solving methodology for sustainability problems. TDR requires researchers to get out in the real world and engage with other societal actors to jointly produce such problem-solving knowledge for research to have a societal impact. This radical process of doing "science with society" instead of "science for society" is becoming more urgent and relevant. However, a transdisciplinary (TD) researcher faces challenges: often, institutions have limited readiness for facilitating TDR, a researcher has to juggle the roles of an academic and changemaker simultaneously and needs new ways of doing science. The research process requires enough manoeuvring space to incorporate reflexivity, adaptiveness, and emergence based on the research context. The research uses case studies, interviews, reflections, and document analysis from two finished and one ongoing TDR PhDs in sustainability science and connects them with the TD literature. Based on previous and ongoing TDR by early-stage researchers (ESRs), this article identifies and discusses six TDR challenges ESRs in sustainability sciences might face.

3.1 Introduction

The planet suffers from the ecological crises of climate change and biodiversity loss, while people suffer from injustices, food insecurity and inequalities (IPBES, 2019; IPCC, 2019; World Bank, 2020). Due to these urgent challenges, knowledge creation needs to connect with implementable and legitimate solutions. Transdisciplinary research (TDR) aims to generate such problem-solving knowledge. TDR introduces a more collaborative research process for solving real-world sustainability challenges by bringing together science and other societal actors (Fam et al., 2018; Gibbons et al., 1994; Hadorn et al., 2008; Lang et al., 2012; van Breda et al., 2016; Witjes and Vermeulen, 2021, Witjes et al., 2021).

This TDR promise of societal change might attract some early-stage researchers (ESRs). For this article, ESR refers to individuals in the first four years of their research career (including PhD candidates). They, therefore, have limited experience organising, conducting, and executing research and research projects. However, TDR brings additional challenges compared to other research approaches. Even though transdisciplinary (TD) literature discusses challenges while making sense from various sources and forms of knowledge to co-create solution-oriented understanding and implement them, only a few papers connect TDR challenges to ESRs (discussed in Section 3.2.2). Using experiences of TD ESRs, we identify and discuss challenges ESRs face and ways to navigate them.

This article addresses two questions: (i) what research challenges could TD ESRs face? And (ii) what can ESRs learn from the experiences of the previous TD ESRs to understand and navigate these challenges? We use two completed PhD projects and one ongoing PhD project as case studies to identify such challenges. This article briefly introduces TDR and then explores TD literature focusing on sustainability science ESRs. Then it draws upon the PhDs to highlight challenges and lessons learned from ESRs' perspectives. The primary audience of the article is TD ESRs engaging in sustainability sciences. However, the challenges identified are not unique to TD ESRs or their teams. This article provides valuable insights to practitioners in sustainability sciences, especially those curious about TDR, and research funding agencies, who demand societal impacts. This article also contributes to the TD literature by linking TD ESRs to sustainability science.

3.2 TDR in Sustainability Sciences

The first section highlights some of the key TD ideas in sustainability science. The second section focuses on TD literature that links to sustainability science ESRs.

3.2.1 Perspective on TD and sustainability research

van Breda and Swilling (2019, p. 824) characterised the TDR approach not as "a new science per se, but rather a new way of doing science." For example, doing "science with society" instead of "science for society" manifests the co-production of knowledge between science and society. Gibbons et al., (1994, p. vii) called this process Mode 2 knowledge production, which guides not only what is produced "but also how it is produced; the context in which it is pursued, the way it is organised, the reward system it utilises and the mechanisms that control the quality of that which is produced." TDR aspires toward knowledge creation that is non-hierarchical, heterogeneous, transient, participatory, socially accountable and reflexive, directed to solve real-world problems (Gibbons et al., 1994). TD methodology is pluralistic and evolving, borrowing and integrating from a fusion of disciplines (Wickson et al., 2006). Koskinen and Mäki (2016) link TD integration of knowledge as a contributor to pluralistic philosophies of science. Hadorn et al. (2008, p. 19) viewed the aim of TDR to: "(a) grasp the relevant complexity of a problem (b) take into account the diversity of life-world and scientific perceptions of problems, (c) link abstract and case-specific knowledge, and (d) develop knowledge and practices that promote what is perceived to be the common good." Simply put, the TDR "pushes scientific research to leave the academic arena with an exclusive academic research culture and aims to search for direct contribution to societal transition by applying co-production of knowledge with non-academic stakeholders" (Vermeulen and Witjes, 2021, p. 27).

Given that TDR involves incorporating knowledge and experience from different perspectives, including non-academic, there is a need to develop the relationships and shared understandings necessary to find shared solutions (Lang et al., 2012). Lang et al. (2012) proposed a three-phase research process. Phase A includes problem framing and team building, phase B includes the co-

creation of solution-oriented transferable knowledge and phase C has re-integration and application of such created knowledge that involves science and society. Similarly, Witjes and Vermeulen (2021) synthesise the proposals for organising the research process by various TD scholars by identifying a six-step TD process, which is: 1. research and strategy, 2. problem exploration and structuring, 3. system understanding, 4. search and compare solutions, 5. choose, decide and prepare for the application, and 6. synthesis and feedback with overall vision and strategy. The authors associate multiple challenges with these steps, which include: the perception of joint-problem framing across disciplines (where identification of knowledge needs and research questions is ideally made with non-academic stakeholders), making sense of various forms of knowledge toward a shared understanding, communicating with diverse stakeholders with multiple interests, applying knowledge co-created to problem-solving and navigating the traditional academic system (Witjes and Vermeulen, 2021).

To contribute to a just and sustainable future, researchers increasingly need to investigate "complex problems that lack definition, have multiple value judgements, lack solutions and resist all attempts to resolve them", characterised as wicked problems (Brown et al., 2010, p. 4). They identify that TDR allows the inquirer and the decision-maker to find solutions together suitable for tackling such wicked problems. Highlighting the need for strong sustainability over weak sustainability, Pelenc et al. (2015) proposed a TD approach to implement strong sustainability (for strong versus weak sustainability, see Dobson, 1996, 1998; Ekins et al., 2003; Neumayer, 2003; Roome, 2012). TDR challenges the limited academic engagement with the real-world by proposing a radical and democratic approach to science. The idea of co-creating systemic, targeted, or transformative knowledge by engaging societal actors and questioning traditional academic ontologies is increasingly popular. However, it is often limited to a niche of TD practitioners.

Scholars have identified characteristics and principles for successful TDR processes. Lang et al. (2012, p. 29) identified three characteristics: (i) the inclusion of various knowledge communities for well-rounded incorporation of essential knowledge; (ii) incorporating knowledge production beyond problem analysis includes diverse goals, norms and vision, and increasing legitimacy, ownership, and accountability for understanding and solving problems and proposing design principles to integrate them and (iii) they identify challenges in the TD process and propose coping strategies. Witjes and Vermeulen (2021, pp. 42–45) synthesised eight principles: Abductive reasoning: reinterpretation and reconceptualisation through the research process guided by hunches, prior academic and non-

academic knowledge Open-minded, multi-actor reflection: collective critical reflection to find solutions for practice and science operating from outside the comfort zones of disciplinary boundaries Iterativeness: critically reflecting on the societal challenge (individually or in a group) to search for the unknown to constantly adapt the process for better outcomes The triple focus: focus on the content, process and implementation encompassing the academic and non-academic components of the research Understanding the bigger problem: using tools like system thinking and multiple actor collaboration to grasp the complexity and wickedness of societal challenges for transformation Multi-level learning: learning from multiple actors using various knowledge sources The long-term full system perspective: understanding and outcomes should have a long term system and sustainability perspective The orchestrated approach: the ability to choose between pragmatic and orchestrated approaches depending on the problem's complexity, wickedness, and urgency. Multiple interpretations, understandings and conceptualisations of TD exist in the literature proposing plural epistemologies. Having a good grasp of theory facilitates the TDR process. However, a researcher must contextualise this knowledge in practice, guided by TD principles.

3.2.2 TD process for ESRs

This section discusses research that explicitly links TDR with ESRs. TDR requires ESRs to (1) engage with (interdisciplinary) academic literature; (2) combine this knowledge with a sector, situation, or practice to create change and (3) design the research to make it relevant, credible, legitimate, and effective (Willets and Mitchell, 2016). Vermeulen and Keitsch (2021) recognise the added societal responsibility to produce socially relevant and implementable knowledge of TD ESRs on top of academic responsibility. However, there is no additional time and resources required for the later part. In addition, ESRs need additional TDR competencies, capabilities and skills to generate societal impact. Such capacities and skillsets for societal change can come at the cost of academic excellence, causing a trade-off (Rogga and Zscheischler, 2021). For academic robustness in TDR, Gaziulusoy and Boyle (2013) proposed an iterative and reflexive heuristic for reviewing and integrating literature across disciplines encompassing visions, values, and norms. However, depending on the researcher's value, time and resources, some might prefer one over the other. Academic robustness could therefore be compromised for prioritising change-making activities.

For instance, compared to conventional PhD, community engagement or implementing identified

solutions for TDR might take time away from focusing on publishing, which is vital for an academic career. Furthermore, Wickson et al. (2006) discussed the hardships of getting TD work peer-reviewed in a context of a not well-established community of peers. Traditional publication outlets focused on the knowledge produced without much importance on the context, process, use of such knowledge etc. (see Gibbons 1994, discussed above), often stripping the TD process. To facilitate TDR, many authors suggest institutional reforms. Felt et al. (2013) identify the necessity of change in knowledge production regimes for TDR to facilitate the additional role of enabling social impact. Based on TD PhD experiences, Rogga and Zscheischler (2021) made a case for new academia to enable interchanging roles of scientists and practitioners by introducing a doctorate program in TDR, especially in sustainability sciences. Sellberg et al. (2021) presented a triple-S heuristic giving attention to science, society and self for a flourishing TDR practice in academia. Witjes and Vermeulen (2021) discussed institutional TD strategy, portfolios or readiness and its influence on TDR. Manathunga (2016) identified supervisory actions to facilitate TD PhDs. Institutions' ability to nurture, support and adapt to TDR is crucial.

Scholars have many suggestions to facilitate TDR. Mitchell and Willetts (2009) show the difficulties of assessing or monitoring progress in a TD process and, given limited time and resources, question the practicality of TD ESR to have a societal impact (2016). Kemp and Nurius (2015) proposed multiple-year training for the TD ESR to build qualities and competencies that enable successful TDR. Such "TD readiness" development involves training covering TD orientation, critical reflection, dialogue, multi-level theoretical architecture, methodological pluralism and team science skills (see Kemp and Nurius, 2015). Similarly, Schrot et al. (2020) found a lack of training causes TD ESRs to use only a small set of existing tools and methods. They recommend lectures on participatory approaches, excursions, hands-on courses, TD mini-projects and toolkits, and even introducing TD elements in the master's studies. Wickson et al. (2006, 1056) proposed six quality criteria for TDR for PhDs: "from clear goals to responsive goals, from adequate preparation to broad preparation, from appropriate method to evolving method, from significant results to significant outcomes, from the effective presentation to effective communication and from reflective critique to communal reflection."

We find diverse interpretations of TDR challenges and multiple ways to tackle them in the literature. Balancing societal impact without losing academic focus, ensuring the right skillset for TDR, and adaptability to navigate academia as required by context is central to TDR practice. Later, we discuss the challenges and how ESRs navigate such challenges.

3.3 Materials and Methods

This article presents two completed PhD projects and one ongoing PhD project as illustrative case studies to provide reflexive insights into ESRs' TDR challenges. The research design was guided by that proposed by Denzin and Lincoln (2017), which encompassed a combination of qualitative approaches, including case study, personal experience, introspection, interviews, observation, and textual analysis.

First, we analysed the two PhD theses, using thematic coding to identify the key challenges and potential coping strategies mentioned in each thesis. These findings were shared with the authors to validate them. Second, we used online semi-structured interviews to interview the authors to learn about their long-term reflection on the TDR process, later integrated into the discussion section. Last, we interviewed the host organisations of the two PhDs to understand the challenges of hosting TD ESRs using semi-structured online interviews. The four interviews conducted in English lasted for forty-five minutes to an hour and centred around TDR challenges. A third illustrative case study in the form of a mid-way reflection of an ongoing TD PhD of the primary author is provided. This account is based on observations, journal entries and reflections on the research process. Data from the thesis transcribed interviews, notes and reflections were analysed to find TDR challenges in the three PhDs to identify six cross-cutting challenges.

The diversity of TDR methodologies and principles used in illustrative cases justifies the case selection. The three PhDs use a variety of TDR processes (methodologies, disciplinary knowledge, etc.) in diverse geographical, institutional and research contexts. All PhDs were driven by the TDR principles of co-creation, problem-solving and integration of science with society. All demonstrate the significance of context and reflexivity in TDR. These PhDs are fairness-driven and solution-oriented. Based on these diverse factors, we argue that the chosen TDR projects provide a basis for sound contextual knowledge for other ESRs to learn from the key TDR insights. Even though TDR is context-specific, insights from one research can be helpful for others (Hadorn et al., 2008). ESRs' TD projects, like the ones discussed, have provided critical insights and enriched the TDR literature (see: Muhar et al., 2013; Rogga and Zscheischler, 2021; Sellberg et al., 2021; van Breda et al., 2016).

3.4 Findings

The first three sections present findings from the PhDs, and the last section brings the hosts' perspectives on TDR challenges.

3.4.1 Illustrative case I - action research in the Netherlands

This section presents the insights from Luz de Lourdes de Pesqueira Fernández's (2014) PhD thesis Friendly Outsider or Critical Insider? - An Action Research Account of Oxfam's Private Sector Engagement as the first case study. Her PhD project follows her action research-based exploration at Oxfam Novib (Oxfam) to explore two things: non-governmental organisations' engagement with the private sector and the role of action research in a scientific inquiry.

Pesqueira's research involved working with and for Oxfam. Over two years, she spent three days a week with Oxfam on her PhD research and one day a week for Oxfam's research activities. Pesqueira worked only one day at the university instead of a conventional PhD working five days. Working with and for the "object of research" provides a relationship-building opportunity to co-create an epistemological community and create embeddedness. In traditional research practices, this closeness to the "subject of the research" could be seen as bringing biases and hindering objectivity. However, her reasoning for this active engagement follows the TDR goals of useful knowledge co-creation and solving real-world problems (de Pesqueira Fernández, 2014, p. 17). Pesqueira describes that the participatory paradigm enhances a democratic dialogue: "co-researchers and co-subjects collaborate to define the questions they want to explore and how they should be explored...the research, then, is not done by researchers on other people, but by people mutually researching each other" (de Pesqueira Fernández, 2014, p. 18). Pesqueira justifies this process as an epistemology of inquiry that generates various knowledge: experimental, presentational, propositional, and practical, in a reflexive process. Nevertheless, Pesqueira also warns about the possibility of being less critical during the engagement and participatory process if one remains unchecked by themselves or their supervisor (de Pesqueira Fernández, 2014, p. 170).

Pesqueira's dissertation uses the first-person perspective instead of a more traditional thesis approach of a passive voice. The first-person narrative allows her to capture the richness and complexities of social interaction, observation, pictures, creativity, reflexivity, and her feelings beyond the scope of the traditional scientific medium. Pesqueira states that "traditional scientific outlets are not broad enough to adequately capture problematisation of social practices, nor the reflexivity involved in action research" (de Pesqueira Fernández, 2014, p. 21). Pesqueira argues that storytelling is central to research validity even at the cost of being viewed as "unsystematic" by a conventional social scientist (de Pesqueira Fernández, 2014, p. 7). One example of where the journal format captures the reflexive and collaborative self-assessment of the impact-oriented process is found early in the thesis:

> "The meeting lasted approximately 90 minutes and was much more formal and demanding than the meeting with SOMO had been. By the time this meeting took place, I had become more aware of the complexity of what I was trying to achieve. Establishing research collaboration with another organisation is actually a demanding process in which questions and approaches must be jointly defined and in which expectations that are relevant for both groups must be met. Besides this, the process also requires dealing with various practical issues related to time frames, financial and technical resources, information access, and confidentiality. (de Pesqueira Fernández, 2014, p. 15)."

Throughout the thesis, Pesqueira reflects on being an outsider at the university and Oxfam. Pesqueira often defends her methodological approach to action research. And reflects, "but even if I was convinced that this was an appropriate way to carry out the research, I occasionally found myself questioning the robustness of the approach, as well as fearing criticisms from colleagues in academia" (de Pesqueira Fernández, 2014, p. 57). Conversely, at Oxfam, her research was sometimes perceived as too impractical, i.e. too academic, making it harder for practitioners to relate. Pesqueira reflects on presenting her analytical framework and conclusions to the team at Oxfam, and she writes, "most people found it difficult to follow my presentation, arguing that the discussion was too abstract" (de Pesqueira Fernández, 2014, p. 87). Elsewhere, she reflects on a remark from an academic colleague about her analysis seeming "like the work of a consultant than a scientist" (de Pesqueira Fernández, 2014, p. 99). Having to please two camps that value different (useful versus scientific) knowledge, finding legitimacy for her research approach becomes an ongoing challenge.

One central dilemma in Pesqueira's research is captured in her thesis title "Friendly Outsider or Critical Insider." In building the epistemic community and maintaining legitimacy, there is a constant need for balancing her two roles (de Pesqueira Fernández, 2014, p. 59). Finding a balance becomes central to her research process. Pesqueira describes this process as "a tension between belonging – being part of the group, securing trust, and becoming involved – or remaining on the sidelines and not being completely part of the world of practice or academia." (de Pesqueira Fernández, 2014, p. 60). This tension directly relates to another challenge, which Pesqueira considers a cognitive gap between the two groups. To bridge this gap between the scientists at Utrecht University and practitioners at Oxfam, Pesqueira communicates and facilitates "to make someone else make sense of the sense one makes of the world" (de Pesqueira Fernández, 2014, p. 99). This process involves communicating her knowledge by writing a report for Oxfam and scientific publications in journals for academia separately. This challenge stems from two factors: (a) traditional academic rigidity with limited space for this messy, iterative research process and (b) explorative research and rigorous academic work that needs to be practical, problem-solving and actionable. Pesqueira reflects on these challenges in her concluding chapter. She questions how much theory is relevant for practice, how much practicality must be incorporated in theory, and where the boundaries begin and end. She reflects on the challenges of finding a balance between being flexible and fixed. Monitoring and defining the success/progress of the research project is not straightforward. She reflects on whether the research is credible to someone who did not participate in the knowledge production process. Despite these challenges, Pesqueira's action research benefits Oxfam from a critical reflection of their work while working with them and for them. Her thesis and two published articles (Pesqueira and Glasbergen, 2013; Pesqueira and Verburg, 2012) during her PhD project enhanced her academic understanding of the NGOs' engagement with the private sector.

3.4.2 Illustrative case II - emergent transformational Design in Burundi

The second case study is Lauren Rosenberg's PhD project on the Burundian speciality coffee sector's sustainability challenges. Rosenberg submitted her PhD thesis titled Turi kumwe (we are together): A transdisciplinary exploration of the Burundian speciality coffee sector and its sustainability challenges to the Faculty of Economics and Management Science at Stellenbosch University in 2017. Rosenberg's thesis focuses on the fuzzy intersection of trade, development, and social justice (Rosenberg, 2017, p. 4)

based on a lived-in experience working at Long Miles Coffee Project (LMCP) as a Farmer Relations Officer in Burundi. Rosenberg follows the emergent transformational design methodology (ETD) (see van Breda et al., 2016) Section 3.2.2), a context-driven TD method. Rosenberg acknowledges the ETD process as an enabler that created 26 full-time employment opportunities for young Burundians during her PhD and contributed to academic knowledge on the speciality coffee sector and TDR (see: [Rosenberg, 2021; Rosenberg et al., 2018]). Rosenberg's research epitomises the Mode 2 knowledge production or "science with society" (Gibbons et al., 1994).

From the onset of the thesis, context plays a central role in unfolding her emergent research. Rosenberg's lived-in experience and work with the coffee company allow emergence, enabling her to co-create transformational knowledge to understand sustainability in the Burundian coffee sector. Rosenberg reflects, "the voices of producers in the literature surveyed thus far are relatively quiet, overpowered by the noise of policy and regulatory documents that expound on the details of certification standards whilst simultaneously competing and debating with each other as to which way is the best way to measure impact" (Rosenberg, 2017, p. 9). In a later chapter, she further reflects, "I have come to understand that sustainable coffee is a learning process embedded in a particular place, not a list of requirements to meet" (Rosenberg, 2017, p. 35).

Lived-in experience enables her to create an epistemic community to unfold the ETD process and evolution of her open research agenda based on the community's needs. Two initial reflections capture her openness, "the day I flew to Burundi and didn't know what was next" and "I wanted to create something that far outlived the duration of the PhD project" (Rosenberg, 2017, p. 14). Reflecting on uncertainties of the process with honesty and admittance of naiveté and hopes is rare in a traditional PhD thesis. Such uncommon lived-in experiences for a PhD can take a toll on the researcher emotionally and physically. She reflects on how adjusting and readjusting to navigating culture shock and research challenges shaped her and, thus, the unfolding of the research. She reflects on research and legal challenges associated with being a foreigner in Burundi, "we spoke for several hours, and I was mostly preoccupied with listening to what was being translated and taking notes as best I could. We went to sleep, only to be woken up sometime in the middle of the night by the police chief and his two guards carrying large guns: they had come to arrest me as I was a foreigner who was staying in the community without permission." Researching in a foreign context can expose one to misunderstandings and

uncomfortable circumstances despite the best interests. Such challenges also shape problem framing, team building and knowledge co-creation.

Like Pesqueira's central dilemma, Rosenberg mentions "participating insider" and "observing outsider" as part of her TD challenge. Her research involves navigating these roles, often with uncertainty and intuition. She views her co-workers as co-researchers (Rosenberg, 2017, p. 16), as the research was with the community and not on the community. This enables her to generate transformative knowledge "rooted in the skills and need of the local culture" while building trust to experiment with interventions that are "provisional, safe-to-fail social experiments that can be adapted to suit changes in the context" (Rosenberg, 2017, p. 17–18). The lived-in experience enables three qualities central to the ETD research: the "logic of hunches…of making connection between things based on intuitive reasoning despite the extremely fallible insight of the researcher" (abductive logic), "creating with that which the context offers…a shift in function of something during evolution" (bricolage and exaptation) and "immersion allows for emergence – opportunities and events that could never have been planned or predicted apart from experience of the context" (allowing for emergence) (Rosenberg, 2017, p. 18–19).

Solving real-world problems is usually not the goal of traditional academic research. Instead, the focus is on a disciplinary or interdisciplinary understanding of the problem, hoping such knowledge leads to change. Thus, such co-created knowledge faces challenges when communicating with academia. Like Pesqueira, Rosenberg struggled to find a place in academia for integrating her research and knowledge. Unlike traditional research, where there is distance and "objectivity" between the researcher (subject) and the researched (object), TDR (tries to) dissolve such divisions. Rosenberg uses a journal format in the first introductory and last concluding chapters with a first-person narrative to capture her research, where she herself, at times, is the "object" of inquiry. She describes it as writing-in (highlighting situated partiality, reflexivity and rigour, insights into the complex emotional process) as opposed to writing-up (distanced position, producing impartial knowledge) (Rosenberg, 2017, p. 192). Comparing her work with other colleagues or relevant authors in the field, she reflects, "my evidence seemed far too anecdotal to matter to anyone apart from the LMPC farmers, LMPC and the community of coffee buyers it works with" (Rosenberg, 2017, p. 194).

Furthermore, she reflects on the evaluation of the TD PhD project compared to disciplinary PhDs.

While visiting a university not necessarily versed in ETD methodology, Rosenberg experiences another dilemma. She recalls, "I experienced a violent collision with the established norms of higher education (inquiry-driven and validated by deductive and inductive logic) at Utrecht University whilst writing this thesis that frequently contributed towards a feeling of isolation and confusion" (Rosenberg, 2017, p. 197). In her concluding chapter, Rosenberg reflects on the insider/outsider dilemma, producing academic knowledge versus solving real-world:

> "I continuously chose to put the formal academic outputs of this research process as a second priority as I was working off the hunch that if the first priority was to contribute towards solving problems in the real-world of the research, the necessary academic outputs would automatically be generated. I was only partially correct in this hunch. It was, and remains, an extremely risky decision to prioritise problem-solving in the real-world above academic outputs as currently, TD doctoral research is not evaluated on the quality of real-world intervention but on the quality of a specific type of written documentation (publications and dissertations) of the real-world intervention. (Rosenberg, 2017, p. 198)."

3.4.3 Illustrative case III—TDR in transboundary waste

This section reflects on challenges in the early phases of TDR (project design, problem exploration, systemic understanding and solution creating) based on ongoing research on the transboundary movement of European waste to China and Nigeria. This section uses the first-person narrative to provide context, process, reflection and present challenges from the author of this article.

I valued and engaged in interdisciplinary learning but only got exposed to TDR during the first-year PhD workshops. Perhaps, it was also my previous impact-oriented experiences working with non-profit sectors that made TDR attractive. Even though my PhD's research questions were fixed, there was methodological flexibility in conducting the research. I dived into the TD literature, and my supervisor, who is versed in TDR, provided support and guidance when necessary.

My institution is based in Europe, and my research is in the Global South. I straddle between these two and their multiple realities for research and life. This also shapes my evolving positionality as a

researcher. To overcome physical, cultural, and epistemological distances, we decided on exploratory fieldwork early on. The plan was to see what was going on, be open and pay attention to what emerged. Both TD literature and my supervisor encouraged "learning by doing." I was navigating unchartered territory in Nigeria and China, even though there was support from local partners. But there were several challenges. After immigration problems, I was picked up three hours late from the airport, and there were conflicting messages about whether to drive in the night to another city because of security reasons. All this in a few hours of arrival. However, I stayed open and navigated using hunches. But I soon realised hunches, which depended on prior experiences, worked best in familiar environments. I was an outsider, and I wanted to fit in.

I am unsure how much I have "fitted in" upon reflection. There is no matrix to measure it. In China, I built a social network of colleagues. But my research progress was slow. China was one of the biggest e-waste importers until the national import ban in 2018. I did two "field visits" in 2 months, limited to interviews without facility tours. The university connection facilitated both visits. My planned visit to Taizhou and Guiyu, cities famous for e-waste recycling, were never approved by the local government. Visits without government support and speaking with residents through a translator only provided simple anecdotal glimpses. I interacted with researchers I met during conferences but still lacked opportunities to connect with essential stakeholders. Most of my limited interactions suggested that e-waste import is strictly prohibited and is no longer a problem. Of course, things would have been better if I had spoken Mandarin and had more connections to navigate the socio-political spaces. The "exploratory" seemed to be missing from my exploratory fieldwork.

My second fieldwork was in Nigeria shortly after the China visit. Although it was August, I was cold and shivering with a fever on my second day in Nigeria. With mosquitoes in my hotel room, fear of yellow fever was constantly on my mind until I got vaccinated. I could not spend my research time being sick. I was in Nigeria, one of the leading European e-waste receivers, for only one month. Luckily, I soon recovered. Support from the host university, a weeklong internship at the Basel Convention Regional Centre and an academic conference introduced me to more stakeholders. A month's stay in Nigeria led to 12 interviews, six field visits, and numerous engagements with various stakeholders. In terms of the TDR process, I 'fitted in' more than in China. It led to future research plans and consortiums, later adapted online due to the COVID-19 pandemic.

The embeddedness of researcher(s) allows relationship building, emergence and progress in research. Despite embeddedness in Nigeria, one challenge was to incorporate the informal sector, which plays a central role in waste management in Nigeria. The informal sector is already marginalised in society, and voices, if heard at all, are often represented by others, not themselves. Our research initially aimed to research with them as integral stakeholders instead of for them. However, establishing any connection, let alone trust, and creating safe spaces, was challenging without embeddedness in the informal sector. Planned follow-up research visits for better embeddedness could not occur due to the Covid-19 lockdowns. Online research restricted in-person visits, which are more conducive to relationship building. We compromised by working with stakeholders online who worked closely with the informal sector and represented their voices.

In our research, socially useful knowledge creation involved continuous negotiation among actors with unequal power or diverging views together (for example, government and the informal sector view each other as a nuisance). Otherwise, it would lead to unjust or unrealistic solutions. I had to facilitate trust-building by creating safe and creative spaces for my research to progress. So, I took the Art of Hosting workshop and hoped to design safe co-creative spaces. Online was a challenge to reach participants without reliable internet, but it also meant I could ask my colleagues to support me for a few hours, irrespective of where they were based. Co-creation created legitimacy but was time and resource-consuming, dragging the research longer than planned. I had to learn new skillsets that I could not easily learn in a university, like hosting workshops, writing scientific findings for stakeholders, etc. Chambers et al. (2021, p. 983) put the compelling promise of co-creation for "developing solutions through legitimate processes that draw on diverse and credible expertise with, by and for those best placed to use them" but also warn about the unique challenges and trade-offs.

Navigating embeddedness in new socio-cultural reality presented challenges, some more easily navigable than others. For instance, I could quickly adapt to the varied sense of time; for example—meeting at nine meant meeting at half past nine or ten, and a one-hour drive meant 2 hours. Others were difficult. In parts of Nigeria where kidnapping is common, my movement was restricted due to security reasons. During the field visit to the public market in Computer Village in Lagos, some locals questioned, threatened, and surrounded the car of the research team with us inside until a "tax" was paid. Exposure to inhuman conditions around me triggered strong emotions. Both pleasant and unpleasant

experiences developed embeddedness and cultural competence. I learned that embeddedness, a critical ingredient to building trust, could occur in planned and unplanned situations if one is open. Lunch breaks and the local extreme traffic jams were also opportunities for embeddedness.

We constantly adapted the research as dictated by the context. Primarily our research focused on e-waste flows (illegal but ongoing) from the EU. As research progressed, we incorporated secondhand imported goods and their domestic usage. We found that problem-solving circular strategies like reuse can exacerbate the same problem. Varied socio-political contexts led to nuanced and diverse interpretations of the same phenomenon. For instance, some viewed imported secondhand goods usage in Nigeria as an enabler for digitalisation and transformation. Others saw secondhand imports as a loophole to dump waste and hurt Nigerian ingenuity and innovation. We learned that the Nigerian government was creating an extended producer responsibility (EPR) system for e-waste. We then adapted our research to co-create knowledge useful for future Nigerian EPR. We sought tools for consensus-building and public deliberation to add sociopolitical legitimacy to our research. We decided to set up an online petition addressed to the governments of Nigeria and the European Union based on our research. The petition outlined the problem and the potential co-created solutions addressing how the governments could (try to) solve the e-waste problem while empowering the informal sector.

3.4.4 Perspectives from the host institution

In doing sustainability science with society, it is necessary to incorporate practitioners' perspectives on TDR. We conducted two separate interviews with LMCP and Oxfam, who hosted the two completed PhDs. LMCP is a small and young social entrepreneurship venture aiming to provide quality coffee for roasters while improving farmers' lives. Oxfam is a major international non-profit organisation that focuses on alleviating global poverty and operates in 20 countries.

Even though these are vastly different organisations, they were clear about their expectations from hosted researchers and the critical academic perspective an academic researcher would bring to their practice. These expectations were solely based on the host's needs, which meant navigating these and creating values for the hosts would be challenging for TD ESRs, especially if not aligned with their research goals. From these interviews, clear communication about expectations was important and must be incorporated into the relationship-building process.

There was a consensus that working in the sustainability field is not always a clear path. One interviewee described being on board with a host organisation as "sitting in the backseat of the car", where the researcher is part of the journey but might not have the control to take over and steer the car. Furthermore, the journey might be pleasant and unpleasant, in which case openness is essential. For TD ESR, openness and agility were necessary qualities to work and integrate with a small disruptive institution or a large multinational institution. During the interview, terms like "go with the flow", "operating from an insecure place", and "not part of a controlled experiment" were frequently used. At the same time, the process of working together was often compared to the act of "dancing together."

While it was clear from the interviews that academic background helped bring some legitimacy to the researchers and their TDR, the practitioners were more interested in creating useful knowledge and change-making for themselves. Maintaining academic legitimacy meant adding value to the institution by fulfilling hosts' needs critically. Fulfilling these needs involves solving a real-world problem, but these are usually not part of the research assessment. As the focus is on change-making and not necessarily knowledge creation, academic outputs are not part of the hosts' needs. Unless the needs and roles of both the researcher and the host are clear, TDR remains challenging and might compromise legitimacy. The interviews reveal how joint problem framing and solving, as acknowledged widely in the TD literature as the crucial first step, was not the case from a host institution's perspective. In both cases, critical (academic) eyes to get things done for the host organisation were their primary motivation to work with academia. Even though the host organisation valued academic criticality, academic work was secondary to their needs. In one case, academic research was seen as a "weekend task" for the PhD.

One role of the TD ESR in navigating the seemingly disconnected reality between academia and practice is to act as the connector. Such a role needs the skillset and capacity to create critical knowledge for academia and useful knowledge for the practitioners, which brings several challenges like integrating, teamwork, relationship building, facilitating, navigating politics and uncertainty of the co-creation process. Having an open and equal collaborative process from the start helps facilitate clearer roles and goals and enables the researcher to navigate challenges and be the connector between academia and practice.

3.5 Discussion

The illustrative case studies identify six challenges faced by the TD ESRs in sustainability science, presented in Figure 3.1. TDR challenges are often classified as inherent (challenges arising from the nature of the TD process), institutional (systemic challenges emerging from institutions' structures and processes), teamwork (emerging from working within academic and non-academic actors) and emergent (emerging from project-related uncertainty) (Gaziulusoy et al., 2016). These challenges are interconnected, overlap, and influence each other. We will discuss the challenges in the research context and link them to the literature as needed. We find TDR experience, TDR design, TD mindset, toolkits, peer-learning and team support essential to navigate these challenges.

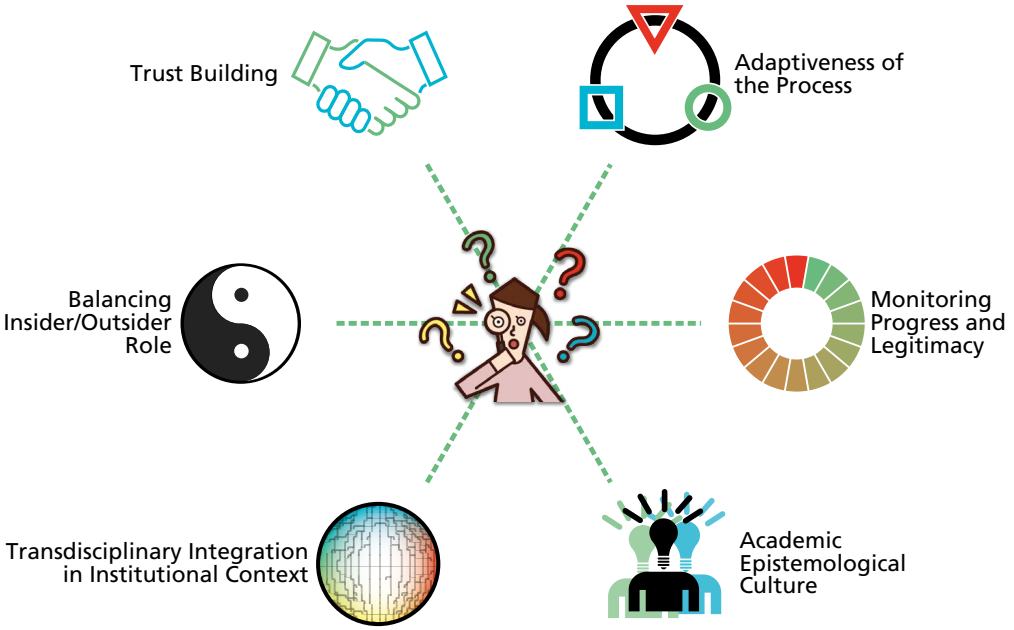


Figure 3.1 The six often interconnected challenges faced by a TD ESR engaged in sustainability sciences

3.5.1 TD integration in the institutional context

Successful TDR depends on the institution's capacities to enable and host the process. Well-integrated institutions might have existing project portfolios, practitioners, or an open attitude (Witjes and Vermeulen, 2021). The institutional context was highlighted in the interviews. Stellenbosch University's strong history of ETD enabled Rosenberg's project. As a visiting researcher at another university without ETD integration, she feels "isolation and confusion." Pesqueira reflects that a combination of her supervisor's openness to TDR and a fully-funded PhD by the Mexican government enabled TD research. Even with some TD integration, Pesqueira constantly defended her action research as scientifically legitimate to her academic peers. She created multiple outputs of the same research to fulfil academic, practitioner and societal expectations, often requiring double and triple work. Having additional responsibilities was also shared by Rosenberg. To enable TDR, an institution must be open to a plurality of epistemologies (including non-academic), have training and support for ESRs, and integrate non-academic output or social impact as evaluation criteria, especially in sustainability sciences. There are systemic challenges beyond one ESR to overcome, and TD scholars have called for institutional change (see Section 3.2.2), which takes time. For TD ESRs in institutions without much TD integration, some ideas to navigate this challenge includes inviting TD researchers in their PhD committee, seeking out, engaging and learning from TD networks and advocating TD integration at the institution whenever possible.

3.5.2 Academic epistemological culture

All PhD cases highlight the institutions' narrow and rigid epistemological rigidity without TD integration. In the illustrated cases, we saw that non-academic actors could produce a variety of knowledge, practice can also shape theory, and knowledge can be partial and reflexive and sometimes not necessarily true or legitimate for everyone. Pesqueira and Rosenberg reflect limited spaces for anecdotes, reflections, uncertainties, biases, hunches, reflexivity, and emotions in academia—which can be central to knowledge co-production. They talked about "slimming down" the slow, messy, uncertain, and often hunch-driven TDR process to fit traditional academic publishing to meet the publishing requirements. They both mentioned process, context, and role of epistemic community, all important in TDR, were stripped down to focus on "data" and "results" to participate in the "publishing

game." As discussed earlier, learning new rules for playing such a "publishing game" might create a trade-off between societal impact and science. Without TD epistemological culture, an ESR needs to plan and even "play the game" to navigate this institutional challenge.

3.5.3 Adaptiveness of the process

Guided by an open and adaptive plan and operating from hunches are often seen in some cases as non-scientific. However, openness and adaptability are central to the TD process. Hertz and Mancilla Garcia's (2021) view intuition or tacit knowledge as an alternative tool to understanding the socio-ecological phenomenon. In PhDs, the research and its strategy evolved with context and uncertainties. Reflecting, integrating uncertainties and adapting became part of TDR. It helped navigate challenges like: how much social impact can a project have? How much ownership/control of the project is too much to enable co-creation? Answers are often context and intuition-driven. Adaptiveness requires ESRs to be open to integrating theories from diverse disciplines but also to revisit theories based on practice. Wickson et al. (2006) talked about TD praxis, where theory and practice co-evolve and thus integrate or resonate. Knowledge is created in the past and is often static, but the reality is dynamic, so ESRs should be open to the limitation of knowledge. In all cases, ESRs depended on adaptiveness to make sense of the complex dynamic real-world problem. Pesqueira talks about being flexible and fixed. Being flexible requires both learning and unlearning, learning about various theories and letting go of them to make sense of reality and learning by doing.

3.5.4 Balancing insider/outsider role

Balancing insider/outsider roles is a central challenge in the TD literature and the illustrative cases. Being "too academic" for societal actors and "not academic enough" for academic actors is discussed in both completed PhDs. In all cases, the embeddedness of the ESR in the epistemic community and finding a way to balance these roles was considered crucial to navigate this challenge. Both Pesqueira and Rosenberg spent most of their PhD with the hosts, which enabled community building. Both PhDs reflected that embeddedness and balancing act should be purposefully built into the research design. Some suggestions included having clear roles and boundaries to be identified collectively with room for adaptiveness during the team-building and problem-framing phase. Such clear roles enable the ESR

to facilitate and connect academia and practice. Whitmayer and Schäpke (2014) identified multiple functions of a researcher in process-oriented sustainability transition, including change agent, knowledge broker, reflective scientist, self-reflexive scientist and process facilitator and recommend complementary integration of roles for navigating challenges. Multiple ESR functions create various roles within the insider and outsider roles. For instance, Rosenberg finished her dissertation, fulfilled her duties at LMCC and created 26 full-time jobs as part of her TDR. van Breda et al., 2016, p. 159) proposed a "reflexive 'double-loop' learning experience" to navigate the researcher's academic and societal role. Witjes and Vermeulen (2021) addressed this dilemma by introducing the triple focus (content, process, and implementation), open-minded multi-actor reflection and orchestrated approach (see Section 3.2.1).

3.5.5 Monitoring progress and legitimacy

Progress and legitimacy are systematically measured using publications and citations etc., in academics. However, academic engagement with society lacks such a framework, even though societal engagement is increasingly seen as important. Compared to a traditional ESR, measuring the progress and legitimacy of a TD ESR might not always be straightforward. Mitchell and Willetts (2009) (see Section 3.3.1) discuss the difficulty of assessing TDR. For a TD ESR, there are challenges associated with measuring societal progress. They can take longer than the duration of research. Some solutions might have unintended consequences. The measuring framework should also encapsulate varieties of ideas about the progress of the (non-academic) stakeholders. Such a framework should accommodate spaces for openness and adaptiveness inherent in TDR. We found that such frameworks were missing in all cases. Both completed PhDs mentioned feeling unsure whether they were doing enough or doing the right thing during research.

3.5.6 Trust building

van Breda et al., 2016 discussed how "TD epistemic communities" emerge from the process of the ESR carefully building relationships with societal actors vital to TDR. Building such a community requires time, resources, capabilities, openness, emergence etc. Both Pesqueira and Rosenberg worked with and for the host organisation, which enabled the emergence of an epistemic community. Trust building

with the Nigerian informal e-waste sector was impossible due to physical distance and lack of contact in the ongoing PhD. This also barred the ESR from having an "insider" perspective, which is critical in the other two cases, hurting the inclusivity of the research and the outcomes. The research still focuses on the informal sector, but ironically without their engagement, as planned. Trust building, a continuous and challenging process, is central to TDR. With limited experience, establishing and then gauging "good enough trust" is challenging. Trust cannot be measured; one has to rely on hunches. Sometimes they work, sometimes they don't. Additionally, a TD ESR must also facilitate trust-building, among others.

3.6 Conclusion

This article explored the challenges of doing TDR from the perspective of the ESR. TDR is increasingly seen as a societal problem-solving path in the context of social and ecological crises and might attract future ESRs. However, ESRs, with limited prior experiences face challenges when doing TDR. This article identifies and discusses six significant challenges based on three PhDs (two completed and one ongoing). These challenges are (i) institutional TD integration, (ii) academic epistemological culture, (iii) adaptiveness of TDR, (iv) balancing roles, (v) monitoring progress and legitimacy and (vi) trust-building. These PhDs use diverse academic ideas and have unique contexts, yet the insights and learnings from their experiences can be useful to other TD ESRs.

We recommend the following to navigate the challenges. Start small. The challenges can be intimidating. Get your feet muddy and manage expectations. An ESR project is one process of a longer TD journey enriched by smaller experiences. Ask for help. TDR is not an individual undertaking. Ask your supervisor, people in your network or the TD researcher community who have more experience. Although TD research styles and tastes differ, there is a shared understanding of working with societies to solve social problems. Borrow ideas from everywhere. Explore literature and research from other disciplines that could make sense and shape your research. Consider going beyond disciplinary walls. Build communities and share experiences. It can bring diverse epistemologies and enable pathways for TDR integration in academia. We discussed the importance of epistemic communities for TDR for navigating multiple project-specific challenges. Similarly, TD communities can help researchers navigate TDR challenges. We encourage past ESRs who learned by doing to share their experiences with others, not only your results. We recommend supervisors and TD teams to promote and facilitate peer learning. PhD dissertations are not always easy to find, and reading a dissertation can be daunting. We encourage TD PhDs (and experienced researchers) to share their reflections or thesis chapters as academic papers, blogs, and podcasts, making their work easily accessible to the community. Balance is essential. The TD ESR needs to juggle academic, social-stakeholder, facilitator, researcher, organiser, and creator roles to connect academia, society and oneself. Knowing when to be flexible and when to be fixed is crucial. We suggest deliberately designing TDR projects to facilitate the various roles of the ESRs. Last, challenges are part of the process and provide learning opportunities. Like in Zen, the obstacle is the path.

CHAPTER 4

How circular is your tyre: experiences with extended producer responsibility from a circular economy perspective

“We can't solve problems by using the same kind of thinking we used when we created them.”

— Usually attributed to Albert Einstein

This chapter is based on Campbell-Johnston, K., Calisto Friant, M., Thapa, K., Lakerveld, D., and Vermeulen, W. J. V. (2020). How circular is your tyre: Experiences with extended producer responsibility from a circular economy perspective. *Journal of Cleaner Production,* 270, 122042. https://doi.org/10.1016/j.jclepro.2020.122042

Abstract

The circular economy (CE) emphasises closing material loops to retain material value. The current practice of tyre recycling in the Netherlands, through a system of extended producer responsibility (EPR), appears an overwhelming success, with claims of 100% recovery. Yet, there is limited critical understanding regarding the system's circularity, considering alternative value retention options and resource recovery outcomes. This study analyses this Dutch tyre EPR system and reflects on how it can be improved from a systemic CE perspective. It uses a qualitative case study approach, using interviews and a review of policy, legal and EPR reporting documents. This paper assesses the governance of this sector and reflects on the existing system, including its circularity and value retention outcomes. Our analysis reveals seven central issues concerning how the EPR system currently functions, resulting in limited circularity and sustainability outcomes, despite high material recovery levels. To address these issues, we recommend the continuous improvement of recovery and sustainability targets beyond a single product life cycle, a more transparent and inclusive governance system, as well as a greater focus on sufficiency strategies, e.g. design for durability and a broader transformation of transport models. This paper adds a practical understanding of the capacity of EPR to contribute to circular economy.

4.1 Introduction

National, regional and local governments have recently begun to present the concept of circular economy as a new pathway to sustainability and economic prosperity. The championing of this inconsistent and contested concept (cf. Korhonen et al., 2018b) comes amid increasing concerns over resource depletion, waste generation and the potential overshoot of planetary boundaries induced by human activities on the biosphere (Henckens et al., 2014; Rockström et al., 2009a). Circular economy is broadly argued to meet these emerging challenges through slowing, closing and narrowing resource loops, i.e. maximising the functional utility of materials and energy (Geissdoerfer et al., 2017; Stahel, 2010a). Circular economy theoretically builds upon and goes beyond earlier measures of waste valorisation and cleaner production initiatives to an integrated systems perspective addressing both production and consumption practices (Ellen MacArthur Foundation, 2013; Vermeulen et al., 2018).

The European Commission (EC) frames circular econmy in conjunction with economic opportunities stating that "[CE] will boost the EU's competitiveness by protecting businesses against scarcity of resources and volatile prices, helping to create new business opportunities and innovative, more efficient ways of producing and consuming" (EC, 2013, p. 1). National governments have similarly outlined specific strategies, including the Netherlands, France and Italy; with the Netherlands setting an initial target of 50% less primary material use by 2030 (Ministry of Infrastructure and Environment and Ministry of Economic Affairs, 2016b). Whilst the environmental and economic concerns underpinning circular economy might be perceived as new, the means through which they are being addressed are manifesting through more conventional or longer-standing organisational practices, including increased recycling targets, waste legislation and extended producer responsibility (EPR) commitments (Milios, 2018).

Scholars have devoted much time to analysing new business models and strategies related to circular economy (cf. Bocken et al., 2016; Lüdeke-Freund et al., 2018). Yet, there is also a need to reflect and examine these older circular economy initiatives and practices to understand their suitability and capacity to facilitate and address the emerging societal concerns evidenced within the existing circular economy debate.

One such system is EPR, which has been collectively and voluntarily adopted in many EU member states for different products, including passenger car tyres (EC, 2014). EU member states are free to choose how to organise the collections and treatment of tyres, which are reported to the European Tyre and Rubber Manufacturers Association (ETRMA); most member states have adopted EPR systems, which have successfully recovered high quantities of used tyres (recovery rates for end-of-life (EOL) tyres in Europe are above 90% since 2007) (ETRMA, 2017; ETRMA, 2018). However, despite such high levels of recovery, there is little direct substitution (closed-loop), i.e. new tyres have a low content of recycled rubber (EC, 2017). Indeed, up to 50% of collected tyres are burned – usually, for energy recovery (Scott, 2015) – a problem further compounded as natural rubber is a designated critical raw material (EC, 2017). Whilst the technological feasibility of such direct material substitution through devulcanization is being debated and explored (Myhre et al., 2012), there is a broader question about the organisation and performance outcomes of EPR as an older circular economy system to meet emerging societal challenges.

Previous research on EPR and tyre recycling in the EU has examined the various treatment options (Torretta et al., 2015) and progress across member states, including the steady departure from landfilling. Alternatively, Winternitz et al. (2019a) examined the EPR systems of three European countries, reflecting on their varying policy approaches, successes and potential limitations. Their findings demonstrated that an EPR system does not necessarily guarantee that waste tyres are disposed of in the most environmentally beneficial manner. Similarly, Lonca et al. (2018) examined the trade-offs of increased material circularity of tyres, contracted against other sustainability indicators, e.g. human and ecosystem health. Their research found that increased material circularity is beneficial from a resource perspective, but not necessarily from other environmental perspectives (Lonca et al., 2018). Such research adds to the complexity of organising disposal systems in a dynamic way that accounts for potentially conflicting issues within EOL processes.

Building on these examples, this chapter aims to critically examine the organisation and performance of an existing EPR system, to reflect on its strengths and suitability to deal with the broader needs within the contemporary circular economy debate. Based on this, we examine the question "how effectively do current ERP systems function from the current ambitions of circular economy?" We use EPR for tyres in the Netherlands as a case study to explore this question. This chapter, therefore, adds

a practical understanding of the contribution of EPR to circular economy and provides insights for new and existing EPRs globally.

This chapter is structured as follows. First, a literature review of circular economy, EPR and tyre treatment practices is presented to further contextualize the analysis (Section 4.2). Next, the research methods are presented (Section 4.3). This is followed by a description of the structure and outcomes of the EPR system for tyres in the Netherlands (Section 4.4). Our analysis (Section 4.5) builds on these results, showing the limitations and challenges for EPR systems to lead to a sustainable circular economy transition before concluding (Section 4.6).

4.2 Literature Review

4.2.1 Circular Economy: Origins, History and Implementation

While the circular economy concept itself dates back to 1990 (Pearce and Turner, 1990), the idea builds on a long history of literature on resource limits and ecological transformations such as the "Limits to Growth" (D. H. Meadows et al., 1972), the "Tragedy of the Commons" (Hardin, 1968b), the "Economics of the Coming Spaceship Earth" (Boulding, 1966b), "Small is Beautiful" (Schumacher, 1973) and "The Closing Circle" (Commoner, 1971b).

More recently the circular economy has drawn its theoretical underpinnings from Industrial Ecology (IE) (Aryes, 1989; Saavedra et al., 2018), cradle-to-cradle (McDonough and Braungart, 2002) and performance economy (Stahel, 2010b). The concept of circular economy is muddled and convoluted but is broadly based on the premise of retaining the functional use of products and materials within the economic sphere as long as possible. It is being advocated, in particular, by private sector consultancies, e.g. the Ellen MacArthur Foundation (UK) and Circle Economy (NL). Estimates suggest the cumulative outcome of earlier circular economy policies has resulted in the (re)cycling of as little as 6% of global materials, and 12% within the EU27, leading to a greater focus on increasing the value retention of material throughput (Haas et al., 2015).

The circular economy is also discussed as an evolutionary concept (cf. Blomsma and Brennan, 2017; Reike et al., 2018). Of particular importance for our analysis are the three phases of the circular economy concept proposed by Reike et al., (2018). First, CE 1.0 (1970 to 1990), is characterised by early waste management practices focused on waste output as an environmental pollution problem to be dealt with through EOL policies. This is when waste treatment and incineration plants started to be developed and operated, especially in the Global North.

The second phase CE 2.0 (1990 to 2010), saw the development of many "win-win" strategies, which make use of waste outputs as valuable resource inputs such as IE (Frosch and Gallopoulos, 1989), Cleaner Production (Fresner, 1998), Industrial Symbiosis (Chertow, 2000b), Product-Service System

(PSS) (Goedkoop et al., 1999), and EPR (Davis and Wilt, 1994). This is when the concept of circular economy was first coined by Pearce and Turner (1990) and when associated ideas appeared, such as "biomimicry" (Benyus, 1998), "cradle to cradle" (McDonough and Braungart, 2002), and "performance economy" (Stahel, 2010b). This period also saw the widespread implementation of integrated waste management and recycling systems in the Global North, including EPR systems, which mandated new responsibilities for private sector actors (Reike et al., 2018b).

The third phase of CE 3.0 (from 2010), when discussions of the concept of circular economy became more widespread and began to be framed against encroaching societal threats, including planetary limits (Rockström et al., 2009), resource depletion, biodiversity loss, excessive waste generation etc. (Reike et al., 2018b). This has led to a more integrated and holistic understanding of material use, which aims to slow, reduce, narrow and close resource cycles in a systemic manner through changes in consumption and production structures and patterns (Reike et al., 2018b). However, this is also a period where varying visions of circular economy are conceived, which are either transformative or reformist depending on their position regarding the capacity for capitalism to overcome resource limits and decouple ecological degradation from economic growth (see Reike et. al., 2018; Friant et. al., 2019).

The implementation of circular economy -related activities and policies occurs in a variety of geographic contexts and scales. Circular economy practices thus range from national programmes, e.g. China's 2009 circular economy 'Promotion Law' or international policies, e.g. the EU's 2015 circular economy 'Action Plan' (Ghisellini et al., 2016), to business models and individual company strategies (see Lüdeke-Freund et al., 2018). Scholars have sought to define circular economy activities through the potential value retention options that can be initiated throughout a product or material lifecycle, commonly described as the R-hierarchy. These range from 3Rs (Reduce, Reuse and Recycle) to iterations from four to ten. A recent review of 69 such R-imperatives outlined a synthesis of 10 comprehensive value retention options, which we adopt as our conceptual framing (Reike et al., 2018b). Whilst the narrative and framing around circular economy articulates its "newness", much of the EU policy approach follows or seeks to build upon older circular economy practices (EC, 2013; cf. Gregson et al., 2015; WFD 2018/851, 2018).

4.2.2 Extended Producer Responsibility

One such older circular economy practice is EPR, which is defined as "an environmental protection

strategy to reach an environmental objective of a decreased total environmental impact from a product, by making the manufacturer of the product responsible for the entire life-cycle of the product and especially for the take-back, recycling and final disposal of the product" (Lindhqvist, 2000, p. 37). Crucially, the concept implies integrating responsibility in the whole product life cycle, where the physical and monetary waste managerial responsibilities (usually assigned to authorities and consumers) are transferred to the product producers.

EPR emerged in the 1990s, building on the experiences of waste managers, recyclers and a policy approach concerned with promoting cleaner production initiatives (Lindhqvist, 2000a). Such developments illustrated the more proactive role private sector actors played in these earlier circular economy systems, giving them greater responsibility for the stewardship of their products. Such 'public-private' configurations represented new steering programmes practised by governments, as opposed to the conventional waste management policy of earlier years (CE 1.0) (Reike et al., 2018b; Vermeulen and Weterings, 1997).

EPR builds on the "polluter pays principle", incentivising producers to prevent waste generation, whilst (supposedly) encouraging eco-design and supporting the appropriate EoL processes, e.g. promoting recycling and reusing activities (Deutz, 2009; Ferrão et al., 2008). However, previous studies show EPR activities are overtly focused on EoL activities, negating an integrated lifecycle perspective that pursues continuous improvement and higher environmental performances through, for example, material choices and design for disassembly options (Vermeulen and Weterings, 1997). The EU has mandated the responsibility of producers for the EoL disposal of vehicles, batteries and accumulators, and waste electrical and electronic goods, whilst most member states have additionally implemented a producer responsibility organisation to process used tyres (Deutz, 2009; EC, 2014; ETRMA, 2015). Member states must ensure their EPR schemes have an appropriate collection and accessible schemes. Alternatively, EPR has also been adopted in various countries in the Global South as a product management tool for EoL tyres (Banguera et al., 2018; Zarei et al., 2018). However, recent studies have illustrated the challenges of adopting EPR in these countries. Such challenges include the limited knowledge of effective practices in Botswana (Mmereki et al., 2019), incentivizing and integrating necessary actors in operations in Colombia (Park et al., 2018), and directly transposing a European policy tool to Brazil (Milanez and Bührs, 2009). Conversely, Cecchin et al.'s (2019) study in Ecuador

highlighted the potential of integrating social economy goals with conventional EoL practices associated with EPR.

EoL processing in EPR systems can be organised in various ways. Spicer and Johnson (2004a) outline three approaches to implementation: (1) 'Original Equipment Manufacturer' takeback, where the original producer takes direct responsibility for collecting and processing; (2) 'Pooled Takeback', where responsibly is shared between a consortium of producers, known as the producer responsibly organisation (PRO), usually organised by a product category code, e.g. tyres; and (3) 'Product Responsibility Providers' (PRP), where a private third-party is contracted by the PRO and assumes EoL responsibly for the product on their behalf. This (theoretically) results in dual benefits for manufacturers and the general public, including, eliminating the financial risk associated with complex EoL processing activities (recycling, incineration, disassembly, remanufacturing, refurbishing etc.). Governments are responsible for rewarding and motivating good behaviour. Key regulatory aspects of an effective EPR system include formulating long-term objectives, fostering continuous improvements and updating targets, e.g. future scenarios, whilst encouraging frontrunners and compelling laggards (Vermeulen and Weterings, 1997). Public benefits include distributed local demanufacturing facilities and immediate economic feedback to product design, driving improvements (Spicer and Johnson, 2004). Challenges for local demanufacturers include knowledge of the original product blueprints, which producers can be unwilling to transfer, and finding suitable markets for recyclable materials. Earlier studies argued that this collective responsibility will weaken the eco-design drive of individual companies (Castell et al., 2008). Next, we document the characteristics and treatment options for tyres.

4.2.3 Composition and Treatment Options for Tyres

Rubbers are thermosetting materials, which makes material recovery challenging because of the vulcanization process during manufacturing (see Adhikari et al., 2000; Medina et al., 2018). Pneumatic tyres are a combination of synthetic and natural rubber, carbon black, elastomer compounds, steel chords, and textile fibres in addition to several other inorganic and organic compounds (Torretta et al., 2015). Natural and synthetic compounds act as sealants while fibre and steel chords give structure and carry tension (Feraldi et al., 2013).

There are several principal treatment practices for EoL tyres (see Table 4.1). First, product reuse (R2), which involves the direct sale of a tyre whose tread is still deep enough for safe use (the minimum tread depth is 1.6 mm in the EU). Second, retreading (R5), which involves replacing the outer tread of a tyre, when its general condition is insufficient. Repurposing (R6) is the reuse of a tyre for alternative uses, for which it was not originally designed, such as protection of racing tracks, materials for artwork, swings etc. Grinding (R7), involves the crushing and granulation of tyres to extract rubber and other components, such as steel and textile fibres (Aiello et al., 2009; Landi et al., 2018a, 2018b). Grinding produces rubber that is of relatively low quality, meaning only a small percentage (1-5%) can be used in new tyres. Devulcanization (R7) is a technological process where the rubber is chemically recycled to obtain higher quality rubber that can be used in higher percentage in new tyres (up to 30%) (Myhre et al., 2012). However, this technology is not yet commercially viable and has not been deployed on a large scale (Saiwari et al., 2019). Pyrolysis (R8) uses high temperatures (without oxygen) and chemical additives, for the recovery of energy, carbon black, activated carbon, oil and steel from EoL tyres; if well managed the process can have relatively low emissions (Myhre et al., 2012; Myhre and MacKillop, 2002; Sienkiewicz et al., 2012). Finally, incineration (R8) involves the burning of tyres with oxygen for the recovery of energy (often for cement kilns and other industrial furnaces); this process is less complex than pyrolysis but creates a significant amount of greenhouse gases and other air pollutants (Myhre and MacKillop, 2002).

Whilst the notion of the 'R-hierarchy' might presuppose a prescriptive and preferable set of recovery operations, these only relate to the product or material attributes and do not account for contextual and broader systems factors, e.g. energy recovery; this might mean a lower R-strategy, could be preferable under some contexts and conditions. Deciding on the most effective treatment option can usually be ascertained through conducting a life cycle assessment (LCA). Various studies have explored this exact question in different national contexts (cf. Corti and Lombardi, 2004; Clauzade et al., 2010; Li et al., 2010; Fiksel et al., 2011; Feraldi et al., 2013; Ortíz-Rodríguez et al., 2017).

Table 4.1 R-hierarchy for tyre treatment

R	Treatment Options
R0	Refuse via reducing vehicle ownership and using alternative modes of transport;
R1	Reduce via life extension
R2	Resell/Reuse discarded tyres which are safe and functional
R5	Remanufacture by retreading functionally sound discarded tyres
R6	Repurpose without or using less physical or chemical treatment
R7	Recycling via processes including devulcanization and grinding.
R8	Recovery of energy via pyrolysis or incineration

There is a broad consensus that energy recovery as fuel can only capture up to 40% of the embedded energy within tyres (Amari et al., 1999). However, these assessments differ in terms of geography and scope, are non-standardised, hard to compare and, overall, they show conflicting and inconsistent outcomes. This points to the need for more standardised impartial regional (Social)LCAs, attributional and consequential, with local data, that can inform specific EPR systems as to the most preferable recovery and treatment option.

New circular economy business models of the 'performance economy' such as Product-Service Systems (PSS), that promote the leasing of products, services or performance instead of direct consumer ownership could facilitate high-value retention options (Camilleri, 2018; Kjaer et al., 2019b; Stahel, 2010b). Indeed, firms that maintain the ownership of their tyres are incentivised to design long-lasting (R1), reusable (R2), recyclable (R7) and retreadable (R6) tyres. However, this is not always the case, and strong regulation and careful management of possible rebound effects are needed to ensure that PSS lead to positive environmental outcomes (Demyttenaere et al., 2016; Hobson and Lynch, 2016; Junnila et al., 2018b).

4.3 Materials and Methods

To evaluate the organisation and performance of an EPR scheme, this research adopted a case study research design, following procedural insights as outlined by Yin (2003). Case studies are defined as an in-depth description of a bounded system and are useful to examine phenomena in their contextual settings; they are particularly adept to understanding contemporary events (Yin, 2003, p. 5). Case studies are suited for qualitative methods, including those used in the study: interviews, literature review, policy and document analysis (Bryman, 2012).

This research uses the case study of EPR of tyres in the Netherlands, a system which has been in operation (to some degree) since 1995. This case selection was justified through two core reasons: (1) the Netherlands has, since 2005, had a high collection rate (≥ 100%) (ETRMA, 2015); and (2) the Netherlands has a substantially higher level of material reuse (e.g. direct reuse and recycling) than the European average, which is roughly 50% recycling and 50% energy recovery (Scott, 2015). This second point corresponds to the intention of moving up the waste hierarchy, the underlying principle for all EU recycling activity (EC, 2008). On this basis, the Netherlands represents a successful European EPR example and, therefore the case for this research (cf. EC, 2014).

A limitation of a case study approach of a single EPR system is that it cannot lead to generalisable recommendations, even though the analysis provides useful, practical insights for other cases. Nonetheless, the analysis of a single case can be used to generate preliminary observations and questions that can form the basis for evaluating future case studies or comparative research. Indeed, considering the specific history, geopolitical situation, socio-economic conditions and governance mechanisms in the Netherlands. The main lessons from this research cannot be generalised to other contexts, especially in the Global South, where conditions differ greatly. Moreover, all waste streams are unique due to their complex composition, legalities, processing techniques, hazardous nature etc. Therefore, the results and recommendations from this research are most relevant to our specific case study. Nevertheless, some of the lessons might apply to other socio-economic contexts and material streams when supplemented by additional research on those other sectors and conditions.

Data collection was undertaken in two phases. First, we reviewed the available literature on the circular economy, EPR and tyres (Section 4.2). This set our theoretical framing and perspectives for critically evaluating the EPR system (Section 4.4). The core data is comprised of policy and legal documents on EPR in the Netherlands from its inception in 1995 to 2017. This was supplemented with the EPR performance data, which (from 2005) has been reported annually to the government. Fieldwork was conducted between January to May 2019, which included nine in-depth unstructured interviews, lasting between 30 and 90 minutes, with government officials, industry and EPR representatives for tyres in the Netherlands. Interviewees either worked for the PRO, were members (producers, importers, distributors or EoL processors of tyres) or government officials involved in monitoring the performance of the EPR system. Fieldwork also included two site visits to tyre manufacturing and recycling facilities based in the Netherlands. Interviews were used to explain and elaborate on insights gained from the literature and document analysis. A complete list of the interviewees, data and their sources are in the supplementary materials of Campbell-Johnston et al. (2020a).

Next, we analysed the data. First, we reviewed the policy documents and performance data and, in conjunction with interviews, constructed an overview of the EPR system in the Netherlands (Section 4.4); this included history, an overview of the policy structure, actors, targets and key roles. Furthermore, we coded the performance of the EPR data using the 10R framework of Reike et al. (2018) to categorise the treatment outcomes. Second, we undertook a critical evaluation and reflection, using insights from the interviews and the literature to reflect on the strengths, weaknesses and issues of organisation and performance, including aspects of continuous improvement, policy scope and value retention outcomes (see Section 4.5).

4.4 Case Study Description

4.4.1 Regulatory and Legal Overview

The introduction of EPR in the Netherlands originates in the 1988 'Note on Prevention and Recycling of Waste', in which context the government introduced the concept of EPR in 1990 to enable a series of participatory policy projects designing the recycling strategies for 29 waste streams (Vermeulen et al., 1997; Vermeulen and Weterings, 1997).

Consequently, for the tyre waste stream the Dutch government introduced the Besluit Beheer Personenwagenbanden (Management of Passenger Car Tyre Decree) in 1995. Broad responsibilities were attributed to producers and importers to organise the collection and treatment of EoL tyres. In this EPR system, garages and tyre service companies collect old car tyres (mostly after replacing them with new ones) and charge the customer a fee for this collection and purchase of new ones. Garages and tyre service companies then pass the used car tyres to collection and processing companies, along with the collection fee, to sort and adequately process used car tyres. A provisional collection target in the Decree was set at 60% product reuse (direct reuse is defined here as any recovery activity from R2 to R8, see Table 4.1), which included a minimum of 20% material reuse (R2 to R7) and maximum of 20% energy recovery (R8).

However, this system was open to exploitation, primarily through collectors taking the consumer fee and not passing the tyres onto processors. The consequential stockpiling resulted in municipalities and provinces financing the collection and treatment of illegally dumped EoL tyres (RecyBEM B.V., 2017, see supplementary material of Campbell-Johnston et al., (2020a)).

After many discussions between sectoral representatives and the Ministry of Housing, Spatial Planning and the Environment in 2000, the 2003 Besluit Beheer Autobanden (Car Tyre Management Decree) was developed. Producers were responsible for organising EoL collection and treatment, either individually or collectively. Key provisions of this act included (i) a focus on car tyres, caravans and trailers; (ii) a

broad definition of 'producer' to include all producers, distributors and importers who are responsible for organising the collection and treatment; and (iii) an old-for-new or 1-for-1 regulation, where the final user of the tyre, must be allowed to return the old tyres at no cost when purchasing a new one. All producers are required to pay a disposal fee for every product brought onto the Dutch market. The treatment targets were not adjusted from the 1995 Decree, setting material reuse (R2 to R8) at 20% of the total weight of collected materials. Moreover, producers and importers were required to report their performance to the government each year. This report must include (a) the number of car tyres that were made available to a party for the first time in that calendar year; (b) the number of used tyres collected in that calendar year; and (c) the percentage of used tyres processed.

Besides the 2003 Decree, the treatment for tyres has been regulated by EC Directive 1999/31/EC, which prohibits rubber tyres from going to landfill, and the Dutch Landelijk Afvalbeheerplans (LAPs) (National Waste Management plans) of 2003 (LAP 1), 2009 (LAP 2) and 2017 (LAP 3).

The first National Waste Plan of 2003 established the goal for 50% of the total weight of used rubber tyres to be reused as material (R2 to R8). However, the 20% goal of the Car Tyre Management Decree of 2003, has precedence over any objective of the LAPs. LAP 2 continued with the same objectives as the previous one but in its 2014 modification, it added a "minimum standard" of at least "material recycling" (R7) for all tyres that can be recycled for less than €175 per tonne. For tyres that are not suitable for recycling or that cannot be recycled for less than €175 per tonne, energy recovery is considered the "minimum standard", and is thus allowed. In 2017, LAP 3 further increased the "minimum standard" for energy recovery to tyres that cannot be recycled for less than €205 per tonne.

The "minimum standard" is based on the 'Ladder van Lansink' (a motion accepted in the Dutch Parliament in the 1980s), which recommends reuse, recycling, energy recovery and landfilling as the appropriate sequence of treatment options (Lansink and Veld, 2010). A 2014 modification to LAP2 further expanded the collection responsibilities from passenger cars and light commercial vehicles to also include motor tyres, trucks, buses, agricultural vehicle tyres etc. Tyres from bicycles and scooters are excluded.
In 2018, the EU outlined a circular economy package, which amended the framework directive on waste (Directive (EU) 2018/851 of the European Parliament and of the Council of 30 May 2018 amending Directive 2008/98/EC on waste). The renewed waste directive creates new requirements for EPR

systems, including having effective data collection processes, transparent operations (including the selection procedure for waste management operators), and dialogue and collaboration with civil society organisations, including social economy actors. The Directive also encourages (meaning it is not mandatory) member states to establish eco-design requirements that ensure products are easily recyclable, reusable, repairable and technically durable, contain recycled materials, and have reduced environmental impacts throughout their entire lifecycle.

These requirements were set to ensure that EPR contributes to a circular economy transition and operates according to the EU waste hierarchy, as established in article 4 of Directive 2008/98/EC. However, these new requirements have not been transposed into Dutch law yet as the Member States have until the 5th of July 2020 to do so, whilst EPR systems have until the 5th of January 2023 to update their structure and operations. Whether this results in substantial changes in the Dutch EPR scheme remains to be seen. However, it provides an opportunity to revisit the governance and circularity of the EPR system for tyres.

4.4.2 Extender Producer Responsibility: Structure and Implementation

In response to the 1995 Decree, tyre importers, distributors and producers founded the 'Vereniging Band en Milieu' (Association BEM), to implement their obligation under this Decree. This body is formerly responsible for communications with the government. To manage the updated system established by the Car Tyre Management Decree of 2003, the tyre producers and importers founded two other organisations. First, the Stichting Fonds Band en Milieu (Foundation Funds for Tyre and Environment, hereafter known as the Foundation) is responsible for the financial management of the waste management system, and the collection and management of recycling fees. The Foundation functions to keep individual members' financial contributions and market share confidential (Winternitz et al., 2019). The Foundation then established RecyBEM B.V., a private company, which is the collective implementation organisation of the Association BEM. RecyBEM B.V. is thus contracted by the Foundation to manage the collection, processing and reporting of the EPR system (see Figure 4.1). In 2013, RecyBEM B.V. began setting voluntary processing targets, starting with 70% material and product reuse (R2, R5, R6 and R7) in 2013 to 90% in 2015. The system is thus structured as a third-party takeback where RecyBEM B.V. is the PRP (see Section 4.2.2).

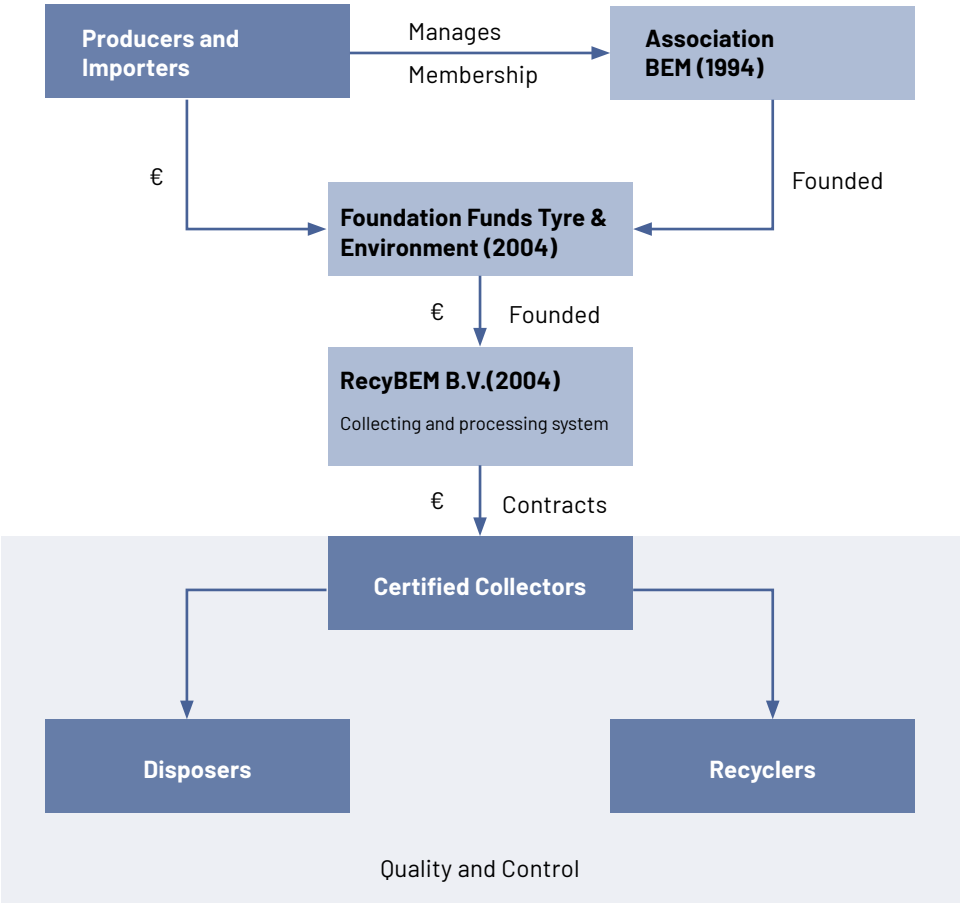


Figure 4.1 Organization of the Dutch EPR (Source: RecyBEM B.V., 2019, edited).

To finance the system, all producers and importers of car tyres, caravans and trailers must pay a waste management contribution fee to the Foundation for every tyre they put on the Dutch market. Between 2004 and 2015, only producers that were members of the Association contributed to the waste management fee. In response to protests from the Foundation over free riders not contributing fees, a 2015 government "general binding statement" (see supplementary material of Campbell-Johnston et al., (2020a)) allowed the PRP to oblige all producers, distributors and importers (both from retail

and internet sales) to pay the waste management contribution fee to the Foundation or to establish another EPR system. Non-members can face legal action from the PRP for not contributing.

RecyBEM B.V. is the main operator of the waste management activities, the costs of which are covered by a contribution fee paid to it by the Foundation (see Figure 4.2). It uses the fee to contract and pay third-party collectors, which are in charge of bringing the tyres to processors, who recover the value from tyres based on the market conditions, RecyBEM B.V. criteria and state targets and regulations. To ensure the quality of the recycling operations, collectors can only operate with recyclers, disposers and processors that have been certificated by RecyBEM B.V., which includes a quality management system, as of 2018 following ISO 9001: 2015 standard (RecyBEM B.V., 2019, see supplementary material of Campbell-Johnston et al., (2020a)).

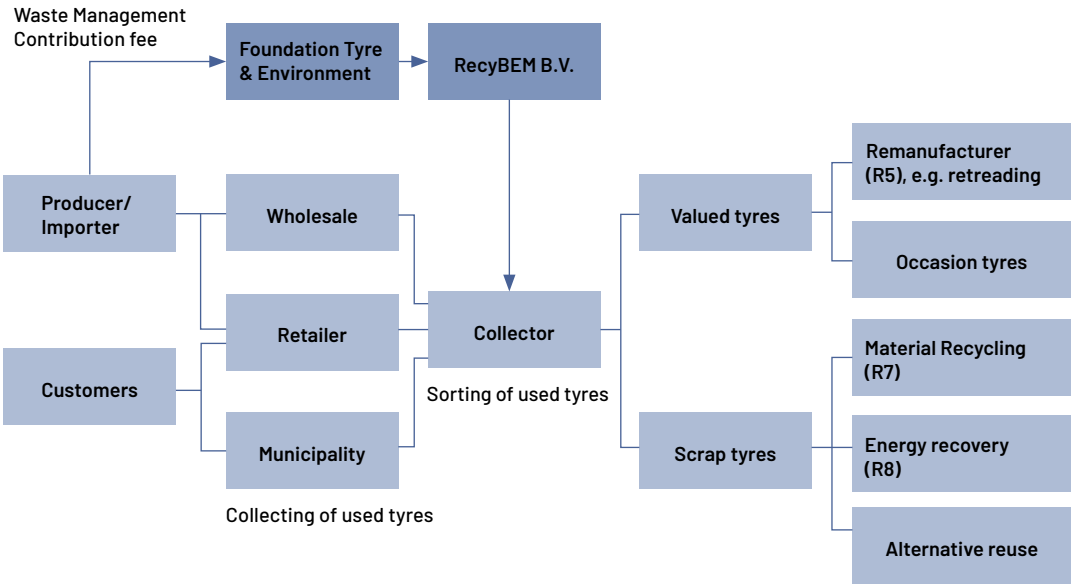


Figure 4.2 Financial mechanism of the Car Tyre Management Decree, source: RecyBEM B.V., 2019, (edited).

In 2004, the waste management contribution fee, paid by importers and producers per tyre sold, was set at € 2,00 and by 2017 this had been reduced to € 1,30. This fee is internalised in the consumer price of a new tyre. Collectors (garages) are paid a part of this fee, which in 2004 was € 1,25 per collected tyre and in 2017 had been reduced to € 1,05 (see Figure 4.3). The difference between the collecting and the recovery fee is used by the PRP to cover administrative costs and unexpected expenses. Every year, the waste management contribution fee and the collecting fee are revised and updated based on a market study conducted by an independent third-party consultancy: Fact Management Consultants. The system operates with a pay-as-you-go structure where each year, a maximum waste management contribution fee is charged and, at the end of the year, a definitive waste management contribution fee is calculated based on the actual sale and recovery outcomes of the year and any surpluses and/or shortfalls are thus settled.

Figure 4.3 Collecting and waste management contribution fee 2017 (own work, source: annual reports see supplementary material of Campbell-Johnston et al., (2020a)).

4.4.3 Performance

The membership of the Association BEM has been rising continuously (Figure 4.4), representing over 90% of producers by 2015. The notable rise from 2015 is a consequence of the "general binding statement" of 2015, giving the PRO the power to compel non-compliant actors to pay into their system.

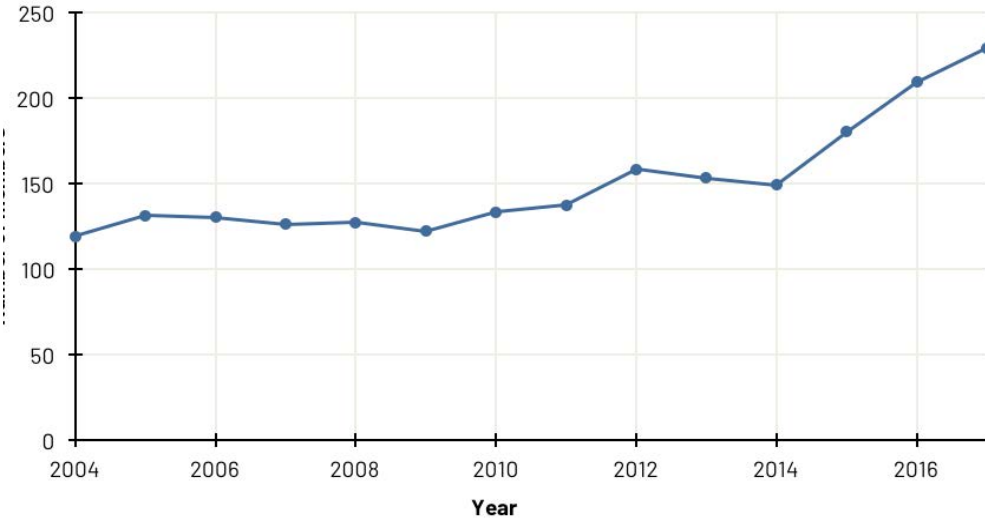


Figure 4.4 Association BEM Members between 2004 and 2017 (own work, source: annual reports see supplementary material of Campbell-Johnston et al., (2020a)).

Figure 4.5 shows the high collection rates of the Dutch EPR system. The higher volume of sold tyres in 2010 and 2011 can be explained by the particularly cold winters of those years and correspondingly higher sales of winter tyres. The higher collection rates of 2016 and 2017 can be explained by the implementation of the "general binding statement" of 2015, which led to new members joining the scheme.

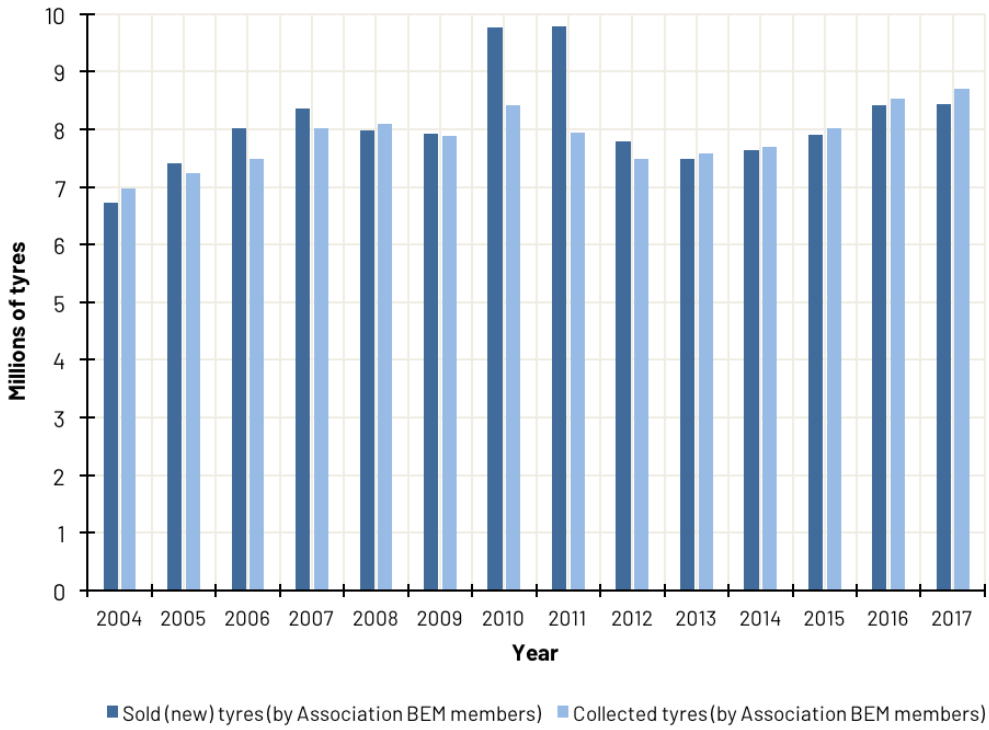


Figure 4.5 Sold tyres vs. collected tyres between 2004 and 2017 2017 (own work, source: annual reports see supplementary material of Campbell-Johnston et al., (2020a)).

Figure 4.6 presents the destination of used rubber tyres managed by the PRP between 2005 and 2017. The red dotted line represents the 50% material and product reuse (i.e. R2, R5, R6 and R7) target established by the first National Waste Plan (2003). The red line indicates the 20% reuse as materials (i.e. R2, R5, R6, R7 and R8) target of the Car Tyre Management Decree of 2003. The dotted black line represents RecyBEM B.V.'s voluntary material and product reuse targets (i.e. R2, R5, R6 and R7): 70% by 2013, 80% by 2014 and 90% by 2015. The solid black line represents RecyBEM B.V.'s voluntary material reuse target (R7): 25% by 2013, 35% by 2014 and 50% by 2015.

Figure 4.6 and Table 4.2 show that the Dutch PRO has continuously met the targets in the National Waste Plan and the Car Tyre Management Decrees, as well as voluntary targets (see supplementary material of Campbell-Johnston et al., (2020a)). Moreover, the interviews from the public and private sectors confirmed that the minimum standard for incineration was also met, meaning no tyres that can be recycled for less than € 175 (2014-2016) or € 205 (2017 onwards) were sent for energy recovery. Therefore, no fines have been given to the organisation for violating the rules.

The explicit nature of the recovery outcomes was further investigated and clarified during the interviews (see supplementary material interviewees of Campbell-Johnston et al., (2020a)). This allowed a better understanding of the implications and complexities of each recovery option. In the case of "product reuse" (R2), representing over 30% of EoL tyres in 2017, interviewees commented that many tyres are sold to countries in Eastern Europe, although the actual destinations are known only to the PRO. Dutch consumers tend to change their tyres before the minimum recommended tread depth in the EU of 1.6 mm, due to the obliged annual car inspection (EC, 2019), so many discarded tyres still have a high use value. However, the future EoL and safe recovery of those tyres are no longer guaranteed once they are exported, if they go to destinations without the capacity to process them.

Regarding retreading operations (R5), very few tyres are suitable for retreading due to quality imperatives, hence very few EoL tyres can take this recovery route. Moreover, the Netherlands does not have any retreading plant, so tyres must be exported for this purpose and, once again, their EoL and safe recovery are not guaranteed in the importing country.

Repurposing (R6) represents a very small fraction of EoL tyres and concerns punctual and limited uses such as cart-track protections, and bumpers on quays and waterways.

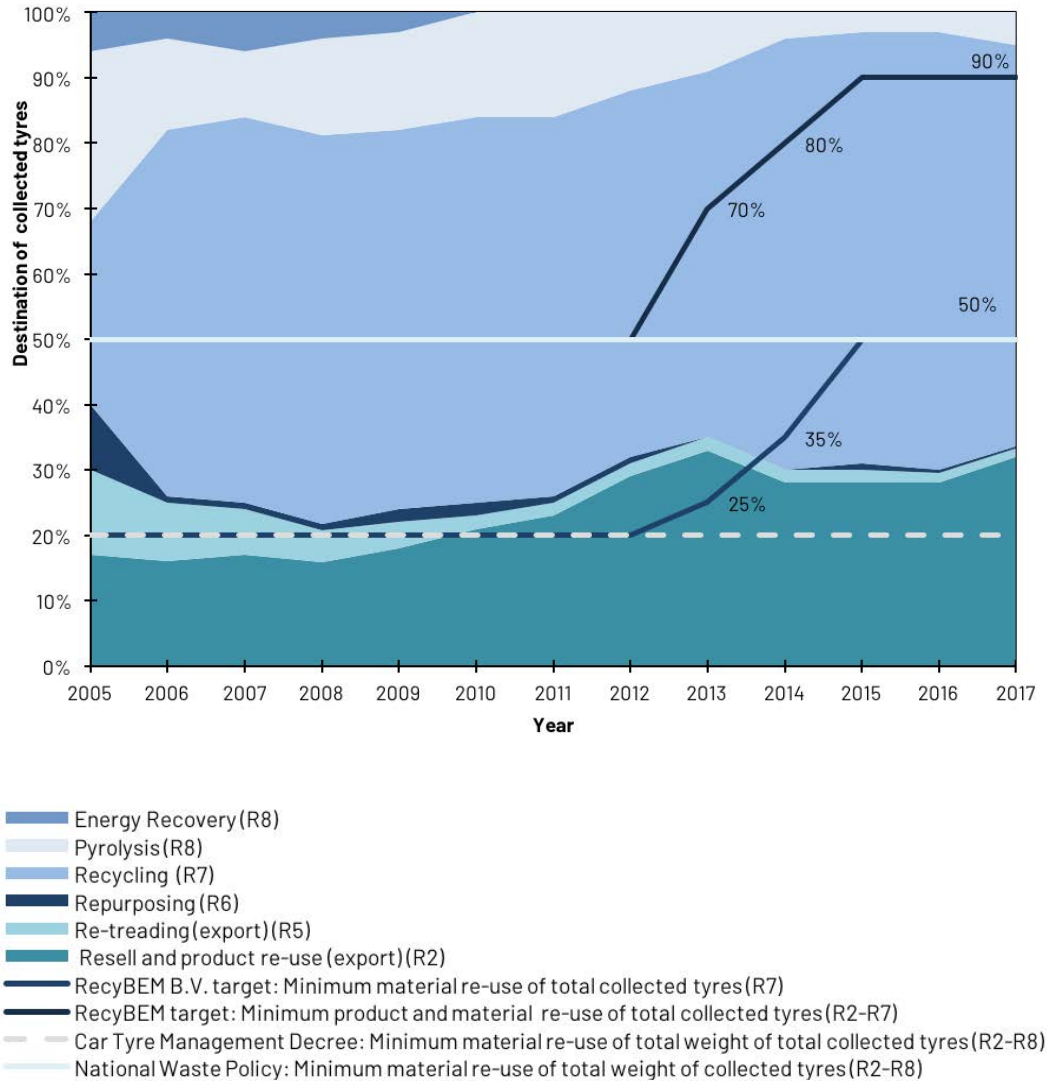


Figure 4.6 Destination of collected used rubber tyres by RecyBEM B.V. between 2005 and 2017 (own work, source: annual reports see supplementary material of Campbell-Johnston et al., (2020a))

	RecyBEM B.V. target: Minimum material re-use of total collected tyres (R7)	RecyBEM target: Minimum product and material re-use of total collected tyres (R2-R7)	Car Tyre Management Decree: Minimum material re-use of the total weight of total collected tyres (R2-R8),	National Waste Policy: Minimum material re-use of the total weight of collected tyres (R2-R8)
Target	20% (2005-2012) 25% (2013) 35% (2014) 50% (2015-2017)	50% (2005-2012) 70% (2013) 80% (2014) 90% (2015-2017)	20% (2005-2017)	50% (2005-2017)
Result	2005-2012: 54% average 2013: 56% 2014: 66% 2015-2017: 64,8% average	2005-2012: 82% average 2013: 91% 2014: 96% 2015-2017: 96% average	2005-2017: 100% average	2005-2017: 100% average

Table 4.2 Recycling targets and results for Dutch tyre recycling 2005 – 2017

Finally, recycling (R7), the most common recovery operation for EoL tyres, is carried out through granulation, which is used in a multiplicity of lower value outcomes, such as insulation materials, and engineering applications (mainly for road construction), filling for artificial sports fields etc. Due to energy efficiency, safety and quality imperatives, new tyres currently contain about one to five per cent of granulated rubber from EoL tyres.

Most interviewees reported a high level of satisfaction with the EPR system in the Netherlands. Tyre producers and distributors value the low cost of tyre recovery operations and the "hands-off" approach that this third-party take-back structure gives them. The PRO enjoys a great level of legitimacy due to its track record of compliance with government targets and low recovery costs. Producers and importers thus give a significant amount of autonomy to the organization (and PRP) and let it manage collection and recovery operations. Producers, importers, collectors and processors are not directly connected and don't collaborate, nor share information to improve tyre recycling outcomes or increase the uptake of recycled rubber in new tyres. There is little evidence that the Dutch EPR system provides an incentive for eco-design, rather it incentivizes producers and importers to outsource recovery operations at the lowest possible cost. While the PRO has financed several research and development projects on devulcanization, this is not enough to foster lifecycle thinking and a full closure of resource loops.

Despite this apparent success, there has been a recent backlash against recycled rubber and the EPR system in response to public concerns over the human and environmental health impacts of artificial sports fields made with recycled rubber granulate (Zembla, 2016). This led to a government inquiry on the topic and a series of reports were commissioned. In line with recent academic research (Bleyer and Keegan, 2018; Peterson et al., 2018), and evaluations of the European Chemicals Agency (ECHA, 2017), the Dutch government report on human health has found no evidence of cancer risks related to artificial turf fields made with recycled rubber (RIVM, 2017). However, other government reports evidenced important environmental impacts, especially for aquatic life (STOWA, 2018; Verschoor et al., 2018). This demonstrates the complexities of a circular system, which aims to narrow, slow, shrink, and close material cycles, and does so in ways that do not affect human and environmental health. This is often complicated, especially when dealing with complex recycling processes and materials containing a mixture of often unknown or toxic chemicals. This complexity poses the main obstacle to tyre management in the Netherlands.

4.5 Analysis and Future Implications

Since the initial experiments in 1995, the Dutch EPR system for passenger car tyres has reached a 100% collection rate, with low energy recovery levels (5% in 2017) and zero landfill. Interviewees viewed the system as stakeholder friendly, financially efficient, and effective at preventing the widespread illegal dumping of tyres, which occurred before the 2003 Decree. The system meets the minimum standards and targets set in the 2003 LAPs and the PROs voluntary targets. However, it also has many key obstacles, weaknesses and limitations both from the perspective of CE 2.0 and CE 3.0. This section outlines these challenges, and proposes recommendations, which, after careful adaptation, could also provide useful insights for new and existing EPRs in the global North and South alike:

Recommendations from a CE 2.0 perspective:

Promoting higher-value recovery: Figure 4.6 and Table 4.2 demonstrate a high focus on recycling, yet the recycling of tyres currently produces low-quality granulate that cannot be used in large quantities in new tyres. This focus on material recovery is thus a form of downcycling, which does not allow for the closing of resource loops. Instead, greater priority should be given to other recovery options such as retreading, reuse and repurposing. Moreover, eco-design must be encouraged so that EoL tyres are easier to remanufacture and recycle and so that new tyres can contain higher quantities of granulated rubber without compromising on their quality. In this regard, further investment in R&D would be necessary and could be implemented by an obligation to use a percentage of the waste management contribution fee to finance it. An autonomous or government-established fund can be established to manage this part of the fee to finance transformative and disruptive innovations, which can challenge incumbents. Another option is to establish a differentiated fee based on the sustainability of tyres (durability, recyclability, percentage of recycled content etc.) to incentivise eco-design and innovation in the marketplace.

Managing exports and leakages: A large percentage of EoL tyres are exported for reuse and retreading (about 33% in 2017). While these are high-value recovery options, in theory, the lack of monitoring of

the destination of these tyres does not guarantee an environmentally safe recovery. It is thus key to set up mechanisms to prevent exports from happening and to have greater oversight over the export destination and final disposal of tyres. This is a critical concern since tyres can have significant adverse human and environmental health impacts if they are not properly recycled (Li et al., 2010; Verschoor et al., 2018). However, controlling exports and following tyres through their multiple uses and owners is a complex process. A possible solution to this problem would be to raise consumer awareness and improve the annual car inspection process so tyres are not discarded before they reach the minimum tread depth. This would keep tyres in use for longer, improve their value for customers, and prevent them from being exported, thus reducing transport emissions and impacts overseas. The above measure would have to be combined with strong controls on the export of secondhand tyres so that tyres with a tread depth under the minimum standard are not exported for direct re-use. Moreover, enforcement of EoL tyre export controls should be reinforced so they are not exported to countries that do not meet Dutch social and environmental standards.

Recommendations from a CE 3.0 perspective:

Aiming for sufficiency to reach the highest value retention options (R0, R1): Having longer-lasting tyres is perhaps one of the most important strategies, which can lead to significant sustainability improvements, as it directly reduces overall tyre consumption (R1 - reduce). The current EPR system has so far done nothing in this regard, and tyre consumption has increased between 2004 and 2017 (see Figure 4.5). The PRO could directly work with rubber tyre manufacturers and importers to design tyre in a way that guarantees their durability. This has the added benefit of reducing the number of resources spent dealing with EoL tyre management further down the product lifecycle. Awareness campaigns among consumers can also increase the lifespan of tyres and be done through a combination of product labels and media campaigns. This R1 strategy is second in the value retention hierarchy, leading to considerable environmental benefits, thanks to the reduced pressure on natural resources (rubber, iron, fibres etc.) and the avoided impacts from production, use and disposal of tyres.

An even more effective strategy would be to reduce tyre consumption by reducing the need for tyres in the first place (R0 – refuse). This could be achieved through effective urban and regional planning, as well as transport policies that encourage public transportation, rail, cycling and walking. However,

these policies are beyond the concern of a PRO and can thus only be established by national, provincial and municipal governments. This shows the limitations of EPR systems in general, especially with the highest value retention options: R0 and R1. To implement these measures, a percentage of the waste management contribution fee can be given to a government agency or an autonomous institution responsible for reducing the overall domestic material consumption and ecological footprint through sufficiency strategies. This agency could thus develop innovative transportation solutions which work towards reducing the need for rubber tyres such as improved national rail networks, and sustainable urban planning solutions.

Collaboration and multi-stakeholder governance: The existing EPR system lacks effective connection and collaboration between tyre producers and recyclers. This inhibits product innovation concerning the application of reclaimed rubber. The EPR system for tyres in the Netherlands could hence be improved by further integrating recyclers, disposers and processors members with the BEM Association. This would reinforce collaboration across the whole value chain and ensure that the EPR system does not just incentivize low-cost recovery options.

Socially inclusive governance considerations have been disregarded by the Dutch EPR system. Various scholars have pointed out the importance of these aspects to construct a fair and fully sustainable circular economy (Hobson and Lynch, 2016; Kirchherr et al., 2017b; Merli et al., 2018; Millar et al., 2019; Moreau et al., 2017), which tackles questions of intellectual property, technology transfer, ownership, production methods, benefit sharing and participation in decision-making processes. While the Dutch EPR does have a successful governance structure that includes all the relevant producers and importers (see Section 4.4.2), it is not particularly inclusive beyond direct industry members. This reduces the capacity for democratic oversight, transparency and accountability, leading to suboptimal outcomes in terms of recovery options and human and environmental health (see Section 4.4.3). To improve this, it is key to foster greater participation of civil society and public authorities in the governance, oversight and management of the EPR system. This can be achieved by forcing the BEM Association to include a certain percentage of civil society members, which represent the interests of citizens and the natural environment. This would force the EPR system to consider wider social and environmental concerns and improve the overall transparency and accountability of the system.

Effective monitoring and continuous improvement of the EPR system: Considering that collection

targets have not been adjusted since 2003, and remain vaguely defined, it is key to update targets and explore the future direction of the sector. In fact, not only are the established recovery targets not ambitious enough but they were already met in the year they were set (see Section 4.4.3).

Setting renewed goals is particularly important as the current system promotes a standard and generally low waste management contribution fee, which has incentivised low-cost and low-quality recovery options over higher-value-retention ones. Moreover, the existing monitoring system reports only collected volumes and treatment processes. This leaves data gaps regarding how recovered materials are used and what is the final fate of exported EoL tyres, all of which can hide unsustainable practices.

The careful regulation and monitoring of the EPR system through effective government policy, civil society oversight, and continuously improving targets and incentives for higher-value retention options (especially R0-R6) is thus key. Moreover, it is necessary to overhaul the ways by which the best processing options are chosen (including the selection procedure for waste management operators) and the ways by which investments are carried out to achieve continuous improvements in new recovery options (e.g. R&D in devulcanization or pyrolysis). Better monitoring, transparency, oversight and civil society participation in these processes is key to ensure the continuous improvement of the EPR system and to promote socially and environmentally sustainable design and recovery practices.

Improving overall social and environmental outcomes beyond EoL tyres: The consequences of potentially socially and/or environmentally harmful uses of granulated rubber show the weakness of focusing on recovery alone rather than actual sustainability outcomes. It also raises the question regarding extended value chain governance, and whether producers should have continued responsibility beyond the first EoL processing of the product. Such expansions of capacities must be done only after impartial, non-conflicting, regional LCAs aimed at maximizing circularity, social fairness and sustainability. In fact, in such complex situations, having clear research and data at hand is vital to plan the best possible recovery options with human and ecological health in mind. Furthermore, a plan to improve the sustainability outcomes of the entire tyre supply chain should be established and implemented in coordination with a more democratic and inclusive EPR structure. This can ensure that the EPR system doesn't just recycle EoL tyres but also leads to tangible improvements in terms

of socio-ecological outcomes, and raw material demand. The overall aim of a circular economy is not just to close resource loops, but to reduce the pressure of human activities on the planet to ensure the well-being of current and future generations (Kirchherr et al., 2017a; Korhonen et al., 2018a). An EPR system should thus be understood as a component of a broader policy objective, which aims to sustainably and equitably reduce a country's overall environmental footprint.

Circular business models: Circular service or leasing business models based on the performance of tyres, rather than selling large quantities of tyres could be encouraged to incentivize higher-value maintenance for producers and consumers (Stahel, 2010). Indeed, under the right conditions, PSS can lead to a sustainable circular economy, since industries which keep ownership of their tyres have a direct incentive to develop long-lasting and easily recyclable products (Camilleri, 2018; Kjaer et al., 2019). It could thus improve reduce, reuse, retreading and quality recycling within the Netherlands, henceforth reducing the overall consumption and export of tires whose fate remains unknown once exported. However, this necessitates careful government oversight and regulation to prevent rebound effects and ensure that PSS lead to reduced overall resource use and create positive social and environmental sustainability outcomes (Hobson and Lynch, 2016).

The identified gaps and these proposed solutions provide an opportunity for the EPR organization to transform from being an EoL tyre management entity to a true driver of circularity, playing a transformative role in addressing prominent contemporary social and environmental challenges. In this transition, the system must be more inclusive, democratic and adaptive to continuous improvements. The existing fragmented systems of isolated EoL tyre management must be integrated into a value chain governance approach and high-value maintaining targets must be envisioned together and collectively worked towards with greater transparency.

The abovementioned recommendations are in line with those of the updated EU waste directive, which calls for EPR systems to include eco-design requirements to reduce environmental impacts as well as to improve transparency, reporting, monitoring and collaboration with civil society. There is thus now a unique opportunity to overhaul the Dutch EPR system through holistic CE 3.0 strategies, leading to both improved human well-being and ecosystem functioning.

However, a possible limitation of the above recommendations is the small size of the Netherlands in the global market for tyres. Indeed, the country imports most of its tyres and can hardly force large tyre producers overseas to significantly change their design and production processes. EU-wide directives with ambitious targets are necessary, especially on for tyre recycling, retreading, repurposing, and the percentage of recycled content in new tyres. Indeed, while the EU has established a new circular economy action plan with various new policies, it has not taken further action on tyres or rubber recycling. Further action from a holistic CE 3.0 perspective is hence needed both nationally and internationally. Another key limitation of the above recommendations is that they are directed towards the unique social, historical, political, economic and technical circumstances of the Dutch EPR system for EoL tyres. Therefore, further research is needed to validate and apply our insights and commendations to other case studies and waste streams.

4.6 Conclusion

This chapter examined and evaluated the structure, organisation, performance and potential limitations of the Dutch EPR system as a case study to explore how these older CE 2.0 systems can be adapted to fulfil the broader societal concerns embedded in the current CE 3.0 debates (i.e. concerns over resource supply, planetary limits, waste generation). It adds a practical understanding of the relationship between EPR and circular economy, and the former's capacity to contribute to the latter. Despite this representing a successful example of CE 2.0 initiatives and fulfilling the obligations of the national legislation, our analysis outlined seven limitations and issues, which, we argue, can be the basis for modifying and creating an EPR that meets the needs of the existing CE 3.0 debate. Current EPR systems of CE 2.0 can achieve high recovery rates, but they do not reduce overall resource consumption and promote full circularity, in line with CE 3.0. Thus, this chapter suggests strengthening the EPR system by proposing a long-term transformative perspective, which can address issues concerning transparency, inclusion, sufficiency, sustainability and continuous improvement. These lessons could be applied to different contexts and waste streams with careful research and adaptation. Moreover, we examined the internal consideration of the Dutch EPR system. As Circularity in the Netherlands is inherently tied to a European and global circularity, any exports should be strictly controlled and regulated to ensure high-value retention and sustainability.

This research further illustrates the limits of recycling and traditional recovery operations. circular economy is often characterised as a tool for closing resource loops and turning wastes into resources. However, low-quality recovery options complicate this as a closed-loop for tyres cannot simply be established with current technologies. Whilst devulcanization could potentially improve recovery outcomes, it is not commercially operational on a large scale and only enables the use of up to 30% secondary rubber in new tyres; still far from a closed loop. This shows the limits of R3-10 and the importance of sufficiency strategies, especially R0-1 to reach a circular economy with tangible results in terms of reduced material demand and ecological footprint. The above points are beyond the scope of this chapter and demonstrate the complexity of the circular economy, and the need for specific case studies to improve its governance and implementation.

Moreover, the insights and recommendations learned from this chapter are limited to the recovery of tyres in the Netherlands, and further research is needed in other contexts to develop specific and culturally adapted recommendations. In particular, transdisciplinary research with key actors and stakeholders could be an effective manner to build solutions for a sustainable, circular, and participatory overhaul of EPR systems.

Future comparative analysis of EU EPR systems is also needed to uncover how they interfere with each other in the context of the single market. A broader study could also provide further insights into structural issues and challenges for EPR systems in general and uncover other possible best practices for EPR systems from a circular economy perspective.

CHAPTER 5

Towards a Just Circular Economy Transition: the Case of European Plastic Waste Trade to Vietnam for Recycling

“Another world is not only possible,
she is on her way. On a quiet day,
I can hear her breathing.”

— Arundhati Roy

Author and activist

This chapter is based on Thapa, K.,Vermeulen, W. J. V., Waal, M. M. D., Deutz, P., and Nguyễn, H. Q. Towards a Just Circular Economy Transition: the Case of European Plastic Waste Trade to Vietnam for Recycling. Submitted to *Circular Economy and Sustainability*.

Abstract

Exporting waste for recycling to destinations without sound recycling capacity raises questions of fairness and sustainability. As recycling infrastructures have been inadequate to keep up with growing plastic waste generation, waste is traded, aiming for sound resource recovery in a global value chain with multiple actors. Waste handling is outsourced to destinations with cheaper operating and labour costs, even at the expense of harming other individuals, societies and the environment. Such trade creates increasing governance and sustainability challenges. In the EU, policies and systems are in place for plastic waste management, which includes separate collection to safeguard against potential harm and reuse resources. However, half of the collected European plastic waste for recycling is shipped for recycling outside the EU without accountability. This case study of the EU plastic waste exports for recycling to Vietnam aims to increase our understanding of waste governance, circularity, sustainability and justice implications. We bring a multidisciplinary perspective to understand the challenges of the EU's recycling practices for the broader socio-ecological system. Then we propose a multidisciplinary framework as an ethical guide for fair future waste shipment practices with strong consideration for the social dimension for a just circular economy transition.

5.1 Introduction

Plastic waste is traded globally for recycling in an increasingly unequal world. The same plastic waste that needs to be recycled or disposed of in one location can be scrap or resource or harm elsewhere depending on social, economic, cultural and technological contexts (Thapa et al., 2022a). Recycling infrastructure and technology determine what happens to waste, with the level of circularity and sustainability in turn reflecting on the level of economic development (Reuter, 2011; Deutz et al., 2015; Cruz Sanchez et al., 2020). For example, recycling in the 'formal' sectors usually at least provides workers with personal protective equipment and treats pollutants before discarding them. In contrast, the 'informal' sector might not have the capacity to manage recycling with such health and environmental consideration (Nas and Jaffe, 2004; Wilson et al., 2006). When plastic waste is shipped for recycling, the local context in the waste value chain (actors and their motivation, waste infrastructure, policies implementation etc.) determines the circularity and sustainability outcomes. A systematic review of transboundary waste trade found a need for a contextual and solution-oriented understanding of such trade (Thapa et al., 2022a). Any attempt at a just circular economy transformation must consider the full value chain, the geographic context and its social, environmental and economic dimensions.

As a significant plastic consumer, Europe produces 26 million tonnes of plastic waste annually (European Commission, 2022). In 2018, plastic waste treatment included energy recovery (42.6%), recycling (32.5%) and landfilling (24.9%) (European Parliament, 2022). Another study finds that 24.5 million tonnes of plastic waste were generated in 2020, of which 50% were incinerated, 14% were recycled, and 8 – 15 million tonnes were unaccounted for (Systemiq, 2022). Accurate plastic waste data is scarce (Boucher et al., 2019; Amadei et al., 2022). Of the collected plastic waste for recycling, about 50% is shipped outside of the EU for recycling because of a 'lack of capacity, technology or financial resources to treat waste locally' (European Parliament, 2022). For instance, 46% of separated polyethene is shipped outside the EU (Bishop et al., 2020). . Major destinations include China (until 2018), Indonesia, the Phillippines, Thailand and Vietnam (Shi et al., 2021). Typically having lower recycling capacities than the EU, these countries account for over half of the global land-based plastic waste leakage to the environment (Hahladakis, 2020). Thus, shipping plastic waste to destinations with less stringent environmental and social regulations (than in the EU) and insufficient infrastructure

to process (domestic and imported) plastic waste is environmentally questionable. Even though the EU has a lofty ambition to 'transition towards a circular economy for plastics' (European Commission, n.d.), such practices of shipping plastic waste for recycling to destinations without accountability show the disconnect between European ambitions and actions.

In the last five years (2016-2020), the imports of all plastic waste in Vietnam and exports of plastic waste from the top five European exporters (Belgium, Germany, Netherlands, Spain and the UK) have increased (UN, 2022; Liang et al., 2021). Despite Vietnamese domestic plastic waste management challenges (Suzuki et al., 2022; Salhofer et al., 2021; Trinh et al., 2021; WorldBank, 2021), it is an EU plastic waste export destination. According to optimistic estimates, Vietnam recycles 9 to 33% of the imported plastic waste, not all of which is according to international sustainability standards (Chau et al., 2020; Salhofer et al., 2021; WorldBank, 2021). Scrap (including plastic) imports serve as raw materials for the manufacturing industry in Vietnam (Chau et al., 2020). In the narrowest economic sense, the plastic waste trade can be profitable for some engaged actors, but at the cost of the individual, society and the environment (Uhm, 2020). Nonetheless, exporting plastic waste makes the exporting country appear artificially cleaner by shifting its waste management responsibility elsewhere (Barnes, 2019). Bishop et al. (2020) explore the fate of shipped polyethelene from the EU and estimate that 1-7% ended up in the ocean. Without due regard for what happens at the destination, exporting plastic waste cannot be considered a long-term sustainability solution. It is a 'tragedy of the commons' – where decisions based on personal interest harm others and the environment (Hardin, 1968). Growth in waste generation causes the waste trade to grow, resulting in an increasingly complex waste value chain. It follows trade rules of relying on cheap shipping and lowering costs by employing the cheapest labour (O' Neill, 2019). By 'distancing the waste' to hide the consequences of overconsumption, the harm associated with waste is cheaply and easily foisted on others, usually the poor, less powerful and the vulnerable (Clapp, 2002; O' Neill, 2019; Barrie et al., 2022; Thapa et al., 2022a,c). However, despite the magnitude of the trade, little is known about plastic waste trade governance and its impacts on destination countries.

In a context where the fate of plastic waste exported for recycling remains unclear, this research i) explores the implication of plastic waste trade for recycling to the circular economy, ii) adds a social dimension to the analysis of the circular economy and recycling value chain and iii) proposes

a multidisciplinary framework for governing the future waste trade. To do so, we ask, i) how is this plastic trade for recycling governed? ii) what are the challenges in the waste value chain? And iii) how to make this trade more circular and just? We explore the social and environmental cost of shipping plastic waste to Vietnam for recycling by mapping stakeholders, analysing policies and conducting an in-depth case study of a recycling village. We employ a multidisciplinary perspective for analysis, drawing on the circular economy, reverse logistics, justice and equity, environmental governance and ethics. We combine this approaches with the notion of *kyōsei* from environmental and business ethics to provide a multidisciplinary framework for governing waste shipment for a just circular economy.

5.2 Context of plastic waste trade

Before we present the theoretical lenses, we discuss the current practices of plastic waste management, focusing on recycling and international trade relevant to the research context.

5.2.1 Plastic waste management and recycling

Between 1950 and 2017, 9.2 billion tonnes of plastic were produced globally, of which an estimated 10% was recycled, 14% incinerated, and the rest ended up in landfills, dumps or the natural environment (Geyer, 2020). Wide usage is related to cost and convenience; however, plastic production and the post-use phase cause several environmental and social harms. Plastic production requires fossil fuels and mined raw materials, including chemicals, linked to several socio-ecological crises (Nielsen et al., 2019). Research estimates that two-thirds of all plastic ends up in the natural environment (Pinto da Costa et al., 2020). Of all the plastic waste in the ocean, we don't know what happened to 99% of it (van Sebille et al., 2015), with estimates ranging from tens of thousands to hundreds of thousands of tonnes for the remaining (Ritchie, 2018). Unmanaged plastic waste has been linked to toxic exposure in marine animals and humans (Bishop et al., 2020). Microplastic is found in human blood and farm animals' milk, meat and blood; however, their effects are unknown (Leslie et al., 2022; Carrington, 2022).

Plastic comes in various shapes, sizes and chemical compositions like polyethene terephthalate; high-density polyethene; polyvinyl chloride, low-density polyethene, polypropylene, and polystyrene or styrofoam (Osswald et al., 2019). This variety determines the use, reuse and recycling, but not all plastic recycling is technically possible (Faraca and Astrup, 2019). By mechanical means like cleaning, shredding and drying, primary recycling maintains or enhances the quality (upcycling), and secondary recycling loses the quality (downcycling) (Singh et al., 2017; Ragaert et al., 2017). Tertiary recycling or depolymerisation involves chemical processes and uses more energy to break down chemically. It is suitable for plastic with multiple compositions and contaminated plastic, which cannot be mechanically recycled (Singh et al., 2017; Ragaert et al., 2017). Current plastic waste management focuses on incineration, landfilling and recycling - the least preferred value retention option in the circular economy (see section 5.3.1)

Recycling type	Description
Primary	Mechanical, upcycles
Secondary	Mechanical, downcycles
Tertiary	Chemical recycling

Table 5.1 Overview of the types of plastic recycling (adapted from Singh et al., 2017; Ragaert et al., 2017

5.2.2 Europe and Asia: an unequal transboundary plastic waste trade

Before the ban on importing waste plastic, China imported significant quantities to feed its large domestic demand with low-cost transboundary imports (Brooks et al., 2018; Leal Filho et al., 2019). However, with a recycling rate of 25% (Jiang et al., 2020), China discarded a larger share into the environment, causing severe environmental problems (Wang et al., 2019). The Chinese import ban disrupted the global plastic waste trade (Wang et al., 2019; Brooks et al., 2018). Plastic waste diversion to new export destinations in southeast Asia. According to Eurostat, EU plastic waste shipped to Hong Kong, India, Indonesia, Malaysia, Taiwan, Thailand, Turkey, and Vietnam increased (Figure 5.1). During this period, Vietnam and Malaysia saw an increase in plastic waste imports of over 100%, forcing them to rethink the legal and policy framework related to plastic waste imports (Wang et al., 2019). In the first six months of 2018, Vietnam saw a nearly 200% surge in imports (Chau et al., 2020).

Germany, the UK (then in the EU), the Netherlands, France and Belgium (in order of quantity exported) were among the top 10 plastic waste exporters in the world in 2016 (Ritchie and Roser, 2018). Model calculations of polyethene shipped from the EU for recycling show that 14% were landfilled, 6.4% were incinerated, and 3.3% ended in the ocean, i.e. 23% were not recycled (Bishop et al. 2020). Researchers are critical of the EU plastic strategies even with stricter revised EU policies. Based on a Dutch study, Calisto Friant et al. (2021) argue being frontrunners focusing solely on a technocentric approach (for example, increasing the recycling rate) might solve symptoms of a problem but not systematically address its causes. For a circular EPR, Vermeulen et al. (2022) propose a shift from downcycling to

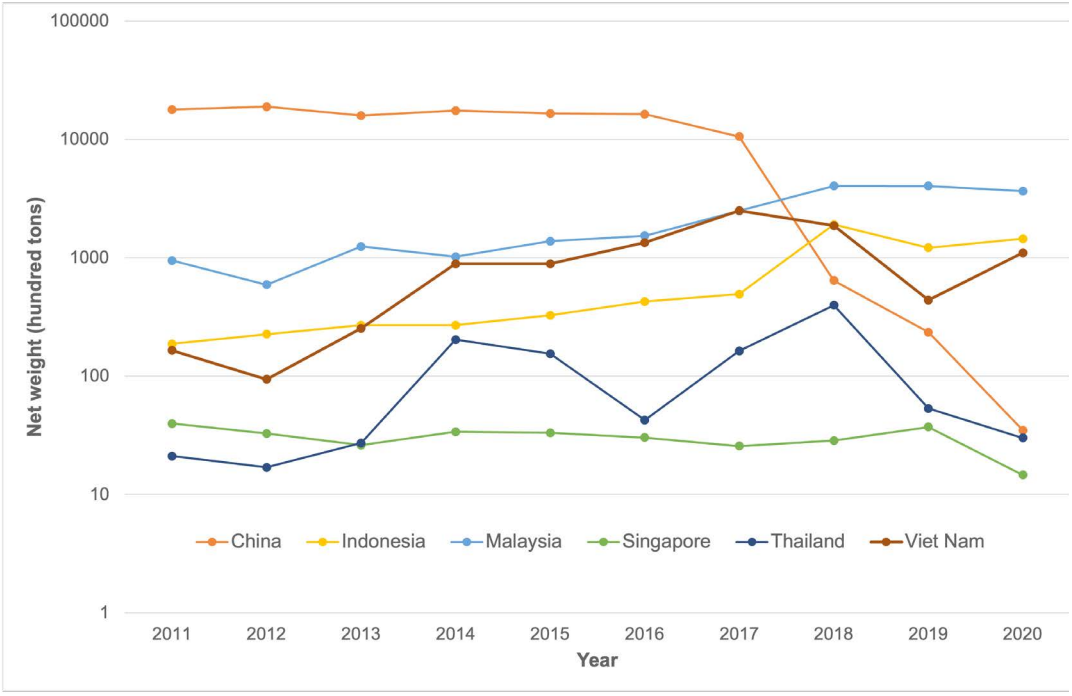


Figure 5.1 Logarithmic graph showing exports of European plastic waste to South East Asian countries in the last ten years as reported by Europe (source: Eurostat)

other value circular retention options (see section 5.3.1 for value retention) by engaging diverse actors and circular practices while incorporating the global waste value chain. Global North to Global South trade of plastic waste in an unequal context for waste valorisation decreases equity, fairness and distributive justice (Cotta, 2020). Other research (see Hickle et al., 2022; Hornborg and Martinez-Alier, 2016) argue such unequal trade causes systemic harm and increases global inequality.

5.3 Theoretical Perspectives

Trading plastic for recycling involves multiple policies and governance structures across the value chain in different geographies. A multidisciplinary perspective enhances our understanding of this complex value chain, its governance and practice. Here we discuss concepts from five academic perspectives: circular economy, reverse logistics, justice and equity, environmental governance and ethics.

5.3.1 Circular economy

Circular economy, our first perspective, advocates regeneration by slowing, narrowing and closing material and energy loops and proposes multiple value retention options (Reike et al., 2018; Geissdoerfer et al., 2017). Short-loop options include refuse, reduce, reuse/resell and repair for waste reduction; medium-loop options include refurbishing, remanufacturing and repurposing for value-adding and long-loop recycling, energy recovery and remining for value retaining (Reike et al., 2018). From a sustainability perspective, researchers argue choosing between value retention options should be steered by integrated market dynamics addressing sustainability, people, planet and prosperity (PPP) framework, quality and functionality (see: Campbell-Johnston et al., 2020, Vermeulen 2018). Researchers point out that the social, moral, justice and transboundary dimensions necessary for a just circularity transition are not yet incorporated into the circular economy discourse (Thapa et al., 2022a,c, Barrie and Schröder, 2021, Calisto-Friant et al., 2020, Gregson et al., 2015). To analyse waste shipment, we take a broader circular economy perspective, including the social and environmental dimensions, with attention to justice and equity globally.

Even though recycling mass materials theoretically lies towards the least preferred end of the circular economy hierarchy, recycling is popular in the circular economy discourse and practices compared to other value retention options due to the policy emphasis on recycling in recent decades. Virgin plastic usually has a higher social and ecological footprint than recycled plastic; thus recycled products are increasingly popular with (environmentally aware) consumers. The EU aims to recycle 65% of municipal and 75% of packaging waste by 2030 and make 100% of packaging waste recyclable (European

Commission, n.d.; Robaina et al., 2020). Observing the lack of plastic (waste) prevention targets, Zero Waste Europe calls for a 20% reduction by 2025 and 50% by 2030 (Zero Waste Europe, 2017).

5.3.2 Reverse Logistics

Our second perspective is reverse logistics - the process of transferring end-of-life products from one place to another to use as a resource or to discard. The linear to circular economy transition partly depends on viable reverse logistics, which consists of stakeholders (producers, retailers, scrap pickers, recyclers etc.), the logistics network and its contexts (Mishra, 2021). A recent systematic reverse logistics for circular economy literature review found some consideration for the triple bottom line (Mishra, 2021). These considerations are: social – stakeholder participation, employment performance and stability, health and safety, collaboration and community engagement; economic – includes return on investments, cost optimisation, efficiency, value capture etc., aided by technology and innovation; environmental – minimising harm to the environment by reducing pollutant by-products, energy use, resource use, land and water use, prioritising and optimising secondary raw materials (Agrawal and Singh, 2019; Mishra, 2021). The review identifies twelve circular economy barriers: some are lack of transparency, access to technology, high cost, short-term profit-seeking, lack of collaboration, circular economy knowledge gap, lack of circular economy incentive and leakages during recovery (Mishra, 2021). Another literature review on a recycling network focusing on social, technological and political dimensions shares similar findings in the social dimension (Santander, 2022). However, neither review shows considerations for decent livelihood, job security, human rights, a living wage, labour rights etc. Such social justice and equity issues are usually associated with the waste value chain (see Thapa et al., 2022c for electric and electronic equipment value chain). Still, they are not given enough attention in the reverse logistics.

5.3.3 Justice and Equity

Our third perspective focuses on the need for justice and equity in circular economy and reverse logistics that primarily considers material flow and reducing environmental harm. The broader criticism of circular economy literature lacking the social dimension (Schröder et al., 2020; Calisto Friant et al., 2021; Walker et al., 2021) seems appliable to the reverse logistics or recycling network

literature. Agyeman (2006) points out equity and justice consideration are usually left out of sustainability discourse by focusing too much on the environmental aspect. Furthermore, considering how activity in one geographic location can affect equality and equity elsewhere, Soja (2010) showcases the necessity of spatial justice in a just transition. Additionally, just transitions must incorporate procedural, distributive and restorative justice (Newell and Mulvaney, 2013; McCauley and Heffron, 2018; Stevis and Felli, 2020). Thus, justice and equity must be incorporated into actors' interactions, relationships and practices across the value chain for a just circular economy transition. Currently, the linear economy, characterised by take-make-dispose, is a driver of social injustice, with consumption and wealth accumulation in the Global North and its related societal and environmental threats shifted to the Global South (Barrie et al., 2022; Hickle et al., 2022).

5.3.4 Environmental governance

Another relevant perspective addresses governance. Governance, in general, solves collective action problems through institutions and their arrangements (Driessen et al., 2012; Lange et al., 2013). In the research context, our collective action problem becomes: how to feasibly increase the circularity of EU's plastic waste for recycling and minimise environmental harm while promoting justice and equity (or at least not creating injustice and inequity)? Governance includes actors and their interactions determined by power and influence (politics), interactions rules of actors (polity) and instruments used to achieve the goals of governance (policy) (Driessen et al., 2012). Environmental governance theories identify various modes of governing sustainability challenges (see: Driessen et al., 2012; Partelow et al., 2020). For instance, in the EU, environmental governance is public-private, while Vietnam's is centralised. Often governance in one country affects policy (and governance) in another, studied under policy diffusion and policy transfer (see: Marsh, 2009; Simmons and Elkins, 2004; Gilardi, 2010). The circular economy is one such influential policy area with wider global uptake, where more and more countries are copying circular economy policies with or without adapting to their local socioeconomic and political context. In an increasingly interconnected world where nations open up to global markets, policy and actions in one place have (intended and unintended) sustainability and equity implications elsewhere, which is studied under the concept of 'telecoupling' (Downing et al., 2021; Hull and Liu, 2018). Telecoupling researches interactions between distant and directly or indirectly connected systems looking at systems, agents, flows, causes and effects to understand how a third

party is affected (Hull and Liu, 2018). For example, how the Chinese ban policy had and is causing a series of positive and negative effects globally (Wen et al., 2021). In this research, we investigate how the circular economy target of a higher plastic recycling rate in the EU creates trade-offs that affect people and their environment in Vietnam. Before that, we introduce an ecocentric ethics perspective of interconnectedness and interbeing.

5.3.5 *Kyōsei* – Ethics for mutual flourishing

The last perspective focuses on symbiosis for mutual flourishing. McRae (2015) revisits the Japanese notion of *kyōsei* or 'symbiosis' or 'living together' in environmental ethics, drawing on mutualistic symbiosis ideas from business ethics. *Kyōsei* is the key paradigm for Caux Roundtable that guides international business for ethical and social responsibility (Carroll, 2013; McRae, 2015). Building on the notion of intrinsic value of the individual, the society and the environment and focusing on interconnectedness among them, *kyōsei* proposes balancing the well-being of the individual with the well-being of the society and the well-being of the environment (see Figure 5.2; McRae, 2015). Ethics emerges through interconnected double negation, first, the individual negating society for individual rights, and the individual negating oneself for the common good (refer to McRae, 2015 for 'double-negation'). This double-negation benefits individual, society and the environment. Otherwise, a conflict exists between the individual, society and the environment, which can be interpreted as a sustainability problem in this research context. McRae (2017) further links to *kyōei* or mutual flourishing, drawing from concepts of 'cooperation for mutual benefit', 'conflict resolution' and 'maximising efficiency' (as in 'avoidance of waste' or 'waste is foolish'). Combining *kyōsei* and *kyōei,* he proposes 'symbiosis for mutual flourishing', which can be applied to navigate conflicts in interactions, relationships and practices in reverse logistics or circular economy actors. For instance, the conflict between cost savings and minimising environmental and social harm can be minimised by investing in waste infrastructure domestically or in the destination of waste exports to ensure mutually beneficial symbiosis. This ethical framework proposes a focus shift from an anthropocentric worldview, which is often cited as the cause of the socio-ecological crisis, to an ecocentric one (McRae, 2015, 2017).

By acknowledging individuals' and society's relationship with the environment, this ethical framework stipulates that (social and environmental) injustices and inequities go against mutual flourishing and

cause harm to everyone in such a relationship. This framework is closely related to concepts of just sustainability, spatial justice and just transition and is firmly associated with strong sustainability, which stipulates that without a functioning biosphere (environment), there will be no society or economy (human and individual) (see Neumayer, 2003). *Kyōsei* interconnects various telecoupling relationships to promote mutual benefit.

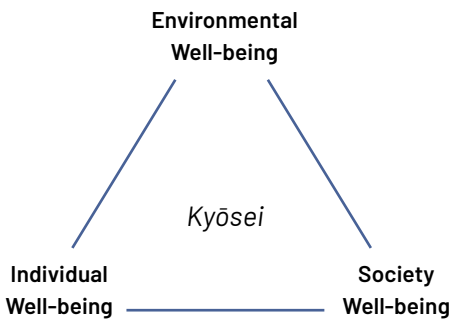


Figure 5.2 Symbiosis for mutual flourishing – an ecocentric ethical framework built on the radical interrelatedness of an individual with society (McRae 2014, 2018)

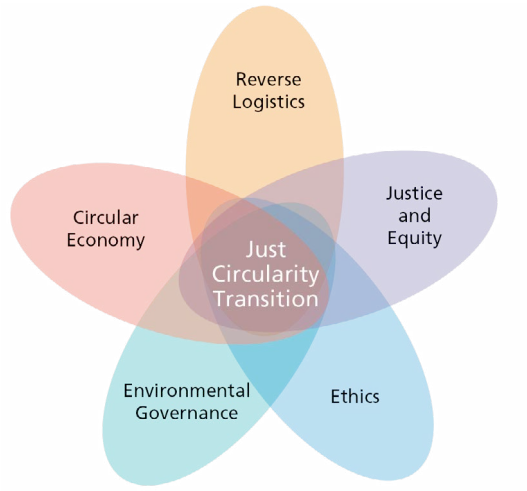


Figure 5.3 Multidisciplinary perspectives framework for analysing waste shipment for a just circularity transition.

5.3.6 Framework for waste shipment for a just circular economy transition

Integrating these multidisciplinary perspectives guides this research and provides a starting point for future research, policies and action for guiding waste shipment for a just circular economy transition. This framework combines abstract (justice, governance and circular economy) and practical and hands-on (policies, reverse logistics and ethics) concepts to guide various actors' relationships in this plastic waste value chain.

5.4 Methods

A qualitative case study (Yin, 2003) guided this exploratory research. The qualitative research enabled us to review the literature, policy documents and reports and map stakeholder to gather a macro view of the trends and practices of the EU-Vietnam plastic waste trade for recycling. Additionally, the case study enabled an in-depth contextual examination of practices adding experiences of people, their livelihoods and practices, and a social dimension to waste trade for recycling. We contacted 50 stakeholders for interviews and interviewed 21 people after multiple follow-ups, notwithstanding the availability of meeting face-to-face in Vietnam. We zoomed in on Minh Khai craft village (section 5.5.4), one of Vietnam's biggest recycling centres for imported plastics. We highlight current trends, determine key drivers and enablers and analyse existing practices.

Vietnam is selected for its relevance in the global plastic waste value chain and as a destination for European exports. As mentioned, plastic waste exports to East Asian countries increased significantly after the Chinese ban. We started broader research on the EU and Japanese circular economy policies and their plastic waste trade in Southeast Asia. However, limited fieldwork opportunities due to COVID-19 and lack of transparency made multiple countries' case studies difficult. We focused on Vietnam, one of the top European plastic waste destinations for recycling, and subsequently established a deeper research collaboration with a national institute working on circular economy research. Vietnamese experts provided local knowledge to investigate this often non-transparent value chain. This collaboration was important in identifying and conducting a case study in Minh Khai – the hub for recycling the imported waste in Vietnam.

Data collection involved four phases. The first phase reviewed academic literature and relevant Vietnamese and EU policy documents on related transboundary plastic waste trade, plastic waste management and circular economy. A total of 55 documents were reviewed, including books, reports, journal articles and policy documents. These provided context and identified actors in this value chain. The second phase mapped out actors and their interactions based on the previous phase for further research. Between November 2020 and May 2022, 50 identified stakeholders from the government,

waste processing and importing companies and non-governmental organisations were approached for online and in-person interviews in Vietnamese and English multiple times. Thirdly, structured and semi-structured interviews were conducted between December 2020 and May 2022 in Vietnamese and English, which were translated (if needed) and transcribed. Questions and interview guides were shared beforehand, especially for government interviews. Lastly, six-weeks fieldwork was organised in March and April 2022, when travel restrictions were lifted after the pandemic. This enabled in-person interviews and site visits, including an opportunity for an in-depth case study at Minh Khai village, assisted by Vietnamese colleagues. A total of nine online interviews, twelve in-person interviews and five field visits were conducted in this period. After this, collected materials from the interviews, interviews and field visits were analysed using the multidisciplinary framework (section 5.3.6).

Limitations

9% of imported plastic waste in Vietnam comes from the EU (Japan 41.9%, Hong Kong 8.25%, the Phillippines 6.47% etc., the rest in 2019) (UN 2022; OEC, 2022). Our research focuses on the circularity and sustainability implications of this EU-Vietnam trade but does not look into similar trade in other countries or waste streams. EU's paper waste export to Vietnam is increasing, and plastic waste export is decreasing (UN 2022). Our findings and discussion on what happens to plastic waste imports for recycling in Vietnam are relevant to plastic waste imports from all nations, not just the EU. As waste trade shifts between geographies (from China to Vietnam to perhaps somewhere else), the general findings from this research remain relevant for similar waste trade elsewhere. Waste trade, including plastic, is highly non-transparent and obscure. Despite several attempts, research collaboration with all value chain actors, like the formal Vietnamese importers and recyclers, was impossible. We include actors from the government, domestic plastic waste management and non-governmental organization and then zoom in on the informal sector engaging in recycling imported plastic waste. Later we discuss the need to address this lack of transparency for a fairer waste shipment and transition to just circular economy (discussed in Section 5.5.3).

5.5 Results

In this section, we present domestic and imported waste management in Vietnam, the challenges of obscurity in the value chain and the case study of Minh Khai recycling village.

5.5.1 Waste Management, Policies and Actors in Vietnam

Understanding domestic waste management is integral to understanding the context in which overseas plastic waste for recycling is imported. The socialist republic of Vietnam, with 96 million people, is one of the world's fastest-growing economies. The central government and its various ministries are responsible for policy-making to guide waste management. For environmental regulations, the Vietnam Environment Administration (VEA), the Department of Legislation, and the Institute of Strategy and Policy on Natural Resources and Environment (ISPONRE) are important stakeholders and fall within the Ministry of Natural Resources and Environment of Vietnam (MONRE).

The Vietnamese Law on Environmental Protection (LEP), first enacted in 1993, is the foundation of the legal framework for waste management in Vietnam (Ortmann, 2017; Tran and Pushkareva, 2020; Bui, Nguyen, Phan, and Nguyen, 2020). A revision in 2020 (effective in January 2022) incorporates extended producer responsibility (EPR) and the circular economy, focusing on green growth along with decrees, decisions, action plans and strategies (MONRE, 2020). However, policy implementation and enforcement remain challenging. For instance, in Ho Chi Minh, there have been ongoing back-and-forth policies for waste segregation into three (organic, waste and recyclables) and two (recycled and others) categories yet without any implementation (interview, RC4). This example also highlights the involvement of multiple government levels and actors, which complicates streamlining policy-making, implementation and enforcement. MONRE is responsible for implementing LEP and shares responsibilities with other bodies making coordination for implementation, enforcement and effective monitoring complicated. Figure 5.4 depicts the actors engaged in the waste value chain, including national government ministries, local public bodies and other stakeholders. Business organisations, especially plastic recycling, play an active role in waste management and influencing policy. One recent example includes lobbying to increase the concentration of impurities allowed in imported

plastic waste (interview: RC 2,4,6; NGO 1). Both the formal and the informal recyclers engaged with imported plastic waste. Academics work closely with government, business and INGOs' projects, indirectly guiding and shaping the policy landscape. NGOs often raise critical voices but are usually in the minority and unheard (Interview, NGO 1).

Guided by existing policies and laws, (mostly) state-owned companies carry out waste (including plastic) management in collaboration with the informal sector, ve Chai. Even though Vietnam aspires to segregate waste, this is not a reality because of financial and technological challenges (interview, RC4). Waste collection is partly carried out by the informal sector, which transports collected waste from households to waste processing companies and sorts the valuables for sale in the secondary market

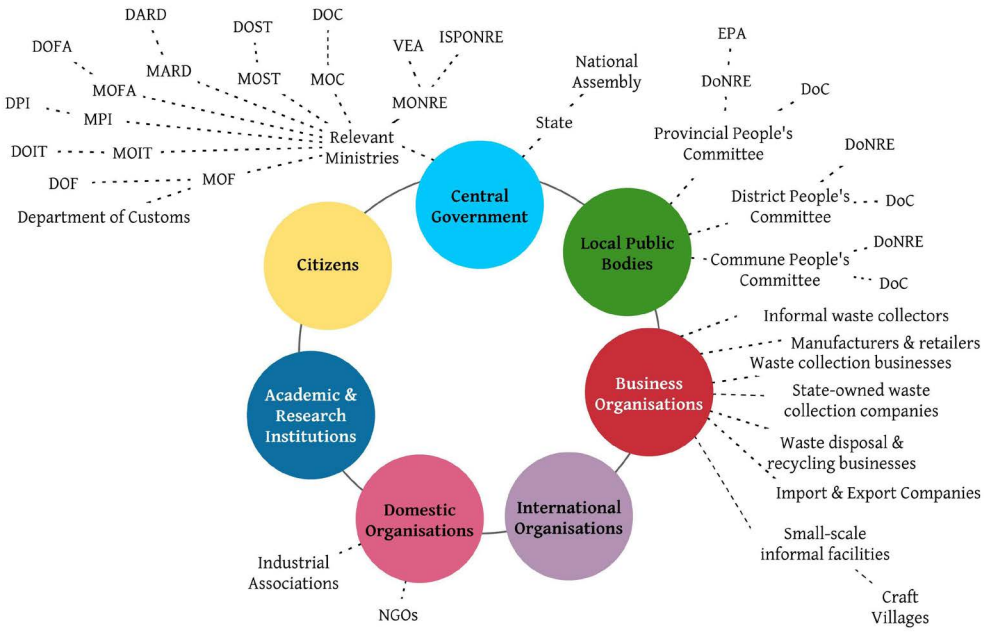


Figure 5.4 Stakeholder map of the relevant actors and actor groups to the Vietnamese approach to developing the waste management system created using the various phase of the research. See appendix for abbreviations.

(interview, RC4). These informal sector workers use pushcarts, bicycles, scooters, vans, tractors or cars for waste transportation and work closely with waste management companies (interview, RC4). Waste pickers are paid by households for their services, usually through a waste picker collective in bigger cities. In a traditional profession dating 'hundreds of years', there is a push for formalisation, which one waste workers reflects 'in fact formal or informal labour is just a concept, what is important is trying to take care and support them' (interview, RC4). She further identified 'sorting garbage' and 'financing and management of new (incinerator) technology' as major challenges that would require 'change in entire system including people, machine and management methods', including some privatisation (interview, RC4). Figure 5.5 summarises the waste management practice in Vietnam.

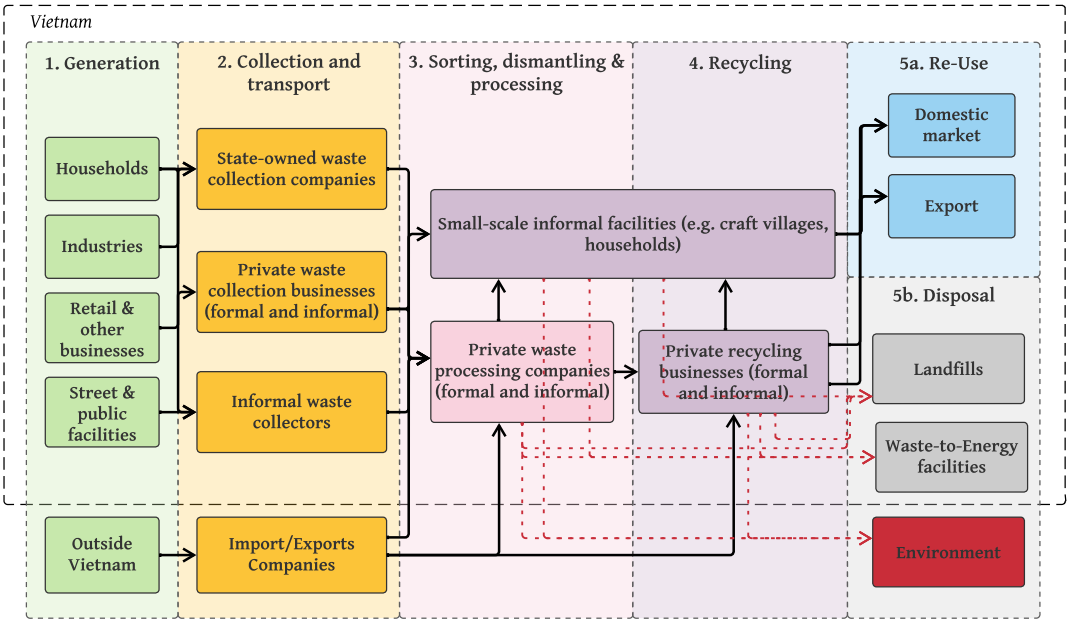


Figure 5.6 EU ships half of the collected plastic waste abroad for recycling, some of it to Vietnam, but the fate of the plastic remains unknown. The question mark represents obscurity in the waste value chain.

5.5.2 'Scrap' imports in Vietnam

Vietnam's Law on Environmental Protection sets guidelines for imported plastic waste per environmental safety standards and publishes a list of permissible scrap materials. There is not enough infrastructure and technology for sound waste management, so waste imports which cannot be recycled are not officially permitted (Interview, GOV 1). It further requires waste importers to use part of the recycled materials for production and sets environmental standards for recycling. A legal decision lists types of plastic waste allowed to be imported, and a decree requires importing companies to have wastewater treatment, a separate storage warehouse, an environmental impact assessment of the company and a certificate of eligibility for environmental protection of the imported scrap (Government of Vietnam, 2015; Interview GOV 1, GOV 3). Importing companies need a permit issued by MONRE that obligates strict regulations and mandates recycling at least 30% domestic recycling (Interview GOV 1). Recycled materials are sold mainly in the domestic market, and non-recyclable materials are discarded. Even though incineration is preferred, landfill remains a dominant form of plastic waste management (interview, WMC1,6,9,10).

Despite a growing demand for recycled plastic in Vietnam, most interviewees mentioned that not all imported plastic waste is of high quality and recyclable. However, they are of better quality than domestic plastic waste, which is unsorted and dirty. Recyclers preferred plastic waste imported from Japan, as it was the cleanest. Imported plastic waste is mainly recycled into pellets. In 2018, after the Chinese plastic import ban, overwhelmed by increased plastic imports, Vietnam halted plastic waste importing permits. Getting a permit remains difficult and requires meeting the requirements and being able to pay a deposit based on imported volume to guarantee no illegal activities are conducted. We learnt that having a 'good relationship' helped to get a permit (Interview, RC 8,10,11). We could not access businesses with such permits; thus, much of what goes on remains obscure. Figure 5.6 maps out how plastic for recycling is collected in the EU and partly what happens to it once shipped to Vietnam. Despite insights into policies and regulations, a lot of practice remains obscure.

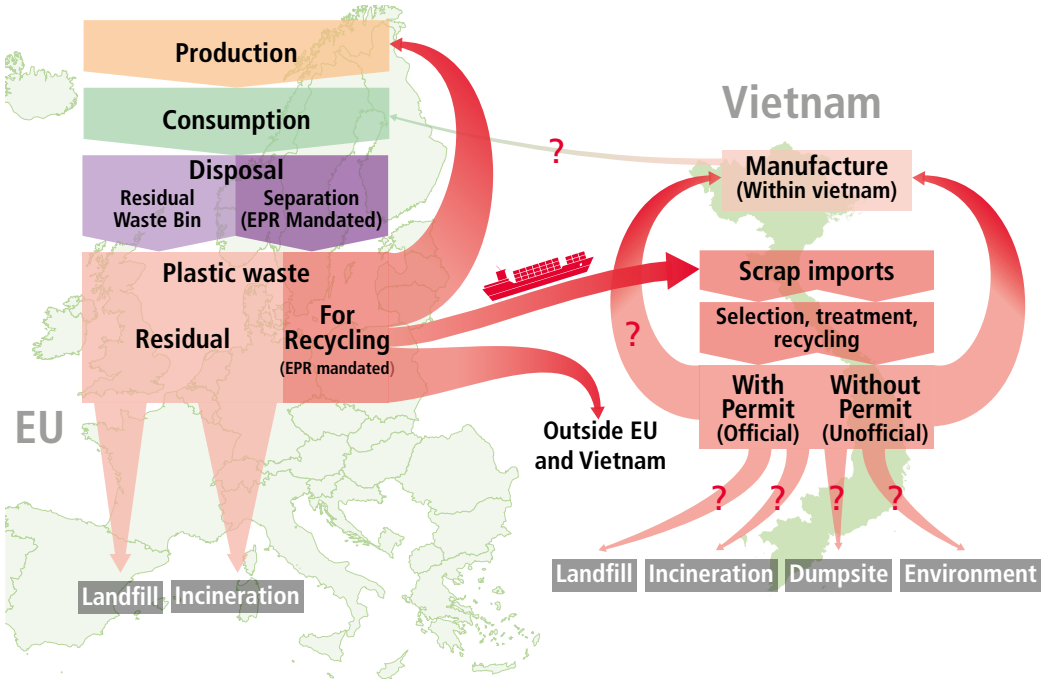


Figure 5.6 EU ships half of the collected plastic waste abroad for recycling, some of it to Vietnam, but the fate of the plastic remains unknown. The question mark represents obscurity in the waste value chain.

5.5.3 Lack of transparency

One major challenge of researching the waste value chain is the lack of transparency (see question marks in figure 5.6). Access to essential stakeholders like MONROE and the port authority was difficult, even though our Vietnamese collaboration partners were connected to the central government. Furthermore, we could not connect to importers and recyclers with government permits to import and recycle such waste. Even though a European company exporting plastic waste to Vietnam stressed the transparency and sustainability of their process (Interview, RC 3), our requests to establish a connection with the importer of their plastic waste in Vietnam went unresponded. Without access to

companies with import permits, we focused on the more accessible 'craft villages', where imported plastic waste is recycled mostly without such permits. However, it is hard to establish what fraction of imported plastic waste they process and what happens to the discards. The craft villages are neither formal nor informal, each business has different legal arrangements, but most have some kind of business permit. They have an informal network(s) but are not as publicly organised as groups like the Vietnamese Plastic Association (VPA).

VPA represents over 300 plastic enterprises and 400 individual and business members in its Plastic Recycling Branch. One industry leader with 20 years of experience in plastic recycling was enthusiastic about sharing the development of new and much-needed relevant sustainability policies and actions on domestic recycling (Interview, RC 6). The interviewee was knowledgeable about domestic plastic recycling but was unaware of any plastic importing or imported plastic recycling company. His company focused on pioneering a domestic plastic waste collection system. On imported plastic waste, he reflected, 'MONRE strictly manages the import of scrap, and at the same time strictly regulates the conditions on wastewater and emissions in the recycling process; there is no effect on the environment and human health' (Interview, RC 6). Later during field visits, we found questionable environmental and human health conditions, despite these laws and regulations. What happened to the imported plastic was obscure even to an expert with years of experience in the Vietnamese plastic recycling sector. Non-experts we met during the research were surprised to learn that Vietnam imported plastic waste for recycling and remarked that Vietnam should focus on domestic plastic waste instead. Circularity and sustainability of waste trade hinge on transparency and accountability in the value chain, which is currently absent.

5.5.4 Fate of Imported Plastic – a case study of Minh Khai craft village

Minh Khai craft village, twenty kilometres outside the capital Hanoi, is one of the biggest Vietnamese recycling hubs for imported plastics. Traditionally rural villages made handicrafts when not busy farming, but in Minh Khai, 870 households recycle 500-600 tonnes of plastic waste daily (Salhofer et al., 2021) for livelihood. Most recycling operates in the front yard of their houses (see Figures 5.7 and 5.8). Practitioners refer to 'scrap' instead of 'waste', as they consider scrap to be a source of livelihood and waste a burden. Without robust domestic plastic waste collection, domestic plastic scrap is dirty

unless it comes directly from the manufacturer. Few recyclers who had one-to-one relationships with domestic manufacturers processed domestic waste. Others depended on imports. Increased demand for recycled plastic content in products (in Vietnam and globally) means the Vietnamese manufacturing sector needs more recycled materials. Without a clean and steady domestic supply of plastic scrap, these recyclers have to depend on imported scraps, often without permits and through informal networks.

Most Recyclers in Minh Khai preferred Japanese plastic waste ('I don't even need to wash it' – Interview, RC A, B, C). Scrap from Europe was dirty and less desirable (see figure 5.7), while US scraps were the dirtiest (Interview, RC C, D). Recyclers preferred to pay more for cleaner scrap. Dirty scrap was cheaper but created more waste and pollution during recycling and produced lower quality recyclate, required more work and fetched lower profit. Depending on the quality, about 15-25% of the imported scrap brought to this village cannot be recycled and is either handed down to other waste collectors or dumped in the environment. Similar research estimates that 25-30% are discarded as residual waste, and 7 million litres of wastewater are discarded daily into open dumps and waterwards from Minh Khai (Yeoh, 2020). Without proper storage, these scraps were kept in the front and backyard of the house, by the side of the road, or on any open land (see figure 5.7). Smoke from melting the plastic into pellets and wastewater from the whole process was not treated. All of which cause health and environmental harm.

Reflecting on the period since the Chinese ban, when Vietnam noticed a sharp increase in plastic waste, one recycler states, 'people made a lot of money when there was an influx of plastic before the government strengthened regulations' (Interview, RC 6). Despite stricter regulations that included issuing selective import permits to companies meeting government standards, getting hold of imported waste is not a challenge to these recyclers without importing permits. For most, it is usually a phone call to a broker or a visit to the port away. Even though importing companies are obliged to recycle imported scraps and not sell them, imported scrap is easily accessible in the market. Different quality of scraps comes at different prices, which affects the quality of recyclate. From Minh Khai, we drove an hour to Hai Phong port following an insider tip and noticed plastic waste with labels for the European market sold by Chinese brokers in one warehouse. China dominated the plastic waste trade for decades before the ban, so Chinese businessmen actively engaged in the plastic waste trade in Vietnam and elsewhere. Near the port, there were many warehouses with plastic waste in various conditions. Some even stored openly next to the river and rivulets. The one we visited was in dilapidated

Figure 5.7 Photos from Minh Khai Village (top to down) showing front yard recycling, storing plastic in the environment and the street and European plastic pile imported for recycling.

condition. Clearly, health, sanitation and environmental guidelines were not a priority in most of these businesses. Policy and its enforcement gaps were omnipresent to observe. Most recycling companies had some license to operate the business and had to follow health and safety regulations. To surpass regulations, bribing the inspector seem to be a common occurrence. Other recyclers mentioned the possibility of importing plastic scraps without a permit by bribing customs officials. Minh Khai craft recycling village looked more like a city suburb among rice fields, filled with modern houses with

Figure 5.8 Photos showing workers in their work environment engaging in secondary recycling of mostly imported plastic for recycling in Minh Khai Village

tropical plants and do-it-yourself recycling in the front yard surrounded by huge waste piles.
All the recycling centres we visited employed basic mechanical recycling, where scraps are sorted, cut, washed, melted and downcycled into pellets (see figure 5.8). Many times, these were covered open spaces in the front yard of the owner's house, with 10-15 employees. Most owners believed their activities were not very harmful 'you get sick living anywhere these days, (interviewee RC 8) 'the water is clean enough to be thrown in the drain' (interviewee RC 10). We observed people cooking, eating and living in this area next to the fumes of melting plastic, spilling wastewater, and children playing. By its side, plastic waste from all over the world was being stored and processed.

Spending a few days in Minh Khai overwhelms you with plastic and its burning fumes. It shows how policies (Vietnamese or European) promoting plastic recycling and its enforcement are disconnected from its global value chain, workers and their environment, enabling such dire recycling circumstances. Exporting plastic increases the recycling rate in the EU at a significantly cheaper price than recycling in the EU, but at the cost of questionable facilities and practices harming workers and the environment. While much of the fate of all such shipments remains unknown, in Minh Khai, most imported plastic waste is downcycled. All these add up to the true cost of European recycling, borne by people and the environment far away. This practice of unequal exchange without ethical consideration harms other individuals, communities and the environment. One cannot help but wonder what an unassuming European plastic consumer, most likely a believer in democracy, equity and justice, and who makes an effort to separate plastic for recycling, would say about this inherently undemocratic and unjust practice.

5.6 Discussion

We use the multidisciplinary framework for analysing waste shipment practices and their implications for a just circular economy transition and propose a way forward. Based on the results, this section discusses why there is a need for ethics, justice and equity in this plastic waste governance and how we envision a better plastic waste trade governance for a just circular economy transition.

5.6.1 Obscure reverse logistics without circularity, justice and equity

In Vietnam, without robust plastic waste collection, imported plastic waste acts as a cheap and profitable feedstock for recycling companies to meet the increasing demand for recycled plastic. As in the EU, recycling infrastructure cannot keep up with the growing plastic waste generation to meet the recycling targets. Increasing recycling focus in the EU without the sound capacity to do so creates an increasingly long and complex waste value chain comprising various reverse logistics actors globally. Failure to build sufficient recycling capacity within Europe leads to exporting plastic waste for recycling, which currently is not regulated for sustainability or circularity. Exporting lowers operating costs, thus maximising profit. Outsourcing to a destination with cheap labour, low work safety standards and cutting corners for pollution management might enable economically cheaper recycling but comes at the cost of harming people and their environment far away. Such EU-Vietnam plastic waste trade for recycling is not transparent and based on unequal exchange. Plastic waste generation and lack of its management in the EU, lack of ethical consideration in policy and its implementation in the EU and Vietnam lead to neo-colonial exploitation in the form of waste shipment for recycling.

Identifying such linear and long-distance trades of low-value waste as significant drivers exploiting and reproducing a divided and unequal world, Barrie et al. (2022) call for fair, inclusive and circular trade. Fairness, inclusivity and diversity in the circular economy are identified by other scholars as a necessary precondition for societal transformation (Calisto Friant et al., 2020; Vermeulen et al., 2022). Even though exports without transparency help the EU meet the recycling target and remove waste from the EU, such trade to a destination without sound recycling is problematic for multiple reasons.

Firstly, failing to take care of waste and shipping waste without accountability shifts harm to individuals, societies and the environment far away. EU plastic waste management should is telecoupled with exploitation and harm elsewhere. Secondly, the waste value chain and reverse logistics actors and their politics is partly built on exploiting each other and the environment. This ultimately weakens the capacity for good governance by promoting corruption, illegal and illicit activities, creating and maintaining obscurity in the value chain. Thirdly, such unequal waste trade makes inequities and inequalities grow bigger by reinforcing them and exploiting them further (see: waste colonialism Pratt, 2011; Fuller, 2022; Manglou, 2022). Fourthly, if the plastic is recycled, that is merely adding to the least value retention option whilst bringing a significant socio-ecological cost. This is a far cry from just circularity. And lastly, such practices without ethics evade regulations that constrain the prioritisation of profit-seeking over society and the environment and do not promote mutual flourishing. Thus the proposed multidisciplinary framework can be a starting point for governing waste shipment for a just circular economy transition, which the EU aspires to.

5.6.2 Governing the circular economy transition carefully

While higher recycling targets in the EU are praiseworthy, superficially meeting those targets by sending plastic to destinations with questionable practices for recycling without accountability is ethically questionable. For instance, estimates show about 23% of the EU's plastic waste for recycling is not recycled (Bishop et al., 2020). Such was the case in Minh Khai village, with recycling loss and downcycling associated, loss of plastics, and harm to workers and the environment. This calls for carefully designing circular economy policies and practices cognisant of and in solidarity with the entire waste value chain and the environment in the EU and Vietnam. This and other research (Thapa 2020b) establish that 'sustainability' efforts like recycling without full waste value chain policy-making and its enforcement can reproduce injustices and inequities on a global scale. Transboundary shipment currently lacks circularity and fails to incorporate the principles of a just transition and spatial equity. With these considerations, perhaps, it is better to incinerate or even landfill in Europe than upping recycling percentage by exporting waste and harming elsewhere. Or else, the EU should be consequential in their circularity ambitions and create trustworthy recycling facilities either abroad or within the EU when it actively claims to work towards a transition to the circular economy. Current policy-practice gaps undermine the legitimacy of the EU and its discourses. Recycling policies should be inclusive, enforceable, monitored and transparent.

Existing practices incentivise and reinforce a lack of transparency in the waste value chain, which hides unsustainable and unethical practices identified in the research. EU policies, action and governance should account for telecoupled consequences to include equity and justice in the full value chain.
Uptake of popular discourses like the circular economy of one place must be contextualised into the social, economic, cultural and technological contexts. Any best practices, policy transfers or policy diffusion must be contextualised and carefully adapted to the local realities. In the adaption process, principles like fair, ethical, inclusive, transparent and collaborative circular economy and waste governance (Barrie et al., 2022; Thapa et al., 2022c) must not be compromised.

5.6.3 Future ethical direction – symbiosis for mutual flourishing

Unequal relationships in the waste value chain undermine potential sustainability and circularity outcomes. Given various complex relationships between actors, policies, countries, societies and the environment and their intended and unintended consequences for individuals, societies and the environment, we propose an interdisciplinary framework to guide future waste shipment as a starting point for a just circular economy transition. This framework proposes ethical waste governance of the whole waste value chain and includes spatial equity and just sustainability. As proposed by *kyōsei*, such waste trade must be transparent and mutually beneficial for the EU and Vietnam, for the individual, the society and the environment. In other words, Europe's circular economy and Vietnam's scrap imports should benefit the individuals involved, societies and the environment. Ethics, justice and equity should guide the governance and practice of reverse logistics and circular economy. The individual-society relationship calls for collaboration, transparency, observance of human rights and dignity, equity and justice, and empowerment of the informal sector. The society-environment relationship calls for governance toward socio-ecological well-being, causing the least environmental harm possible, reducing plastic consumption and waste generation, and implementing the waste prevention principle (Duvic-Paoli, 2018) and waste proximity principle (Resse, 2018). Actors in the full value chain and their interactions with society and the environment should promote mutual well-being, as opposed to the current exploitation.

5.7 Conclusions

In our research, we found the shipment of European plastic waste for recycling contradictory to circularity, sustainability and justice values. Our study has helped to reveal previously obscure elements of how this value chain works by focusing on recycling and its socio-ecological impacts. From our case study in Vietnam, we found downcycling is a common practice which is not aimed at the highest value retention and causes health and environmental harm. We found a lack of full waste value chain consideration on the part of exporters and a lack of policy implementation in Vietnam, which further causes social and environmental harm. The plastic trade focuses on the current market logic of maximising profit at any cost and lacks ethical consideration for other humans and the environment, the same logic that caused or is causing current social and ecological crises. Value chain actors lacked accountability, EU and Vietnamese policies lacked enforcement, and practices lacked transparency, thus creating loopholes for exploitation. We propose a multidisciplinary framework for guiding future waste shipment for better governance and practice for a just circular economy transition. Our proposal is partly guided by ecocentric ethics *kyōsei* to promote mutual well-being in the interdependent relationship between individuals, society and the environment, enabling just circular economy policy and practice. From the often narrow material and some environmental focus of the current circular economy discourse, this framework emphasises the various interrelationships in the circular economy and reverse logistics actors with attention to ethics, justice and equity. This framework incorporates spatial justice and just sustainability. Besides guiding the current EU-Vietnam plastic waste trade, it can guide the governance of other (resource or waste) trade. We propose future interdisciplinary and transdisciplinary research exploring other waste streams and other aspects of circular economy transitions via ecocentric ethics, justice and equity besides the plastic waste value chain.

Even though consumers are held responsible for separating plastic waste in Europe, of total plastic waste, only one-third is recycled, half of which remains unaccounted for. Increasing consumption generates more waste, whose management lengthens and complicates the value chain and can cause harm and exploitation. Thus, we recommend reducing unnecessary consumption and waste generation. For generated waste, we recommend a shorter and simpler value chain that is more transparent, accountable

and ethical. In setting future policies and practices in the EU and Vietnam, we recommend carefully taking a collaborative and inclusive global waste value-chain perspective accountable to promoting social and environmental equity and justice globally, or at least not adding to inequity and injustice.

Interview Lists

A total of 21 interviews were conducted. The stakeholders are identified and named in the table below:

Stakeholder	Number	Names
Recycling Companies	2 Online, 9 in-person	RC 1 – 11
NGO	2 in-person	NGO 1 – 2
Academic/Researcher	2 Online, 2 in-person	ACA 1 – 4
Government	4 Online	GOV 1 – 4

CHAPTER 6

Ultimate producer responsibility for e-waste management–A proposal for just transition in the circular economy based on the case of used European electronic equipment exported to Nigeria

"We . . . must try to live without causing unnecessary harm, not just to fellow humans but to all beings. We must try not to be stingy, or to exploit others. There will be enough pain in the world as it is."

— Gary Snyder

Poet, essayist and activist, from The practice of the wild

This chapter is based on Thapa, K.,Vermeulen, W. J. V., Deutz, P., and Olayide, O. (2022b). Ultimate producer responsibility for e-waste management–A proposal for just transition in the circular economy based on the case of used European electronic equipment exported to Nigeria. *Business Strategy and Development*. https://doi.org/10.1002/bsd2.222

Abstract

Used European electric and electronic equipment (UEEE) has multiple use cycles in various countries, including Nigeria. Although the EU-Nigeria e-waste trade is illegal under EU and Nigerian law, previous research shows that some imported equipment is only fit for disposal. Imported UEEE has a short lifespan. Such European e-waste exports imported to Nigeria have sustainability and circularity implications for both places and raise questions about justice and equity. Using a transdisciplinary approach, we identify existing practices and challenges in Nigeria and co-create actionable solutions towards a sustainable, circular and fairness-driven UEEE and e-waste value chain. We find current extended producer responsibility (EPR) does not focus on the entire global value chain, is linear, and lacks transparency, accountability, and consideration for spatial equity. To overcome these shortcomings, we propose ultimate producer responsibility (UPR). UPR aids sustainability and circularity transition while paying attention to justice and equity. The research adds global and social dimensions to the European circular economy (CE), otherwise primarily focused on national material cycles.

6.1 Introduction

Waste and used products are shipped between countries like any other commodity according to existing laws and market conditions. Additionally, there is a grey area of illicit transboundary shipment of waste. Despite their circularity and sustainability intentions, most national circular economy policies and practices do not effectively address the transboundary movement of waste and used products. "Closing the loop" considerations are implicitly restricted to territorial boundaries of the policies; for example, EU circular economy policies only aim to retain materials within the EU despite their frequent transboundary movement. So far, only the Sound Material Cycle Society – the circular economy policy in Japan, has an explicit "international resource circulation" policy as one of its key pillars implemented by various ongoing international collaborations (Ministry of Environment, 2018).

Circular economy worldwide, as the saying goes, is selling like hotcakes. Japan implemented circular economy in 2000, China in 2002 and European Union in 2015. Chatham House's (2020) data shows that 39 countries have adopted the national circular economy policy. However, there are multiple interpretations, definitions and implementations of circular economy (Kirchherr et al., 2017; Korhonen, Nuur et al., 2018; Murray et al., 2015). Our research analyses European Union (EU) waste governance that has direct implications in Nigeria and elsewhere, so we use the European Parliament's understanding of the circular economy. The EU views the circular economy as a consumption and production model involving "sharing, leasing, reusing, repairing, refurbishing and recycling existing material and products as long as possible to extend the life cycle of the product" (European Parliament, 2021). The EU also identifies multiple motivations and benefits to transitioning from the traditional take-make-consume-throw economic model to a circular "closing the loop". Some EU motivations include: reducing waste and creating value, securing crucial finite raw materials for increasing resource demand while reducing environmental impact from extracting and using raw materials, reducing emissions, boosting economic growth, creating an estimated 700,000 jobs, and helping consumers within the EU (European Commission, 2020a; European Parliament, 2021). The European circular economy approach also seems vital to the global well-being of current and future generations. If everyone on the planet

consumed as unsustainably as EU residents, a resource capacity of 2.8 earths annually would be required (WWF and Global Footprint Network, 2019). EU is a significant contributor to the ecological crisis and, historically and presently, a top contributor to global CO2 emission (Hickel et al., 2021).

The EU adopted a Circular Economy Action Plan in 2015 to facilitate the transition to a circular economy. Revised in 2020, the new circular economy Action Plan adds aspiration towards the international dimension. Acknowledging the "millions of tons of European waste exported to countries without consideration for proper treatment", the EU wants to "ensure that the EU does not export its waste challenges to third countries" (European Commission, 2020a). Furthermore, the EU acknowledges the "just transition movement" as a key tool for transitions to happen fairly, "leaving no one behind" within a "safe operating space" to stay within thresholds for resource use in some of its policies (European Commission, 2020a, 2020b, 2020c). Despite the circular action plans and just transition aspirations, shipment of European waste electric and electronic equipment (e-waste) and used electric and electronic equipment (UEEE), especially to places with little or no capacity to sustainably manage them, is ongoing. Such practices that can cause socio-ecological harm far away and contribute to global inequality are neither circular nor part of a just transition, both frequently cited in the EU's discourses. Such gaps between policy rhetoric and practices create harm outside the EU and have generated criticisms by scholars (Calisto Friant et al., 2021; Gregson et al., 2015).

Nigeria is a top destination for European e-waste and UEEE exports, both because and despite the weaknesses in waste management practices. The Person in the Port Project in 2015/2016 found 71,000 tonnes of UEEE being imported to Nigeria, 77% of which arrived from the EU and 11% being e-waste (Odeyingbo et al., 2017). Research led by an NGO installing trackers on UEEE in Europe found illegal exports to destinations without proper waste management capacity and identified such leakages as "holes in the circular economy" (Basel Action Network, 2018). Some exported UEEE evades functionality checks, so their durability remains uncertain. Nigeria explicitly recognises UEEE import as cover for e-waste import in its National Environmental (Electric/Electronic) Regulations of 2011 (Federal Republic of Nigeria, 2011). Like elsewhere, Nigeria also aspires towards a circular economy (African Development Bank Group, 2021). Even without national circular economy policies, various circular platforms exist in Nigeria. However, the lack of waste collection and the presence of many active open dumpsites with frequent open burnings remain everyday realities in Nigeria, associated with

traditional, financial, political, social, institutional, regulatory and technical realities (Aremu, 2020). The skilled informal sector actively engages in waste management in Nigeria, fulfilling the vacuum of a functioning waste management system. For instance, only a few formal e-waste processing facilities exist in Nigeria. The informal sector in Nigeria is characterised by causal working arrangements, both within the law or outside it, either for family or friends or self-employed, without job security, social protection or enforcement of labour standards (Ohajinwa et al., 2017). Every year, over 100,000 informal workers process half a million tonnes of e-waste, which are toxic (Ogungbuyi et al., 2012). About 8000 small businesses refurbish and resell UEEE, employing 21,600 people (Ogungbuyi et al., 2012). Often people in the informal sector work in precarious health and environmental condition without knowledge about occupational health risks (Osibanjo and Nnorom, 2007; Nnorom and Osibanjo, 2008; Sullivan., 2014; Perkins et al., 2014; Ohajinwa et al., 2017). With perils, their practices aid the circular economy by reintroducing discarded materials to the economy (Gutberlet and Carenzo, 2020). The imported e-waste and non-durable e-waste further burden the waste management system in Nigeria.

The current EU-Nigeria exports of e-waste and UEEE are neither circular nor fair. With these twin considerations for circular economy and fairness concepts, our research aims to (i) understand the current trends of imported e-waste and UEEE and their management practices in Nigeria, (ii) understand the problems, perceptions, and challenges from various stakeholders' points of view, and (iii) to co-create a contextual solution-oriented knowledge that might have a societal impact. Our research is guided by transdisciplinary research (TDR) principles, which enable academic work to address a societal need. We combine research findings, practitioners' reflections and their needs and integrate them with multidisciplinary knowledge on circular economy and just transition to create solutions-oriented knowledge for identified challenges. We propose a context-specific co-created solution-oriented pathway for sustainable e-waste governance–the ultimate producer responsibility (UPR), which adds justice, equity and circularity to the existing extended producer responsibility (EPR). As there is limited TDR research in the field of transboundary waste or just circular economy transition, this research fulfils the vacuum and hopefully sets an example for future TDR research.

6.2 Research Design

In a review of the transboundary waste movement, we have argued for more contextual, nuanced and collaborative research and suggest TDR as a problem-solving approach for knowledge creation (Thapa et al., 2022b). This study uses a TDR approach that integrates various academic disciplines and works with society to generate contextual and useful knowledge (Gibbons et al., 1994; Hirsh-Hadorn et al., 2007; Leavy, 2011; Vermeulen and Witjes, 2021). Scholars acknowledge TDR as a way to solve "wicked problems" and transition towards "strong sustainability" (Brown, 2010; Pelenc and Ballet, 2015). In TDR, academic knowledge is combined with TD principles like abductive reasoning, open-minded multi-actor reflection, iterativeness and long-term systemic perspective as required by the context (Witjes and Vermeulen, 2021). These TDR principles informed our research process. For example, multi-level learning enabled the research process to be guided by academic and non-academic knowledge, and multi-actor reflection enabled crucial collective reflections that shaped the research outcome. Abduction is the process of adapting research based on a hunch by utilising the emerging findings, theoretical knowledge and the researcher's past experiences and positionality (see Sætre and van de Ven, 2021; van Breda and Swilling, 2018; Witjes and Vermeulen, 2021). Abduction helped the research adapt to contextual needs and challenges. The emergent research design, rooted in doing TDR in the African context, enabled theory and research practice to inform each other as the research unfolded and adapt the research to the contextual needs (van Breda and Swilling, 2018). While developing understanding or co-creating solutions, the focus was on long-term and system perspectives with an open mind. Although we started from conceptual ideas in circular economy and the transboundary movement of waste, other concepts from e-waste literature, just transition and global inequality, shaped the various steps of our research process and provided scientific validity. Adapting from Witjes and Vermeulen (2021) synthesis of TDR phases, the fairness-driven research can be divided into four distinct steps, as depicted in Figure 6.1 and discussed below.

A team of experienced academics conducted the vision and strategy phase to investigate the sustainability implications of the circular economy by creating a PhD training consortium. The present

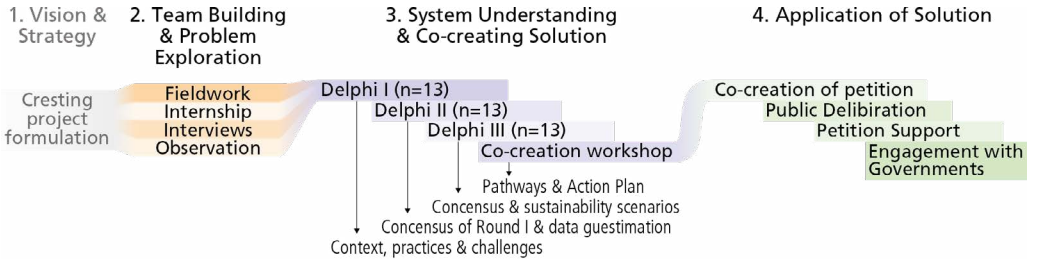


Figure 6.1 The transdisciplinary research (TDR) steps integrated various disciplinary methods to enable team building and problem exploration, system understanding and co-creation of solutions, and application of knowledge.

research is one of the 15 PhD projects in the Circular Economy: Sustainability Implications and Guiding Progress project (CRESTING). The team wrote the grant, formulated guiding questions for the research, created collaborations, and secured funding, which enabled the first author to be hired to undertake the project.

The team building and problem exploration phase included month-long exploratory fieldwork in Nigeria for the lead researcher to be embedded in the research and cultural context. This placement at the University of Ibadan included a week-long internship with the Basel Convention Coordinating Centre for the African Region (Basel-Africa). Researchers visited six recycling factories (e-waste and plastic) for observation, conducted 12 in-person semi-structured stakeholder interviews in English and attended two conferences. These provided opportunities for the researcher to be situated in the problem context and build relationships, which contributed to an epistemic community central to the unfolding and emerging of the TDR (van Breda and Swilling, 2018). This embeddedness of the researchers helped to adapt the research to the contextual needs and design for societal impact. With support from local partners, it was easy to reach out to most stakeholders like the government, recyclers, non-profits, researchers and academics. However, our interactions with the informal sector remain limited. The pandemic and adapting the research to online interactions limited us from including them as planned.

The system understanding and co-creating solutions phase was adapted amid the uncertainties and

chaos of COVID-19. Due to the pandemic, the planned four-month visit was impossible, so the research was adapted online. To incorporate open multi-actor reflections, we incorporated an online Delphi research, which consisted of three rounds of research with e-waste experts in the African context, followed by three workshops and frequent communication throughout the process. Delphi enabled a systemic and diverse understanding of the problem, built consensus using multiple consultations and confirmation rounds, and helped build societal relevance and validity of the created knowledge. Used initially as a consensus-building method among experts (Dalkey and Helmer, 1963), we adapted the Delphi method to map out existing knowledge on challenges, practices and prioritisation (Franklin and Hart, 2007, Yousuf, 2007, Campbell-Johnston et al., 2021; Wurster, 2021). A total of 24 African e-waste experts, mainly from Nigeria but also from Kenya, Ghana, South Africa, Zimbabwe and Italy, representing government, recycling companies, researchers, academics and national, international and non-governmental organisations, participated in the three Delphi rounds. Each round of the Delphi study consisted of 13 participants (though not the same ones). The Delphi I gathered a stock of challenges and practices. Delphi II helped build consensus on the mapped-out challenges and practice keys from round one and generated expert estimates to quantify the problem. Building on research thus far, Delphi III created three transition scenarios (see Table 6.2). Expert feedback, desirability and feasibility on the scenarios were collected. The Delphi followed three online workshops of 3 h each, intended to create action items for the scenarios.

We designed three two-hours online workshops (n = 16, 8 and 5) iteratively to build consensus and assure shared outcome ownership. The first was organised as part of the Circularity Africa 2021 conference. We used the Art of Hosting method to design the workshops, ask participants to identify actors and their specific actions and rank the top five actions based on urgency and practicality to reach the desired scenarios. The Art of Hosting method aims to facilitate a safe, open and inclusive space for participants. As reliable and fast internet connection for all participants was challenging, we used the simplest online sticky notes for capturing ideas (see Figure 6.2).

The application of the solution phase enables the researcher to take co-created knowledge based on doing science with society to a broader public for future societal impact. We had planned to disseminate solutions during the Circularity Africa conference for support from experts and politicians before taking the results to the governments. Due to the pandemic, this phase was adapted into an online petition to seek broader public support. Petitions have played a significant role in societal

Figure 6.2 Examples of an online workshop to pick the top five actions to achieve a desirable sustainability scenario for imported used electric and electronic equipment (UEEE) and e-waste in Nigeria

transformation and are an integral political instrument for collective action and transformation (Hale, 2013; Carpenter, 2016). Petition creation involved multiple drafts, with feedback from research participants in each round. The petition draft was shared with 24 experts for comments, modifications and co-ownership. Consequent drafts were shared three times, and the petition was finalised with eight co-authors and taken online publicly. The research output was strategically incorporated into the petition to benefit waste governance in Nigerian and European contexts. The Nigerian government is designing an extended producer responsibility (EPR) (UNEP, 2019). And the European Parliament acknowledges their problem with shipping waste internationally in its revised circular economy action plan with ambitions to improve (European Commission, 2020a).

During all phases, there was ongoing research work in Europe focusing on the transboundary movement of European waste and a case study of e-waste governance in the Netherlands. The researchers were embedded in a research team that looked at the European circular economy's discourses, policies and practices. This embeddedness in similar projects and a bigger research team shaped the research and brought a more nuanced context and systemic understanding to the research process.

6.2.1 Limitations

Online workshops enabled us to reach out to diverse e-waste experts, including those outside Nigeria, versed in the Nigerian context. However, it limited participation by the informal sector workers in Nigeria. The informal sector plays an invaluable role as local experts in what they do, yet their voices are marginalised. Even though the project aspired to incorporate their voices during the exploratory fieldwork, it was impossible to build relationships and garner trust in an online setting. We consider this the most significant limitation of the research. However, their voices, albeit represented by other stakeholders, are present in the research.

Although 24 experts participated in the Delphi, each round consisted of only 13 individuals. Closely collaborating with our local partners, we reached out to 62 experts, including the informal sector, for the Delphi I and received 29 responses, 16 of which were incomplete. The online research enables access but can also be limiting. To overcome this, we planned multiple and adequate feedback for the participants and stakeholders during all the research phases.

6.3 Theoretical Context: Circularity and Just Transition

We use academic literature to make sense of current practices in EU-Nigeria shipment of UEEE and e-waste in the context of circularity, global inequality and just transition.

6.3.1 Circular economy and transboundary UEEE shipment

Some see the circular economy as beneficial or potentially beneficial for the people and the planet (Bressanelli et al., 2021; European Parliament, 2021; Wijkman and Skånberg, 2015). Others question such views and show the rebound effects of a circular economy (Makov and Font Vivanco, 2018; Zink and Geyer, 2017). The mainstream circular economy discourse of efficiency, rather than sufficiency, hinges on economic growth (Bauwens, 2021; Calisto Friant et al., 2020), albeit constrained by environmental considerations (Ellen McCarthur Foundation et al., 2015; European Commission, 2020b). Such discourses reflect the ideology that the economy can grow forever without harming the environment (Allen et al., 2012; von Weizsäcker, 2014). Such "green growth", especially in the global north countries with its alarming historical and current ecological footprint, has been criticised as a strategy that aids little in creating solutions for urgent socio-ecological crises (Genovese and Pansera, 2020; Hickel and Kallis, 2019; Korhonen, Honkasalo, and Seppälä, 2018). Asserting the impossibility of absolute decoupling economic growth from environmental pressures, Parrique et al. (2019) call to rethink what constitutes growth and progress. Apart from the circular economy being a "green growth" centric model, scholars criticise circular economy for not being inclusive (Calisto Friant et al., 2020), lacking the social and human dimensions (Lemille, 2020; Schröder et al., 2020a, 2020b) and the moral dimension (Gregson et al., 2015). Thus, the literature shows that the mainstream circular economy narrative has been subject to several criticisms and needs careful reconsideration.

The various value retention options topology and the "CE leakages" discussed by Reike et al. (2018) are particularly important for our analysis. Resell, reuse and repair options retain products' value and functionality more, create less waste, and are thus preferred. Recycling or down cycling,

where products lose original functionality, create waste, or wasteful by-products, is less desirable. Incineration, landfilling, and so forth are the least preferable. "CE Leakages" refer to waste shipment outside these circular loops from Europe. Some of whose fate (value-retention options) is unknown (European Commission, 2020a). Transboundary e-waste and UEEE shipments from Europe to Nigeria exemplifies circular economy leakage. A non-profit sector engaged in justice advocacy revisits leakages of e-waste from Europe as "an externalisation of costs with real consequences in terms of harm to human health and the environment" (Basel Action Network, 2018). Such actions could aid in increasing global inequality and injustice.

6.3.2 Need for just transition in the Circular Economy

There are multidisciplinary explorations and understandings of just transition. The International Labour Organisation (ILO) calls a transition just if maximising social and economic opportunities "is as fair and inclusive as possible to everyone concerned, creating decent work opportunities and leaving no one behind" (ILO, 2021). Scholars advocate that a just transition should amount to procedural, distributive and restorative justice (Newell and Mulvaney, 2013; McCauley and Heffron, 2018; Stevis and Felli, 2020). Wang and Lo (2021) identify five thematic areas of just transition: a labour-oriented concept, an integrated framework for justice, a theory for socio-technical transition, governance strategy and public perception. Velicu and Barca (2020) show just transition as a democratic way out of the social and ecological crises and inequalities, the causes of such crises. Agyeman (2008) points out that sustainability discourse and practice usually leave out inequity and injustice, racism and classism and call for "just sustainability". Adding a geographical dimension to just transition, Soja (2010) calls for "spatial justice" for an equitable geographic distribution of resources, services and access as a basic human right. Schröder et al. (2020b) add a just transition to a circular economy, calling for effective and fair governance, transparent and accountable institutions and new financial mechanisms to support the circular economy transition globally. The transboundary shipment of hazardous waste, including e-waste in the past, has been associated with environmental injustices and toxic colonialism (Clapp, 2001; Iles, 2004; Pellow, 2008; Lipman, 2015; Temper and Shmelev, 2015), with researchers often advocating fairness and distributive justice. A just socio-technical transition, like the circular economy, then must address environmental sustainability, well-being and the deeper causes of inequality in a democratic way globally in action and not merely words. The idea of UPR, discussed later, proposes to bring these concepts to circular economy policies and practices.

6.3.3 Transboundary e-waste shipment: Challenges, solutions and EPR

The transboundary shipment of e-waste, which contains toxic elements, to countries without the capacity to handle their sustainability, is often associated with exporting harm to people and the environment far away (Heacock et al., 2016; Perkins et al., 2014; Sullivan., 2014; Thapa et al., 2022a). Because of its toxic nature, exports from OECD to non-OECD countries are banned under the Basel Convention, yet we find illegal and illicit exports ongoing. Exporters and importers of e-waste are both complicit in prioritising their own short-term economic interests and the expense of environmental justice (Kim, 2006). Academics from various disciplines propose solutions to the e-waste problem. Manhart (2010) and Wang et al. (2012) suggest best-of-two-worlds combining cheap manuals from global south countries with state-of-the-art facilities. Lepawsky et al. (2017) call for electronics repair, reuse, repurposing and recycling with ethical and sustainable considerations. Various EPR versions make producers and importers responsible for e-waste recycling and have been studied or proposed as domestic solutions (Atasu and Subramanian, 2012; Campbell-Johnston et al., 2021; Campbell-Johnston et al., 2022; Lin et al., 2001; Schnoor, 2012; Thapa et al., 2022a; Widmer et al., 2005). In the EU's WEEE directive, EPR guides e-waste management, and Nigeria aspires to establish one. However, existing EPR structures have been criticised for heavily focusing on recycling instead of various circular value retention options, for not being inclusive of circular actors and for producers not taking responsibility once the product is out of the national or EPR jurisdiction (Vermeulen et al., 2022).

6.3.4 Global inequality: Waste trade as unequal exchange

Existing technologies dictate the capacity and quality of e-waste recycling (Awasthi et al., 2016; van Yken et al., 2021). However, a lack of financial resources means limited access to technology–one of the reasons why the global south does not have a sound waste management system (Aremu, 2020; UNEP, 2015). Hickel (2018) argues that the income gap between the global north and the global south has tripled since 1960 because of the politics of integrating poorer countries into the global economic system on unequal terms. Using a theory of unequal exchange, Hickel et al. (2022) show that the global north relies on the net appropriation of resources and labour from the global south in the post-colonial era, which is responsible for inequality, uneven development and ecological breakdown. Citing ecologically unequal exchange as a source of environmental conflicts, Hornborg and Martinez-Alier

(2016) discuss the need to incorporate the realities of unequal exchange into mainstream economics and policies. As far as we know, no studies measure the correlation between wealth and waste management practices. However, the global waste management outlook (UNEP, 2015) and (D-Waste, 2013; D-Waste, 2014) show the concentration of dumpsites in the global south and more technology and resource-dependent management systems concentrated in the global north. Similarly, large informal sectors of waste workers are associated with waste management in the global south (including Nigeria) with precarious livelihoods and working conditions (Terada, 2012; Wilson et al., 2006). Yet, waste management practices (including circular economy) tend to focus more on material cycles, and economic and environmental aspects, leaving out the social dimension. Using the Nigerian example, Woggsborg and Schröder (2018) show the lack of informal sector inclusion in the EPR as an obstacle to meeting the triple bottom line of people, planet and prosperity, which is essential for just transition.

6.3.5 Combining concepts to make sense of practices

Even though the EU circular economy action plan values reuse, repair, and refurbishment and explicitly discusses reducing waste and just transition (European Commission, 2020; European Commission, 2020a), non-functional and non-durable UEEE is still shipped to destinations like Nigeria, which lack sound infrastructure for e-waste management. Transboundary shipment of toxic e-waste has been linked with unsustainability and injustices (Lawhon, 2013; McAllister et al., 2014; Sullivan., 2014; Perkins, 2014; Hossain et al., 2015; Amuzu, 2018; Akese and Little, 2018). The abovementioned concepts on the circular economy, transboundary waste, just transition, and global inequality help make sense of the context and guide the research.

6.4 Results

The dynamic interplay between theory and practice enhanced understanding and provided fundamental scientific and societal knowledge for intervention. In this section, we show how EU e-waste and UEEE export creates harm in Nigeria and present a co-created solution to make it sustainable, circular and just.

6.4.1 UEEE and e-waste: A Nigerian overview

We found omnipresent usage of used items, from mobiles and cars to aeroplanes. Most people we encountered saw quality UEEE as an enabler for development and progress. However, a few people were strongly vocal about how UEEE hurts Nigerian resilience, ingenuity and innovation. Often people mentioned the irony that one of the wealthiest countries in terms of resources could not produce its domestic mobile phones or computers and had to depend on imports. Most people we interacted with were aware of UEEE imports providing a loophole for importing what is effectively e-waste into Nigeria.

By contrast, the interviewed government officials stated that the problem of e-waste imports was illegal and rarely occurred. During our time there, the Nigerian government, supported by the UNEP, was preparing an EPR system led by the National Environmental Standards and Regulations Enforcement Agency (NESREA), which was still in its preliminary phase (UNEP, 2019). A 2014 operational guideline produced by NESREA served as a general guide for all waste. The 2011 National Environmental (Electrical/Electronic Sector) Regulation, focusing on the 5Rs (reduce, repair, reuse, recycle and recover), served as the official regulation for e-waste in the absence of e-waste specific EPR. As a signatory to the Basel Convention, Nigeria observed the rules of the Convention. The Basel-Africa in Ibadan serves the need for "capacity building to tackle the technical, legal and institutional requirement for the implementation of the Convention" (Basel-Africa, 2017). Even though some people criticised the Basel Convention for not addressing the real problem, in line with scholarly work (Portas, 2016), others, including the staff at Basel-Africa, saw it as influential in shaping the existing Nigerian and African policies regarding the imports of e-waste. Complicated protocols for public access to ports meant that

we could not visit the port authorities to observe the imports of UEEE (and potentially e-waste). The government viewed e-waste imports as illegal and thus not a significant challenge.

However, from our interactions with formal EEE recyclers and the informal refurbishing and reusing sector, we confirmed that imports of UEEE and even e-waste were ongoing. These initial findings would later be validated in the Delphi survey and workshops. During our visit to the Computer Village in Lagos, one of Nigeria's biggest informal EEE facilities, we could observe the repair, reuse, and scavenging of parts from non-functional EEE and resell. We observed scavengers gathering discarded parts to extract valuable material. We did not see the crude recycling (burning, acid-leaching, etc.) that is mentioned in the literature (Adesokan et al., 2016; Manhart et al., 2011; Nnorom and Odeyingbo, 2020), but we were told such would be the fate of collected e-waste for material recovery before being dumped elsewhere. Some workers in the informal sector were concerned about health and safety. However, most people did not have access to basic safety and precautions (gloves, masks, protective glasses, etc.). Injuries from pushing handcarts, cuts from sharp e-waste parts, electric shocks, inhalation of lead fumes, exposure to other hazardous substances like dioxin and heavy metals, and frequently poor health, including eye irritation, cough and headache, were identified during the problem exploration phase. Despite this, we also noticed self-organisation and self-governance. The informal sector organised against the local authorities, who perpetually wanted them to move out of their current location. They collectively invested in generators to tackle the frequent power cuts in Nigeria. Often judged as unorganised, they seem high and organically organised. One workshop participant working closely with the informal sector observed that "the informal sector is well organised. The formal institutions do not understand the informal sector and seem to criminalise it. There is a need to understand and appreciate the informal sector" (workshop participant).

The formal recycling industries also lacked essential health and safety precautions. During fieldwork, we could only identify two formal e-waste recycling companies. They focused on the collection and mechanical extraction, after which the most complex, hazardous and valuable parts were sent to Europe for recycling for a fee. They expressed that the technology associated with e-waste recycling was prohibitively expensive, which kept them from investing in advanced systems. They often partnered with big businesses and institutions for their e-waste demand. In the absence of organised e-waste collection by local authorities, one of their challenges was to get hold of e-waste. In the absence of an adequate formal sector, the informal sector fulfilled most functions of e-waste processors, albeit crudely at the cost of the environment and health. Although some circular economy

practices of reducing, reusing, repairing, refurbishing, recycling and recovering were seen in Nigeria's existing e-waste and UEEE governance practices, these came at the cost of harming the workers and their environment.

In the broader waste management context in Nigeria, we notice a lot of unsustainable practices and a lack of proper systems and infrastructure. StreetSide dumps, dumping on open lands and burning outdoors were commonplace observations. Some social enterprises transformed these challenges into opportunities (Wecyclers, n.d.) to create social and environmental value but were limited to plastic waste at the local scale.

6.4.2 Imported UEEE and e-waste: Practices and challenges

Current practices of UEEE imports were identified as one of the primary loopholes for e-waste import or soon-to-be e-waste. Similarly, imports without proper practices or infrastructure were associated with environmental and health harm and exploitation of society (e.g., child labour was discussed and observed during field visits). Reselling, repairing, recycling and reusing were standard practices with imported UEEE, while imported e-waste was used as repair parts and extracted for resources. The national government's role was identified as policymaking, monitoring, regulating and implementing, whereas hardly any roles were associated with the local or regional government. The informal sector, often viewed as waste workers outside the system by research participants, engaged in dirty and dangerous jobs while salvaging, repairing, and reusing. Experts agreed that the informal sector played an important role in dealing with imported UEEE and e-waste and should be an integral part of the future EPR system. Citing hazards associated with processing e-waste without training, some expressed that the informal sector should be limited to collection only. When asked about the main challenges for sustainable governance of imported UEEE and e-waste, lack of regulation, lack of infrastructure and funds, corruption and lack of transparency and lack of producers' involvement were identified. Main opportunities included economic gains from proper management, job creation, bridging the digital divide, opportunities to create better regulation that brings human and environmental benefits, and capacity building.

We included a collective mapping exercise and distilled a graphical representation of the existing practices for imported UEEE (Figure 6.3) and e-waste (Figure 6.4). Again, the informal sector played a significant role in the current practices of both UEEE and e-waste. UEEE and e-waste practices

undergo various R-hierarchies like reuse, repair, resell, recycle and recover (components, material). Of all imported UEEE, our expert guesstimates show that functioning UEEE (63%) are reused, refurbished, and resold, whereas non-functioning UEEE (37%) are either repaired, recycled or recovered formally or informally. E-waste captured at the port is sent back to the country of origin (although the frequency remains low) or sent to proper e-waste recycling. Those not captured undergo refurbishing, repair, recovery/scavenging, recycling, and reuse for parts before either burning or landfilling by the informal sector. Formal companies are not allowed to process imported e-waste.

We asked experts for the current and reliable data source. Without much success, we asked experts to quantify the problem with a guesstimate during Delphi II. Those guesstimates are similar to the ones provided by existing research reports. Based on the EEE categories (mobile, PCs, household equipment, etc.), the UEEE presents 33% to 50% of the EEE market and has a life span of 1.5 to 3.25 years (see Table 6.1) before becoming e-waste. Up to 41% (an average of 37%) of imported UEEE are e-waste in disguise, thus creating a significant loophole for importing e-waste in Nigeria even though it is illegal to do so (see Table 6.1).

Experts identified an EPR system, where producers and importers were responsible for e-waste management, as a way forward for sustainable e-waste management. Collaboration between the various governmental and non-governmental actors nationally and internationally and sound enforcement and monitoring remained the top conditions for such EPR to function well. Experts identified corruption, lack of awareness, lack of monitoring, lack of infrastructure, lack of transparency and lack of coordination between countries in the current system as the top challenges for a transition to sustainable governance of UEEE and e-waste in Nigeria.

6.4.3 Towards circularity and fairness

Three scenarios based on the imports, domestic usage, national policy, local policy, informal sector and the EPR were introduced to the experts as ways forward (see Table 6.2 for a summary and Appendix A for a more detailed description).

The Policy as usual scenario describes the ongoing observed practices. Currently, UEEE and e-waste imports are not controlled, and there is limited value retention and resource recovery before being

burnt or dumped on the streets, dumpsites and landfills. Existing policies are not strong enough and lack enforcement and monitoring. There is a discussion for future EPR, but yet to be implemented. In the lack of a functioning public waste management system, the informal sector is active and dominates the market with few formal sector engagements. It results in severe health, social, environmental and economic harm.

The Small Step Forward scenario envisions a future with occasional port authority regulation of UEEE and e-waste imports. Some collection, value retention and material recovery exist but are still not appropriately organised. National environment and waste law provide some guidance with better enforcement and monitoring than policy as usual. The local government is engaged in some collection in big cities only. Future EPR is still under discussion, and the informal sector still plays a vital role but without the highest value retention or material recovery practices. Still, severe health, social, environmental and economic harm exists.

The Transformative Step Forward envisions scenarios where imports are closely and systematically monitored, and there are sufficient co llection po ints fo r domestic e-waste, providing consumer incentives across Nigeria. The highest possible value retention and material recovery are mandated by the national government and organised by a mix of the EPR (that includes the informal sector). Producers and importers fully fund EPR with special provisions for UEEE. The informal sector is well organised, trained and regularly partners with state-of-the-art recycling facilities. There is hardly any e-waste in landfills. Health, social, environmental and economic harm is reduced significantly, and there are plenty of economic opportunities in the e-waste management sector.

Transformative Step Forward was the most supported (mean = 8.79/10), followed by other scenarios (mean = 4.93/10 each). However, scenarios II and III had similar feasibility for implementation (mean = 6.86/10 and 6.14/10, respectively). Identified actors responsible for bringing any transformation in Nigeria included NESREA, Extended Producer Responsibility Organisation in Nigeria (EPRON), Environmental Ministry, local government and formal and informal sectors. The workshops collaboratively identified actors and their actions for future pathways leading to a mix of the most desirable and most feasible scenarios (III and II). Table 6.3 depicts the workshop results of the first workshop. The three workshops co-created action points to solve the challenge of imported e-waste and UEEE in Nigeria.

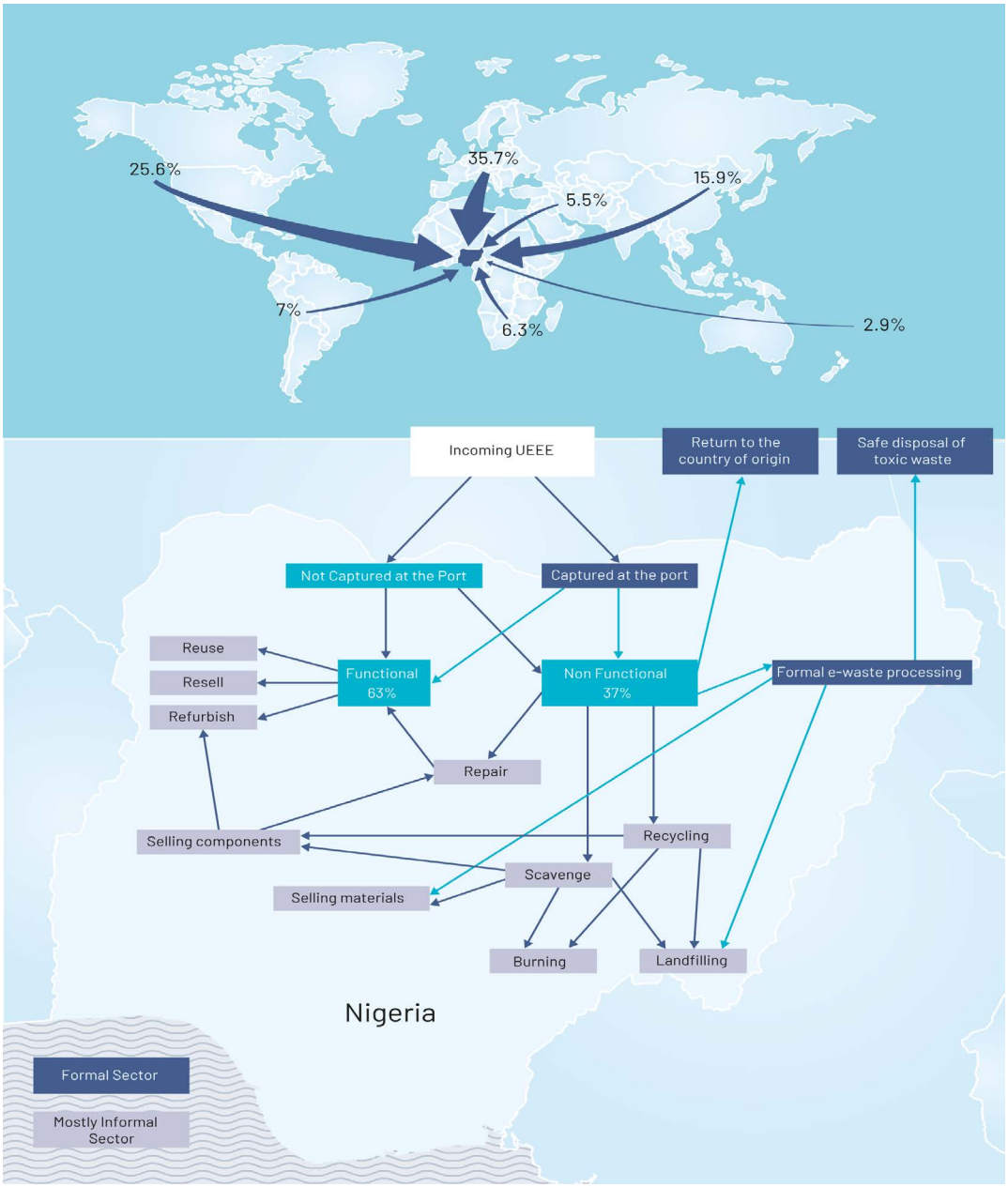


Figure 6.3 Expert guesstimated international used electric and electronic equipment (UEEE) exports to Nigeria and various practices for imported UEEE in Nigeria as identified by the Delphi participants. Green represents more formal practices, and orange represents informal.

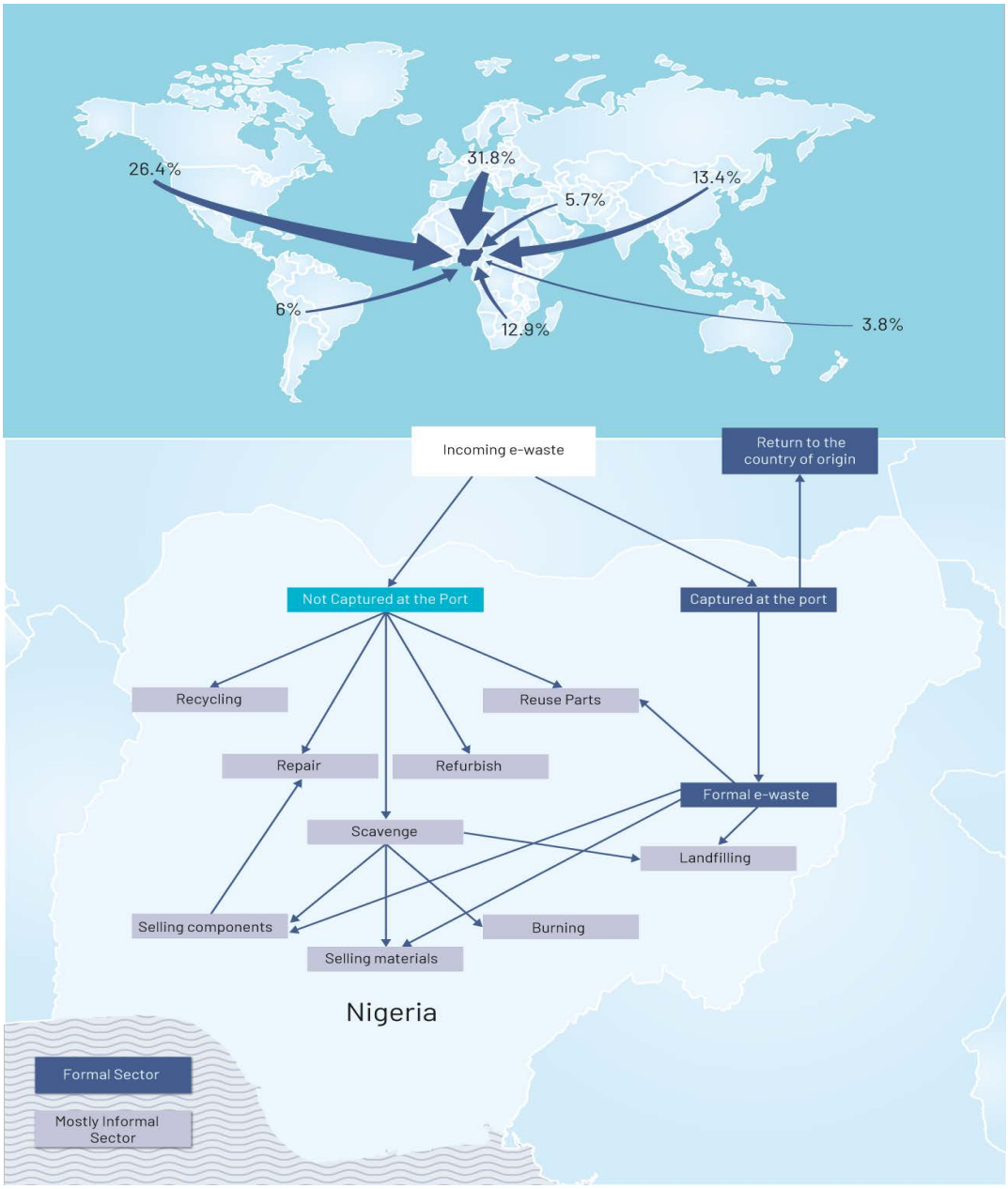


Figure 6.4 Expert guesstimated international e-waste exports to Nigeria and various practices for imported e-waste in Nigeria identified by the Delphi participants. Green represents more formal practices, and orange represents informal.

6.4.4 TDR for change-making

The co-created knowledge with social and scientific validity enabled two interventions: a policy brief for policymakers and a science-based public petition for concerned citizens (Appendix B). In the petition addressed to the government of Nigeria and the EU, we publicly present the problem context and the co-created solutions for support. Some recommendations include: empowering the informal sector, globally accountable e-waste reduction and sustainable management, e-waste governance with transparency and monitoring, raising e-waste awareness and making producers' responsible internationally for e-waste management. Furthermore, certification of functionality and durability with UEEE exports, easy access to repair and other circular value-retaining options and international collaboration of port authorities for sound shipments are also recommended (see discussion). This petition calling for a global just circular economy transition is ongoing at the time of writing.

Product category	UEEE in all EEE products purchase	Average UEEE lifetime	Imported UEEE that are e-waste
Mobile phones and tablets	49%	17 months	41%
PCs and laptops	69%	27 months	36%
Small household products (microwave, mixer etc.)	52%	24 months	36%
Large household products (washing machine, refrigerator etc.)	69%	37 months	36%

Table 6.1 Average guesstimates of Nigerian e-waste for the various categories of EEE.
Abbreviations: EEE, electric and electronic equipment; UEEE, used electric and electronic equipment.

6.5 Discussion

Our research shows that the challenge of sustainable e-waste management gets even more complicated when UEEE and e-waste are shipped internationally. Market mechanisms, political equalities or inequalities, national and international policies implementations and enforcement, and various actors and motivations dictate waste shipments and what happens to the waste. In this context, decreasing e-waste generation by reducing consumption, designing more durable EEE, practising circular value retention options within Europe and taking precautions whenever necessary in the first place seem to be the best solution. But this seems impractical given the current political-economic contexts of profit-maximisation at any cost and only lip-serving attention to global inequalities.

As EEE consumption increases globally and in the EU (Eurostat, 2022), waste management tools like EPR need to be more circular, sustainable and just. The current European EPR makes European producers and importers financially and logistically responsible for the sound management of e-waste within their national boundaries, primarily for recycling. This producer's responsibility no longer applies when UEEE or e-waste is shipped outside the national jurisdiction. Such shipments of e-waste and non-durable or non-functional UEEE to Nigeria represent an ecologically unequal exchange that causes environmental and health harm goes against European circular economy ambitions, and aids in inequality.

Current policies and practices overlook the multiple-use phase of European EEE, in and outside the EU. Functionality and durability are not guaranteed for transboundary UEEE shipment, so exported UEEE has a short life span. This only delays the shipped UEEE from becoming e-waste when outside the EU and out of the jurisdiction of the responsible EPR system. Responsibility is shifted to Nigeria, where the informal sector mostly engages in value retention practices like reuse, resell, refurbish, repair, scavenge, recovery and e-waste management without proper safety, technology or infrastructure. This responsibility shifting encourages bad actors to find loopholes to ship e-waste, which is illegal (expert guestimate showed 37% of incoming UEEE is non-functional). Current export–import practices in unequal terms hinder sustainability and circularity, cause harm and aid global spatial injustice and

	I – Policy as Usual	II – Small Step Forward	III – Transformative Step Forward
Imports	• Occasional control and inspections • Illegal import prevalent • No monitoring, no data • Loopholes for e-waste importation	• Regular sampling of imports • Occasional monitoring and limited data • No transparency	• All e-waste and UEEE controlled • All UEE inspected for functionality and durability • Illegal imports sent back • Activities logged for data and transparency • Partnership with international destinations for – no unwanted imports
Domestic Usage	• No data on new EEE/UEEE ratio • No instruction for disposal • Lack of collection and proper disposal dumping prevalent • Active informal sector	• Some data on new EEE/UEEE ratio • Limited municipal disposal with active informal sector • Landfilling with very few value-capture opportunities	• Monitoring of new EEE/UEEE with data availability • Consumers aware of sustainable disposal and collection points • Collection points based on value maintenance • No landfilling/dumping, circular practices enforced
National Policy	• Weak waste management policy with no focus on e-waste • Lack of enforcement and coordination between implementing bodies • No value retention policy	• Existing guidelines on toxic waste implemented • Some EPRs focus on recycling rather than value maintenance • Clear and specific regulations for e-waste categories • Limited coordination	• Integrated national policies for value maintenance and sustainable management • Specialised government body for facilitation and coordination • National targets and plans to achieve these targets • Support for state-of-the-art facilities and sustainable practices
Local Policy	• No collection • No recycling policy • No awareness • E-waste in dumpsites and landfills	• Some local collection activities • Few collection points in urban areas • Some quality assurance at the local level • Some social awareness creation	• Policies for collecting, creating awareness and value retention • Coordination and support from the national government • Easily accessible collection point in all communities with incentives for proper disposal • NGOs integrated with local governance
Informal Sector	• Unorganised, polluting and dangerous • No government support • Health, environmental and social problems • Unsystematic: cherry-picking value retention process at the high social and environmental cost	• Limited support and control from the government, still seen as a nuisance to be replaced by big facilities • Recognised as crucial for collection and value maintenance but without the active support	• Integrated into EPR with well-defined roles • Support from the government and collaboration with the formal sector • Trained and well-equipped for the highest value retention • Recognised and organised
EPR	• No EPR, only discussed as a normative principle • Producers and importers not organised • Few formal sectors only deal with a fraction of e-waste	• EPR as information and logistic responsibility for producers and importers • EPR not integrated into the local context, lack of monitoring • Little sustainable guidelines for processing and recycling, lack of capacity building	• Producers and importers financially responsible for product life extension, value maintenance and end-of-life processing • EPRs of exporting countries and national importers are financial contributions to the management of imported UEEE • Robust collaboration with stakeholders in the value chain • Dedicated EPR organisation responsible for capacity building with state-of-the-art facilities and knowledge

Table 6.2 Summary of the three scenarios depicting the sustainable ambitions of e-waste and UEEE management in Nigeria.

Top Actors and Action Points
National Government • Incorporate and upgrade capacities of the informal sector as part of the Extended Producer Responsibility (EPR) to empower • Improve awareness in the informal sector related to the harms of e-waste • To limit activities of the informal sector to reduce environmental and health hazards **Customs and Port Authorities** • Regular inspection, functionality tests and monitoring • Capturing data • Prior informed consent to be enforcement • Ensure certification of functionality for all used imports from the importing countries **Local Authorities** • Organizes collection, sorting, and disposal of e-waste • Establish policies for e-waste management • Organise municipal authorities, companies, and institutions **Stakeholders for Effective EPR** • National government to enforce EPR • National government to establish sustainability guidelines and standards • Organise OEM, importers, and retailers in compulsory ERP structure • Retail engagement in the collection system • Incorporate the informal sector

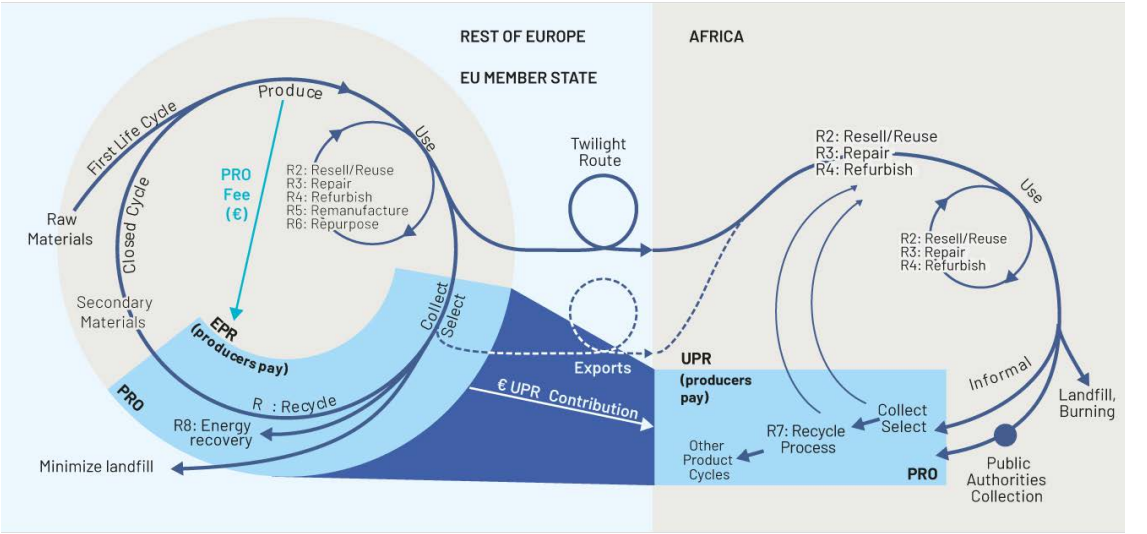
Table 6.3 Top actors and action points identified during the first workshop (n = 16)

inequity. The future transition should focus on ethical and equitable collaboration to minimise harm, facilitate safe multiple-user cycles globally and build capacities to make the global e-waste value chain safer, just and circular. The now marginalised informal sector workers, who add circularity and perform some of the responsibilities of European EPR, should be empowered. Another research also highlights such unethical behaviour of global north producers who transfer responsibilities for waste recovery and recycling to the South, creating environmental risks and social burdens, especially for the marginalised (Cotta, 2020).

In our research context, "reuse", a preferred circular economy value retention option in the literature, leads to delaying waste, unfairly shifting polluters' responsibilities under the EPR to others and creating harm in Nigeria. Reuse further enables illegal and illicit actors to ship e-waste via "twilight" routes–which are neither clear nor documented well (see Figure 6.5). For a just transition to the circular economy, UEEE exports must have a functionality and repairability guarantee to extend the use of the product as long as possible while minimising harm as much as possible. Despite the ultimate destination, the original producers must be responsible for sound management of the end-of-life phase (e-waste). For a just circular economy transition, we propose revising EPR to UPR.

The basic idea behind UPR, that the producers should be responsible for their waste everywhere, first emerged when visiting recycling companies in Lagos. This hunch emerged due to the embeddedness in the Nigerian research context, interacting with stakeholders and getting insights into the e-waste management challenges. Emergent TDR (see Thapa et al., 2022b; van Breda and Swilling, 2018) facilitates such emergence based on contextual needs. Concepts of just transition (Velicu and Barca, 2020; Wang and Lo, 2021), just sustainability (Agyeman, 2008) and spatial justice (Soja, 2010), which advocate equality, justice, equal distribution and access, also guide this emergence of UPR. UPR proposes solutions to overcome the three EU EPR design flaws that hinder a circular economy transition identified by Vermeulen et al. (2022). These flaws are (i) focus on efficient and lowest value retention option via downcycling, (ii) exclusive inclusion of actors only focused on recycling, and (iii) no consideration for multiple user phases, especially outside of the EU (Vermeulen et al., 2022). Unlike EPR, UPR (see Figure 6.5 and Thapa, Vermeulen, Olayide, and Deutz, 2022) incorporates multiple contextual realities of the UEEE and e-waste value chain. With circularity and sustainability considerations, UPR acknowledges the shifting geographies of UEEE and e-waste flow from one

country to another and their socio-ecological impacts, depending on the destination countries' sound waste management practices and infrastructures. UPR further acknowledges global socio-economic inequalities and questions the ethics of shifting waste or soon-to-be waste to another country with fewer sound (e-)waste management capacities. UPR emerged during open-minded multi-actor engagement and reflections focused on understanding the bigger problem while building consensus and legitimacy during the process.



EU: European Union
EPR: Extended Producer Responsibility

PRO: Producers Responsibility Organization
R2-8: Value retention option hierarchy (Reike et al., 2018)
UPR: Ultimate Producer Responsibility

Figure 6.5 Diagram showcases the current multi-phase flows of used electric and electronic equipment (UEEE) and e-waste from Europe to the rest of Europe and Africa (Nigeria) via. exports and twilight (illegal and illicit) routes. The ultimate producer responsibility (UPR) extends producers' responsibility for the sound end-of-life management anywhere the product becomes e-waste, irrespective of the geographic location, to enable a just and circular transition for collection, reuse, repair, refurbishing and recycling. The UPR extends the European extended producer responsibility (EPR) globally, as shown in the figure, with the red shade connecting the EU with the rest of the EU and Africa.

Following the polluters pay principle, the UPR suggests the producer either set up infrastructure or pay a fair share to ensure sound e-waste collection and management for their discarded products globally. In the Nigerian context, UPR makes either the original producer responsible for e-waste management in Nigeria or creates a fund transfer mechanism via existing EPR structures to facilitate and ensure sound e-waste management. Such a fund transfer mechanism of UPR is not a charity transfer or questionable development aid but a fair fee transferred to responsible parties to prevent harm if the producers' responsibilities shift elsewhere. UPR proposes fair funds transfer mechanism within existing EU EPR schemes. Doing so provides resources and infrastructure to prevent harm caused by shifting geographies of EU waste and create safe, well-paying jobs in destination countries, adding the equity and justice dimension that the current EPR lacks.

With circular economy consideration before end-of-life management, UPR prioritises the highest value retention options to maintain value for as long as possible and prevent waste globally. Moving away from the recycling-focused EPR, UPR proposes waste prevention and introduces multiple value retention options to reduce exports of ecological and health harms currently associated with some transboundary shipments. Value-adding activities like reselling, repairing, refurbishing, remanufacturing, repurposing, and so forth are prioritised before recycling and energy recovery. Cascading principle proposed by Campbell-Johnston et al. (2020) suggests incorporating quality and functionality and the triple P (planet, people and prosperity) to guide decisions for choosing between various value retention options. Cascading could serve as a starting point. In the Nigerian context, making EPR inclusive means including the hitherto marginalised but important circularity-enabling actors like the informal sector.

Ultimate producer responsibility (UPR) carefully adds circularity and just transitions globally to the existing UEEE and e-waste governance, currently primarily dominated by consideration solely for the market mechanism without much care for people, the planet, equity and (procedural, distributive, restorative justice, spatial) justice. Thus, UPR envisions a more transformational approach to circular economy with consideration for current inequity and harm (intended or otherwise) in faraway places associated with UEEE and e-waste shipment. UPR acknowledges that circularity and sustainability in one location are tied globally and proposes incorporating the longer-term spatial context. The principles of UPR could potentially be applied to other waste and product categories.

However, UPR can have limitations and rebound effects. For example, it does not tackle the crucial problem of EEE consumption and e-waste generation that instigates shipment of UEEE and e-waste. For UPR to function, fair international collaboration, transparency, and traceability are necessary and require openness, time and effort. Discourse and aspirations alone are insufficient; the political will, resources and actions are needed for just circular economy transition. UPR is susceptible to corruption, identified as a waste governance challenge in the literature and our research. UPR needs international solidarity to function, which also requires openness, time, effort and political will. Regulation implementation and enforcement will need to be dramatically increased compared to the present situation in both exporting and importing countries. UPR is not a solution to existing inequalities but a proposal to prevent further unequal exchange that exacerbates inequality and harm in the name of environmental performance in one part of the world. UPR is one of the solutions that emerged in the research context, but there could be a plurality of ways towards a just, sustainable and circular solution.

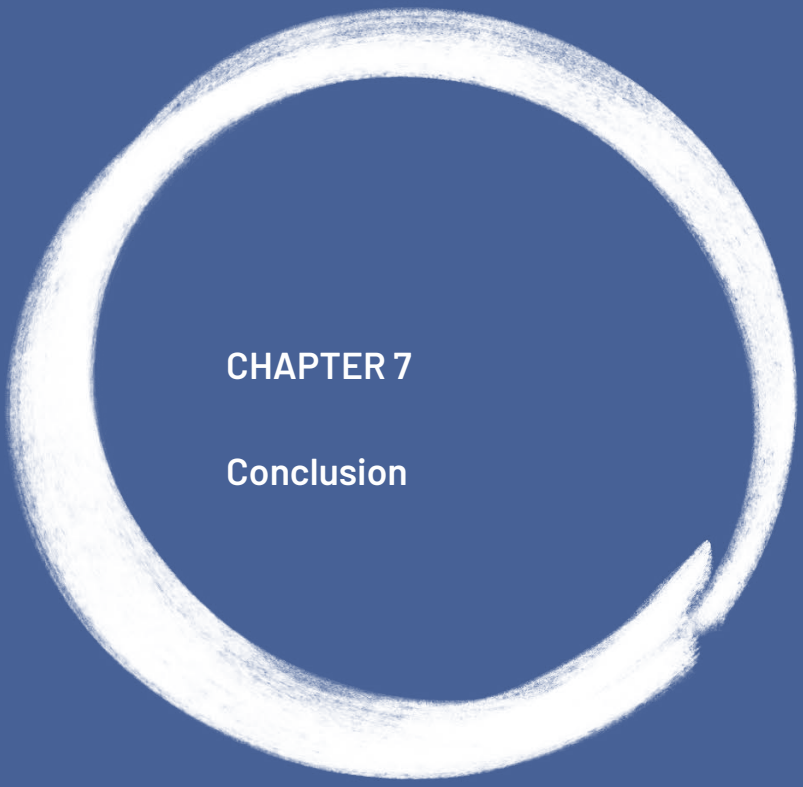
6.6 Conclusion

This research studied e-waste and UEEE exported from the EU and imported to Nigeria. It took stock of Nigeria's various practices, challenges and perceptions and co-created solution-oriented pathways guided by TDR principles. We find that current UEEE and e-waste shipment to countries without a capacity for sound e-waste management do not contribute to circularity or sustainability in the exporting and importing countries but add to the global e-waste problem. It further obstructs a just transition and contributes to global-scale spatial inequality through an unequal global (ecological) exchange that causes harm elsewhere.

Existing policies, implementations, enforcements and policy loopholes in the EU and Nigeria govern UEEE and e-waste shipments. Unsustainable, uncircular and unjust shipping of non-functional or non-durable or soon-to-be e-waste UEEE to destinations without sound e-waste management and not making producers responsible for e-waste management is a global sustainability problem. We find that circular ambitions and policy solutions must explicitly incorporate just transition, especially in the context of increasing global inequality. With regards to circularity and just transition, there should not be any transboundary shipment of non-functional or non-durable UEEE. Our research shows that the EU's aspiration for circularity is inexplicably tied to global circularity and global justice.

Currently, circular economy policy and discourse are focused on the material flow at the national level without sufficient consideration for international flows of materials and the implications for global equity. We propose revising the existing EPR to UPR by making producers responsible for managing waste globally, adding more value retention options and focusing on just transition. UPR builds on being inclusive, fair and collaborative to promote justice and equity, all concepts crucial in the circular economy transition. UPR emerged as a solution to the e-waste problem in a specific context guided by concepts of just transition, just sustainability, spatial equity, environmental justice and ethical consideration. Principles like justice, equity, transparency, circularity and sustainability inherent in UPR can be applied to other waste streams and geographies.

A solution-driven co-creative and adaptive methodology like TDR can integrate scientific and societal knowledge to facilitate a more nuanced understanding of sustainability challenges by incorporating diverse societal actors to create solution-oriented knowledge with some built-in social legitimacy. This research could also bring fairness in the research process and thus in the created knowledge, especially in the context of spatial injustice. Future (TDR) research could focus on more equitable and socially just circular economy transitions.



CHAPTER 7

Conclusion

"The word "policy" is very much in use these days. There seems to be a policy for just about everything. I have heard that the so-called developed nations are contemplating a garbage policy to send their trash on huge barges to the Third World. I think that we need a "policy" for dealing with our suffering. We do not want to condone it, but we need to find a way to make use of our suffering, for our good and for the good of others. There has been so much suffering in the twentieth century: two world wars, concentration camps in Europe, the killing fields of Cambodia, refugees from Vietnam, Central America, and elsewhere fleeing their countries with no place to land. We need to articulate a policy for these kinds of garbage also. We need to use the suffering of the twentieth century as compost, so that together we can create flowers for the twenty-first century."

- Thich Nhat Hanh

Peace Is Every Step: The Path of Mindfulness in Everyday Life (1992),

This final chapter integrates findings from previous chapters to answer the questions that guided this PhD research (see 7.2). Transboundary shipment of waste and its management is a wicked sustainability challenge. Complex problems with diverse actors, their multiple value judgements and motivations, power structures and relationships, and varied sociocultural, political and economic contexts interact dynamically in this waste value chain. Additionally, the waste shipment value chain lacks transparency and accountability. Some actors exploit others and the natural environment, and waste shipment practice lack sustainability and circularity. The multiple actors create a plurality of understanding of this challenge and offer multiple perceived solutions, some of which contradict each other.

Transdisciplinary research (TDR) integrates interdisciplinary scientific knowledge with societal knowledge to understand this wicked problem. By including multi-actors knowledge and reflections, the created knowledge is relevant to the context and aims to have both scientific and social legitimacy. This research approach integrates various epistemologies to generate systemic and targeted solution-oriented knowledge. This inclusive and collaborative research approach brings a plurality of understanding to the circular economy literature and transboundary waste movement, incorporating the social, ethical, justice and global dimensions – which are rarely discussed in the circular economy transition literature and policies.

7.1 Reflections on the thesis chapters

The following section provides reflections on the individual chapters and integrates them to answer the research questions in the next section (see 7.2).

Transboundary waste binaries - literature review: A literature review of 218 articles from the previous 35 years of academic understanding of transboundary waste flows in Chapter 2 set the stage for and guided this research. This review provided interdisciplinary insights and valuable lessons covering current and historical trends in the literature. The review found sustainability challenges, pervasive data scarcity, policy gaps at various levels, and a lack of research collaboration in the transboundary waste movement. The research identified 'transboundary waste binaries', which are recurring themes of strong opposing views prevalent in the literature. These binaries do not adequately represent the contexts, their interrelationships or the plurality of understanding of this wicked problem. Showing the limitation of such binary understanding from a problem-solving perspective, a nuanced, collaborative, contextual and solution-oriented understanding was proposed. The creation of contextual solution-oriented understanding guided the rest of the research process. For example, while it remains true that rich and powerful countries exploit poor countries in an unequal waste trade, exploitative relationships are also prevalent in between the value chain actors, not only between countries. Chapter 2 provided an updated state-of-the-art understanding of the transboundary waste literature and paved pathways to add nuanced, contextual and problem-solving understanding to this field of research.

Science with Society: Transdisciplinary research provided an impact-oriented research approach to navigate sustainability challenges. Chapter 3 explored the theory and practice of TDR research from an early-stage researcher (ESR) perspective. By integrating societal and scientific knowledge, TDR facilitated designing an inclusive research process to generate a plurality of impact-oriented epistemologies. This diversity is crucial when researching wicked challenges like transboundary waste shipment. This chapter highlighted six TDR challenges and discussed ways to navigate them. It combined existing TDR literature with lessons from two completed TDR PhDs in different socioeconomic contexts and a self-reflection on the ongoing PhD. This chapter brought valuable ESRs

perspectives to the TDR literature in sustainability science, intending to share experiential knowledge to a research field often associated with 'learning by doing'. This chapter highlighted relevant TDR principles and qualities that could guide TDR researchers. For example, the chapter recommended being agile and adaptive, balancing various roles, listening to hunches and managing expectations for TD ESR. These qualities also guided this PhD process to navigate different social, cultural, political and economic contexts, deal with a lack of transparency and uncertainty and conduct this Global North and Global South collaborative research during the COVID-19 pandemic.

EPR, Waste Governance and Circularity of Dutch Tyre: Despite high collection and recovery levels of tyre waste in the Netherlands, the outcomes have limited circularity and sustainability. Chapter 4 analysed the circularity of Dutch rubber tyre waste management organised by the EPR, where tyre producers and importers are financially responsible for waste management. Current practices focus on efficient and cost-saving recovery practices without consideration for the more sustainable and circular value retention options. Research showed a need to consider value retention options other than existing downcycling practices, where material value is degraded instead of enhanced. For circularity, collaboration and inclusive multi-stakeholder governance are essential. For circularity and sustainability, waste governance must be transparent and focus on broader social and environmental outcomes instead of the current narrow material focus. One-third of discarded tyres are exported, but the process lacks transparency, accountability and export controls, and there is no oversight of what happens to exported tyres. Despite collected discarded tyres being exported globally, sustainability or circularity considerations for the international waste value chain are lacking. This insight into the EPR system, waste governance and stakeholders and their interactions guided case studies in Vietnam and Nigeria, where European waste and discard are shipped within the institutional context of EPR systems.

Circularity of EU plastic waste exported for recycling: About half of collected plastic from the EU is exported to various parts of the world with much obscurity along the way. Chapter 5 presented empirical findings on what happens to EU plastic waste exported to Vietnam. Vietnam does not currently have a sound plastic waste management system. Working closely with Vietnamese partners, we mapped relevant European and Vietnamese policies, stakeholders and practices. Like in the rubber tyre recycling chain, plastic waste governance and its value chain lack transparency and accountability. A case study of informal recyclers recycling imported plastic showed a lack of care for the workers' health, safety and fundamental human rights. Plastic recycling in this context, causes harm to waste

workers and their environment and is neither circular nor sustainable. Focusing on getting rid of European waste by exporting to recycle without ethical considerations causes social and ecological exploitation and injustices. Findings in Vietnam showed an urgent need for a just, sustainable and functioning governance of European plastic waste exports. This chapter proposed an ecocentric ethical framework to guide waste governance and circular economy transition. *Kyōsei*, a framework for 'symbiosis for mutual flourishing', proposed mutually beneficial relationships between individual-society, society-nature and nature-individual relationships in the waste value chain governance to replace the current exploitative ones. This framework was built on multidisciplinary perspectives combining the more abstract (justice, governance and circularity) and the more hands-on (policies, reverse logistics and ethics) for a just circular transition. Waste governance guided by this framework creates a shift from the current exploitative waste value chain by bringing in considerations for the people and the planet in and outside the EU.

The circularity of EU used products exported to be reused: Chapter 6 presented the findings from another collaborative project exploring the shipment of secondhand electric and electronic equipment from the European Union to Nigeria. It showed, how without consideration for fairness and equity, shipping secondhand equipment for reuse causes social and ecological harm. Reusing, a circular value retention option in theory, was neither circular nor sustainable in practice, but unfairly shifted waste management responsibilities elsewhere. The responsibilities of European producers for sound e-waste management mandated by the EPR were shifted to Nigeria through the exports of secondhand equipment, which eventually becomes e-waste sooner than later. The current EU circular economy discourse fails to account for the multiple loops of value retention like reusing, reselling and repurposing in or outside the EU. Waste Electric and Electronic Equipment (WEEE) governance takes no accountability and responsibility for the European discard shipped outside the EU, which is toxic when not managed properly. Disregarding justice, fairness and equity in policies impede the circularity transition in the EU and elsewhere, and this unequal trade makes the increasingly unequal world even more unequal. Together with twenty-four e-waste experts, we co-created a policy intervention incorporating justice, equity, circularity and sustainability. This Ultimate Producer Responsibility (UPR) proposes that collecting and managing e-waste sustainably according to the highest possible value retention options falls upon the manufacturers irrespective of reuse cycles and geographic location. UPR aims for systemic intervention to make WEEE governance transparent and accountable, prevent e-waste globally by promoting repair and reuse, and incorporate local and international sustainability guidelines and human rights for a just circular economy transition.

7.2 Reflection on the guiding research questions

The PhD research aimed to answer the question, "What is the sustainability and circularity implication of Europe's current practice of shipping waste and discards to countries without sufficient waste management infrastructure?". To do so, it examined the trends and practices of waste shipment, the actors and the drivers, the policies and their effectiveness. Finally, it attempted to create solution-oriented knowledge and policy interventions. The following section discusses the sub-research questions and integrates them to answer the main research question.

sub-RQ1: What are the trends and practices of transboundary waste and discard shipment from the EU to low-income countries for recycling or reuse?

The waste management system in the EU seems well-organised using the EPR system, which governments report as a success story with high collection and recycling rates. While one does not see waste on the street and in the natural environment, like in Nigeria and Vietnam, waste management is not sustainable and circular (discussed in section 7.2.3). Empirical case studies of tyre waste (chapter 4), plastic waste (chapter 5), and secondhand electric and electronic equipment (chapter 6) show that waste shipment to other countries from the EU is non-transparent, unaccountable and unfair. Such waste shipment unfairly shifts the EU's waste management responsibility to countries lacking sound waste management capacities. This trend, linked with social and ecological injustice since the 80s (chapter 2), unfortunately, is ongoing despite circular economy rhetoric and aspirations of the government and businesses. Current trends and practices need interventions (discussed later). In line with other research and reports, our empirical evidence shows that waste and discarded shipments from the EU to low-income countries for recycling and reuse remain unfair, unethical, obscure and lack sufficient attention to maximising sustainability and circularity.

sub-RQ2: Who and what enables and drives these trends?

The complex and non-transparent waste value chain involves different actors and their contexts

interacting dynamically, motivated without care for sustainability or circularity. We find that stakeholders and their inclusion and exclusion in the value chain, their motivations and relationships, and the various contexts enable and drive the trends of waste shipment. In chapter 4, we map out the actors in the Dutch tyre EPR and recommend the inclusion of more actors engaged in the circular economy. Focusing on EU waste shipments, chapters 5 and 6 identified global stakeholders in the value chain, including collectors, exporters, customs officials, importers, formal and informal waste workers, recyclers, repair persons, scavengers and landfill workers, government, academia, non-profit and civil society. These actors, their motivations and relationships, power dynamics, trust, fairness, and collaboration determine and drive waste shipment and its outcomes. Policies, rules and regimes guide these actors at multiple levels, some more effective than others. National, regional (e.g., European) and international level policies govern different categories of waste and waste shipment. More than policies and regulations, their implementation, enforcement and monitoring directly influence waste shipment and determines its transparency, circularity and sustainability. European policies and actions telecouple, i.e., interact directly and indirectly with connected systems globally impacting each other. For example, Chapter 5 finds that increased recycling ambition in the EU without international sustainability considerations causes socio-ecological harm in Vietnam.

Some actors operate outside these policies and regulations. An estimated 15 to 30% of EU waste shipments are illegal, and such waste trafficking also influences the waste shipment trend. In a context without robust and just policies, especially their enforcement, various relationships in the waste value chain, primarily motivated by cost-savings and profit maximisation, appears to drive the trend and intentionally and unintentionally exploit the natural environment and other actors in the value chain. To summarise, actors, existing policies, laws, regulations and governance, the presence or lack of ethical consideration and different socioeconomic and political contexts all dynamically interact to enable and drive transboundary waste shipment trends.

sub-RQ3: Which current policies govern these practices, and are these policies adequate?

As mentioned in answering sub-RQ2 above, various national, European and international policies govern transboundary waste, but without sound implementation, enforcement or monitoring. In the EU, waste framework directives, waste shipment regulations and circular economy action plans

govern national policies. The waste streams selected for the research, tyre, some plastic and e-waste, are governed by the European EPR regulations. Apart from policy enforcement and monitoring, the research finds three design flaws that limit circularity and sustainability in the existing EPR. First, EPR promotes downcycling, the most efficient and cost-effective but the least circular option, that downgrades product and material value instead of maintaining or upgrading it. It is material- and recycling-focused without broader social and ecological considerations. Second, the decision-making process is limited to the producers, importers and recyclers. The lack of inclusion of other actors reinforces waste collection and downcycling practices. Circular economy actors engaging in practices like refusing, reusing, reselling, and repairing, along with societal actors from non-profits and civil societies (particularly those affected by the final dumping at the end of the life cycle), are excluded from the existing EPR governance. This narrow focus and lack of inclusion lead to the third design flaw. EPR focuses on managing its waste within its national jurisdiction and ignores the international dimension. Since the 1980s, the waste has been shipped outside the EU, but the EPR pays no attention to its sustainability. Ignoring the multiple global cycles of EU waste restricts EU circularity, creates injustices and reinforces inequality. Even though it is essential to consider a full waste value chain globally, the current European circular economy and waste governance action plan pays little to no attention to it.

The Basel Convention is the key multilateral treaty that guides the shipment of some waste streams. Considering the ever-increasing level of transboundary waste shipment (Portas, 2016; Barsalou and Picard, 2018), the Convention has been criticised for failing to achieve its founding aims of regulating and reducing transboundary waste, set in 1992. Limitations of the Basel Convention partially led to the formation of the Bamako, Stockholm and Rotterdam conventions. Chapter 2 gives an overview of policies discussed in the last 35 years of academic literature with criticism and suggestions to improve the Basel Convention.

Chapter 4 focuses on a case study of the Dutch tyre EPR, which operationalises the European waste governance directive. Chapter 5 focuses on Vietnamese policies that govern plastic waste, including its imports. Chapter 6 focuses on Nigerian policies governing e-waste and importing secondhand electric and electronic equipment. Despite various policies, the case study finds a lack of policy coherence, enforcement and monitoring at national and international levels. Existing policies that

govern transboundary waste do not guarantee sustainability and circularity and overlook the associated social and ecological injustices of the waste trade. Despite policies and policy mixes at multiple levels, they could be more effective. Current policies need to account for how waste, directly and indirectly, is interconnected and impacts other systems globally. In light of this, the research developed a theoretical multidisciplinary framework to guide transboundary waste shipment for a just circular economy transition and co-created a policy intervention (Ultimate Producer Responsibility), outlined below.

sub-RQ4: What policy interventions can make waste governance more sustainable and circular?

The research finds a systemic need to make waste governance fair and sustainable to achieve a circular transition in the EU and elsewhere. In the Vietnamese case study, we propose an ecocentric ethical framework for transboundary waste shipment for a just circular economy transition as a systemic solution focusing on promoting spatial equity and justice in the value chain. This *Kyōsei* framework for mutual symbiosis is based on empirical findings combined with an interdisciplinary theoretical perspective on the circular economy, reverse logistics, justice and equity, environmental governance, and ecocentric ethics from the Asian philosophical tradition. The framework proposes ethical symbiotic relationships for the mutual well-being of the individual, the society and the environment in the various waste value chain relationship for mutual flourishing. Policies and actions guided by this *Kyōsei* framework aim to end current exploitation and promote transparency, accountability and mutual well-being.

In the Nigerian case study, we use principles in the proposed framework to co-create contextual and socially legitimate policy intervention. Ultimate Producer Responsibility (UPR) expands the European EPR by incorporating justice, circularity and the full value chain perspective, including transboundary shipment for multiple reuse cycles, to make it circular, sustainable and fair. As discussed before, the UPR results from transdisciplinary EU-Nigeria collaborative impact-oriented research. The PhD research proposes principles and interventions to make waste governance more sustainable and circular for a just circular economy transition.

Integrating the answers to the above sub-research question helps answer the overall research question.

RQ: What is the sustainability and circularity implication of Europe's current practice of shipping waste and discards to countries without existing sufficient waste management infrastructure?

We find that Europe's current practice of shipping waste and discard to countries without sound waste management practices is neither circular nor sustainable. Without any consideration for justice and equity, such waste and discards shipments are causing social and ecological harm to people and their environment globally. The research finds a disconnect between EU rhetoric and aspiration for the circular economy transition and its actions and proposes solutions to align practices with aspirations of sustainability and circularity, which others have also observed (Calisto Friant et al., 2021, Leipold, 2021, Hartley et al., 2018, Kirchherr et al., 2018).

When looking at Dutch tyre waste management in chapter 4, we found tyres shipped abroad as a recovery strategy, but without transparency and accountability. Chapters 5 and 6 delved deeper, finding that current waste or discard shipments shift waste management responsibilities from the EU to other countries, usually economically poorer countries. This trade is not accompanied by an adequate transfer of financial, technological and knowledge to ensure the sustainability of imported waste. Case studies in Vietnam and Nigeria (chapters 5 and 6) study exports of plastic waste, secondhand electronic and electric equipment and e-waste. Both countries currently lack the capacity for sustainable domestic waste management. Despite some policies at various levels guiding waste shipment, policy implementation, enforcement and monitoring are lacking at national, regional and international levels in the EU and elsewhere. This leads to a lack of transparency and accountability in the value chain. In both countries, the poorest, powerless and marginalised people, who made up the informal waste management workforce, were responsible for processing European waste and discarded using the crudest technology in inhuman working conditions. Imports that could not be used were often dumped into the natural environment after salvaging some of it (described as cannibalism, see Reike et al., 2018, p. 257), creating pollution and toxicity in the environment.

The research findings make a strong case for incorporating the full waste value chain perspective in European waste governance discourse and practice. Doing so includes paying attention to the impacts of European waste and discard on people and their environment globally. This ethical approach to waste governance incorporates justice and equity in policies, practices and their implementation

and prevents causing harm elsewhere by unfairly shifting the EU's waste management responsibility. Without justice and fairness, the current unequal shipment of EU waste contributes to making the unequal world more unequal. Furthermore, such exploitations of people and the planet prevent adding and maintaining the value of European products and waste - a direct threat to establishing a European circular economy. European circularity is directly or indirectly interconnected to various systems globally. Thus a full value chain perspective, including multiple border crossing reuse cycles, with consideration for sustainability, circularity, justice, equity and ethics, is needed in European waste governance for a just circular transition in Europe. The research contributes to the European just transition aspirations by proposing two concrete things: a) a multidisciplinary framework to guide transboundary waste governance for a just circular economy transition and b) a UPR policy intervention tool to make the secondhand and e-waste value chain just, circular and sustainable. Other research recommendations for boosting EU circularity and sustainability include reducing waste generation and sound management of waste in geographic proximity, as discussed in chapters 2, 4 and 5.

7.3 Reflection on the research and research process

The thesis process is guided by collaboration between universities in Europe, China, Nigeria and Vietnam, which enabled collaboration with wider stakeholders. Collaboration with local partners in Vietnam and Nigeria was vital to have a systemic understanding of the challenge and investigating justice and fairness in the value chain. In current EU waste or circular economy policies, international actors are not included, even though EU waste impacts them. Collaborative and inclusive problem-solving research bringing the Global North and Global South is rare in the transboundary waste movement or the circular economy research. It is necessary for designing a just transition. While collaboration creates a much-needed nuanced understanding, international collaboration itself requires more time and resources.

Transdisciplinary research, focusing on collaboration and co-creation, adapts the research to the context, thus providing a contextual and systemic understanding of the sustainability challenges. While banning transboundary waste trade has been proposed and discussed as a solution in the policy and academic sphere, solutions to wicked problems are not as straightforward as black or white. While a few stakeholders advocated a complete ban on secondhand imports to Nigeria, most advocated better regulation; such imports add value to Nigerians. In Vietnam, recycled plastic plays a vital role in the manufacturing industry and provides socioeconomic benefits. Without reliable access to clean plastic waste for recycling domestically, stakeholders rely on clean imported plastic waste. While importing dirty plastic waste was banned, a mix of stronger regulations with better enforcement was preferred over a complete plastic waste ban.

Transdisciplinary approach enables research with an agenda for societal impact. Thus, research outreach is part of the TDR research process. For outreach, we explored various avenues targeting policymakers, stakeholders and the public. Output includes a video, a petition advocating the incorporation of UPR in the existing European EPR system accompanied by a policy-blueprint, writing popular science articles, press releases, and social media posts and sharing/dissipating created knowledge in the form of podcasts, seminars, meetings and similar interactions. Academics are

not trained for these impact-oriented activities, which usually take time and resources away from academic research and output. Despite academia's increasing focus on research impact, such time and resource-consuming activities are not part of the academic evaluation. Considering non-academic output in the academic assessment and accepting plural epistemologies facilitates and promotes the TDR process and encourages TD researchers, especially ESRs, who wish to pursue academic research with societal impact.

A collaborative approach like TDR helps understand sustainability challenges from diverse and systemic perspectives to help create nuanced solution-oriented understanding. However, TD research comes with a set of challenges, six specific to ESR, which are identified and discussed in chapter 5 (see 5.3). A Zen-like non-dual approach, where obstacle and path are opposites but also the same, is helpful for navigating challenges. When embodied in the research, this mindset helps build trust: self-trust and trust-building with others in the collaborative process. In hindsight, embodying this epistemological approach facilitated navigating the six identified and other emerging challenges during the research. Like the UPR in this research, a co-created equitable solution is situated in a broader socio-political and economic system. Systemic changes from TDR research, if any, often is not seen during the PhD period; however, learning and doing TDR is itself the reward, even if systemic changes are slow. Collaborating, co-understanding, co-creating, improvising and adapting to challenges are important in academic research and also in all walks of life.

The research investigates how policies and governance in the EU impact the rest of the world. Recycling and reusing policies of EU waste and discards have sustainability and circularity implications in distant places. Understanding waste shipment practices, their impacts and creating solutions requires a diversity of epistemologies encompassing social, political, cultural and technological aspects. For instance, Asian philosophy focuses on ecocentrism and interdependent relationships between individuals, society and nature. *Kyōsei* or symbiosis for mutual flourishing, partially guides our proposed framework for waste shipment for just circular economy transition. Transdisciplinary and collaborative reasons enable a plurality of epistemologies and solutions to understand a wicked problem and enrich academic discourses and practices.

The abstract and case-specific knowledge generated in this thesis has implications beyond the transboundary movement of waste and circular economy and beyond academia and aims to promote

the common good. North-South research collaboration is essential to investigate solution-oriented epistemology and co-design transition in a research field that lacks collaboration and has an unequal contribution to the academic literature (chapter 2). Collaboration becomes even more important to design solutions in an unequal world with uneven economic development, to ensure equity and justice are integrated into the solutions and the transition discourses. Furthermore, the collaboration also brings a plurality of values and understanding, essential for implementing a just transition.

The fact that waste is unfairly shipped to countries without waste management capacities creating socio-ecological injustices and harm since the 1980s, shows a more significant political and economic problem. Research, reports, and newspapers advocating ethics, justice and fairness in waste governance have been frequent since the 80s yet remain to be addressed in policy and governance. Addressing the exploitation of humans and nature and ensuring justice and equity during waste management is more expensive and thus not profitable. The political and economic motivations of the EU to not bring equity, sustainability and circularity in its transboundary waste governance are beyond the research scope of the thesis. Like the EU Japan exports waste to other countries but has a policy (International Resource Circulation) to transfer resources, finance, knowledge and technology to destination countries along with its waste to enable sound waste management. It is one of the five pillars of its Sound Material Cycle Society policy. Policy and practice comparison between Japan and the EU was pursued but limited due to time and resource constraints, but nevertheless resulted in an insightful master's thesis. Collaboration and knowledge sharing between policymakers in Japan and the EU (and beyond) to gather best practices and translate them to local contexts could help tackle the challenges of transboundary waste better.

The PhD research finds that despite international regulations and two recent European circular economic action plans since 2015, European waste and discard causes global sustainability, fairness, and circularity challenges. Solutions to address these challenges include incorporating the international impact of European waste and making waste trade sustainable, fair, and circular. Thus, without sustainability, justice, equity and a full value chain perspective, circularity cannot be achieved in Europe or elsewhere. This thesis adds these concepts vital for the just circular economy transition in the scientific literature using case studies in the Netherlands, Vietnam, and Nigeria.

7.4 Reflection on Scientific Contribution

Knowledge created in this thesis aims to aid a global and European transition to the circular economy. I aimed to create knowledge that is scientifically and socially relevant. Thus far, the circular economy has focused mostly on material focus, which resulted in techno-centric research without much emphasis on broader sustainability and social considerations (Calisto Friant et al., 2020; Kirchherr et al., 2017). Most circular economy research thus far focuses on increasing efficiency, reducing cost, dependence on technology and creating newer business models (with limited actor inclusion or narrow geography focus). They make contributions to the circular economy transition. However, they provide a partial picture. For a bigger picture, the circular economy must investigate the social and ethical dimension, justice and equity implications, fairness and full-value chain perspective. Without research on these topics, the relationship between circular economy and sustainability remains uncertain. For example, market-dependent waste export to get waste out-of-sight without considerations for sustainability, justice, equitable knowledge and technology transfer causes socioecological injustices and material value loss. This case of market failure could be fixed with a more holistic approach. In a global context of socio-ecological crisis, energy, resource, and focus on circular economy transition without transition to sustainability will be a missed opportunity. This calls for broadening the scope of circular economy research towards an interdisciplinary and transdisciplinary approach, which the thesis aimed to do.

The interconnectedness of the Global North and Global South enables material flows and the creation of products. This interconnectedness enables creation of our morning coffee, the paper this dissertation is printed on or the electronic equipment you are reading this thesis on and manage when we discard them. Yet research on circular economy and transition barely integrates Global North and Global South and a full value chain perspective. Interactions between people from the Global North and Global South and their socio-ecological systems are crucial to make systemic transformation that the circular economy proposes. Yet the circular economy research focus disproportionality on and limited to the Global North. In an increasingly unequal world, circular economy research barely focuses on ethics,

equity and justice in the global context. For instance, it is well known that managing European waste and discards historically and currently harms actors, especially the informal sector in the Global South and their environment. Yet existing circular economy transition research focusing on waste barely include them. This thesis explicitly makes this connection with collaborative research between Global North and the Global South.

A holistic picture is necessary for a circular economy transition and to make linkages to sustainability. This PhD thesis attempts to fill the abovementioned research gaps for a bigger picture, systemic and nuanced knowledge. To do so, we zoom in and zoom out and adapt the research to include the social and environmental dimensions along with equity, justice, ethics and fairness. This research is guided by a transdisciplinary methodology, allowing emergence and co-creation whenever possible during the research integrated scientific and societal knowledge for a solution-oriented understanding of sustainability challenges. This approach opens newer ways of knowing, navigating unequal power dynamics and widens the richness of epistemologies in circular economy literature while. The PhD establishes that there is not a single loop in the circular economy but many loops in and outside national boundaries and engages multiple actors globally. While mainstream circular economy research focuses on European stakeholders, other actors in the global value chain inside and outside the EU who are affected by the circular economy policies and actions are usually left out of the circular economy research. Research for this thesis aimed to bring them together.

At the heart of this thesis is an interdisciplinary exploration connecting various literature, forms of knowledge and the Global North and Global South. For instance, well-established academic fields of transboundary waste literature, environmental justice, environmental governance and ecocentric ethics are integrated to enrich our understanding of the circular economy and its sustainability implications and to guide the transformation. A sustainable and just circular economy transition scholarship and policies must include equity, justice and ethics. The PhD fulfilled such gaps to create solution-oriented knowledge towards a just circular economy transition.

7.5 Future research recommendations

During the research process, a plurality of solutions, including the reduction of transboundary waste trade were observed. While banning the trade of waste and discard was debated by various actors in the value chain, reducing waste trade as a solution was a more legitimate solution among actors. Reducing waste and discard trade also links to reducing waste generation, which is linked to consumption reduction. Reducing excessive consumption could also have broader positive socio-ecological beyond the waste value chain and circular economy. Various forms of consumption are related to socio-ecological crises discussed briefly in the introductory chapters. For instance, if everyone consumed like the Dutch, humanity would require an annual biocapacity of 3.6 planet earth. Higher value retention options that also reduce consumption, like refuse, reduce, reuse, and repair, would prevent waste generation, thus be more circular and sustainable, and could address the socio-ecological inequities caused by resource overconsumption. Research linking consumption to transboundary waste trade can provide valuable insights.

Another important line of research could focus on making the waste value chain more transparent and accountable. Current data limited to waste's weight and economic value are unreliable and do not capture sustainability, circularity and their contexts. Ten kilograms of mobile phones, computers, vacuum cleaners and washing machines have different toxicity and socio-ecological impact, yet they are lumped together in the same category without further differentiation. Research on monitoring and capturing data is essential to overcome the obscurity in the waste value chain and understand and create a solution-oriented understanding. Data, transparency and accountability can give insights to waste trade in all geographies, including North-South, South-North, North-North and South-North, bringing us a more factual picture of waste trade and contextual solutions.

The various loops like reuse, repair, and recycle in the circular economy occur globally, yet circular economy policies hardly look beyond the national borders. For a circular economy, sustainability of these various loops that can take place worldwide must be considered. This thesis focused on the governance

perspective of waste. Other (inter)disciplinary understanding is necessary. Waste shipment is often associated with toxic colonialism and environmental racism. For instance, both Nigeria and Vietnam are former European colonies. 2022 report shows the Netherlands dumping plastic waste to Indonesia, its former colony. From such research, a more nuanced understanding of equity, justice, fairness and lack thereof can design anti-colonial solutions to waste management. Unequitable development of the world has led to unequal division of labour, often associated with injustices. Cost savings and profit maximisation lead to unfair waste shipment to economically poorer countries creating injustices and inequities. A systemic exploration of injustices emerging from exploiting the unfair division of global labour in the waste trade could show the scope of the problems and their solutions.

To conclude, the research finds that European circularity is interconnected with global-scale material flows and loop-closing and their circularity and sustainability. The practice of the shipment of European waste and discards to Nigerians and Vietnam for recycling and reuse is not sustainable or circular. The current European waste and circular economy policies lack attention to the international dimension. For a circular transition, an entire global waste chain must be incorporated into waste governance to ensure fairness, equity and justice. Policies and practices focusing on symbiotic relationships promoting mutual well-being can promote European and global circularity, sustainability, equity and justice.

Publications thesis chapters

Campbell-Johnston, K., Calisto Friant, M., Thapa, K., Lakerveld, D., and Vermeulen, W. J. V. (2020). **How circular is your tyre: Experiences with extended producer responsibility from a circular economy perspective.** *Journal of Cleaner Production*, 270, 122042. https://doi.org/10.1016/j.jclepro.2020.122042

Thapa, K., Vermeulen, W. J. V., Deutz, P., and Olayide, O. (2022a). **Transboundary movement of waste review: From binary towards a contextual framing.** *Waste Management and Research: The Journal for a Sustainable Circular Economy*. https://doi.org/10.1177/0734242x221105424

Thapa, K.,Vermeulen, W. J. V., and Deutz, P. (2022b). **Science with society: Challenges of early-stage researchers engaging with transdisciplinary research in sustainability science.** *Sustainable Development*. https://doi. org/10.1002/sd.2328

Thapa, K.,Vermeulen, W. J. V., Deutz, P., and Olayide, O. (2022c). **Ultimate Producer Responsibility for e-waste management - a proposal for just transition in the circular economy based on the case of used European electronic equipment exported to Nigeria.** *Business Strategy and Development*. https://doi.org/10.1002/bsd2.222

Thapa, K.,Vermeulen, W. J. V., Waal, M. M. D., Deutz, P., and Nguyễn, H. Q. **Towards a Just Circular Economy Transition: the Case of European Plastic Waste Trade to Vietnam for Recycling.** Submitted to *Circular Economy and Sustainability* (submitted).

List of additional publications connected to this thesis

Thapa, K.,Vermeulen, W. J. V., Olayide, O., and Deutz, P. (2022). **Policy brief: Blueprint for ultimate producer responsibility**. Copernicus Institute of Sustainable Development, Utrecht University. https://doi.org/10. 5281/zenodo.5957809

Vermeulen, W. J. V., Campbell-Johnston, K., and Thapa, K. (2022). **Extended Producer Responsibility and Circular Economy: Three Design Flaws.** Ökologisches Wirtschaften - Fachzeitschrift, 37(1), 21–23. https://doi.org/10.14512/oew370121

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Video based on Nigerian research
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Summary

In recent years, the circular economy has been increasingly seen as a transition in the European Union and globally. Regional and national policies like the Circular Economy Action Plans have been implemented at the EU and country levels. One of the core pillars of the circular economy is to reduce waste and discard and maintain its value to "close the loop".

However, the focus on circularity is limited to national and European levels. Europe exports a significant amount of waste to non-EU countries, including the Global South. Waste or discards, once shipped to be reused or recycled, is out of sight and out of the mind of the EU. A review of transboundary waste literature since 1985 highlights that waste exports, especially to countries without a sound waste management facility, have been documented to create social and ecological injustices since the 80s. Such trade without equity and fairness considerations has been associated with increasing global inequalities. Despite European circular economy ambitions, policies and actions, such irresponsible waste trade is ongoing. Such waste trades are not yet incorporated in the circular economy literature, and this thesis aims to contribute to this literature gap.

With the belief that any transition, including the circular economy transition, should be just, fair and equitable, the PhD thesis explores the transboundary movement of European waste. This environmental governance research is guided by a transdisciplinary ethos that aims to integrate scientific and societal knowledge to (co)create contextual solution-oriented knowledge. The research investigates "What is the sustainability and circularity implication of Europe's current practice of shipping waste and discards to countries without existing sufficient waste management infrastructure?" Mixed-method research investigating policies, empirical evidence, multidisciplinary academic knowledge, and practitioners' perspectives are provided in the three in-depth case studies of the following waste value chain: rubber tyre waste, second-hand electric and electronic item and their discards and plastic waste in the EU, Netherlands, China, Nigeria and Vietnam.

Recycling and reusing are circular and sustainable options, in theory. However, contextual analysis of the exported waste streams finds that without accountability and ethical consideration, they are neither circular nor sustainable but cause social and ecological harm. Existing discourses on the circular economy need to consider the multiple use cycles of products in and outside of one country, thus not paying attention to the whole value chain of waste and discards. Current European practice

unfairly shifts waste management responsibility elsewhere to places that might not have enough capacity for sound waste management. Part of the European waste management responsibility is shifted to the poor and the marginalised, which harms them and the environment.

The current European circular economy discourse and practices need to sufficiently incorporate the social dimension, which is vital for transition. Current waste shipments and their impacts without accountability demonstrate a lack of attention to ethics, justice and equity in European policies and practice. Some scholars and experts view such waste shipments as neo-colonial exploitation. Based on research findings, the thesis proposes a fair, ethical and mutually beneficial symbiotic relationship instead of the existing exploitative relationship in the waste value chain. We have designed the research process to use the findings to create a fair waste shipment framework that guides policy and practices for a just circular economy transition. Guided by this framework, a policy intervention, the ultimate producer responsibility, is co-created for transparency, accountability and circularity in the waste value chain. This intervention aims to make the original producers responsible for their waste globally instead of their current responsibility being limited to national jurisdiction.

The research illustrates that European circularity is interconnected with global circularity and sustainability. Current European waste and discards shipped elsewhere without consideration for justice and equity are neither sustainable nor circular. Existing circular economy and waste policies need to more explicitly account for the multiple cycles of waste and discards internationally. For a circular transition, the entire global waste value chain should be considered to ensure fairness, equity and justice. The study recommends European policies and practices that promote mutual well-being that is equitable, just and sustainable for a circular economy transition. Policies and practices focusing on symbiotic relationships promoting mutual well-being are needed to promote European and global circularity, sustainability, equity and justice.

Samenvatting

De laatste jaren wordt de circulaire economie steeds meer gezien als een transitie, zowel in de Europese Unie als wereldwijd. Regionaal en nationaal beleid, zoals beschreven in de actieplannen voor de circulaire economie, zijn inmiddels op EU- en nationaal niveau geïmplementeerd. Een van de kernpijlers van de circulaire economie: het verminderen van afval, en het behouden van de waarde van materialen om "de kringloop te sluiten".

De aandacht voor circulariteit blijft echter beperkt tot het nationale en Europese niveau. Europa exporteert een aanzienlijke hoeveelheid afval naar niet-EU-landen, waaronder landen in de Global South. Afval of afgedankte producten, eenmaal verscheept om te worden hergebruikt of gerecycled, verdwijnen vervolgens uit het zicht en van de agenda van de Europese Unie. Uit een overzicht van de literatuur over grensoverschrijdend afval sinds 1985 blijkt dat de uitvoer van afval, vooral naar landen zonder goede afvalverwerkingsfaciliteiten, sinds de jaren 80 sociale en ecologische onrechtvaardigheden veroorzaakt. Dergelijke handel zonder rechtvaardigheidsoverwegingen wordt in verband gebracht met toenemende mondiale ongelijkheid. Ondanks de Europese ambities, beleidsmaatregelen en acties op het gebied van de circulaire economie gaat deze onverantwoorde afvalhandel gewoon door. De aard en de gevolgen van dergelijke handel in afval is nog niet opgenomen in de literatuur over de circulaire economie. Deze dissertatie draagt bij aan dit hiaat in de literatuur.

Vanuit de overtuiging dat elke transitie, ook die van de circulaire economie, rechtvaardig, eerlijk en onpartijdig moet zijn, onderzoekt dit proefschrift de verplaatsing van Europees afval over grenzen. Dit onderzoek naar milieu-governance wordt gedaan vanuit een transdisciplinair perspectief, dat wetenschappelijke en maatschappelijke kennis wil integreren om contextuele oplossingsgerichte kennis te (co)creëren. Het onderzoek stelt de vraag: "Wat is de implicatie voor duurzaamheid en circulariteit van de huidige Europese praktijk om afval te verschepen naar landen zonder voldoende bestaande infrastructuur voor afvalbeheer?". Een mixed-method onderzoek is uitgevoerd, waarin beleid, empirisch bewijs, multidisciplinaire academische kennis en de praktijk worden onderzocht in drie diepgaande casestudies in de volgende afvalketens: afval van autobanden, afval uit tweedehands elektrische en elektronische artikelen en plastic afval in de EU, Nederland, China, Nigeria en Vietnam. In theorie zijn recycling en hergebruik circulaire en duurzame opties. Uit een contextuele analyse van de geëxporteerde afvalstromen blijkt echter dat deze opties, zonder verantwoordingsplicht en ethische overwegingen, noch circulair noch duurzaam zijn, maar sociale en ecologische schade veroorzaken. Huidige discoursen over de circulaire economie moeten rekening houden met de

meervoudige gebruikscycli van producten in en buiten een land, en daarmee aandacht besteden aan de hele waardeketen van afval en secundaire materiaalstromen. De huidige Europese praktijk verschuift de verantwoordelijkheid voor afvalbeheer ten onrechte naar plaatsen die wellicht niet over voldoende capaciteit voor goed afvalbeheer beschikken. Een deel van de Europese verantwoordelijkheid voor afvalbeheer wordt verschoven naar de armen en gemarginaliseerden, wat hen en het milieu schaadt.
In het huidige Europese discours en de huidige praktijk van de circulaire economie moet de sociale dimensie, die van vitaal belang is voor de transitie, voldoende worden geïntegreerd. De huidige afvaltransporten en de gevolgen daarvan tonen aan dat er in het Europese beleid en de Europese praktijk te weinig aandacht is voor ethiek, gerechtigheid en rechtvaardigheid. Sommige wetenschappers en deskundigen beschouwen dergelijke afvaltransporten als neokoloniale exploitatie. Op basis van de onderzoeksbevindingen stelt deze dissertatie een eerlijke, ethische en wederzijds voordelige symbiotische relatie voor, in plaats van de bestaande uitbuitingsrelatie in de afvalwaardeketen. We hebben het onderzoeksproces zo ontworpen dat kan worden gebruikt om met de bevindingen een kader voor eerlijke afvaltransporten te creëren, dat richting geeft aan beleid en praktijken voor een rechtvaardige overgang naar een circulaire economie. Geleid door dit kader wordt in co-creatie een beleidsinterventie, de "ultieme producentenverantwoordelijkheid", gecreëerd voor transparantie, verantwoording en circulariteit. Deze interventie beoogt de oorspronkelijke producenten wereldwijd verantwoordelijk te maken voor hun afval in plaats van dat hun huidige verantwoordelijkheid beperkt blijft tot de nationale jurisdictie.

Uit dit onderzoek laat zien dat dat Europese circulariteit verbonden is met mondiale circulariteit en duurzaamheid. Het huidige Europese afval en afval dat naar elders wordt overgebracht zonder rekening te houden met rechtvaardigheid en billijkheid, is noch duurzaam noch circulair. Het bestaande circulaire economie- en afvalbeleid moet meer nadrukkelijk rekening houden met de meervoudige cycli van afval en secundaire grondstoffen op internationaal niveau. Voor een circulaire transitie moet rekening gehouden worden met de hele mondiale afvalwaardeketen om eerlijkheid, billijkheid en rechtvaardigheid te waarborgen. De studie beveelt Europese beleidsmaatregelen en praktijken aan die wederzijds welzijn bevorderen, op een manier die rechtvaardig, billijk en duurzaam is voor een overgang naar een circulaire economie. Beleid en praktijken gericht op symbiotische relaties die wederzijds welzijn bevorderen, zijn nodig om Europese en wereldwijde circulariteit, duurzaamheid, billijkheid en rechtvaardigheid te bevorderen.

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Even though the source for anything is the multitude play of the universe, often beyond our comprehension, one source that I can pinpoint for doing this PhD is my first of many philosophy classes with James McRae, which exposed me to eastern and western environmental ethics and the topic of transboundary dumping of toxic waste. Over the years, I had the pleasure of attending classes with professors James McRae for eastern philosophy, William Young for world religion and philosophy, Richard Lael for U.S. history, Laszlo Pinter for adaptive management and resilience of socio-ecological systems and Wayne Zade for the Beat generation literature. You taught me what to think but also how to think freely for myself. I salute you all!

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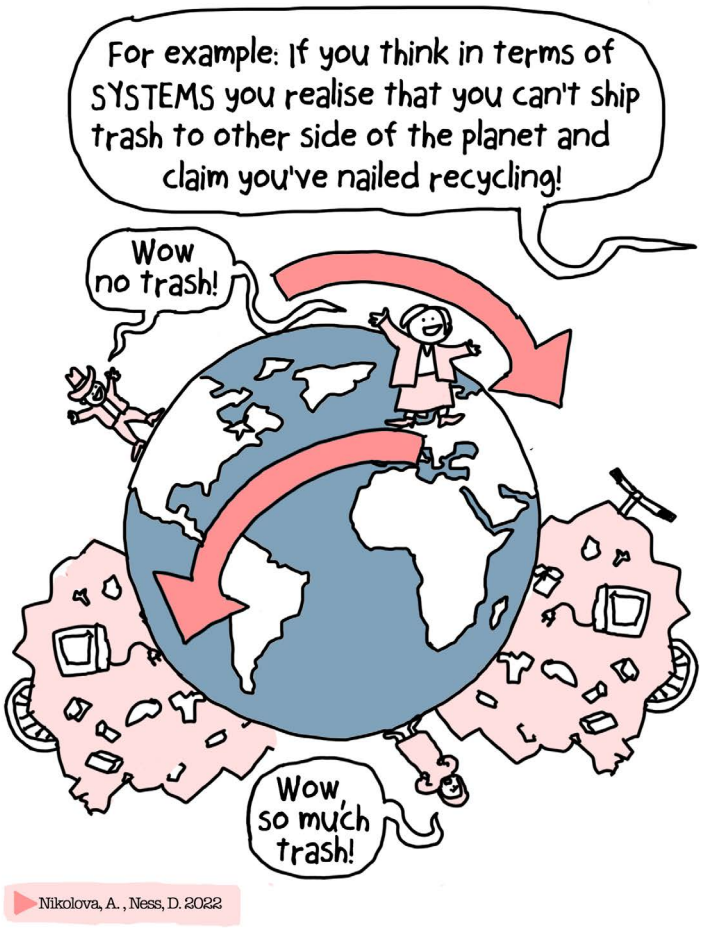
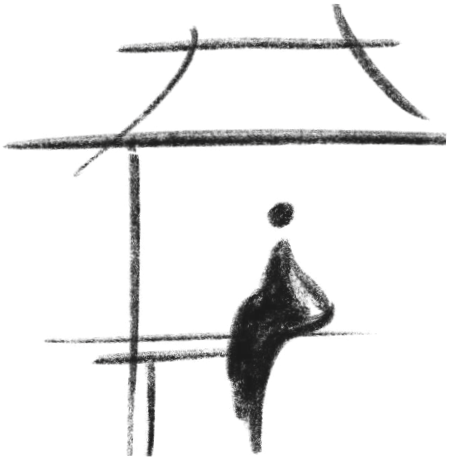
Lastly, this thesis is dedicated to the Rohingyas; many have been killed and tortured since the onset of the genocide in Myanmar, and even more are displaced. There were many mornings I woke up thinking about the war and the genocide in the last two years since I learnt how the pension fund of the University invested in the businesses of the perpetrators of the genocide. I never thought the act of doing PhD focusing on justice, equity and ethics would indirectly link me with ongoing genocide. I pray for peace, for you and for all sentient beings and hope that the actions of the universities and its pension machinery will someday be ethical and stand with you, for you, and for struggles like yours and not capitalise on your plight as a financially profitable opportunity.



Source: The Impossibilities of the Circular Economy — 360Dialogues, 2022

About the author

Born in the mountain village of Charikot, his life explorations have taken him to live in several places in Nepal and worldwide. He enjoyed a joyful childhood growing up in Nepal, sometimes without roads and electricity and has learned to navigate cities oversaturated with modernity. After high school in Kathmandu, he pursued a bachelor's in liberal arts at Westminster College (US) and a joint master's in environmental science, policy and management at Central European University (Hungary). He currently lives a *tranquilo* life in San Cristobal de las Casas (Mexico), working as a volunteer in a community waste project.



CRESTING team in Utrecht during the second PhD workshop, February 2019.