1 Introduction

1.1 Background

Despite the finite nature of resources, the global economic system is still geared to growth (cf. Obinger 2004: 13–20). Consumption is also linked to this permanent striving for growth regardless of whether they are industrialized or developing countries. This consumption is often accompanied by a careless use of products and resources (cf. Fellenberg 1997: 106–120). In addition, this type of growth promotes the quantities of different waste, because it creates more consumption and therefore more packaging or production waste (cf. Fellenberg 1997: 106–120). According to 2050 forecasts a doubling of waste worldwide is expected (cf. Muheirwe et al. 2022: 1). One type of waste that people are often confronted with in everyday life is the Municipal Solid Waste (MSW) which includes "(…) items such as packaging, food waste, grass clippings, (…). MSW does not include industrial, hazardous, or construction waste" (United Stated Environmental Protection Agency (US EPA) 2014: 2). The various components of MSW also pose challenges for its treatment. In particular, the high amount of plastic packaging pollutes the environment and contributes to high waste management costs (cf. World Wide Fund for Nature (WWF) n. d.). These high costs also explain the shipping of waste from industrialized nations to developing countries. There, the handling of waste is still usually cheaper due to weak laws and a lack of environmental protection measures. Often, the waste there is stored in wild dumps, incinerated or can be find everywhere in the environment (cf. Naturschutzbund Deutschland (NABU) n. d.). Even though there are various conventions

to prevent this kind of illegal shipping, especially the Basel Convention from 1989, such shipments still take place (cf. Basel Convention 2019). But the amount of self-produced waste in developing continent such as Africa is far higher than the imported waste. The waste volume in the Sub-Saharan Africa including plastic waste (Details about plastic categorization see chapter 4.3.2) is estimated to 231 metric tons generated annually (cf. Muheirwe et al. 2022: 1). The interconnected world, the economic systems and also the dependencies on imports and exports lead to huge amounts of waste that are generated globally but often have to be dealt with locally. A high increase is expected in cities in developing countries in particular where they have hardly any possibilities to cope with these volumes of MSW. A major challenge for the cities or municipalities lies in the responsibility for governance, the operating and the funding of waste management which takes approx. 19 % of the municipal costs (cf. Taylor 2000: 408; Kaza et al. 2018: 102). Improving waste management in developing countries often fails due to lack of funds, infrastructure and insufficient capacities at the institutional level (cf. United Nations (UN) Habitat 2007: 5–40; Guerrero et al. 2013: 220–232).

Zambia, the third largest economy in southern Africa, is confronted with various environmental problems caused by "rapid urbanisation, unsustainable population growth and inadequate town planning" (UN Habitat 2007: 5). The environmental destruction also comes from the mismanagement of MSW. It is estimated that about 50 % of MSW from developing countries remains uncollected (cf. Muheirwe et al. 2022: 1). Especially the plastic waste has negative effects e. g., clogging drains and gutters. Due to the blockages from the drains, the water is unable to pass through and might become contaminated which is the cause of cholera. The residents of Lusaka have also already been affected by this in 2018 and 2022 (cf. ReliefWeb 2022 see Fig. 1:).

Fig. 1: Blocked sewer, Misisi, Lusaka, October 2022 (own image)

And even though the impacts are felt locally in the city and need to be resolved, it is also important to involve international and national actors and their requirements (cf. Taylor 2000: 408). Dealing with MSW is also addressed directly and indirectly in the international 17 United Nations (UN) Sustainable Development Goals (SDGs) e. g., in SDG 6: Clean water or sanitation or SDG 12: Responsible consumption and production (cf. UN in Zambia n. d.). To achieve the SDGs, global and local actions must be implemented. An overview of the concrete targets in Lusaka and their impact on the SDGs can be found in the Annexure 9). Also various national initiatives address this complex waste topic either through the objective of a sustainable economy: "Africa by 2063 will have been transformed such that natural resources will be sustainably managed and the integrity and diversity of Africa's ecosystems conserved" (African Union Commission 2015: 34) or directly as a defined goal "We, therefore, undertake to achieve (…) interconnected (…) Circular Economies that are sustainably developed (…)" (Southern African Development Community (SADC) 2020: 5).

Circular economy (CE) (see chapter 2) and the opportunities that arise from the reduction of linear material and energy flows can also contribute to the solution of the waste problem in Lusaka (cf. Eurostat n. d.). The Extended Producer Responsibility (EPR) (see chapter 2.3) is considered a tool for achieving CE. According to the Organization for Economic Cooperation and Development (OECD) the EPR describes "(…) an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle." (OECD 2016: 21). So EPR is consistent with the Polluter Pays Principle regarding the shifting of responsibility and all related costs for the products towards producers (cf. OECD 2016: 21). This responsibility includes the ecological impact of the products throughout their life cycle from product design up to the final disposal. By covering the entire lifecycle of products, it is not surprising that EPR implementation can be multi-faceted and time-consuming (see chapter 2.3). Zambia does not have a fully functional EPR system yet, even if legal drafts and regulations exist since several years (see chapter 4.2). Looking at the current situation in Lusaka (see chapter 4), the urgency of dealing with plastic waste becomes clear. Sustainable solutions and financing for the handling of plastic waste must be established in the short term. In order to promote infrastructure development, eliminate plastic waste, and lay foundations for a functioning waste management system and full-scale EPR systems, plastic credits (PC) might be used as a quasi-immediate solution (cf. Nguyen et al. 2022).

Conceptually, plastic credits are an offsetting certificate for plastic waste, its collection and, in some cases, treatment (see chapter 3). Producers can purchase this type of credit to offset the company's plastic footprint. The Polluter Pays Principle can also be seen here, although the purchase of PC takes place on a voluntary basis yet. The benefits for companies here include improving their brand image through the use of claims such as plastic neutral (cf. Johnson 2022: 12–18). PC projects can contribute to the removal and disposal of plastic waste from the environment in the short term and at the same time reduce the financial burden on the municipalities (cf. Prevent Waste Alliance n. d.).

Whether and how PC and EPR can be used together to address the plastic waste problem in Lusaka is highlighted throughout this paper.

1.2 Research field and problem statement

The developing country of Zambia, and the city of Lusaka in particular, is faced with a large amount of plastic waste that already poses health risks to the population (cf. ReliefWeb 2022; see chapter 4). Short- and long-term solutions for dealing with waste must be found and implemented. According to the national visions and strategy papers, the development of a CE is part of the desired long-term solution (cf. SADC 2020: 5). In order to implement the CE in Lusaka, an EPR system can be a useful, although rather long-term, solution. Since the introduction of such systems might take years, the question arises which actions can be done in short-term. PC might be a mandatory solution to reduce the current plastic waste. The question arises, however, as to whether PC will make a meaningful contribution to a future EPR system and the desired CE, or whether it could even disrupt it. If a meaningful synergy between PC and EPR is possible, it is also essential to identify the local specifics in Lusaka and the resulting requirements. The effect of PC on EPR has not yet been sufficiently investigated scientifically. So far, there are a few selected project reports, studies are not available on this topic. For this reason, the research question of this thesis is:

"To what extent Plastic Credits can be used as an EPR bridge concept in Lusaka, considering local specifics need, the costs and environmental impacts?"

To answer this question, the following sub-questions are also addressed in this thesis:

- Could PC be a relevant component for the implementation of an EPR system in Lusaka? If so, which criteria would need to be considered for implementation?
- How does the local waste management in Lusaka work?
- How can the strengths of PC be used and how can their weaknesses be compensated?

- What are the requirements of PC and the associated business models?
- What are realistic costs of PC in Lusaka?
- Would the implementation of mandatory PC be reasonable and feasible?
- What environmental and social impacts can be achieved through PC in Lusaka?

Waste management and also EPR systems are implemented differently due to their local conditions such as culture, financing system, institutional framework, technical and human capacities and waste types (cf. Muheirwe 2022: 3). PC projects are also subject to these local conditions. For this reason, this thesis focuses on the city of Lusaka, Zambia and its local requirements (see chapter 4). Since PCs and their mechanisms are an essential part of the work, the focus is on plastic waste. Other waste types, such as hazardous substances, are not considered in this thesis. For the cost calculation of PC, an explicit waste flow is assumed (see chapter 6.1). This flow includes the incineration of plastic waste in a cement plant and do not refer to any other plastic recycling process. The selection of this process is based on the assumption that it represents a realistic scenario and does not require any additional infrastructure on site. This paper addresses the local requirements for a plastic credit-based project or even business model in Lusaka. The business model itself is not part of the paper due to the defined scope.

1.3 Methodology

This thesis relates to the following main knowledge streams: the current impact of PC and their relevance to CE and EPR, and a consideration of local challenges and opportunities in an implementation of PC in Lusaka, Zambia. The following image (see Fig. 2:) shows the methodological approach by phases:

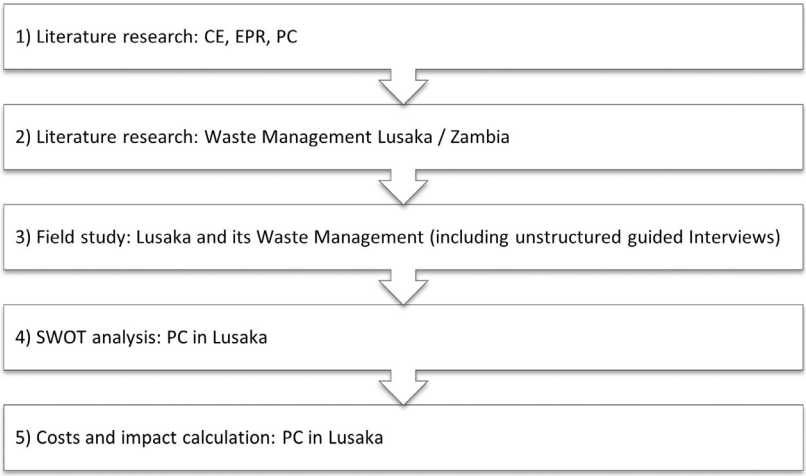

Fig. 2: Methodological approach (own illustration)

In order to understand the complex market of PC, their modes of action and concepts, and interrelationships with CE as well as EPR, literature research on this bac kground information was first conducted (1). In parallel with the above basic research, a literature review was conducted on the development and current status of waste management in Zambia's capital city, Lusaka (2). Based on these literature reviews, initial assumptions could be made about potential issues in the implementation, which have been validated during a field study in Lusaka in October 2022. During the field study qualitative, unstructured guided interviews with experts as well as interviews with residents or waste pickers were conducted (3). Based on the literature review and field study the intersections between PC and EPR are identified. In addition, the strengths and weaknesses of PC are highlighted and aspects for its combination with EPR are described. In the SWOT analysis, the local specifics and the basic idea of the PC model, relevant aspects of a future EPR system are aligned and concrete recommendations for a future PC project or even business model are developed (4). In the next step the price of PC is calculated. Also, environmental, economic and social impacts of the implementation of PC are mentioned (5).

1.3.1 Literature research

The empirical research method of the literature research, is to be assigned to the qualitative research and covers the search and selection of publications, in order to answer the posed problem definition. Thereby, the methodology refers to already existing knowledge. While an unsystematic literature research is rather used to get an overview of a topic, the systematic literature research is advantageous if there is already a question to be answered and thus specific literature can be searched (cf. Brink 2013: 46–108). This paper is based on both approaches, whereas the unsystematic literature research is mainly used to delimit the task area. While the systematic literature research is applied directly to the task. The systematic literature search comprises five steps, as shown in the table (see Tab. 1:).

Tab. 1: Literature research (own illustration based on Kalina et al. 2003: 74–110)

Steps	Significance
Determine search terms	Includes the creation of lists of relevant synonyms, catchwords and keywords related to the assignment.
Perform literature research	Includes searching for literature using the lists of synonyms, headwords and keywords.
Skim search results	Includes cursory review of literature found for rough presorting of relevant literature to answer the assignment.
Make literature selection	Includes the selection and source mix of relevant and frequently cited literature to answer the assignment.
Prepare documentation	Includes the preparation of the paper, paying attention to proper citation.

In the first step, a systematic literature review (SLR) was conducted. First, search terms relevant to this work were defined. Broad research was first done using various criteria that feed into the research question and the following sub-questions:

- What is CE?
- How do waste management, CE and EPR interact?
- What are the criteria of EPR?

- What is the mode of operation of PC?
- Are there interrelated modes of action between PC and EPR?
- Who are stakeholders and participants in the PC market?
- What are the challenges to be considered in the implementation of PC?
- What are the opportunities and risks associated with PC?
- How does waste management work in Lusaka, Zambia?
- What are the challenges of waste management in Lusaka, Zambia?

In literature research, a distinction is made between primary and secondary literature. While primary literature comprises the original literature, secondary literature contains content that originates from another author. It is advantageous to focus on primary literature and to use secondary literature only in exceptional cases (cf. Kalina et al. 2003: 74 –110).

1.3.2 Field study & unstructured guided interviews

For the classification and possible evaluation of the results of the work, it is necessary to explain the methodologies used (cf. Gebhardt et al. 2011: 156). After the initial literature research, gaps became apparent with regard to local and, in particular, current conditions in Lusaka, Zambia. These gaps related in particular to the concrete design of waste management and its functioning as well as related price structures.

Thus, the objective of a ten-day field study was to close these information gaps. Owing to limited a priori information in advance, it seemed reasonable to approach it with the help of a qualitative methodology (cf. Gebhardt et al. 2011: 98). Specifically, this meant developing several guiding questions that were addressed in guided interviews with selected contacts (for structure guided interview, see Annexure 1). The most important issues are addressed and noted in bullet points. According to Lamnek this is not necessarily done in concrete wording. When and how the question was specifically asked is not fixed, but results from the course of the conversation (cf. Lamnek 2016: 515–607). This chosen method does not aim at a statistical forecast, but rather at gaining knowledge in order to approach the actual local challenges (cf. Gebhardt et al. 2007: 91–98).

The selection of interview partners (see Tab. 2:) was based on two criteria. Firstly, on the basis of the previously conducted literature research regarding possible stakeholders, and secondly on the basis of recommendations by the locally based Maluwa Foundation, Green Earth Solutions (GES) as well as the company BlackForest Solutions GmbH, which are active in the field of waste management (cf. Maluwa Foundation 2022; BlackForest Solutions 2018).

Tab. 2: Interview partner field study 2022 (own illustration)

Institute / Position	Date / Annexure
Aggregator Misisi	(15.10.22 / Annexure 2)
Waste Collector 1	(17.10.22 / Annexure 3)
Waste Collector 2	(19.10.22 / Annexure 4)
Recycler 1	(20.10.22 / Annexure 5)
Recycler 2	(21.10.22 / Annexure 6)
Lusaka City Council (LCC)	(17.10.22 / Annexure 7)
Waste Picker	(18.10.22 / Annexure 8)

In addition to the scheduled interviews, brief interviews were conducted as part of what is most closely described as participant observation. Participant observation here also includes participation in everyday life (cf. Gebhardt et al 2011: 157).

For the study in Lusaka, this included visits to illegal (Misisi) and legal landfills (Chunga) as well as interviews with concerned persons such as the aggregators, the waste collectors, the recyclers and the LCC (see Chapter 4). The aggregator and the waste collector were interviewed because the informal sector plays an important and supporting role in waste management in developing countries and thus also in Lusaka. Here, it was important to understand the informal structures and mechanisms. The registered waste collectors are subject to official structures, such as official requirements, price definitions and regulations. During the interviews, an understanding of the mechanisms and further insights into everyday problems could be gained. In addition, one small and one larger recycling company were selected for interviews to get an idea of the state of recycling in Lusaka and the possible quantities that can be processed. Admit-

tedly, however, the willingness among recyclers for interviews was low. The interview with the LCC and the visit to the landfill were conducted in order to get an on-site picture of the waste problem and also to understand the official figures, structures and background.

It was disclosed to all conversation partners that the questions were asked in the context of a master's thesis. In general, the interview partners were open and helpful, especially in the participant observation. Logging the conversations, although originally planned, was not possible. Although all conversation partners knew the background of the interviews, a certain skepticism could be felt. However, in order to obtain the most valid statements possible, the author decided to record the interviews in writing only. This led on the one hand to a keyword-like transcript and a natural accompanying interpretation by the author. These were used as a basis for further interpretations and for closing any gaps in the research field. On-site and interview support was provided by a local Maluwa Foundation project manager. This helped to ensure that the interview partners were open and approachable and that language barriers have been overcome as well.

1.3.3 SWOT Analysis

SWOT analysis is used for strategic planning and management of companies. At its core is a positioning analysis by internal factors (strengths and weaknesses) and external factors (opportunities and risks). This analysis provides a comprehensive overview of the company's situation and lays the foundations for business models and company positioning (cf. Wollny and Paul 2015: 189). In this thesis the SWOT analysis is used for analyzing the idea of PC as a bridge concept towards EPR. For that reason, strengths and weaknesses of PC related to a future EPR system are contrasted to the local, external opportunities and risks. On the basis of this comparison, measures are then developed that must be taken into account when implementing a PC project or even a PC-based business model that is intended to contribute to EPR.

1.3.4 Costs and impact PC

The price for PC is calculated on the basis of a defined waste flow. This takes into account waste collection, transport, sorting and incineration in a cement plant. In addition, the administrative costs for the introduction of PC are calculated based on comparable projects. The data obtained from the field study and literature review form the basis for this price calculation. In addition, the possible impacts in the social, environmental and economic fields by using PC are mentioned.