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Sustainable Collaboration; Transforming Alliances for EPR in non-OECD Context

A case of Pakistan

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Abstract

Extended producer responsibility (EPR) has been successfully implemented in various developed countries. The complex waste flows and the presence of the informal sector in non-OECD countries makes the execution of EPR challenging widely. The informal sector owing to its contribution to the waste management sector has been advocated for inclusion and recognition by researchers and practitioners. The association of the informal sector with EPR has a negative connotation since it complicates the feasibility and logistics involved in formal planning. However, existing practices and research pertinent to the inclusion of the informal sector in solid waste management offer transferable lessons to be considered under EPR. A recent development suggests exploring the linkages of EPR with sustainable livelihoods and re-structuring of value chains and to distribute gains more equitably. Following this suggestion, four research objectives are pursued: 1) Functioning of EPR initiative when implemented in a country with the informal sector, (2) Facilitating producers in extending their responsibility to tackle packaging waste by exploring the contemporary issues pertinent to the end-of-life (EoL) management of the waste in Pakistan, (3) Understanding and identification of potential tradeoffs concerning the informal sector, and (4) Propose a more feasible phase-in approach in implementing extended producer responsibility policy (voluntary or/and mandatory) in countries with an informal sector.

This research follows a *case study strategy*. To see how EPR functions with an informal sector, the case of South Africa is analyzed and the environmental effectiveness of three industry-led voluntary EPR initiatives is evaluated. The collection of material for recycling is used as proxies to assess how much the policy achieved its goals of adequate end-of-life (EoL) product management. The case study of South Africa is based on a systematic literature review, whereas, the contextual case study of Pakistan is based on *topical* interviews. The research is framed by theory-based evaluation (TBE). The analysis of policy relevance revealed that several contemporary EoL product management issues and needs in Pakistan are linked to the intended outcomes and objectives of the EPR principle. Whereas, the political feasibility analysis revealed that the implementation mechanism is found with constraints and challenges. The feasibility of including the informal sector in EoL remains contested. Formal recyclers and private sector already engage with the informal sector, while producers are likely to engage due to their internal sustainability targets, exogenous factors, and the *strategic* advantage, i.e. the dominance of the informal sector in the collection phase. However, flexibility in the implementation of the EPR principle is likely to encourage actors to engage with selective informal groups. Based on these findings and the analysis, two implementation mechanism models are developed, as a phase-in approach, for the execution of the EPR principle in countries with the informal sector. These models are developed considering the contextual issues of EoL management relevant to the EPR goals and the *subjected to implementation mechanism* concerns as identified under the analysis of relevancy, learnings from the case study of South Africa, and literature review. The models are framed following theory-based evaluation (TBE). It reasons that this approach would be more apposite, and discusses the salient features of each implementation model/stage.

Keywords: Extended Producer Responsibility, Informal Sector, End-of-life product management, Theory-based evaluation, environmental intervention, packaging waste

Executive Summary

Extended producer responsibility (EPR) is an environmental policy approach to promote the *post-consumer* handling of waste products (OECD, 2001a) and to encourage improved environmental profiles (Lindhqvist & Lifset, 1997). EPR is designed to shift financial or/and physical responsibility (partially or fully) of the product's end-of-life (EoL) and post-consumer stage on the producer away from municipalities (OECD, 2001a). EPR principle is associated with end-of-life (EoL) management, however, the application of the EPR principle has been manifested in a range of environmental policies, encompassing management, prevention, behavior change, among many, owing to its flexibility and broadness. The main objective of this thesis is to facilitate producers in extending their responsibility to tackle packaging waste by exploring the contemporary issues pertinent to the end-of-life (EoL) management of the waste in Pakistan. Understanding and identification of potential tradeoffs concerning the informal sector is another major research goal. Through this thesis, the author attempts to propose a more feasible approach to producer responsibility policies (voluntary or/and mandatory) in countries with the informal sector in the waste sphere.

Overview of Research Questions and Methodology

Research Question	Overarching research design methodology	Method for data Collection	Data Sources	Method for Data Analysis
How can an EPR function when implemented in a country with the informal sector?	**Ex-post evaluation** of a case in South Africa	Literature Review	Government documents, peer-reviewed research, consultancy reports, annual reports	Analysis using Manomaivibool's (2009) Framework for Policy Evaluation
What are the contemporary EoL product management issues in Pakistan?	Ex-ante evaluation of relevancy	Literature review Interviews Field survey	Government documents, peer-reviewed research, consultancy reports, stakeholders (municipality officials, formal recyclers, producers, non-profit organizations, informal sector)	Analysis using Manomaivibool's (2009) Framework for Policy Evaluation
What is the feasibility of implementing the EPR principle in Pakistan?	Exante evaluation of political feasibility	Literature review Interviews Field survey	Stakeholders (municipality officials, formal recyclers, producers, non-profit organizations, informal sector)	Analysis using Meltsner (1972)
What is the feasibility of including the informal sector in EoL product management under EPR principle in Pakistan?	Exante evaluation of political feasibility	Literature review Interviews Field survey	Peer-reviewed research, consultancy reports stakeholders (municipality officials, formal recyclers, producers, non-profit organizations)	Analysis using Meltsner (1972)

Research Design and Analytical Frameworks

This research applies theory-based evaluation (TBE) as the main framework of analysis; undertaking the *ex-post* and *ex-ante* policy evaluation of EPR principle-based intervention to answer the research questions. TBE is an evidence-based policymaking and evaluation tool that not only assesses the outcomes and performance of a program/intervention, but also provides the casual linkages to the success or failure of the

program. TBE is used in addressing all four **Research Questions** while applying different proxies and criteria for intervention evaluation. TBE has a long history of utilization and has been applied in various fields to analyze implementation mechanisms and success or failure of intervention, i.e. gauging outcomes. Hence, it is a well-accepted methodology.

Correspondingly, this research follows a *case study strategy*. The contextual case of EPR implementation in South Africa is analyzed and environmental effectiveness criteria are utilized for its ex-post evaluation, together, answering **Research Question 1.** The case study of South Africa was based on a systematic literature review and subjected to the framework adopted from Manomaivibool (2009), explained in detail in **Section 4.8.1**. The context study of Pakistan, following Manomaivibool's (2009) framework, explored the range and extent of issues of the contemporary EoL product management issues in Pakistan to answer **Research Question 2.** Short case studies of existing EPR initiatives in Pakistan to support the analysis for **Research Question 3**. In addition to these cases studies, political feasibility and relevance criteria are used for ex-ante evaluation of the EPR interventions supporting the answers to **Research Questions 2, 3, and 4**.

Main Findings

The voluntary EPR schemes in the context of South Africa have shown considerable success considering the recovery rates. However, the social aspects of these initiatives remain questionable. None of such initiatives exclusively included the waste pickers in their scope of resource allocation (collector remained as the net bottom stakeholder in the supply of recovered materials), besides the significant contribution of waste pickers in achieving the recovery rates. The flexibility to design the EPR implementation mechanism provides room for unequal gains in the supply chain and to use performance indicators for advantage and ease, e.g. recycling rate vs quality of the recycled products.

The End-of-Life (EoL) management of product waste in Pakistan faces several significant challenges, ranging from the inadequate performance of waste service providers and municipalities, issues surrounding the informal economy, and lack of enabling environment to encourage moving up the hierarchy in the waste management. Pakistan has a poor infrastructure for EoL management, e.g. no material recovery facility exists. The recovery rates for recyclables with market prices are high due to the efficient informal sector, except for material that has little to no market value, e.g. LDPE, MLP. Analysis of points of interventions of various actors shows a pattern of not *beyond the walls of the factory* manifesting in the EoL product management. Three consecutive cascading effects were reported by interviewees: 1) issues in product design, 2) cross-contamination, and 3) varying recycling practices and limited technical knowledge of the informal sector. The recycling of counterfeit products creates further issues, e.g. harming sales, net demand, and profit, ethical issues, traceability, monitoring, and performance issues. It also highlights the role of the informal sector in EoL product management. It also provides anecdotal evidence of the environmental effects of the informal sector. It demonstrates the weak political and institutional feasibility of municipalities resulting in inadequate waste services and EoL management.

The analysis of policy relevance revealed that several contemporary EoL product management issues and needs are linked to the intended outcomes and objectives of the EPR principle, e.g. reduction of public spending on waste management, data collection, better logistics, improved collection, and recycling rates. However, the political feasibility analysis revealed that the implementation mechanism is found with constraints and challenges. Producers aiming for circular approaches will need to establish system evaluation processes and support municipalities in implementing source segregation, as closed-loop strategies cannot sustain

when down cycling/cascading is so rampant. The political feasibility analysis under the TBE framework showed some general factors to be considered in program design and implementation of the EPR principle.

The feasibility of including the informal sector EoL remains contested. Formal recyclers and private sector already engage with the informal sector, while producers are likely to engage due to their internal sustainability targets, exogenous factors, and the *strategic* advantage, i.e. dominance of the informal sector in the collection phase and the fact that it is a cheap solution to reach results such as separate collection, sorting and recycling. Under the business as usual scenario, product waste is recovered by waste pickers, maids, and itinerant buyers. Waste pickers recover material from communal bins, dumpsite, and landfill which are heavily cross-contaminated. Such unsustainable practices create critical issues including 1) Significant cascading effects (downgrading of material), 2) poor working conditions for waste pickers, and 3) unequal gains; waste pickers, and itinerant buyers are only paid for the recyclable materials but not for their collection and sorting service. Furthermore, informal recyclers add to the overall cascading effects due to their lack of capacity and variable recycling practices e.g. use greater quantities of additives and have variable processes, resulting in low-quality products.

However, the flexibility in the implementation of the EPR principle is likely to encourage actors to engage selective informal groups in the EoL product waste. This creates a critical concern for the successful implementation and execution of the EPR concept i.e. the low existing formal recycling capacity will disregard the collection and sorting efforts. Since the ratio of existing formal recycling capacity against the product waste to be managed in developing countries is very low. For municipalities to get involved in the inclusive approaches will need support and push from producers. The recommendation and strategies mapped in **Section 2.3** are critical to the inclusion of the informal sector needs serious consideration from policymakers, municipalities, and producers. Overall, strategically planned feasibility of inclusion is medium to high.

Concluding Remark

This main contribution of this research is to be the first step towards developing an implementation mechanism for the execution of the EPR principle in countries with a substantial informal sector (see **Sections 6.1 and 6.2**). The first of a kind of assessment for the policy relevance and political feasibility in context to Pakistan is done. The study also contributed to investigating the contemporary EoL product management issues in Pakistan through the framework of theory-based evaluation, providing detailed exploratory and normative analysis to the issues. The feasibility of industry-led voluntary EPR schemes and contested issues of socially sustainable EoL product management elucidated that issue of setting targets and limitation of proxies used to evaluate the performance of EPR initiatives.

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Abbreviations

CSR	Corporate Social Responsibility
EPA	Environmental Protection Act
EoL	End-of-Life
EPR	Extended Producer Responsibility
GER	Green Earth Recycler
GRC	Glass Recycling Company
HDPE	High-Density Polyethylene
LDPE	Low-Density Polyethylene
LWMC	Lahore Waste Management
MLP	Multi-Layer Packaging
MNC	Multi-National Company
MoU	Memorandum of Understanding
MSWM	Municipal Solid Waste Management
NGO	Non-for-Profit Organization
OECD	Organization for Economic Co-operation and Development
PET	Polyethylene Terephthalate
PETCO	PET Company South Africa
PRO	Producer Responsibility Organization
PVC	Polyvinyl Chloride
RQ	Research Question
UBC	Used Beverage Carton
WP	Waste picker
WM	Waste Management
WEEE	Waste electrical and electronic equipment

1. Introduction

1.1. Background

The global environment is continually deteriorating owing to unsustainable production and consumption patterns such as lifestyle changes, the short lifespan of products, linear economy, and cradle to grave approaches. This allows manufacturers to benefit from the lack of product regulations by externalizing environmental footprints and disposal costs to the taxpayers and municipalities (Mcdonough, 2010; Rousakis & Weintraub, 1994; Tufet-Opi, 2002). Accordingly, consumption of goods and services generates a range of externalities throughout the full product lifecycle, from the extraction of virgin material to End-of-Life (EoL) method; resulting in pollution, biodiversity loss, carbon emissions, and other genuine tradeoffs (Matheson, 2019; OECD & Ministry of the Environment, 2014). For instance, according to Kaza et al. (2018) post-consumer waste accounts for almost 5% of total global greenhouse gas emissions.

Correspondingly, most adverse environmental impacts from EoL management are rooted in the inadequate or incomplete collection and recovery of wastes. For instance, according to the World Economic Forum (2016) each year, at least 8 million tons of plastics leak into the ocean. In a business-as-usual scenario, the ocean is expected to contain 1 ton of plastic for every 3 tons of fish by 2025, and by 2050, more plastics than fish, by weight (World Economic Forum, 2016). Furthermore, Ellen MacArthur Foundation (2017) reported that a staggering 32% of plastic packaging escapes collection systems, generating significant economic costs by reducing the productivity of vital natural systems such as the ocean and clogging urban infrastructure. The cost of such after-use externalities for plastic packaging, plus the cost associated with greenhouse gas emissions from its production, is conservatively estimated at USD 40 billion annually – exceeding the plastic packaging industry's profit pool.

Equally, considering the inadequate EoL product management and uncontrolled burning of municipal solid waste contributes significantly to urban air pollution via emissions of e.g. heavy metals and persistent organic pollutants (POPs). For instance, if product waste contains polyvinyl chlorides (PVCs) (present in cloths, straws, cables, etc.), open burring will generate highly carcinogenic dioxins that are responsible for cancer in many cases (Liu et al., 2008). Above all, even modern sanitary landfills are not completely sealed (Sachs, 2006b). According to IPCC (2007), landfill disposal methods, including state-of-the-art landfills with best quality operations and regulation, were responsible for almost half of the methane emissions attributed to the municipal waste sector in 2010. Therefore, many EU countries have placed hefty landfill and disposal taxes/fees to minimize its impact, simply by redirecting the waste to better EoL options and moving them up in the waste hierarchy (Wiesmeth & Häckl, 2011), while implementing extending producer responsibility (EPR) principle-based policies and interventions to address the environmental impacts and internalize the product externalities from their design to EoL management (Akenji et al., 2011).

When assessing the power to implement changes in the product system, it appears that producers are significant stakeholders (Manomaivibool, 2009a). Secondly, they have the best data and information to gauge the reuse and recycling potential and possibility. Following the discourse, Lindhqvist (2000), advocating *Extended Producer Responsibility* (EPR), suggests that "the design of products and product systems" therefore should be regarded as the root cause of the problem. *Extended Producer Responsibility (EPR)* with its integrated product policy approach pushes stakeholders to consider life cycle impacts and to expand their premises of environmental safety and sustainability *beyond the walls of the factory* (Sachs, 2006a). It highlights the role of producers due to their influence and serves as a stepping point towards sustainable

resource management (Akenji et al., 2011). A brief account of various strategic advantages of the EPR model is presented and illustrated below in **Figure1**.

- Assigns *liability* and defines actors liable for the various parts and stages of the product life cycle (e.g. Collection, usage, recycling, disposal) in case of failure and damage from a product.
- Supports municipalities and governments in meeting the financial feasibility of the EoL management of products by sharing (partially or fully) management expenses responsibilities with producers.
- Induces improvement and changes in product design and selection of constituents. Thus, contributing to improved environmental profile of products and promoting system thinking and innovation.
- Obliges producers for documentation and information disclosure and provision among stakeholders.

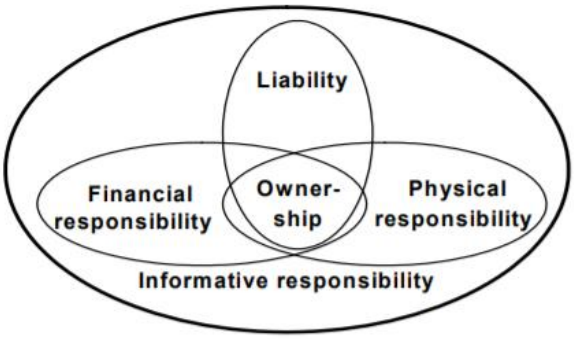

Figure1: Model of extended producer responsibility (Lindhqvist, 2000)

Extended Producer Responsibility (EPR) has been successfully implemented in various European countries. Emerging economies, realizing similar challenges, e.g. difficulty in treating product waste, limited capacity of the municipalities, need for circular supply chains, externalities and associated public health and environmental impacts; are opting for EPR-based interventions (Atasu, 2019; Kojima et al., 2009; Manomaivibool, 2008). India, China, Thailand, Malaysia, Indonesia are increasingly developing EPR-based legislation (Akenji et al., 2011). However, most of the EPR policies developed in emerging economies are concerning e-waste (Manomaivibool, 2009a). There is still a gap to explore the implementation mechanism for EPR policies to tackle packaging waste. Moreover, the limited capacity for downstream management for End-of-Life (EoL) and presence of Informal Sector impede the sustainable EoL management and success of EPR in non-OECD member countries (Akenji et al., 2011; Kiddee, Naidu, & Wong, 2013; Kojima et al., 2009).

Emerging economies adopting EPR have reported various concerns; limited capacities of the formal sector (Steuer et al., 2017), uneven distribution of collection and treatment facilities and level of skills/expertise across the facilities (Akenji et al., 2011; Tong et al., 2018), formal facilities not meeting collection targets, the informal sector outcompeting formal system (Steuer et al., 2017; Tong et al., 2018; Yu et al., 2010), and consumers behavior dominated by economic incentives (preferring higher prices offered by the informal sector) (Ardi & Leisten, 2016; Wang et al., 2017; Ignatuschtschenko, 2017; ILO, 2014;). Despite the underdevelopment of EoL and municipal waste management systems, lack of expertise of municipalities and local governments, limited financial resources, and presence of informal sector that challenge sustainable waste management and execution of EPR in non-OECD member states (Akenji et

al., 2011; Kiddee et al., 2013; Kojima et al., 2009), many advocate the transfer of EPR practices and experiences of developed countries to developing countries (Manomaivibool, 2009; Manomaivibool et al., 2007; OECD, 2001b; Nnorom & Osibanjo, 2008). However, the question of the feasibility, performance, and sustainability of EPR schemes in emerging economies is not clear, considering the challenges faced during the design and implementation mechanism (Akenji, 2012). The literature reports several studies dedicated to analyzing and evaluating the implementation mechanism for e-waste (Awasthi & Li, 2017; Khetriwal et al., 2005; Kojima et al., 2009; Manomaivibool, 2009). Whereas, studies analyzing the case of EPR for packaging waste in emerging economies remain scarce (Anton Nahman, 2010).

Considering the above-presented issues owing to the presence of the informal sector, researchers and practitioners, learning from various cases, pilot projects, and supporting themselves on conceptual models and theories over past 30 years, suggest the inclusion of the informal sector into waste management (Dias, 2016; Meagher, 2013; Navarrete-Hernandez & Navarrete-Hernandez, 2018; Scheinberg et al., 2016; C. A. Velis et al., 2012). For instance, the *Wasteaware model* developed by Wilson et al. (2015) and endorsed by the International Solid Waste Association (ISWA), the World Bank, and UN-Habitat considers the informal sector as a critical part of the waste management system in lower-middle-income countries. It considers the *integration of the community and/or informal sector* as a criterion of adequate waste management (Wilson et al., 2015). However, the degree of inclusion and the interfaces for interactions among different actors vary (Velis, 2017). Proponents of the informal sector's integration have mostly assessed the integration from the perspective of 'solid waste' management. While not much attention is paid in integrating the informal sector into EoL product management and in schemes like EPR (Woggsborg & Schröder, 2018). Research has been dedicated to exploring the informal sector's competitive advantages, environmental externalities, negative health implications of the informal sector (Belgiorno & Cesaro, 2017; Dias, 2016; Fergutz et al., 2011; Oates et al., 2018; Wilson, 2007b). However, very little attention is paid towards bridging the gap between the informal and formal sectors and assessing the potential synergy between the two (Ignatuschtschenko, 2017; Li & Tee, 2012; Neto et al., 2018).

The remainder of this chapter continues with an introduction of a problem definition in the context of Pakistan (**Section 1.2**) which leads to the establishment of an overall objective of the research (**Sections 1.3 and 1.4**). **Section 1.5** defines the target audience and Section 1.6 sets the scope and limitations for the content addressed in this thesis. The terminologies used in this study are briefed in **Section 1.7**. The **final Section (1.8)** introduces the overall structure of this thesis.

1.2. Problem definition

Pakistan lacks a unified body dedicated to waste management and issues around, therefore, like many other developing countries the national Environmental Protection Act (EPA) 1997 serves as the primary referral to the provincial or municipality plans. Very few articles within the act of 1997 are dedicated to waste management, with no focus on waste reduction and minimization. Like many other developing countries, the scope of the act and subsequent plans of the municipalities in Pakistan remain limited to collection and disposal methods, *command-and-control regulatory* model, emissions standards, and technology procurement mandates (Matheson, 2019). This has not only made the waste management system expensive but has also kept the product impacts externalized (Sachs, 2006a). Following this outlook, industries and businesses in Pakistan remained focused on what Esty (2017) points as a traditional *command-and-control regulatory* model i.e. centering on cleaner production techniques and manufacturing processes, disregarding product externalities. Since factory emissions are more visible than that of the product system, preference to emission control is given by clients and

partners in international contracts or transactions particularly (Sachs, 2006a). This leads to significant environmental pressure and high social cost from the consumption in Pakistan; considering the quantities of products put in the market and present post-consumption management of product waste.

WWF (2019) reports that an estimated 87,000 tons of solid waste generated per day – with an annual increment of 2.5% owing to rapid urbanization and population growth in the major metropolitan areas of Pakistan. Artificial polymer is one of the primary waste constituents accounting for approx. 10% of the total waste i.e. 3.3 million tons of plastic waste generated per year in Pakistan (UNDP, 2020) whereas, 60% of the plastic waste (mainly packaging waste) ends up at beaches (WWF, 2019). The activities of the informal sector contribute to redirecting the product waste to the value chain corresponding to the market value of the recyclables, still, landfills are reported to receive significant quantities of packaging waste. Packaging or product waste ending up at landfills is primarily waste material with no market value, such as low-density polyethylene (LDPE) and multilayer packaging (MLP), adding to disposal cost and contaminating organic waste streams, thus reducing the potential of organic waste for composting. In recent years, concerns about the impact of packaging waste and the total life-cycle concept are increasingly recognized. Consequently, up-surging interest in the extended producer responsibility-oriented policies.

Relating to the fact that the formal recycling in Pakistan (like many other middle-income countries) accounts for a small share in the total EoL management of product waste, while the waste captured by the system is 60% with a service coverage of as low as 43%; the likelihood that product waste is illegally dumped and openly burned is significantly high, increasing externalities associated with the product's overall life cycle. The municipalities and local governments lack the capacity (technical and financial) to ensure adequate level waste services, often facing the issue of lack of funding and revenue generated while serving as a stakeholder with a weak influence against product externalities and environmental profile (Manomaivibool, 2009). It has been recognized that municipalities without the support from producers have "too much" of a burden or responsibility on them. Thus, making municipalities entitled to charge or assign responsibility to producers, the *beneficiary*» of the product (Jacobs & Subramanian, 2012) conforming to the *polluter pays principle* and *extended producer responsibility* principle. However, it is not explored if EPR principle-based interventions are relevant to the contemporary issues of Pakistan and even if EPR policies would be encouraged, it is unclear how the EPR principle can be adopted against the challenges pointed out in the Background (**Section 1.1)**.

Thereby, it is interesting to research the performance of the EPR intervention for packaging waste in emerging economies and potential tradeoffs concerning the informal sector when advocated to be included in EoL product management. Correspondingly, to propose a more feasible phase-in approach in implementing extended producer responsibility policy for packaging waste in countries with a substantial informal sector. In this thesis it means, considering Pakistan as the contextual setting of the research.

1.3. Research Objective

This research has three main purposes 1) to understand 'policies diffusion' in context of extended producer responsibility principle-based interventions and policies, 2) what are the convergence factors i.e. adopting a policy [EPR] because it is responding to conditions/problems that are similar in the setting (local, national, or regional), and 3) to investigate issues around the informal sector that if they are efficient (as most of the literature

points out to be), why it has not been successfully integrated into many countries including Pakistan. Thus, to facilitate producers in extending their responsibility to tackle packaging waste by exploring the contemporary issues pertinent to the end-of-life (EoL) management of the waste in Pakistan. Understanding and identification of potential tradeoffs concerning the informal sector is a major research goal. Through this thesis, the author attempts to propose a more feasible phase-in approach in implementing extended producer responsibility policy (voluntary or/and mandatory) in countries with a substantial informal sector.

1.4. Research questions

RQ1: How can an EPR function when implemented in a country with the informal sector?

RQ2: What are the contemporary EoL product management issues in Pakistan?

RQ3: What is the feasibility of implementing the EPR principle in Pakistan?

RQ4: What is the feasibility of including the informal sector in EoL product management under an EPR principle in Pakistan?

1.5. Audience

This thesis primarily serves as a development approach to introduce extended producer responsibility (EPR) in Pakistan, building on a comprehensive understanding of the theories and practices in the realm of EPR. Thus, aiming at government, producers, and practitioners concerned with developing a downstream waste management system, corporate social responsibility projects, and policy approaches to tackle the downstream impact of plastic waste. The thesis will also contribute to literature on the feasibility of producer responsibility schemes in developing countries. It will provide greater insight into the issue of integration of the informal sector (extent and degree) and consequences if excluded. Answering the research questions will also contribute to the inclusive development sphere and the transition of developing countries towards achieving sustainable development goals.

1.6. Scope and limitations

The scope of this thesis covers downstream management of packaging waste, therefore, set premises around the associated actors and stakeholders involved in the EoL management, i.e., municipalities, waste pickers, junk dealers, formal and informal recyclers, and non-profit organizations involved in inclusive growth and waste management. This thesis will largely revolve around economic feasibility and modeling, encompassing transaction costs, and financial mechanisms along with the constructive approach to address the issue of the informal sector. The research covers two feasibility analyses, answering different questions but for similar contextual background, therefore limiting the selection of information gathered for each analysis to avoid overlapping of information and repetitiveness. Environmental effectiveness criteria are the most dominant criteria used in the intervention evaluation field as the measurement of outcomes (Hildén et al., 2002). While proxies used to measure the criteria corresponded to the availability of the data, which had its limitation. Exploratory and normative approaches are applied to overcome this limitation. Defining the boundary for the contextual study for answering the feasibility for the inclusion of the informal sector and feasibility for the implementation of EPR is difficult. Since the EPR principle entails fundamental principles and underlying motivation but provides flexibility in the mechanism of implementation and the boundaries of value chain responsibility and beyond compliance behavior are becoming less clear (Hickle, 2017). The other key issue in the analysis and framing is that in case of emerging and developing economies the immediate outcomes may be considered as intermediate and intermediate as long term goals, considering the limited capacity (Akenji, 2012). Geographically, the context studies focus on the downstream management of plastic waste in Pakistan,

supported by single case studies of South Africa. I wish also to recognize the limitations of perspective that accompany a literature review comprising largely in English.

1.7. Definitions

Producer is used to represent the obliged entity towards product waste including firms and companies putting products in the markets, fillers, bottlers, and exporters.

End-of-Life (EoL) management in this thesis means everything related to post-consumer waste handling including collection, sorting, and recycling.

Recycling is used to mean the reprocessing of the waste materials in a production process for the original purpose or other. It does not include energy recovery and organic recycling.

Informal sector is used to mean the collective informal economy in the waste management sphere, including all the informal hierarchical groups: waste pickers, scavengers, informal waste collection service providers, junk dealers, middlemen, wholesalers, or contractors, preprocessors, and recyclers. The characteristics of being *informal* are mentioned in **Section 2.3**.

1.8. Structure

Introduction: Defines the topic of the thesis and introduces the main underlying themes.

Literature review: Provides a detailed overview of the literature on extended producer responsibility and aspects of the informal sector in waste management.

Theories and Concepts: Summaries theories and concepts are central to the thesis. Reviews the assessments and policy evaluation reports of EPR schemes globally and explains theory-based evaluation (TBE).

Methodology: Outlines the research and empirical data collection strategies and analytical framework used in the study.

Results: Contains findings from the qualitative aspects of the thesis (interviews and baseline survey). Provides economic feasibility model and transaction flows of designed EPR schemes for Pakistan.

Discussion: Summarizes the analyses and findings of the thesis while drawing findings and perspectives from previously conducted research and available reports.

Conclusions: contains the conclusions to the research and recommendations for further research.

2. Literature Review

This chapter provides an introduction to the current status of waste management system in reference to other developing countries (**Section 2.1**). Followed by the description of historical trends in waste management worldwide (**Section 2.2**). **Section 2.3** provides a systemic review on the role of the informal sector in EoL product management through the lens of five popular schools of thought/policy approaches: dualist, voluntarist, structuralist, legalist, and co-production. It then presents the contribution of the informal sector to the socio-economic and environmental layers of the countries and finally the intervention action to integrate the informal sector.

2.1. Status-quo of Waste Management in Pakistan

Waste management systems in developing countries particularly ones with the informal sector can be categorized into two chains: service chain and value chain. The service chain sector covers a range of public services including waste collection, transport and disposal, street cleaning and sweeping, and space management – mainly functioned by the public sector (local government and municipalities) or/and public-private partnership (OECD, 2016). The value chain sector corresponds to the *valorization* of recovered material e.g. recycling, re-use, diversion to secondhand market, commercialization, and trading (Marello & Helwege, 2014; Rosa & Cirelli, 2018). The value chain sector in developed countries is functioned by the private sector, ranging from multi-national companies to micro-enterprises. In the case of Pakistan, the informal sector mainly operates the value chain sector while contributing to service chain in the areas where formal services are not provided (Adila & Nawaz, 2009; Asim et al., 2012; Majeed et al., 2018)– such has been the case in Cairo (Fahmi & Sutton, 2010) and India (Wilson et al., 2006a). Poor people in developing countries have access to service despite inequity in the service provision by institutions, owing to the *diversity [informal sector and their services]* (Joshi & Moore, 2004) – see **Section 2.3** for a detailed account of the informal sector. The interactions between the informal sector and formal entities occur largely at two stages of the value chain. Either when collected and sorted waste is taken over by junk dealers or after the informal processing and recycling (Williams et al., 2013a; Wilson et al., 2010). The latter is usually traded locally or exported.

In developed countries, the service chain and value chain work in a *relatively* synchronized manner, thus enabling the reasonably smooth execution of the EPR system. However, the reuse and recycling in Europe are not spare of informal activities either. Weghmann (2017) estimated that in Europe there are around one million active informal recyclers and re-users, however, *sidelined* in the waste management and circular economy agendas. It could be contended that the EPR systems in Europe work not because of their exclusion approaches but rather how their systems have evolved (intentionally generally) over time – case of South Africa shows similar observation see **Section 5.1**. Therefore, it is safe to assume that the context of waste management spheres and execution of waste-related policies/concepts is not just a matter of the degree and extent of synchronization of the chains and informal-informal settings but also how systems have involved over time. Weghmann (2017) argues that if recycling is considered an important public service it would improve the conditions and notion around the informal economy. The historical policy trends and paradigm shifts in the waste management sphere signify how these systems have evolved and the school of thought policymakers was influenced by – see **Section 2.3**, perhaps from the perspective of political economy and system evolution, this would be of more interest, which is not in the scope of this thesis.

The way waste management systems have evolved in countries like Pakistan perhaps due to lack of policy intervention, supporting institutions, and free-market that the service and value chains lack complete harmony. UN-HABITAT (2009) in a report suggests that the presence of

the informal sector in the waste management sphere is a by-product of governance system failure. Lack of EoL infrastructure development, the relative dominance of the informal sector due to service inequality, diversity, and responding to the market signal, shaped the waste management system in a way that the service and value chains function in their separate spheres, barely interacting or recognizing each other (see **Figure 2**). The service chain follows the old-school approaches, limiting themselves to the collection, transport, and disposal – befitting *out sight out of mind* notion. While the value chain is primarily taken over by small to medium enterprises, mostly by the informal sector. Accordingly, the movement of recyclables materials from the service chain moves to value chain either by waste generators themselves (selling recyclable to itinerant buyers), informal waste pickers[1], or/and formal sanitary workers. This problem persists due to the two-tier nature of the issue. Pakistan like many other middle-income countries faces a two-tier issue in the end-of-Life management of products. First, Pakistan lacks a well-established waste management system with limited financial and human resource capacity. Second, there is the absence of waste management policies and legislation to create an enabling environment to move up the waste hierarchy and to strategize following ground realities.

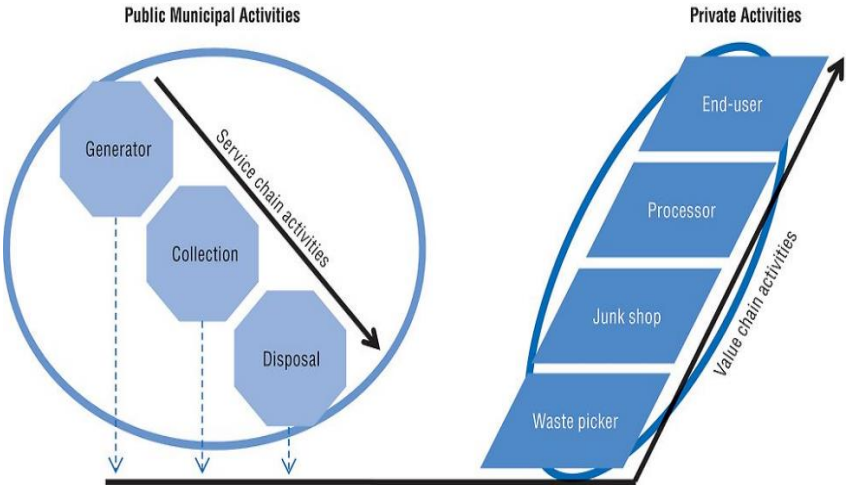

Figure2: Service and value chain framework in developing countries (OECD, 2016)

In Pakistan, reprocessing and recycling of materials are limited to the market demand and intrinsic value of the waste fraction. For instance, the movement of plastic into the value chain depends upon its type (HDPE, PET, PETE, PP, PVC PE) are usually in demand, while LDPE and polystyrene are usually discarded. **Figure 3** shows the complexity of the value chain in Pakistan. The market demand and economic viability of materials are influenced by market failures such that *technically* recyclable material ends up being discarded or dumped. Moreover, the lack of a sophisticated waste management system boosts the cross-contamination of materials, lowering their intrinsic value.

[1] I find it hard to assign waste pickers to either of the chains due to their movement across service and value chain and dependencies of other actors on them.

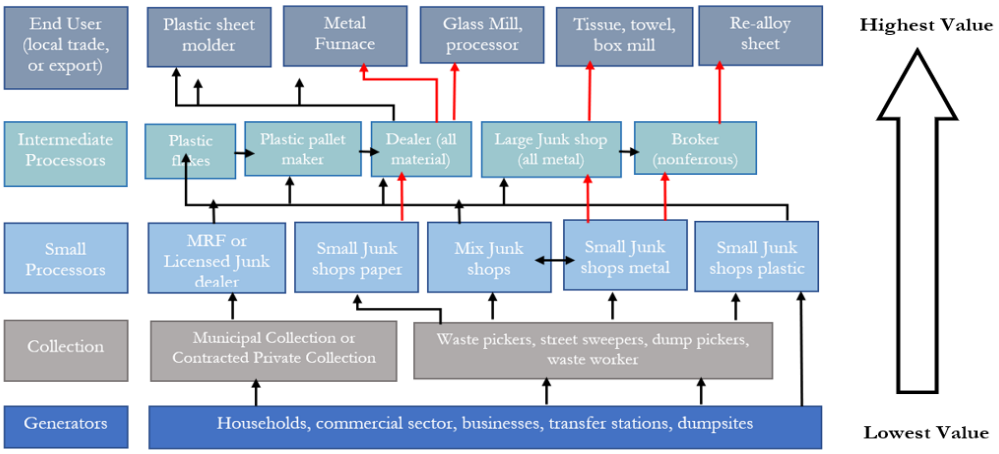

Figure3: Schematic of the value chain in Pakistan. Adapted from OECD (2016), Wilson et al., (2006a).

A policy decision is required as to whether inequalities in the collection should continue to exist and be promoted without the payment of additional fees. There is no system of dealing with commercial waste separate from municipal waste. Commercial waste is mixed with household waste at the primary level and collected by the sanitary staff of the SWM Department in the morning (Bank, 2010). To provide a holistic view of the solid waste management that corresponds to the EoL product management in Pakistan, a systematic analysis using Wasteaware indicators and matrix to rank the waste management practices in Pakistan based on governance and physical indicators is presented below, see **Table 1**. The indicators cover country profile including background information, waste characterization data, waste collection coverage, and data physical indicators involving epidemiological, environmental, and economic factors of MSWM.

Table 1: Summary results for the Wasteaware benchmark indicators for Pakistan

Category	**Indicator**	**Result**	
Country		Pakistan	
Background Information			
Income Level	World Bank income category	Low-Middle	
	GNI/Capita ($)	5,860 (2018)	
Population	Persons	212.2 million (2018)	
Waste related data			
Per capita waste generation	kg/day	0.28 to 0.61	
Waste composition			
Putrescible	Percentage	61.4	
Paper	Percentage	7.88	
Plastic	Percentage	9.46	
Metal	Percentage	0.13	
Others	Percentage	21.13	
Physical Components			
Public Health - Waste Collection	Waste Collection Coverage	43.%	Low
	Waste captured by the system	60%	Low/Medium
	Quality of waste collection service	16.7%	Low

Environment - waste treatment & disposal	Controlled treatment or disposal	5%	Low	
	Degree of environmental protection in waste treatment & disposal	8.34%	Low	
Resource management - reduce, reuse, recycle	Recycling rate	20%	Low/Medium	
	Quality of 3Rs -reduce, reuse, recycle- provision	8%	Low	
Governance Aspects				
Inclusivity	User inclusivity	20.8%	Low	
	Provider inclusivity	40.%	Low	
Financial stability	Degree of environmental protection in waste treatment & disposal	31.3%	Low	
Sound institutions - proactive policies	Adequacy of the national framework	50%	Low/Medium	
	Local institutional coherence	50%	Medium	

Note: GNI stands for Gross National Income. Indicators receiving poor/low grades are colored red, low-medium grade colored red & orange, upper-medium grade colored orange & green and high grades colored green.

The Wasteaware model results indicate that MSW of Pakistan mainly comprises organic waste i.e. 61.4% while plastic accounts for 9.46% i.e. 3.3 million tons of plastic per year (UNDP, 2020). Yet, 60% of the plastic waste ends up at beaches is packaging waste. The packaging waste, however, could not be estimated due to a lack of composition of data dedicated to packaging waste. Nonetheless, the chunk from plastic, paper, metal, and even other waste (glass) together may account for a significant portion of packaging/product waste in the SWM generation trend. The *waste service coverage* scores 43% ranked as low performance while the *waste collection* ranks low-medium i.e. 60% - threatening public health and presenting high social cost for product externalities. As plain failure in collection leads to sewage blockage and breeding ground to vectors, insects causing sanitation issues, and health problems (Wilson, 2007). However, the *quality of waste collection service* found to be low, as litter being accumulated and scattered around communal bins, open dumping, overflowing of containers (see Annex E for photographs capturing service inadequacies during the field survey and Annex D for supplementary data supporting qualitative metrics).

Adequate disposal and EoL management of waste remain a critical issue such that indicator for *controlled treatment and disposal* scores barely 5%, hence the lower performance. The social cost exponentially increases in the case of a non-engineered landfill, dumping, and informal recycling (Matheson, 2019) which is the context of Pakistan. Likewise, the indicator of the *degree of environmental protection* scores 8.13% (low) as No pre-treatment of the waste is done, all recovery potential within the waste in untapped. Concerning *3Rs*, as explained earlier, the informal sector is primarily contributing to the recovery and recycling of the material.

The *governance aspects* mostly consist of qualitative metrics. The *user inclusivity* indicator i.e. the say of users in WM service is ranked low since public involvement, efforts for awareness, and behavior change are subject to occasional events. Moreover, within 60% of waste collection service provision, there is high inequity in service provision such that areas with high incomes residents take the preferences while many low-middle income areas are left with no service at all. The informal sector and the informal sector, not-for-profit organization, and low-medium

scale entrepreneur fill this gap. Considering their limited capacity, donkey carts, tricycles, small vans are used for the collection and transport. However, are efficient and provide cheap door-to-door collection (varying from 50rs per month to 350rs per month[2]). The informal sector, however, faces issues with the disposal of the waste since municipalities do not allow them to dispose at official sites. *Provider inclusivity* indicates the degree to which WM services providers are involved in the planning and implementation phases. It scores 40% (low), considering the service providers do not have the authority to pose fines and penalties to induce behavior change or implement source segregation, tenders for WM services are often subjected to politics, while the informal sector and SMEs are usually left out of the system and processes. The WM sector faces financial issues owing to limited budgets but also due to corruption. The indicator for *legislative progress* which considers as enablers for improved WM services and EoL management is ranked low/medium due to the presence of guidelines at the national level, however, has significant room to improve.

2.2. Historical perspective: policy drivers and modernization

The history of environmental policies surrounding waste management has been evolved largely due to three main drivers: public health, resource management, and environmental protection (OECD, 2016). Waste problems like other environmental problems are instigated by *environmental uncertainties*: risk, uncertainty, ignorance, and indeterminacy (Wynne, 1992). Public health protection was the leading driver in waste management during the 19th century, devolving into environmental protection during the 1970s, and eventually embracing efficient resource management (Wilson, 2007b). The later driver is the motive surrounding the lifecycle policies we see today in developed countries (OECD, 2016). However, waste management in Pakistan like many other developing countries is still being derived by public health and environmental protection motives (Baud et al., 2014; Wilson, 2007a; Wilson et al., 2010), the reason we see the premises of waste systems limited to service chain only. Over the decades, as the understanding of environmental complexities and problems grew, external pressures from the public and environmental NGOs demanded the expansion, integration of service value chain simultaneously minimizing the conventional disposal methods i.e. landfilling and incinerating. In response, various economic policy instruments have been employed (disposal tax, landfill tax, pay as you throw) to induce behavior change and to finance the service chain. The resource conservation motive is often perceived for the transition of waste management systems' focus (OECD, 2016). However, in practice, limited availability and high prices of land for disposal resulting in pricier disposal (threshold 40$ per ton) along with environmental policy intervention tools like taxes, charges, and subsidies have been the major reason for synching of these two sectors (Baud et al., 2014; Scheinberg et al., 2011). The historical trend of EPR portraits similar pictures, in 1991 Germany's EPR system came into play, coinciding with severe landfill shortage and high packaging waste volumes (Gallego & Lenzen, 2005; Hanisch, 2000). Cheap availability of landfill space could pose a disincentive against EPR, as it was observed in the early waste management history of the USA and Canada *(Hanisch, 2000)*. However, the EPR system besides being expensive, proved *contagious* and swiftly spread across Europe and later to the USA, Canada, and Asian countries.

2.3. Role of Informal Sector in EPR or/and downstream management

It is estimated that globally around 20 million waste workers are associated with end-of-life/waste management informally (Marello & Helwege, 2014) reasons for which vary from global financial crises (OECD, 2016), low wages, social and financial insecurities progressive

[2] USD 30 cents to 2.1 dollars

impoverishment (Steuer, 2016), to migrations and conflicts. Wilson et al., (2006a) define the informal sector as:

The informal sector is characterized by small-scale, labor-intensive, largely unregulated, and unregistered, low-technology manufacturing or provision of services.

This definition captures the nature of the informal sector, including the extended attitude and impression stakeholders hold of them. That is not paying taxes, unregulated, and embedded sentiments for the labor-intensive disposition. The definition provides room for its extension to the five popular schools of thought/policy approaches: dualist, voluntarist, structuralist, legalist, and co-production.

Dualist school suggest that the informal sector develops due to stagnant economy (lack of or decline in economic growth), therefore, informal activities are viewed as *last resort* and *survival-oriented* livelihood choices (Moser, 1978). Navarrete-Hernandez & Navarrete-Hernandez (2018) terms this economic relation (rise in informal activities and sector with the contraction of the economy) as *counter-cyclical*. This relation was observed during the economic crises of 1994 in Mexico and 2001 in Argentina. Beall (1997, p.6) identifies this approach in waste management as the rise of privatization policies, considering the prevalence of dualist conception institutes like IMF and World Bank promoted privatization. (Fahmi & Sutton, 2010) argues that the repression approach towards the informal sector in Egypt could be linked to the 1990s economic reforms proposed by IMF, embracing the World Bank's strategy at time for the privatization of public services. Beall (1997) concludes a similar policy attitude i.e. exclusion of the informal sector in Pakistan. Dualists promote repression of the informal economy and generation of formal employment (Navarrete-Hernandez & Navarrete-Hernandez, 2018).

Voluntarists contend that formal-informal linkages exist in the spectrum; workers making rational decisions, maximizing on monetary and non-monetary benefits (Navarrete-Hernandez & Navarrete-Hernandez, 2018). Voluntarists recognize the informal workers as micro-entrepreneurs, however, associate them with low productivity due to limited capacities, lack of knowledge and skills, limited resources (Maloney, 2004) and deliberate escape from state regulation but not to the tedious registration processes, unlike legalists (Chen, 2016) – rational decisions. Williams et al. (2013) report that the informal recyclers in the e-waste recycling yield 70% less gold as compared to that of formal recyclers, thus proposing the idea of interface organization that would leave collection-to-dismantling to the informal sector while recycling to formal i.e. making rational decisions. Voluntarists consider the informal sector unfair; putting the formal sector at a disadvantage due to their non-compliance and tax avoidance (Farrell, 2004). Like dualists, voluntarists promote repression of the informal economy and generation of formal employment.

Structuralist ascribes the informal sector as the sub-ordinated unit of the economy (Chen, 2016). Thus, viewing waste pickers and informal workers playing a *pro-cyclical* role to the economy i.e. reduced recovery and labor costs (Navarrete-Hernandez & Navarrete-Hernandez, 2018). The informal workers grow with the expansion of the recycling sector as the demand for recovered material increases with the expansion of the economy and industry. Structuralists view informality as a product of capitalism: formal entities maximizing on cheap labor, weak labor rights, or labor union autonomy (Chen, 2016). Ezeah et al. (2013) re-echos this point by saying that the *Informal sector workers do not operate in a vacuum* suggesting that their gains involved for various stakeholders. Structuralist show soft support for the informal workers and promote

that governments should take up the issues of inequity (Chen, 2016; Navarrete-Hernandez & Navarrete-Hernandez, 2018) and reinforce the equal gains (C. A. Velis et al., 2012).

Legalists contend that the informal workers are micro-entrepreneurs and highly efficient thus, they play a structural role in the economy however, they remain informal due to cumbersome and tedious processes of registration and formalization (Chen, 2016; Navarrete-Hernandez & Navarrete-Hernandez, 2018). Legalists promote that governments should simplify legal and bureaucratic formalities to benefit from the untapped contribution of the informal sector in the state assets (Chen, 2016), however, decreased state and government is rather common under this school of thought (Navarrete-Hernandez & Navarrete-Hernandez, 2018)

Co-production emerges when service provision poor, the public authority is weak, and inequity in service (Joshi & Moore, 2004). The informal sector plays a critical part in providing services to urban poor (Gutberlet, Kain, et al., 2017). Co-production interventions are being encouraged and implemented in Asia and Latin America (Navarrete-Hernandez & Navarrete-Hernandez, 2018). Co-production can serve as a strategic approach to establish an interface between the powerless workers and powerful institutions (Fergutz et al., 2011). Co-production is understood to promote inclusive growth (waste pickers particularly) in the waste management sphere through formal recognition, legalization of activities, government support for waste cooperatives, investing in their capacity building, and recycling (Dias, 2016; Navarrete-Hernandez & Navarrete-Hernandez, 2018). Co-production approaches have been adopted in Brazil (Gutberlet, Carenzo, et al., 2017), Columbia (Dias, 2016), Argentina (Gutberlet et al., 2016), Chile (Navarrete-Hernandez & Navarrete-Hernandez, 2018) among many others. Co-production schools promote support policies and intervention for the informal economy.

The informal sector besides their lack of recognition and not a so-well-perceived impression contributes to the socio-economic and environmental layer of the country (see **Table 2**). Stemming from a similar backdrop, the informal sector is advocated to play a potential part in the successful execution of EPR systems in developing countries, such as *achieving recovery targets and facilitating affordable and sustainable financing* (OECD, 2016) along with fostering sustainable development goals and green transition at various levels. The informal sector (waste pickers, middle man, and junk dealers) plays a critical role in the circular economy in non-OECD context; re-using products, diverting waste to secondhand markets, supply secondary material, reduce landfill and waste-to-energy reliance (Fergutz et al., 2011; Gutberlet, Carenzo, et al., 2017; Scheinberg et al., 2016).

Table 2: Informal sector performance in the waste management sphere

Indicator	Response Variables	Comments
Economic efficiency	Impact on the productivity of the local industry **(+)**	The informal sector provides cheap labor and substitutes for the raw material, adding to the reduction in production cost and increased competitiveness (Navarrete-Hernandez & Navarrete-Hernandez, 2018).
	Contributing to WMS **(+)**	Scavengers divert material from going to landfill, saving up to an estimated 20% cost (Fergutz et al., 2011; Kaza et al., 2018; Wilson et al., 2015)
Social equity	Service equality **(+)**	Poor people in developing countries have access to service despite inequity in the service provision by institutions, owing to the ‚diversity' (Joshi & Moore, 2004). Informal waste collectors provide waste management services, filling the service gap, and reducing service provision inequality espoused from the formal economy (Navarrete-Hernandez & Navarrete-Hernandez, 2018). The informal sector plays a critical part in providing services to urban poor (Gutberlet, Kain,

		et al., 2017). The interaction among informal workers is not limited to the economic domain but carries symbolic meaning and adds to the social assets of the informal workers. Rosa & Cirelli (2018) reported that Roma people involved in waste picking built relations with residents and shopkeepers, who would give them things that would normally throw away or left unsold. Solimente (2015)reported similar social recognition of metal scarp scavengers in Rome, Italy.
	Poverty reduction **(+)**	Informal work in waste management is a source of livelihood to a major of the urban poor (Wilson et al., 2006a). Wilson et al. (2006a) suggest that informal waste work has traditionally been practiced by marginalized and outcast groups. Rosa & Cirelli (2018) reported similar occasions for marginalized Roma groups in the cities of Italy and France.
	Exploitation of waste pickers **(-)**	Many view this as perverse solidarity, the profit margin in the informal chain increases with the moving up in the hierarchy of informal groups, while waste pickers benefiting the least (Fergutz et al., 2011; Navarrete-Hernandez & Navarrete-Hernandez, 2018; Wilson et al., 2006a). Fergutz et al. (2011) re-echoes this point by suggesting that in some cases 500% surplus is generated between the value of collected recyclable and final recycled material/product, while barely 10% goes to waste pickers. Some specialists find the relationship between waste pickers and junk dealers and other actors in the informal economy as "perverse solidarity" as the valorization of waste allows a 500% surplus through the cycle, while waste pickers secure barely 10% of it (Fergutz et al., 2011). Middlemen loan handcarts and other facilities on the condition that waste pickers and itinerant buyers do not sell recovered material to other dealers (Coletto & Bisschop, 2017).
Environmental protection	Prevention of waste entering landfill or resource recovery **(+)**	It is estimated that in Rio de Janeiro (city in Brazil) waste pickers recover twice the material quantities than that of the official waste management system (Carvalho et al., 2012). Navarrete-Hernandez & Navarrete-Hernandez (2018) reports that in Santiago de Chile, waste pickers account for 70% of the waste recycled. Waste pickers in Ahmedabad save 200,000 tons of CO_2 eq. emissions annually (Oates et al., 2018)
	Public Health – Waste Collection **(+)**	2/3rd of the total waste in Cairo is collected by waste pickers and 80% recycled by informal groups (Fahmi & Sutton, 2010). Waste pickers and recyclers provide social and environmental benefits through resource recovery, including cleaning cities (Fergutz et al., 2011)
	Prevention of toxic material entering landfill **(+)**	Scavengers potentially extend the lifespan of the landfill (Fergutz et al., 2011) Activities of the informal sector (collecting, reusing, recycling) contributes to pollution prevention (Navarrete-Hernandez & Navarrete-Hernandez, 2018; Wilson et al., 2006a)
	Diversity of material recycled **(+)**	Waste pickers scavenge materials with good to little return value, e.g. aluminum, various types of plastics, metal, glass, etc. They respond to quick to the market needs and if the market is created to material that previously had no value (e.g. LDPE or multilayer packaging), they adopt per market signals and recover a variety of materials (Hande, 2019; ILO et al., 2014).
	Physical health **(+)**	Exposure to toxic and hazardous waste often mixed with solid waste induce injuries and exposure to fatal diseases and infections like HIV, hepatitis. The nature of the work of waste-pickers is particularly demanding, they walk miles per day and carry waste to junk dealers, issues of headache and fatigue is common. Those who scavenge at landfills or dumpsites are exposed to rodents,

	emissions like methane, H2S, etc. (Dias, 2016; Gutberlet, 2015; Navarrete-Hernandez & Navarrete-Hernandez, 2018; Wilson et al., 2006b)
Child labor **(-)**	Children and youth have been the face of waste pickers in many global south cities (Gutberlet, et al., 2017)
Waste dispersion **(-)**	The informal service provider normally is not allowed to dispose of collected waste therefore, they dump them in water bodies or at open dumpsites. Scavengers disperse waste around communal bins to scavenge recyclable with market value.
Working condition **(-)**	The work without personal protection equipment, therefore exposed to higher occupational hazards

Inclusive growth approach in waste management is not limited to single policies or intervention, researchers and practitioners have identified various interfaces, informal-formal linkages, and intervention points to promote the role of informal workers in the waste sphere. Some of the intervention points are access to waste, legal recognition, role in SWM formally, among many. **Figure 4** illustrates a dynamic flow graph, enlisting intervention action to integrate the informal sector. Ideally, these intervention points should be adopted simultaneously. However, there is little published research paying attention to bridging the gap between informal and formal sectors, assessing the potential synergy and dynamics between two (Ignatuschtschenko, 2017; ILO et al., 2014; Li & Tee, 2012; Neto et al., 2018). EPR being a stepped door to the circular economy, emphasize the better product design and material circularity, for which the informal sector has been reported to play critical (ISWA/EXPRA/RDN, 2014). Similarly, (Luken, 2011) presents the informal sector (recyclers particularly) as major urban recyclers, thus, attracting manufacturers and industrial users. Following this discourse, (Velis et al., 2012) invites researchers to explore the scenarios of 're-structuring' supply chain to have 'equitable distribution of gains' i.e. material circularity and 'sustainable livelihood' together.

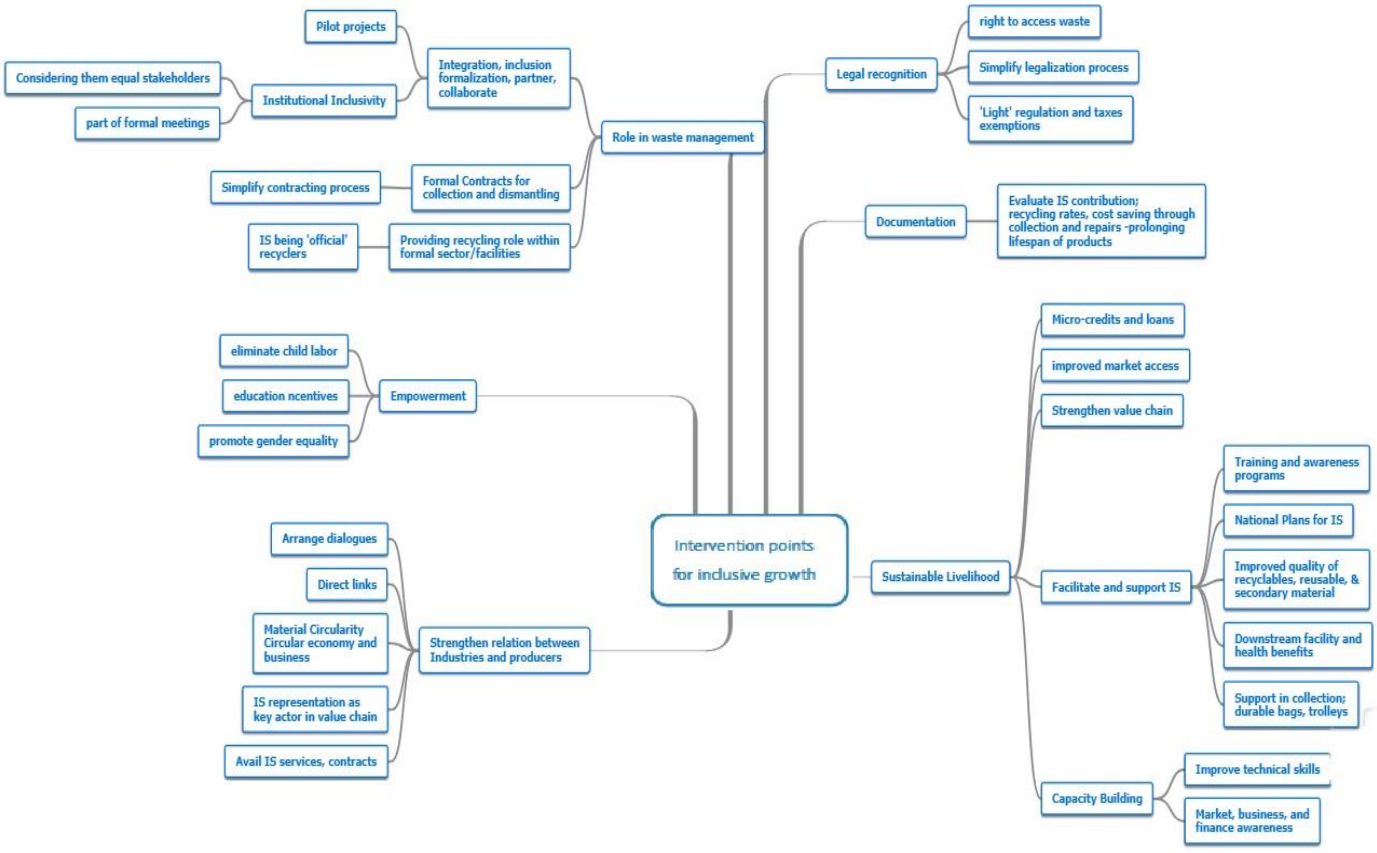

Figure 4: Dynamic flow graph, enlisting intervention action to include the informal sector.

3. Theories and Concepts

This chapter introduces the theories and concepts that are central to this study. **Section 3.1** starts with an introduction of extended producer responsibility (EPR) – a major theme of this thesis. **Sub-Section 3.1.1** starts with the definition of the EPR and highlights key insights to the concept. **Sub-Section 3.1.2** lays out the intended outcomes of the EPR principle-based interventions which are critical to the analysis and discussion of the research. **Sub-Section 3.1.3** highlights the significance of the implementation mechanisms developed to employ EPR. The Chapter ends with (**Section 3.2**) the development and key features of the analytical framework behind the research i.e. Theory-based evaluation (TBE) used in this research.

3.1. Extended Producer Responsibility

3.1.1. What is Extended Producer Responsibility?

Extended producer responsibility (EPR) is an environmental policy approach to promote the *post-consumer* handling of the waste products (OECD, 2001a) and to encourage improved environmental profile (Lindhqvist & Lifset, 1997). Lindhqvist (2000) defines EPR as:

A policy principle to promote total life cycle environmental improvements of product systems by extending the responsibilities of the manufacturer of the product to various parts of the entire life cycle of the product, and especially to the take-back, recycling, and final disposal of the product.

EPR serves as an umbrella covering various policy options (advance disposal fee, take-back system, product tax, recovery, and recycling subsidies) (Palmer & Walls, 1999). Thus, providing the *rationale* to select appropriate policy option within context (Lindhqvist, 2000; Manomaivibool, 2009a). EPR is designed to shift financial or/and physical responsibility (partially or fully) of the product's end-of-life (EoL) and post-consumer stage on the producer away from municipalities (OECD, 2001a). It is comprehensive and holistic policy package, integrating various policy tools (Table 3) to achieve its underlying objectives:

- Establish improved collection and management of EoL products
- Design environmentally friendly products
- Integrate externalities within consumption and production web
- Stimulates stakeholder engagement and coordination.

Table 3: Overview of Policy Instruments Consistent with EPR. Adopted from: Lindhqvist (2000), MS2 (2006).

Administrative / Regulatory instruments	**Comments**
Take back system (mandatory, negotiated, or voluntary)	Take-back systems are realized as a *patent* form of EPR and are usually associated with the recovery and/or recycling targets.
Collection and recycling targets	Standards are adapted to increase local recycling markets and to regulate imports.
Product standards or recycled content standards	Restrictions and bans are viewed as moving up the waste hierarchy approaches.
Landfill restrictions	Landfill restrictions correspond to the market inefficiencies since product waste collected but not recycled under the producer's responsibility, do not fully reflect the social cost of leakage, land-use, and future remediation in the marginal disposal cost (Runkel, 2003).
Economic / Market instruments	

Deposit-refund systems (DRS) Levy, product tax, or/and Subsidies Recycling credits Upstream combination tax/subsidy (UCTS) Advance disposal fees (ADFs) or advance recycling fees(ARFs)	Some DRS programs are viewed as full EPR, then as market instruments. Material or product taxes are intended to reduce the use of virgin or difficult to manage materials in favor of recycled or less difficult materials. Each instrument has its limitations and advantages.
Information-based instruments Product labeling Reporting and information disclosure,	Information provision to key stakeholders (recyclers, dismantlers, smelters) pertinent to product composition
Other industry-based measures Leasing*	Leasing is viewed as a symbiotic relationship between businesses, however, is impractical for products with short life cycles (relatively), e.g. packaging

*Some exclude leasing from EPR-based policy instruments

EPR principle is associated with end-of-life (EoL) management, however, the application of the EPR principle has been manifested in a range of environmental policies, encompassing management, prevention, behavior change, among many, owing to its flexibility and broadness. Thus, it depends upon the *purpose* of EPR under consideration in a contextual setting and the *extent* (life cycle phases) and *degree* (partial, full) of responsibility assigned to the producers (Tojo, 2004a). The EPR principle in its purpose has been realized to improve waste management practices and lifecycle phases and the system surrounding products (Lindhqvist, 2000). The understanding of the extent of responsibility also varies, some subject it to the post-consumer life-cycle phase of the product only while some bring point and process of design and production of products, subjecting various phases of the entire life-cycle of a product under the scope (Tojo, 2004a). The degree of responsibility (physical, financial, or both) has been incorporated as fully or partially. However, the elements of social responsibility are also being evoked as 'restructuring of the supply chain' and 'equitable distribution of gains' in material circularity (C. A. Velis et al., 2012), triple bottom line (TBL) (Woggsborg & Schröder, 2018), and social sustainability in EoL management (Sarkis et al., 2010). The reasons to employ the EPR principle in assessing the role of producers in tackling packaging waste are the intended outcomes; immediate and long term (see **Section 3.1.2**) and underlying motivations for EPR approach, as laid out by (Lifset, 1993):

(1) *To bring about specific results, especially to achieve high levels of reuse, recycling, and related forms of recovery…*
(2) *To alter behavior, particularly to influence materials use and product design decisions by producers;*
(3) *To tap the expertise of producers for activities that relate to their capabilities as designers, manufacturers, marketers, and distributors; and*
(4) *To obtain financial resources to allow more ambitious environmental and, especially, waste management goals to be achieved than could be accomplished through public, taxed-based sources*

The author considers the implication of these motivations in phases considering the socio-economic of Pakistan. Therefore, motivation (1) and (4) are viewed to be of interest for the initial phase while motivation (2) and (3) as a subsequent goal which perhaps should be supported with grace or transition period. In the case of the voluntary initiative, this is viewed as short and long term goals of the programs/initiatives. Akenji et al., (2011) proposed a similar approach in implementing EPR to manage e-waste in Asian countries i.e. breaking down the EPR principle (motivations, outcomes) *into a number of building blocks that can be implemented one by one as surrounding conditions evolve*. The work of OECD (e.g. (OECD, 2001a)) serves as a reference model for the development and implementation of EPR principle, however, it is assumed by many that the underlying motivations of the EPR principle should be met simultaneously

(Kojima et al., 2009; Wang et al., 2017). For instance, proposing the EPR principle without much emphasis on the design for environment (DfE) or/and cleaner products, many may not consider it as the *true* embodiment of EPR. The author believes that countries and producers can become ambitious with changing time, awareness, and economy to commit to the implementation of a comprehensive EPR principle.

3.1.2. Intended outcomes of the EPR program

EPR is a policy that attempts to internalize product externalities and bring circularity to the value chain, pushing producers to convert their supply chains into the cradle-to-cradle process, promoting improved product design, recycling, and reuse. The prospect of EPR encompasses improved communication and network management among stakeholders involved in the end-of-life processes and circular business models. Thus, providing incentives (economic and information-based) to consider the environmental and operational process surrounding EoL.

Reduction of public spending on waste management: Extending the responsibility of end-of-life management of products away from the municipalities, taxpayers (public funding), and traditional waste dealers to producers (eventually to consumers) reduces the financial burden and public spending associated with waste management operation. France by 2015 managed to save 15% of its public funding on waste management by assigning producers 80% of the cost (collection treatment, and recycling) in managing household packaging waste (OECD & Ministry of the Environment, 2014). In South Korea, producers bear the full cost (70-90% to remunerate recyclers and 1-5% for awareness) (OECD & Ministry of the Environment, 2014).

Data Collection / Better Logistics: *The involvement of private actors tends to increase the efficiency of waste management practice, such as better logistics for transportation, especially when it is not subsidized* (Tojo, 2004b).

Improved collection and recycling rates: Emphasis on material recovery induces facilitation and development of recycling and material recovery facilities and technologies (Tojo, 2004b) improving management performance. Collection and recycling rates serve as the basic environmental effectiveness criteria in waste policies as the lack/absence of downstream management facilities would negate the efforts made in the upper stream regarding design changes and material recyclability. Since the introduction of EPR in Germany (1991) the recovery rates of packaging waste have increased from 39.2% to 66.7% (1991 – 2015) and the disposal[3] rate of unrecoverable waste shrunk 11% i.e. 32% to 21% between years 2000 to 2015. While an overall recycling rate of 97% of recovered waste was achieved for all packaging waste (plastic, aluminum, glass, tin plate, paper, board, liquid packaging board) in 2015 (BMU, 2018).

Reduction in overall waste management costs: EPR as EoL management of products brings visible divergence of product waste from landfills, dumpsites, and incinerators and reduction of toxic constituents from products. Simultaneously encouraging close material loops and circular supply chains thus, reducing the increasing pressure on natural capital (virgin material and extraction of mineral) – critical in designing sustainable products. This allows producers to bring circularity in their supply chain and reducing waste during the process. Elimination of toxic ingredients can reduce the indirect costs associated with health and safety and environmental damage. It may also change the status of the waste stream (hazardous waste to non-hazardous, e.g. mercury-free production) thus, reduce waste management costs. Since the introduction of EPR in Germany, the disposal rate has shrunk from 32% to 21% (BMU,

[3] The landfilling of un-pretreated organic waste is banned since mid-2005. There were 68 waste incineration plants and 32 fuel plants in 2017 (BMU, 2018). Some practitioners do not include landfill bans under EPR policy instruments (Tojo, 2004b)

2018). Improved Feedback: Information responsibility encompasses labeling and cross-sector information sharing such as material, chemical, and component list as a means to assist downstream management of product (recycling, recovery, and reuse).

Design for environment (DfE) innovations: There is no process without tradeoffs, however, the impact of those could be minimized. Similarly, the development of EoL facilities and infrastructure may provide a better option but cannot minimize the embedded externalities within the product structure and design. Design for improvement and downstream management is a two-way stream, highly interconnected. DfE plays a critical role in EoL management, e.g. quality and quantity of recovered material, recovery method, and technique. Municipalities and local governments, on the other hand, serve as a stakeholder with a weak influence against product externalities and environmental profile (Manomaivibool, 2009a). The industrial processes and production depend upon the natural capital for raw material, assimilative capacity, and service provision. This ecological web implies that the product footprint and externality don't begin upon disposal but rather an origin during the production interface (Sachs, 2006b). The production interface largely influences the fate of disposal means and potential of reuse and recyclability of the product, for which consumers have little to no influence/say. When assessing the power to implement changes in product design and constituent, it appears that producers are the significant stakeholder with decision making authority (Manomaivibool, 2009a). Siebert (1991) advocates it to the extent that *if a product cannot carry its liability costs, it should not be on the market.* Producers and manufacturers can internalize the cost-benefit valuation to warrant design changes given the EoL management. Second, they have the best data and information to gauge the reuse and recycling potential and possibility.

Behavioral Change: Passing down of improved EoL cost to consumers (changes in price, recovery tax, etc.) induce behavior change inciting waste reduction – stemming from the idea behind 'pay as you throw' (PAYT) or polluter pay principle (PPP) under shared responsibility or 'outside the production facilities' (Naoko Tojo, 2004, p 9). Similarly, the EoL product liability to shoulder the cost and responsibility of environmental damage and recovery associated with product disposal. Shifting and transitioning the responsibilities of waste management attempt to bring environmental and sustainability concerns at the forefront of businesses. Besides the responsibility, the established or improved feedback system between the upper stream and downstream raise awareness and demand for information sharing pertinent to EoL management of product waste and externalities. Since EoL management has a negative cost (the reason we see recycling subsidies) EPR instruments create incentives for producers to minimize these cost, ultimately internalizes cost associated with waste into business finance (Sachs, 2006b)

Market Creation: EPR policy targets for recycling and recovery generate a steady supply of recovered material creating demand for recycling and recovery material.

3.1.3. Model for Extended Producer Responsibility Implementation

The extended producer responsibility principle has been implemented under various models across the world. These models could be categorized into six groups (see **Table 4**): 1) State fund model operates through an echo levy, adopted by Ghana and China. Under this model an escrow account is established where producers pay in a fixed fee as an eco-levy or recycling fee which is then used to finance various parts and channels of the system for collection, aggregation, storage, recycling, and treatment, 2) PRO model i.e. Producer responsibility organizational model. It is the most common model of implementation viewed as being relatively less expensive and efficient in transferring obligations under producers' assigned

responsibilities. It has a long history in Europe and becoming popular in other countries including India, Thailand, etc. PRO serves as an interface facilitating the producer under EPR obligations to meet their targets, 3) State-fund model is an in-between or hybrid model adopted in Taiwan which has a state-run PRO i.e. an independent government-owned body with an independent mandate of its own; 4) Market-driven model is much more prevalent in Germany and to some extent in Australia. It has been subjected to market dynamics, creating pertinent infrastructures and incentives to collect and recycle more and better. This has been an efficient working model, such that Germany's implementation of EPR is the most well-known (Lindhqvist, 2000). However, it requires relatively more organized coordination and trust, with the centralization of information to allocate responsibilities. This has not been a very popular model because it requires a lot of coordination, management, and administration; 5) Hyper-competitive model in the UK based on the trading of credits (Ojino, 2016), an *exception is the packaging recovery program in the UK; this program allocates costs between supply chain echelons, with the largest portion (48%) assigned to the retailers* (Jacobs & Subramanian, 2012), and 6) Recycling driven model or voluntary model, usually realized in the absence of legislation or to avoid punitive regulations. It becomes a good-will approach by companies who realize the commitment beyond the need of the legislations. Under this model producers are usually in direct contract with recyclers. This model has been adopted in Kenya, in South Africa especially. Producers set up the PROs and mechanisms to fund the whole collection and channelization.

Table 4: Summary of EPR implementation models

Responsibility	State Fund Model	Industry-led PRO Model	Market-Driven Model	Recycler Driven (Voluntary Contract)
	State-run PRO (Taiwan)		Hyper-Competitive Model (UK)	
Physical	The government body collects and disburses fee towards collection, recycling, disposal, awareness, etc.	PROs administrate, contract, & monitor system. Producers define & direct PROs	PROs (e.g. DSD) responsible for the collection, & recycling Clearinghouses allocate responsibility to producers	Producers have a direct contract with recyclers
Financial	Producers pay fee or tax at the point of import or sale	Producers pay membership fee & transfer obligation to PROs	Producers directly contracting logistics & treatment providers. Producers pay transport & treatment costs	Producers pay transport & treatment costs
Countries	Ghana & China	France, Sweden, Austria, Canada among others	Germany & Australia	Kenya & South Africa

Note: EPR models are not limited to those included in the table.

It is important to realize that EPR is a principle, not a concrete business model therefore, even under the same legislation and set targets, producers and manufacturers have the flexibility to choose preferred appropriate EoL management methods for their product waste. The involvement of local authorities, however, remains an important aspect of all EPR implementation models since, in most jurisdictions across countries, local authorities and municipalities decide how the concrete collect would look like. For instance, in Quebec (province of Canada) the recyclable (packaging, containers, and printing material) is collected

as a single stream waste by the municipalities (560 municipalities) and processed in 22 recovery facilities, member companies (3,400) are involved only at treatment phase while they finance 100% of the whole process under the EPR system (Vermette, 2019). Thus, the implementation of the EPR principle creates a relay of opportunities/need for producers/industries to help municipalities in understanding and establishing the best model for their respective regions. To expound on the flexibility, countries in Europe present an interesting case (see **Figure 5**).

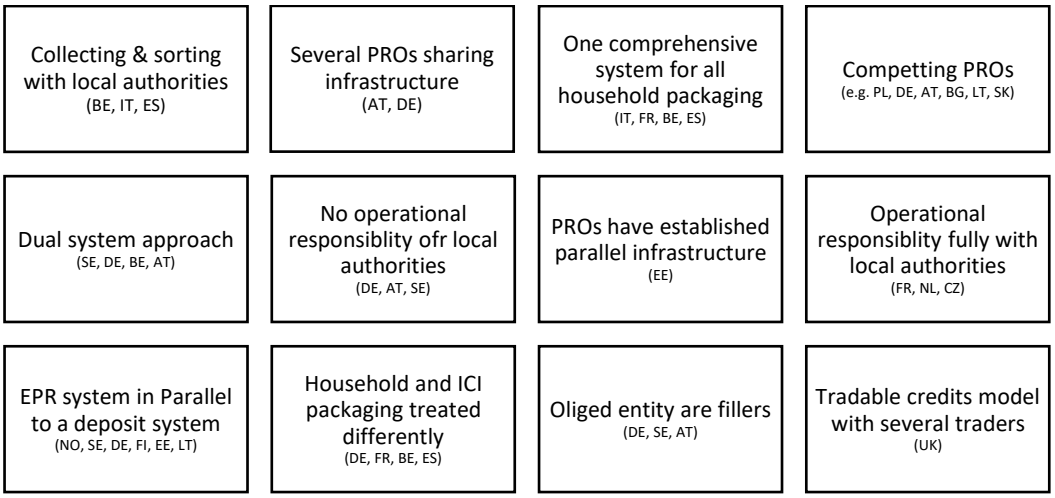

Figure 5: Flexibility in the implementation of the EPR principle, an example of European countries

3.2. Theory-based Evaluation (Program Theory)

Theory-base evaluation (TBE) also known as program theory applies an approach to explaining how interventions are linked and influenced by associated activities and inputs to bring intended outcomes (Manomaivibool et al., 2007; Rogers, 2008). EPR as an intervention has a *complication* level intervention, having various components embedded in the process. While the non-OECD context with complex waste flows and informal sector in the setting draws in *complex* aspects to the intervention. (Rogers, 2008) defined the evaluation of complicated and complex interventions as *challenging*. Since the *path of success* is flexible and hard to predict. Following the simple logic models developed by (Kellogg, 2004), simplified version EPR is demonstrated in **Figure 6**.

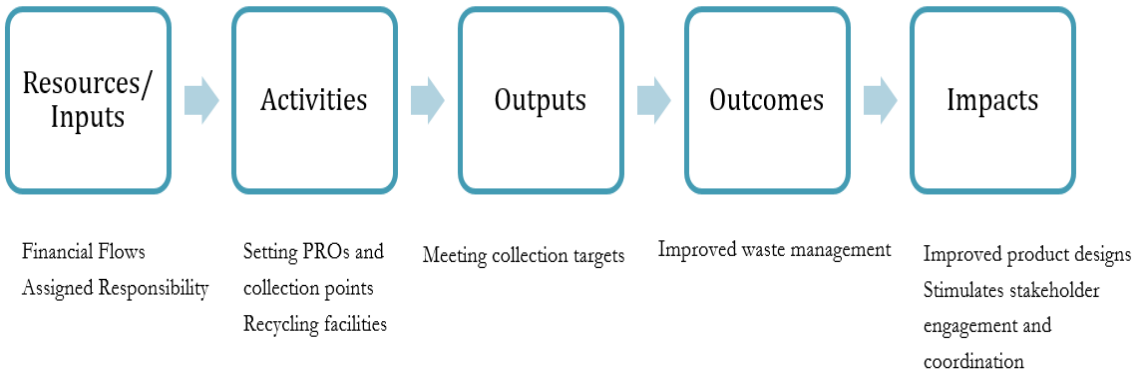

Figure 6: Simplified version of EPR. Logic model. Adapted from W. K. Kellogg Foundation (2004)

Theory-based evaluation or program theory entails careful consideration of aspects of the program as a whole in determining the success in bringing desire change or achieving goals (Sharpe & Bay, 2011). Multi-method approaches, e.g. observations, surveys, interviews, etc. are used to measure program variables and processes (Sharpe & Bay, 2011). Programs are hypothesized in bringing change to the social conditions, these changes are viewed as outcomes

to be measured to evaluate the potential success of the goals being achieved. Therefore, social conditions (substances and structures) become an inherent part of the investigation (Sharpe & Bay, 2011). Outcomes depend upon the degree of resources and treatment dedicated to them and may affect the intermediary processes and outcomes (Sharpe & Bay, 2011). For instance, inadequate training and capacity building of the workers involved in the value chain may interact with the quality of recovered and recycled material, impacting the intended outcomes. For ex-ante policy evaluation, program theory should be specified thoroughly. In the case of complex environments, assumptions could be drawn that the program involves several mechanisms of change and impact (Sharpe & Bay, 2011; Hermann-Pawłowska & Skórska, 2017).

Extended producer responsibility in countries with the informal sector is subjected to similar complex environments, with the issues of social sustainability and financial responsibility that several mechanisms of change and impacts should be realized for the successful implementation of the intervention. Therefore, attention should be paid to the dependencies and relations between the identified mechanisms, when applying program theory (Hermann-Pawłowska & Skórska, 2017). An intervention can rely upon these various mechanisms to foster a *virtuous circle* where initial success enables an environment for further improvement and success (Rogers, 2008). (Hermann-Pawłowska & Skórska, 2017) categorize outcomes into three groups: 1) initial outcomes: changes to skills, knowledge, and capacity; 2) intermediate outcomes: behavioural changes; and 3) long-term outcomes: meeting the needs. In this thesis, EPR provides a problem theory and purpose for interventions. To provide a comprehensive understanding of contemporary issues in the EoL management of product waste in Pakistan, first by building on existing and emergent theories and concepts coming from the literature review, and then by analyzing the verbal data or qualitative interviews. When constructing the theory of program, the problem areas and needs to be met must be identified and understood. Thus, up to taking potential spillover (positive and negative, both), links, important steps, and implementation issues within the scope of the program (Sharpe & Bay, 2011).

The evaluation (problem theory embedded in TBE) however, had two weaknesses; (1) The author covered a wider scope of the issues and in-depth understanding of meticulous root causes in the **Result Chapter**, however, the graphical representation (see **Chapter 6**) was limited. As the aggregated mapping (wider scope) of the contemporary EoL management problems obscured some of the interdependencies and linkages to the root causes of individual challenges/issues. (2) It was observed by the author that the aggregated mapping/presentation may not fully reflect the significance of the issues, thus limiting the ability of the program developer to prioritize issues at times. For example, the aspects of the waste pickers were not as pronounced in the problem tree and model of TBE (see **Figure 19**) as the author expected it to be. To overcome these weaknesses, the concept of the *virtuous cycle* was emphasized, and details to the root causes where thoroughly explained in the **Result Chapter**.

4. Research Design

This Chapter explains the design of the research that constitutes this thesis. It starts with a brief discussion of the philosophical stand of the research, which is influenced by the *Constructivism* school of thought. Then a description of the literature review, case study selection, field survey, and qualitative interview processes. The chapter subsequently discusses the Wasteaware model used for the systematic analysis of waste management in Pakistan. The chapter ends with the development and presentation of key features of the analytical framework behind the research, i.e. contextual study and evaluation criteria used in this research.

Figure7 illustrates this research agenda, presenting the overall research methodology and applied research design

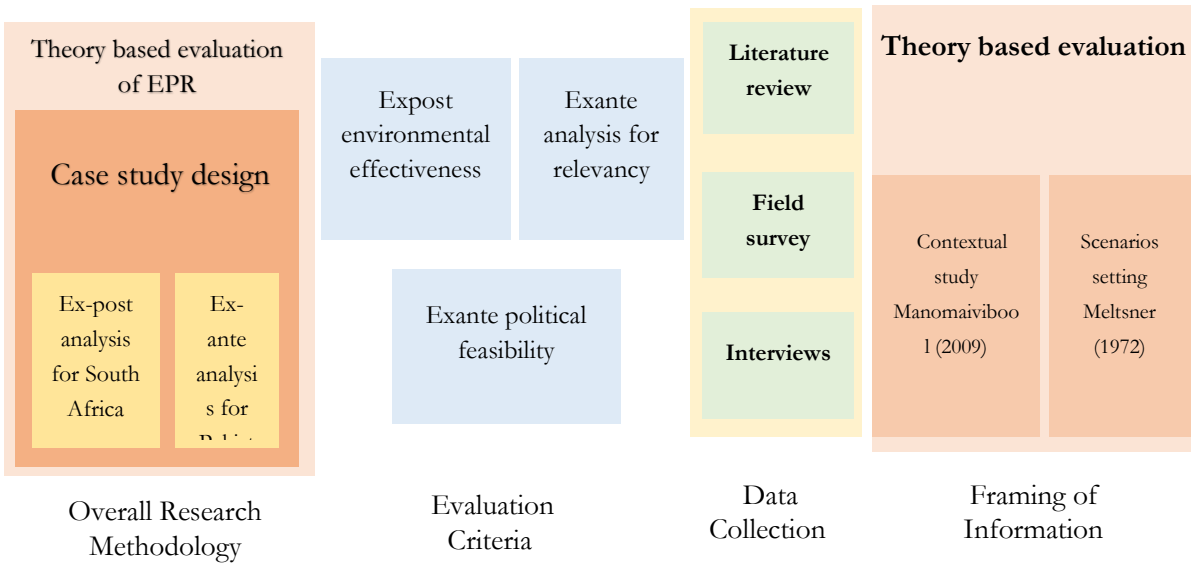

Figure 7: Illustration of the research agenda: overview of overall research methodology and applied research design.

4.1. Research Orientation

Positivism has successfully contextualized EPR schemes in OCED countries, explaining the physical and financial flows and responsibilities of stakeholders in waste management. However, evaluations and *emergent understanding* of bringing social context and complex interactions in the play, call out for a constructive Dissection of issues (Douthwaite et al., 2003). EPR in non-OECD countries fosters *social construction*; vulnerable to socio-economic, corporative, cultural conditions (Manomaivibool, 2009a). The EPR model has three main outcomes, *upstream changes*, *downstream waste management* (development of infrastructure), and formation of *feedback mechanisms* (communication network and stakeholder management). The primary focus is downstream management and feedback mechanism to foster upstream changes. It is the understanding of the author that extending the responsibility of EoL products to producers will bring matters concerning EoL management upfront in the businesses, providing incentives to consider the overall environmental profile of their products.

4.2. Literature review

The focus of the literature review is on the EPR and stakeholder network management to manage product waste. Considering the context specification, a 'comparative' outlook between developing and developed countries are maintained. The primary focus of the literature review is on the role of producers in the EoL management of products, and the role of the informal sector in the waste management sphere. The literature review also contributed to the selection

of the most appropriate policy/program evaluation theories, as well as, critical factors to support analysis and discussion. The first step was to explore scientific databases (google scholar, Lund research database), followed by selecting literature relevant to the stream of keywords such as EPR, "informal sector + inclusion", "inclusive growth + waste management", and "integration + informal sector" and "formalization + informal sector" (the non-OECD context was added to EPR search as so will be the case when looking into sustainable livelihood linkage with EPR and businesses. Two groups of keywords; 'EPR' or: "producer responsibility" and the other on 'informal sector' are used as one separate search while applying the 2015-2019 context. For the status quo in Pakistan keywords were "waste management + Pakistan" entries since 2006, first three pages explored.

Bibliographies of reports are also used to identify relevant research, conference proceedings, reports, and documents. Subsequently, information is extracted and analyzed by maintaining a synthesis matrix in Excel. Usually, the first three pages of google scholar search are screened, preferring articles with the highest citation and relevance (direct indication and link in the title or abstract). Separate matrix sheets were organized for the case study and negative and positive aspects of informal sectors, contributing to the literature review section. Literature is categorized into five groups EPR, social inclusion, alliance, supply chain, and economic analysis. The content analysis of the literature reviewed is conducted via NVivo.

4.3. Case Selection

The cases of South Africa and Pakistan both share some common features: both have informal economies actively involved in the waste sphere, the social sustainability issues in EoL product management has similarity, e.g. child labor, marginalized groups, poor working conditions. The municipalities' performance in both countries is unsatisfactory, limited by various institutional and political capacities. South Africa has three cases of industry-led voluntary EPR initiatives, while Pakistan has one such existing example while another alliance is emerging as an industry-led progression – like that of South Africa. Such similarities allow the analysis to be homogenous and in-depth (Tojo, 2004b), while expanding the understanding, systematically observing and reflecting upon the "important shared patterns which cut across cases" (Yin, 1994, p.44-51 quoted in Tojo, 2004b). The other motive for selecting the case of South Africa is their experience with EPR intervention, both mandatory and voluntary. Thus, ease of gathering data to evaluate the environmental intervention evaluation criteria, e.g. environmental effectiveness using proxies such as collection and recycling rate, number of downstream facilities, etc. The data for this study were collected and triangulated through systematic literature review and analysis. One of the interviewees from the NGO also shared some insights into the case of South Africa but these were limited. There were some limitations to this study, namely, the informal sector in South Africa has primarily focused in the collection phase, i.e. as waste pickers, while in the case of Pakistan, the informal sector is equally dominant in the collection and recycling of material. Therefore, the scope of contemporary issues and concerns for EPR was rather narrow in the case of South Africa.

4.4. Data Collection

The following methods were used to collect data for the study: 1) Field survey to observe informal activities and to include informal workers' perspective 2) in-depth structured interviews with formal recyclers, 3) in-depth structured interviews with experts from non-profit organizations and waste management (private and public) officials, and 4) follow up communications with the interviewees. This allowed the triangulation of data (Blaikie & Priest, 2019).

4.5. Field Survey

To include the perspective of the informal sector in the EPR scheme for Pakistan and to understand the socio-economic context, hierarchy, and political economy embedded in the informal sector in Pakistan, a field survey was conducted. The field survey aimed to get an insight into the waste activities and livelihood dependencies along with observation and documentation of their workplace and work practices (see Appendix B for the survey questionnaires). This investigation was carried out in Karachi (various zones identified through snowballing i.e. asking participants to locate further informal activities in Karachi, from 12 February 2020 to 15 February 2020. I met twenty-three workers; ten waste pickers, three recyclers, and ten junk dealers/middlemen – all of them were men (age 16 to 68). All of them carried out waste-related activities regularly. Several kids were observed to be involved in waste-related activities; however, they were not surveyed because of the language barrier (most of them were Afghan migrants).

4.6. Qualitative Interviews

Qualitative interviewing is critical to understand the evolving dynamics and socioeconomic strata of the context, fundamental to evaluation research. This embodies social norms, economic structure, cultural beliefs, and embedded interlinks and interdependencies (Castañeda et al., 2019). Assessing the potential of EPR in Pakistan, since capturing the practitioner's insight and stakeholders' views is instrumental in this research. The focus of the interviews was to gain important insights into explanations of contemporary EoL management issues in Pakistan; scope of issues and the interconnections to various areas of concern within the broader scope of waste management and factors concerning the inclusion of the informal sector: why they are not promptly considered in the formal waste management projects, what outlook does multinational companies and formal waste management entities take concerning informality and responsible supply chain/procurement.

The representatives of a total of three formal packaging recycling companies (PET and beverage carton) in Pakistan and four officials of waste management companies were interviewed to identify problem areas and breadth of issues in the EoL management of waste in Pakistan. A sustainability executive from a multinational company was interviewed to gather primary information on the voluntary producer responsibility initiatives and to know MNCs' views on the role of producers in supporting EoL management of product waste and matters of the responsible supply chain. A total of three experts from national and international non-profit organizations (Waste Aid UK, WIEGO, and WWF-Pakistan) working on inclusive waste management issues were also interviewed. The main purpose of selecting interviewees from a wide range of stakeholder groups was to develop a holistic and in-depth understanding of the issues, interdependencies, and spill over effects of different resources and actors. This was necessary to internalize or utilize the theory-based evaluation adequately. In addition, it was noticed by the author that most of the EPR experiences and informal interactions were researched under the scope of e-waste, which has its limitations since the scope of EPR is influenced by the purpose and type of product (see **Section 3.1**). Consequently, it was critical to identify these differences and the political economy involved. It was realized during the snowballing process of getting in contact with different practitioners that the informal economy has various commonalities across countries. However, the status quo of the economy influences the extent of their involvement and activities. This was also observed when analysing the case of South Africa. The selection of interviewees was based on background knowledge and preliminary research on the issues in EoL in developing countries. Interviewees also recommended new contacts (potential interviewees), the so-called snowball sampling. The list of interviewees and their positions at the time of interviews are summarized in Appendix A. Separate interview guides were prepared for different categories of stakeholders (see Appendix

C for interview guidelines). The orders and number of questions were different from interview to interview. Interview guides were sent to interviewees before the interview (except Respondents 2, 10, and 11), to facilitate the smooth and efficient conduct of interviews. Although, all interviews were structured (tightly designed interview protocol) and a guide was used, the interviewing approach was iterative and flexible (Blaikie & Priest, 2019).

Interviews served as the main data collection tool. The interview guides were to ensure that sufficient and necessary information was gathered in a single interview, lasting 45-120 minutes. In some cases, follow-up communication via text was carried out. Interview questions in the guide were being revised and reviewed, at times during the interview, if necessary; follow-up questions were added/introduced to get greater understanding and inspiration behind the ideas or opinions presented and about the information gained in previous interviews. For instance, the issue of capacity building of the informal recyclers and preprocessors was brought up against the dominant few of diverting collwcted waste to formal recycling companies.

4.7. The Wasteaware Model

Wasteaware model is a systematic analysis tool, using Wasteaware indicators and a matrix to rank the waste management practices in Pakistan based on governance and physical indicators (Wilson et al., 2015) in tabular format. These indicators were developed referring to the guidelines of the UN-Habitat. The advantage of using the Wasteaware model is the convenience for comparison, as UN-Habitat under this model assessed the waste management systems of more than 50 countries (Waseer & Khan, 2016). However, the use of this model is up-scaled to assess a country profile or city. The author is aware that this may generalize some of the data or representation of sub-indicators. The indicators cover country profile including background information, waste characterization data, waste collection coverage and data physical indicators involving epidemiological, environmental, and economic factors of MSWM. The governance indicators cover the institutional and financial sustainability and inclusivity aspects of MSWM. The indicators are then graded and color-coded based on low (red), lower-middle (red & orange), upper-middle orange & green), and high (green) grades or ranks, following a grading system. This grading scores the indicator based on its corresponding sub-indicator. For this research, the country profile i.e. income and population data are obtained from the World Bank (2018a). The waste-related information data is obtained through a systematic review of peer-reviewed and grey literature and relevant information from interviewees. Online news journals, photographic evidence from social media, and observation of interviewees were considered to assess the quality of waste management practices as necessitated by some of the sub-indicators. Annex D can be seen for further details.

4.8. Analytical Framework

This research applies theory-based evaluation (TBE) as the main framework of analysis; undertaking the *ex-post* and *ex-ante* policy evaluation of EPR concept-based intervention to answer the research questions. TBE is an evidence-based policymaking and evaluation tool that not only assesses the outcomes and performance of a program/intervention, but also provides the casual linkages to the success or failure of the program. TBE is used in addressing all four **Research Questions** while applying different proxies and criteria for intervention evaluation. TBE has a long history of utilization and has been applied in various fields to analyze implementation mechanisms and success or failure of intervention, i.e. gauging outcomes. Hence, it is a well-accepted methodology.

Correspondingly, this research follows a *case study strategy*. The contextual case of EPR implementation in South Africa is analyzed and environmental effectiveness criteria are utilized for its ex-post evaluation, together, answering **Research Question 1.** The case study of South Africa was based on a systematic literature review and subjected to the framework adopted from Manomaivibool (2009), explained in detail in **Section 4.8.1**. The context study of Pakistan, following Manomaivibool's (2009) framework, explored the range and extent of issues of the contemporary EoL product management issues in Pakistan to answer **Research Question 2.** Short case studies of existing EPR initiatives in Pakistan supported the analysis for **Research Question 3**. In addition to these case studies, political feasibility and relevance criteria are used for ex-ante evaluation of the EPR interventions supporting the answers to **Research Questions 2, 3, and 4**. The rationale for choosing these criteria are self-evident. The environmental effectiveness criterion, as goal achievement criterion, demonstrates how well the EPR based interventions are performing and implemented in a case. The analysis of policy relevance reveals that several contemporary EoL product management issues and needs are linked to the intended outcomes and objectives of the EPR concept. While the political feasibility analysis identifies opportunities and challenges to the implementation mechanism. The political feasibility analysis using Meltsner (1972) scenario setting framework under the TBE concept produces some general factors to be considered in program design and implementation of the EPR concept (voluntary or mandatory).

4.8.1. Contextual Study: Manomaivibool's (2009) Framework

The contextual study presents an exploratory approach to gain insightful information on the EoL product management issues in a case. Thus, providing a meaningful starting point to the development of the implementation mechanism to address packaging waste through EPR-based interventions. The *Material Flow Analysis* (MFA) offers a structure to the exploration in the context of countries with a dominant informal sector, in this case, Pakistan (see **Figure 8**). The MFA establishes the *comparability across single-case studies* (Manomaivibool, 2009). It pays attention to physical flows and actors involved in the EoL product management, which is divided into two broad segments: service chain and value chain.

The service chain corresponds to the range of public services, including waste collection, transport, and disposal. The value chains sector involves *valorization*, i.e. adding value to waste via recycling, extraction, and recovery of material (sorting, separation, cleaning, and washing), waste to energy, re-use, diversion to secondhand market, commercialization, and trading (Marello & Helwege, 2014; OECD, 2016; Rosa & Cirelli, 2018; C. A. Velis et al., 2012; Williams et al., 2013a; Wilson D, Velis C, 2013). While waste pickers and itinerant buyers act as intermediaries between service and value chain.

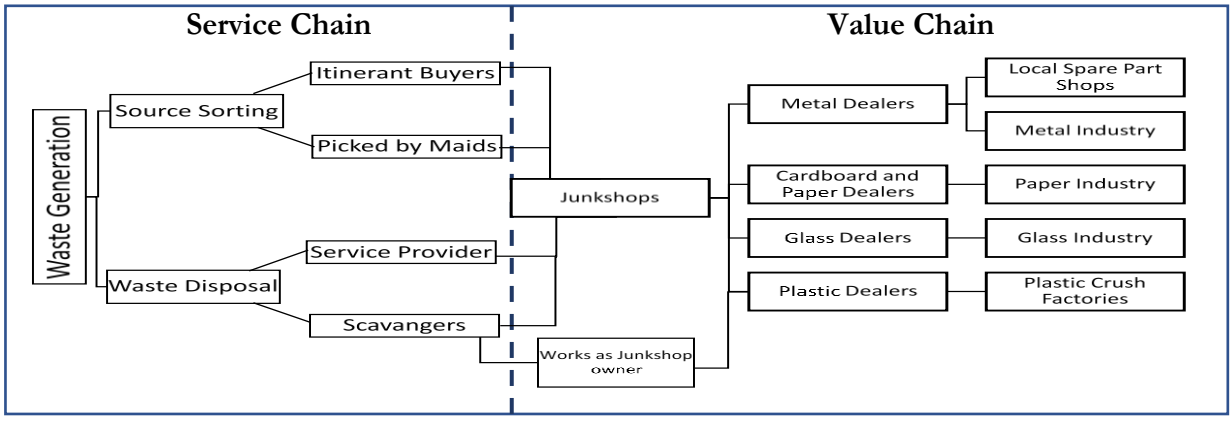

Figure 8: The system boundary of the contextual analysis: Modification of the Manomaivibool Analytical Framework to identify structures and pattern in the EoL product management

The framework delivers structures and patterns in EoL product management when applied to a case. These structures and patterns are produced following fundamental EPR objectives: 1) physical flows of waste to formal EoL product management entities to ensure EoL management activities are being carried out in sustainable manner (environmentally sound and socio-technically acceptable); 2) resource flows from producers to support EoL management activities so that the product system externalities are internalized (partially or fully) including finances, roles, and responsibilities; and 3) monitoring and reporting developments to ensure the adequate performance of the interventions in meeting intended outcomes.

The analysis interplays between these elements and contextual factors. For instance, the actors involved in the informal economy, e.g. waste pickers, middlemen, junk dealers, are not necessarily as dominant in all emerging economies, or the interaction among formal and informal actors may vary, impacting the physical and financial flows and monitoring elements. Thus, the objective of the analysis transforms into assessing the performance of the EPR interventions and to identify associated challenges/opportunities.

4.8.2. Evaluation Criteria

Evaluation criteria measure the merits and worth of the policy or intervention. It also validates the results of the theory-based evaluation (Manomaivibool, 2009b). Mickwitz (2003) suggests that the evaluation of environmental interventions should examine various aspects, e.g. relevance, impact, effectiveness, persistence, flexibility, efficiency, transparency, predictability, equity, and legitimacy (political). Bemelmans-Videc (1998, p. 7-8) advocates for effectiveness, efficiency, democracy, and legality as *dominant* criteria for public policy evaluation. Whereas, all these four *dominant* criteria affects the political feasibility or legitimacy of interventions (Tojo, 2004a). This research focuses on three criteria, i.e. relevance, environmental effectiveness, and political feasibility.

4.8.2.1. Criteria for Relevancy

The relevancy criterion compares the anticipated outcomes of the intervention with the needs in the society or target area with sufficient knowledge and understanding of the contemporary issues (Hildén et al., 2002). Thereby, the intended outcomes of the EPR intervention (as explained in **Section 3.1.2**) are cross compared with the identified contemporary issues in the EoL product management in Pakistan. A distinction between immediate, intermediate, and long-term objectives/outcomes is adapted to emphasize the opportunities/leeway subjected to the implementation mechanism of the EPR intervention, owing to the flexibility of the EPR concept in design and adaption.

4.8.2.2. Environmental Effectiveness Criteria

The environmental effectiveness of the producer responsibility initiative or EPR is reflected through the established activities and implementation mechanism to achieve set outcomes (Manomaivibool, 2009a). Intended outcomes of EPR are briefed in the previous Chapter (see **Section 3.1.2**), however, it could be narrowed for the result-oriented management (Rogers, 2008), or if the implementation mechanism becomes too complicated as aspects of the program, central to bringing change demand careful consideration (Sharpe & Bay, 2011). To measure the effectiveness and success of programs, outcome proxies are normally set. Considering the contextual background of EoL management in Pakistan, two downstream proxies, i.e. collection and recycling rates, are discussed, while *quality* of materials associated with these proxies is brought to consideration due to its relevance.

4.8.2.3. Political Feasibility Criteria

The political feasibility criterion concerns political acceptability or hurdles to the implementation (Mossberger & Wolman, 2003). Meltsner (1972) suggests that setting political scenarios using analogies, extrapolations, causal relations, and facts, represents the political feasibility of the policy. Scenario setting can be classified into three types, 1) predictive scenario is designed to know *what will happen?* 2) normative scenario is intended to explain *how can specific target be reached?* 3) explorative scenario attempts to answer *what can happen?* (Schubert et al., 2015). However, these distinctions are not always clear as normative and explorative both are used to make political decisions. Meltsner (1972) proposes that one way of setting scenarios is to develop political categories to gather information and these categories are to change depending upon the *theoretical perspectives*: 1) actors, 2) motivations, 3) beliefs, 4) resources, and 5) site. For this thesis, considering the scope and relevance to the problem area, three of the categories are considered (see **Figure 9**) for the graphical representation of framework):

Actors: Meltsner (1972) suggests that the selection of actors, relevant to the intervention, shouldn't be limited to the atomized approach, i.e. actor should remain open-ended term and adapted per the need of evaluation. An actor could be an individual, group, bureaucracy, role, or even state. Following this categorization, producers, non-profit organizations, formal recyclers, municipalities, waste management companies, and the informal sector are designated as key actors to assess the political feasibility of EPR concept-based initiatives.

Motivation: the political feasibility of policies and programs is influenced by the motivation of actors, having a spectrum of needs, motives, believes, objects, and interests (Meltsner, 1972). One issue with motivation is that it changes with time and place, and actors tend to hold back on being explicit about their motivations. Nonetheless, it is the motivation of the actor that becomes the 'price' that other actors may have to pay to get his support/alliance. Very much like the motivation, this *price* also varies over a spectrum and does not have to be *monetary* in nature. Meltsner (1972) argues that if the price for a pivotal actor's motivation is not higher than it can be *satisfied*, matters of political feasibility could be resolved there.

Resources: In a policy problem area, every key actor has something, i.e. a resource, to offer to the other actor that may satisfy his motivation. These resources can be as diverse as the motivations, e.g., money, information, skill, network, position. Such an actor with relatively low authoritative power based on a top position could become a pivotal actor to the policy due to the resources they possess, e.g., the informal sector in EPR projects due to their strong social resources, i.e. network and information – coined as livelihood assets (Bebbington, 1999). Resources can be built and gained over time, hence changing relations or influence of the other actors.

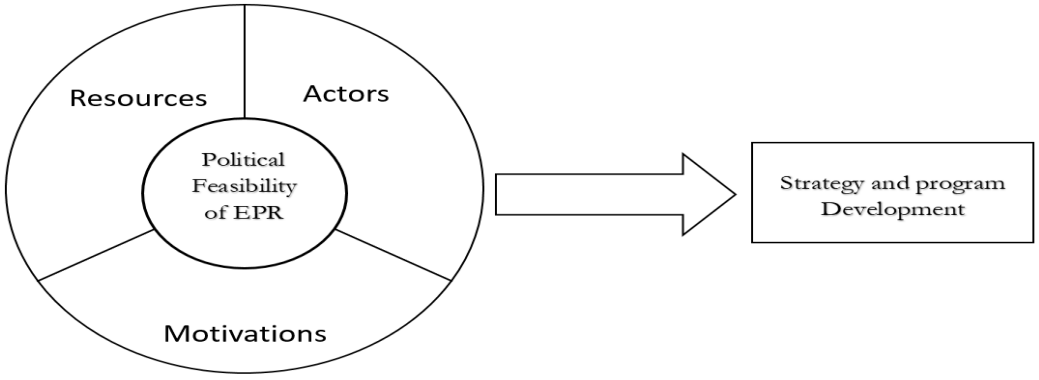

Figure 9: A conceptual framework to assess the political feasibility of the EPR principle

5. Results and Analysis

The EoL product management consists of several components and actors with varying roles, linkages, dependencies, and challenges that are the primary subject of this Chapter. The subsequent **Section 5.1** presents the main findings from the case of South Africa. It serves as a comparative analysis model for the implementation of the EPR principle in Pakistan. The EoL product management sphere in Pakistan and South Africa has various similarities including dominance or the informal sector, inadequate municipal waste management performance, and progressive approaches from industries to transition to the EPR principle voluntarily.

Section 5.2 presents a detailed overview of various common and critical issues with the EoL management of the produced waste. **Section 5.2.1** focuses on the social sustainability aspects of the supply chain that producers viewed particularly difficult to address. **5.2.2** Summarizes the cascading effects at various stages and the drivers behind in the EoL product management in the current setting. These drivers, such as lack of communication between upstream and downstream, cross-contamination and quality of recovered material, inefficiencies in the informal recycling process, and lack of capacity and variable recycling practices are briefly introduced. **Section 5.2.3** summarizes the issue of counterfeit products that can potentially hamper the success and implementation of EPR initiatives. **Section 5.3.4** touches upon the lack of database and reporting, while **Section 5.2.5** briefly introduces the market for recyclables and the need to create and support the market for improved EoL product management.

Section 5.3 presents the analysis of the relevancy of EPR in context to Pakistan.

Section 5.4 presents the political feasibility of implementing EPR in Pakistan.

Section 5.5 presents the main findings, introducing the factors that hinder or promote the formal-informal linkages in EoL product management. The understanding of the linkages and factors is critical to understand the extent and degree of mutual dependencies, elemental to develop implementation mechanism for EPR schemes.

Section 5.6 introduces the pre-existing cases of voluntary industry-led EPR initiatives. Two examples are presented; the case of Tetra Pak with Green Earth recyclers and project *CORE* i.e. an alliance of multinational companies to tackle plastic waste in Pakistan. The voluntary implication of certain elements of the EPR principle in these initiatives supports the case for mandatory or more developed EPR initiatives.

5.1. Case Study: South Africa

This Section will present South Africa's experience with extended producer responsibility schemes for packaging and product waste. A brief account of the waste management and informal sector is laid out to indicate the relevance of the case to extended producer responsibility implications in Pakistan. Since the challenges faced by developing countries are very different than that of developed countries and even within developing it is significantly different for countries with dominant informal sectors and countries without (Gupt & Sahay, 2015). However, I would argue that it is also the extent of dominance and points of involvement of the informal sector within the supply or waste chain that leads to different experiences with similar policies and programs. This will become more evident as I will relate the case study of South Africa with the contextual case of Pakistan in the **Discussion Section**.

South Africa is a country with a population of 58 million (2019 estimates) and the gross domestic product (GPD) of 368.3 billion USD. South Africa faced rapid economic stagnation as the annual growth rate (%) fell from 1.4% to 0.4% from 2017-2019, resulting in an unemployment rate of 29% (World Bank, 2018b). Besides the economic stagnation, South Africa like many other developing countries has rising trends in population growth, urbanization, industrialization, and modernization – leading to a rise in the generation of waste (Sebola et al., 2018).

5.1.1. Brief Account of Waste Management Situation

Solid waste management in South Africa faces issues with inadequate waste management services (limited collection coverage, illegal dumping), limited institutional capacities, incoordination among departments, landfill airspace issues, lack of awareness, information dismantling, and regulations, limited policies and legislations related to waste (Linda Godfrey, 2016; A. Nahman & Godfrey, 2010) (although far more and advance than that in Pakistan – See **Table 5**). Landfill disposal is preferred over other EoL management options such that almost 90% of the general waste goes to landfill (L Godfrey & Phukubye, 2016) while only 10% of the total waste was diverted from landfill disposal. Municipalities are limited in their capacities while in-coordination and inadequate funds further scant the resources. Municipalities spend most of their budget on city cleaning and waste collection and transportation than on EoL management. Besides, high unemployment rates put in the waste picking activities, mostly informally, such that around 60,000–90,000 of South Africa's population is associated with informal waste pickers working, as reported by the government, however, the numbers could be as high as 0.6% i.e. 215,000 (Linda Godfrey, 2017). In response to these issues, a 1998 agenda for integrated waste management was emphasized by the National Waste Management Strategy (NWMS) to improve the coordination among functional units and to divert waste away from landfills by promoting waste minimization and recycling. However, the issue of insufficient funds persisted (A. Nahman & Godfrey, 2010) which motivated South Africa to adopt the EPR principle.

Table 5: Comparison of Waste Policy and Regulation between South Africa and Pakistan

Waste Policy and Regulation in South Africa	**Waste Policy and Regulation in Pakistan**[4]
Environmental Conservation Act, 1989	Pakistan Environmental Protection Act, 1997
National Waste Management Strategy (NWMS) 1999	Hazardous Substance Rules
White Paper on Integrated Pollution and Waste Management, 2000	Guideline for Solid Waste Management, 2005, 2003 & Hospital waste management rules, 2005 (not related to SWM)
National Environmental Management (NEM): Waste Act (Act 59 of 2008)	
Integrated Industry Waste Tyre Management Plan (IIWTMP) of the Recycling and Economic Development Initiative of South Africa (REDISA), 2012	
Waste Amendment Act (Act 26 of 2014)	

[4] Pakistan has no national waste management strategy, and the existing few drafts and legislation are focused on permits and standards.

5.1.2. Motivations Leading to Adapt EPR Principle

The transition of South Africa's waste management system from *brown agenda* i.e. focusing on collection to disposal while public health being the major driver, to EPR principle or *green agenda*, could be grouped into government-initiated (legislative) transition and industry-led (voluntary) transition. The motivations for both roots from slightly different needs, issues, and drivers, however, were not found to be mutually exclusive. Legislative progress added to the spectrum of motivation for the later (after 2001) voluntary initiatives. Before the government-initiated EPR regulation for plastic bags (2000-2003), South Africa had an example of voluntary of EPR scheme as a joint venture (1993) by two beverage and food can manufacturing companies; ArcelorMittal (60% shares) and Nampak, bringing positive performance to the recovery and recycling of metal can hence, attesting "to the benefits of the industry-based intervention to encourage recycling" (quote from Anton Nahman, 2010). Under this initiative a PRO was established, Collect-a-can, registered as a non-profit company, and was not only responsible for reverse logistics but also the recycling of cans. This has been mostly motivated by the demand for metal resources and social needs to an extent (Linda Godfrey, 2017). There was recycling being carried out even in the 1970s in the areas of Johannesburg and Pretoria, however, the local market had been limited owing to low supply and demand, resulting in stock-piling of cans (Collect a Can, 2011). The failing market and low return of beverage cans for the processes were the main motivation for this initiative, Collect-a-can states its mission as "ensuring that metal cans and related can production material are effectively recovered"(Collect a Can, n.d.). While job creation and *safeguarding the livelihood* has been an implicit motive, considering that scavengers had been pivotal actors in the waste value chain in South Africa.

South Africa's approach towards integrated waste management had elements of EPR principles embedded as the *polluter pays principle*. The National waste management Act (1998) states that "responsibility for the environmental health and safety consequences of a policy, program, project, product, process, service or activity exists throughout its lifecycle" (quoted in Anton Nahman, 2010a). However, the attention to the EPR principle was not paid until the beginning of 2001 when the issue of single-use plastic (SUP) bags became so prevalent along with inadequate waste management and visible leakage of plastic to the environment that is was called 'national flower' (Anton Nahman, 2010b). The SUP bags were distributed free of charge, providing no motive for a reduction in consumption, collection, and recycling. The attention towards single-use plastic (SUP) was brought up in a report by the Polokwane Declaration, which concluded it to be an issue of insufficient recycling rate (Linda Godfrey, 2017) - reinforcing the views of many other practitioners and researchers who associate the lack of resource recovery and landfills being the default and cheapest method of disposal as a 'market failure' (Anton Nahman, 2010b; OECD, 2006; Walls & Palmer, 2001). This report together with National Waste Management Summit set targets for recycling which subsequently, were ratified by the government and corporate sector. This served an impetus for the *legislative* embodiment of the EPR principle. Thus, setting a new paradigm shift/stage in the waste management sphere, "The Emergence of Recycling" (Linda Godfrey, 2017).

South Africa started its historic *legislative* journey towards EPR by adapting regulatory instrument in 2003, as a response to massive single-use plastic bag issue, set standards for thickness and printing along with 20% of the levy were posed on producers and importers, the revenue of which was flowed in for recovery and recycling of plastic bags. Several intended outcomes were set for the legislation. Firstly, standards for thickness correspond to impact on the weight of bags (ease in collection and reduction on leakages due to wind, etc.). Second, the printing regulations aimed at reducing cascading effect by manufacturer, increasing the prospect for end-uses of recycled SUP

bags. Thus, holistically making EoL management of SUP bags cost-effective and viable and creating motives for other actors in EoL SUP management. The passage of 2001 – 2003 from actualizing the SUP issues to introducing the regulatory instrument, insinuated an impression from the government to have similar regulatory policies for the other waste streams. This served as the main motivation behind voluntary EPR initiatives: *industry efforts to pre-empt possible government regulatory action, on the belief that it could develop and implement more effective, sustainable, and lower-cost solutions than government-imposed regulations* (Linda Godfrey, 2017). The glass industry in 2005 signed a Memorandum of Understanding (MOU) with the Department for Environmental Affairs (DEAT) to avoid *punitive legislation of the plastic bag type* (Anton Nahman, 2010b). The PET industry states its motive behind the voluntary initiative as an *effort to self-regulate post-consumer polyethylene terephthalate (PET) recycling* (PETCO, 2016c). Against these settings, two voluntary producer responsibility organizations (PRO) namely PETCO and GRC to manage PET and glass product waste, respectively were established, providing further motivation for collection and recycling. Both of them serve exclusively typical PRO roles; facilitating communication and logistic between recovery to the recycling companies, without getting involved in the recycling themselves. Coca-Cola was the leading MNC behind the PETCO initiative, showcasing the role MNCs can play in leading the EoL management of their products (Anton Nahman, 2010a). This perhaps arguably has exogenous motivation, e.g. a trickling down effect of the focal company's commitment and initiatives to the subsidiary companies against globalization and stakeholder pressures. Nonetheless, the creation of PETCO increased the recycling of post-consumer PET bottles from 16% to 55% between 2005 – 2016, glass also showed an improved recycling rate (Linda Godfrey, 2017).

5.1.3. Allocation of Resources: Roles, Responsibilities, and Flows

Analysis of the allocation of resources, roles, responsibilities, and maintaining critical flow is critical to not only the *ex-ante* evaluation of policies but also for *ex-post* evaluation as a measure to assess the sustainability of the policy/program and effectiveness of the implementation mechanism developed.

5.1.3.1. Single-use Plastic Bags Ban

Before a single-use plastic bag ban, bags were given free of charge and were thin, lightweight, and heavily tainted with printing, making recycling inefficient and limiting the range of end-use of recycled products. Therefore, recycling was significantly low, i.e. 1% (Anton Nahman, 2010a). To make the EoL management of SUP bags viable, levy on producers (importers and manufacturers) were introduced (3c per bag i.e. 0.00179 USD per bag) which was passed on to consumers in the form of plastic bag tax. The levy served as advance recycling fee to improve collection and recycling rate, however, with no physical responsibility assigned to producers. A non-profit organization *Buyisa-e-bag* was established by the government utilizing levy funds, a joint venture between the government and the plastic bag industry. Therefore, the high involvement of the government. *Buyisa-e-bag* has two main purposes 1) ease in the collection by setting buy-back centers, and 2) create employment, provide supplementary income for collectors, and develop entrepreneurs. The responsibilities assigned to *Buyisa-e-bag* were to monitor and control with the duty to produce monthly and annual financial and performance reports (Mclellan, 2014). While sustainability in the operation of centers was proposed to be through the direct involvement of municipalities (Makgoga, n.d.).

The levy is collected by the South African Revenue Service and transferred to the Special Fund, administered by the National Treasury, while the Department of Environmental Affairs and Tourism (DEAT) service the liaison Buyisa to request funding for its operational annual plans. Nahman (2010a) reported that in the year 2006, 90 million Rand i.e. 5356854 USD of levies

were collected (3000 million bags × 3c per bag) of which 20% was allocated to DEAT, 13% was passed on to Buyisa, who then had to pay 5.4 million Rand to South African Bureau of Standards to enforce SUP standards for thickness and printing. Hence, Buyisa to be left with only 7% of the total levies collected while having the most responsibility to fulfill. Nothing to be surprised, after eight years of existence and collection of levy, collecting almost one billion Rand from consumers, none of the objectives pertinent to sustainable jobs and recycling was met (Mclellan, 2014; Anton Nahman, 2010a). A change in behavior was noticed as the public started to reuse their bags in response to passed on tax to consumers. Which on one hand added environmental benefit while on the other created finance and logistics issues. Since, the less revenue was being generated through a levy in response to a decrease in purchase from consumers, leading to employment and activity cuts at the organization responsible for recovery (Linda Godfrey, 2017; Anton Nahman, 2010b). The poor phase-out planning the initiative led to reduced levy to sustain the recovery activities, however, it also led to an increase in single-use plastic bag use. Also, the mismanagement of funds did not stimulate the recycling industry of single-use plastic bags (Anton Nahman, 2010b). Second, it was reported by various reports that funds allocated to *Buyisa-e-bag* were insufficient while the major chunk of tax revenue ending up with government departments. The allocation of resources during the development of policy was evaluated to be politically feasible, however, could not remain politically sustainable i.e. *to maintain its stability, coherence, and integrity as time passes, achieving its promised goals amid the ineviTable vicissitudes of politics* (Patashnik, 2003), hence, surrendered to corruption and setback.

5.1.3.2. Collect-a-Can

As a joint venture by two beverage and food can manufacturing companies; ArcelorMittal and Nampak, a PRO was established, Collect-a-can, registered as a non-profit company. It is responsible for reverse logistics (physical responsibility) and the physical recycling of cans while being funded for all its operations exclusively through these two companies, ArcelorMittal covering 60% of the financial stake. The other actors involved in the whole EoL management chain are the steel mills and foundries, to whom, collect-a-can send the recovered material from initial recycling. However, they only partake in the material flows of the EoL can management, no subsidies are allocated to them. ArcelorMittal, more recently, under its voluntary EPR commitments has pledged to incorporate recovered can in the production of mild-steel (Anton Nahman, 2010a). To sustain the supply, Collect-a-can buys used beverage cans from consumers and collectors above market price. Collect-a-can through effective subsidies increased the market price of the can hence increasing the quantum of supply of used cans. The other interesting aspect of Collect-a-can is its source model to impacts the role of SMEs and the informal sector (actors in the society and important to EoL management). Collect-a-can for its recovery accepts various quantum of collected cans, it sells a standard bag to accommodate 30 kg of loose cans (340 ml), baling machines landed on loans if the collector can supply ten tons of cans or more per month, and transport assistance provided at reduced cost per kilogram of the collected can. Overall, Collect-a-can involves a limited number of actors, such that no liability on the importers is posed. Collect-a-can's source model thus maintains cost-effective operations to sustain the return of cans. Also, unlike plastic bag regulations, collect-a-can tries to keep the incurred cost (passed on cost) to the collectors and consumers low (Anton Nahman, 2010b). This arguably could be because the motive is to recover material not to reduce consumption per day. In addition, cost-efficiency could be higher when producers themselves establish EoL management infrastructure while maintaining symbiotic relations with other actors in the society.

5.1.3.3. Glass Recycling Company (GRC)

The glass industry in 2006, a year later after signing the MOU, established a PRO; the Glass Recycling Company (GRC). Unlike Collect-a-can, GRC had involved government, the Department for Environmental Affairs (DEAT) together with its industrial partners; glass manufacturers, fillers, and recyclers (GRC, 2020a). However, the involvement of the government department has been limited to attain the political feasibility necessary for the initiative, as DEAT is obliged to no other responsibility. GRC limited its responsibility as PRO to facilitating the logistics and recovery for recycling but did not partake in the recycling itself. GRC does not buy or sell glass directly, rather establishes communication among various actors and facilitates the processes, e.g. registration, contracting. Following this model, GRC (2017) reports that 50,000 active glass collectors in South Africa are facilitated by buy-back centers or directed to potential certified buyers in the area. It does not provide financial or transport assistance in setting collection enterprises but provides personal protection equipment based on the evaluation criteria of the vendor. Concerning collection responsibility GRC set and operate glass banks (large containers) and payment to collectors across South Africa. GRC partakes with other actors in the chain by following an *advanced repurchase model* which accounts for a combined advance recycling fee with an incentive system (Anton Nahman, 2010). Under this model, a levy is paid on every ton to the two glass manufacturing companies, who serve as recycling companies as well (Consol Glass and Nampak Weigand Glass), at the point of purchase by the member companies, serving as advance fees or PRO fees (GRC, 2020b). These funding are used to cover all the expenses of GRC's activities; recovery and administration operation, the economic incentive to collectors, glass bank availability and operation, capacity building, marketing, and raising awareness (GRC, 2013). GRC involves various activities and operational means to ensure sustainable quantum of glass supplied and recovered. The salient characteristic of GRC in maintaining the recovery rate is capacity building of collectors by connecting them with the manufactures directly, adding entrepreneurial aspects to their activities (Anton Nahman, 2010a). Thus, offering good price to the collectors i.e. equivalent to that of virgin batch material. Like Collect-a-can, GRC does not provide permanent jobs but assist in capacity building.

5.1.3.4. PETCO

PET packaging industries in 2004 to avoid government regulations against the issue of PET waste and inadequate EoL management adapted the EPR principle and established a PRO, PETCO. PETCO, similarly to GRC also signed MOU with the Department for Environmental Affairs (DEAT) together with its industrial partners; bottlers, resin and pallet producers, convertors (David Black, 2016). However, it has been actively involved with the government. The government supports the PETCO initiative through research, education, and awareness projects, formalizing public-private partnership (PPP), introducing source segregation pilot projects, and enabling regulatory environment (PETCO, 2016a). As a PRO, PETCO facilitates the logistics and recovery for recycling but does not partake in the recycling itself. PETCO adopting a business model based on an advanced recycling fee (Anton Nahman, 2010a) supports the PET recycling market, keeping the price artificially high. Such that 70% of the total annual budget of PETCO is dedicated to supporting recycling projects (subsidies based on per ton of PET recycled), increasing collection rates, and developing end-use market, hence achieving annual *volume* targets (PETCO, 2016b). Therefore support recycling projects and recyclers particularly when the market for PET in unstable: *financial support for recycling operations and infrastructure, transport subsidies, and/or a safety net during adverse economic cycles* (Anton Nahman, 2010). Thus covering collectors under the scope as well – the recyclers pay on per ton basis to the collectors for the recovery of used PET 'at prices that are based on the prices recyclers themselves receive from PETCO' (Anton Nahman, 2010). The salient feature of this model is

its voluntary recycling levy, collected from convertors (converting resins into PET bottles), bottlers, and importers on per ton of resins purchased (PETCO, 2016c). Hence serving as PRO fee so to be used for its operational purposes. The recycling levy is collected by resin producers on behalf of PETCO. The resin producers along with other brand owners, e.g. Coca Cola, pay an annual grant to support PETCO operations. PETCO imposes *full* life-cycle responsibility on PET packaging and product producers, thus producers obliged to full physical and financial responsibility. Assuming the allocation of financial responsibility for recycling corresponds to the physical responsibility of recycling.

5.1.3.5. Normative Analysis of Allocation of Resources

In all the initiatives the allocation of role and responsibility to the municipalities is not emphasized. The producers perhaps enjoy the convenience of setting up buy-back centers and banks as their collection system. While the collection for recycling rates improving over the years gives producers incentives to work with the models they have established and not to invest in material recovery and sorting facilities. This perhaps gives municipalities a leeway as well to relax, considering that onus of sorting and recovering is on producers now. The main role has been played by the PROs in fulfilling producers' responsibility on their behalves, PROs play an instrumental role in the relatively successful execution of industry led EPR initiatives in South Africa. The information management roles and responsibilities have also been delegated to PROs who use different outlets and platforms for information sharing and awareness-raising including TV and radio services, programs in schools, billboard commercials, website and telephone services, etc. **Figure 10** shows the flows of material from waste generators to recyclers and end-users. The MFA points to the lack of synergy between the service chain and value chain questions the environmental soundness and social sustainability of this intervention. Given the status of the current waste collection system and reliance on the waste pickers for the recovery of material, the quality of the recovered material is not of priority, considering inadequate waste collection tends to produce 'dirtier' material. Furthermore, paying attention to the actors involved in the EoL product management, the waste pickers are not included in the scope of resource allocation (collector remained as the net bottom stakeholder in the supply of recovered materials), besides the significant contribution of waste pickers in the recovery rates.

In none of the reports by all the PROs, issues of quality of recovered material are not brought up, considering that recyclables are still being recovered from landfills with heavy contamination and brought to buy-back centers. Bringing the issues of contamination and quality is likely to add more actors and responsibilities in the model. Also, in the coming years when a threshold of collection for recycling be achieved in the absence of sorting and recovery facilities and source segregation, which makes some portion of the product and packaging ending up in the landfill despite scavenging, the effectiveness of voluntary initiatives, in the long run, could be questioned. There is certainly strength anticipated for mandatory initiatives and administrative instruments, e.g. continuous environmental improvement, incorporation of market mechanism, stringency (Tojo, 2004b). Considering the argument for mandatory and voluntary initiatives, the case of Collect-a-can does raise some questions. For instance, in the 20+ years its operation, Collect-a-can has not extended its service to other actors and no liability on the importers is posed. That per se is not against the EPR principle, as there are various ways of implementing EPR (see **Section 2.4.3**), however, it limits the possibility for importers to communicate with downstream managers and recyclers. Similarly, none of the initiatives mentions fines and penalties for producers to comply. In the case of PETCO, PET brands such as Coca Cola are not the members liable for an annual fee but contribute via grants, the

difference like membership fee and the grant could also be linked to the degree of responsibilities assigned to the actors, which in this case is unclear. In the allocation of resources for voluntary initiatives, monitoring of recycling activities is not made explicitly clear. The legislative EPR initiative for SUP bags has a department designated for monitoring, however, the whole project succumbed to other allocation inefficiencies. (Ojino, 2016) reports that PETCO verifies its collection and recycling results by independent auditors, however, the parameters are not verified. Since it has been the experience with many PROs that *are activities reported by the recyclers actually what happens?* Manomaivibool (2009a) suggests that these supporting mechanisms are very often overlooked, however, are *necessary* to the overall effectiveness of the programs.

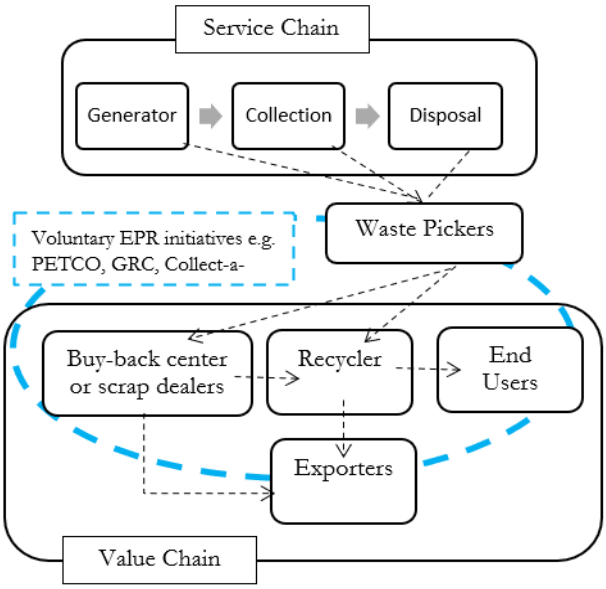

Figure 10: Material flows and the role of the informal waste picker in value- chains for packaging waste in South Africa and Pakistan. (Case of South Africa adapted from Linda Godfrey, 2017)

The voluntary EPR schemes in the context of South Africa have shown considerable success considering the recovery rates (see **Figure 11**). However, the social aspects of these initiatives remain questionable. None of such initiatives exclusively included the waste pickers in their scope of resource allocation (collector remained as the net bottom stakeholder in the supply of recovered materials), besides the significant contribution of waste pickers in the recovery rates. Waste pickers in 2014 contributed 80-90% of the packaging waste (L Godfrey & Phukubye, 2016), 53% of glass and 64% of scrap metals received (Sebola et al., 2018) being picked, sorted, and moved to the value chain in South Africa, while the trends remain same (Linda Godfrey, 2017). The absence of source segregated, and lack of integrated waste management initiative leaves waste pickers prone to unhealthy livelihood practices as the major portion of waste pickers are active at the disposal sites. Although the Department of Environment Affairs (DEAT) announced several times against the uncontrolled salvaging on landfill by waste pickers: "Uncontrolled salvaging on general landfill sites will be phased out as soon as possible and formal recycling centers following separation at source will be promoted" (quoted in L Godfrey & Phukubye, 2016), however, the number of waste picker working on landfill outgrew over time. BOP Lab (2008) in a co-produce report with Collect-a-Can shares the concerns for its *sourcing from* a model that *how to best ensure that its aim to empower lower-income individuals is achieved, while not compromising the viability of legitimate and established business ventures, which play an important role in the community*. The issue of inclusion of waste pickers in the value chain have been contested over a decade (see **Section 2.3**), the intervention of waste pickers very early on in the waste stream and at disposal sites supports the argument for inclusion in the municipal waste management system. However, considering that municipalities in South Africa are confined to

waste collection and no partake in recycling revenue to support further inclusion, puts producers under the limelight. The author believes that the debate surrounding the inclusion of the informal sector can take a progressive turn if issues of social sustainability of supply chain and impact of the quality of recovered material are taken as potential indicators for the measure of waste-related initiatives.

Table 6 shows a summary of identified key responsibilities and roles in the EPR initiatives in South Africa.

Table 6: Allocation of Key responsibilities for EPR initiatives in South Africa.

Scope	**EPR-based regulations (Year)**	**Producers responsibility**			**Stakeholders role**		
		Financial	**Physical**	**Recycling – recovery target/DfE**	**Separate collection/ recycling agency**	**Retailers**	**Consumers**
Single-use plastic bags	Mandatory (2003)	levy of 3c used as funding for collection and recycling by Buyisa-e-bag	None	30 m thickness & printing standards	Buyisa-e-bag (non-profit) company collects	None	Passed on tax to consumer, proposed cashback at buy-back centers
Tyres	Mandatory (IIWTMP) (2012)	Pay the advance recycling fee to REDISA	None	100% recovery or DfE measures taken	REDISA collects & outsource recycling[5]	None	Passed on tax to consumer
Metal cans	Voluntary (industry initiative) (1993)	Provide funding to collect-a-can (PRO) scheme,	Own recycling facility	100% recovery or no DfE measures taken	Collect-a-can (PRO) collects and recycles	None	Consumers paid above market price on returning
Glass	Voluntary (industry initiative) (2006)	Pay advance recycling fee to GRC (PRO)	None	100% recovery or no DfE measures taken	GRC (PRO) outsource recycling	None	Get cash on returning used glass to buy-back centers or scrap dealers
PET	Voluntary (industry initiative) (2004)	Voluntary levy per ton of PET purchased from resin producers – revenue used to finance recycling operation	None	100% recovery or no DfE measures taken	PETCO (PRO) outsource recycling	None	Get cash on returning to buyback centers or scrap dealers
Paper & Packaging	Under discussion, mandatory scheme since 2015						

Note: EPR: extended producer responsibility; DfE: design for environment; REDISA: Recycling and Economic Development Initiative of South Africa; GRC: Glass Recycling Company; PRO: producer responsibility organization. PET: polyethylene terephthalate

[5] REDISA supplied tyre feedstock to recyclers at no cost (Sebola et al., 2018)

5.1.4. Other findings

In South Africa, the informal waste pickers have gained increasing recognition over time and practitioners acknowledge their contribution, while, the formalization remains questionable (Sebola et al., 2018). (L Godfrey & Phukubye, 2016) observed that the perception towards the issues of formalization and integration of the informal waste pickers into the solid waste management system is divided into two major schools of thoughts in South Africa; a) formalization of waste pickers through SMEs and co-operatives as mean of integration; and b) extending responsibility of formalization of the informal worker to the formal entities, e.g. waste recycling companies. Questions of formalizations and integration are now more under discussion as the government has been seriously considering mandatory EPR for paper and packaging product waste (Linda Godfrey, 2016, 2017). The presence of informal workers in the waste management streams in South Africa has many similarities to that of Pakistan, however, the presence of later groups (other than waste pickers) are not reported as explicitly in South Africa's waste management sphere as visible and diverse they (informal recyclers, preprocessors, wholesalers) are in Pakistan. The social aspects associated with waste pickers remains the same while cascading effect to the recyclable could be assumed to lower in South Africa, considering the non-existent involvement of the informal prepossess and recyclers in South Africa. Nonetheless, these elements of the informal economy add to the overall complexity of waste management in Pakistan.

5.1.5. Analyzing Outcomes: Environmental Effectiveness of the EPR Initiatives in South Africa

In the evaluation, the collection rate is used as a proxy for environmental effectiveness as a measure for the immediate outcome of EPR-based initiative. The data for the collection of material for recovery is sourced from a peer-reviewed paper and have been triangulated from the available statistics on the websites and annual reports of the PROs. Collect-a-Can has been operational for 20+ years, however, only data from 2007 is used for consistency and comparison with other voluntary initiatives for the evaluation purposes.

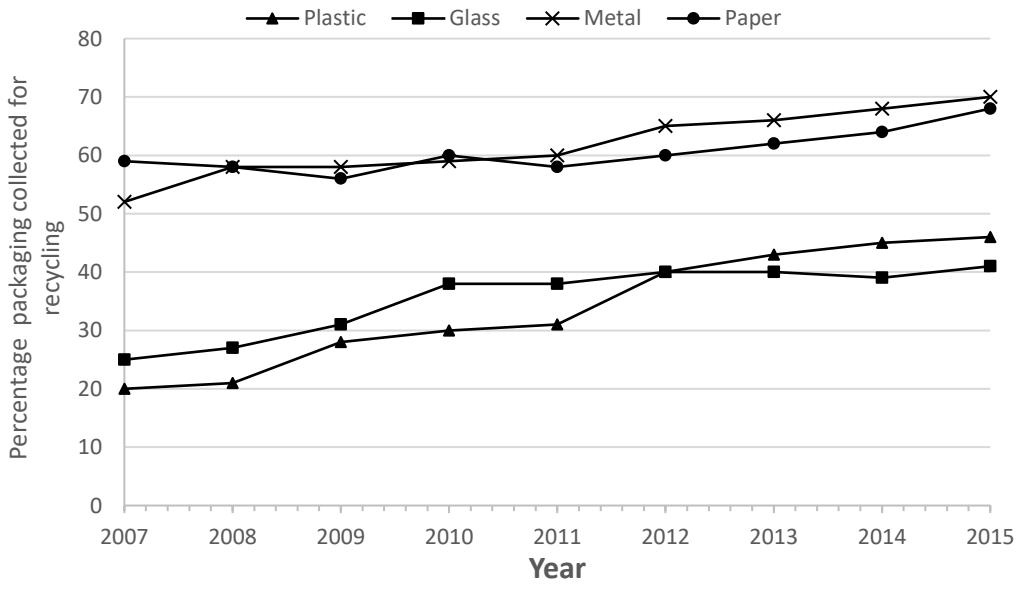

Figure 11: Historical trend in the recovery of packaging for recycling in South Africa. Source: (Linda Godfrey, 2017)

The transition from voluntary to legislative EPR program has been a great concern and threat to the producers to incentivize better collection and recycling rates. However, a push from the government on the set collection and recycling rates target was found lacking. There is no legal demand for set targets therefore, hard to assess these rates for their performance against a benchmark. The allocation of fees in the case of PETCO is based on volume recovered while for GRC and Collect-a-can is based on weight. It is to be noticed that these collections for recycling rates are not representative of recycling and should not be considered so. The 100% collection and recycling rate in the long-term ambition of all PRO, however, without any time frame mentioned. Nonetheless, gradual improvement in the collection rates was observed for all packaging types. Before the Collect-a-can, the market for scrap metals and cans was low in demand and supply, both, with no incentives to the consumers or collectors on return if they would (Anton Nahman, 2010b). Considering, Collect-a-can has attained a relatively consistent increment in the recovery rates from 52% in 2007 to 70% in 2015. The collection increment between 2008 -2010 had been low relative to other years but progressive. It conveys that the voluntary intervention of Collect-a-can is environmentally effective.

Similarly, the recovery rate of glass packaging before 2006 was low (20-26%) owing to the lack of stewardship to the glass products. Under the scope of GRC activities, it developed downstream infrastructures, e.g. buy-back centers and glass banks, providing economic incentives to consumers and collectors. There are now 4017 glass banks in South Africa, provided free of cost, and can hold 1800 bottles or 600 kg (full). These initiatives of GRC has attained a relatively consistent increment in the recovery rates from 25% in 2007 to 41% in 2015. The GRC seems to be struggling with its continuous improvement as the collection rate since 2010 has been on slow progress, 2012 onwards particularly i.e. only a 2% increment in the collection between 2012 and 2015. The GRC intervention had been successful early considering the improved collection from 25% to 42%, is modestly high, conveying the environmental effectiveness had been modest, greater insights would be needed in the socio-economic situation of the country for the explanatory analysis of the environmental effectiveness.

Among all the product packaging waste/material PET had the lowest recovery rate as low as 2% before the introduction of the EPR principle in the PET packaging industry in South Africa (Viljoen et al., 2019). PET being a *non-traditional* waste stream and vulnerable to various technical inefficiencies and limited information added to the unstable market for rPET and price volatility besides the fluctuations in oil prices or virgin PET. PETCO, therefore, played a role in bridging this gap between the demand of rPET for a multitude of end-user purposes and the low supply of PET (Viljoen et al., 2019). Considering, PETCO has attained a relatively consistent increment in the recovery rates from 20% in 2007 to 46% in 2015. It conveys that the voluntary intervention of Collect-a-can is environmentally effective. However, the social aspects of these initiatives remain questionable. None of such initiatives exclusively included the waste pickers in their scope of resource allocation (collector remained as the net bottom stakeholder in the supply of recovered materials), besides the significant contribution of waste pickers in the recovery rates. The flexibility to design the EPR implementation mechanism provides room for unequal gains in the supply chain and to use performance indicators for advantage and ease e.g. recycling rate vs quality of the recycled products.

5.2. End of Life (EoL) Management of product waste in Pakistan

5.2.1. Recovery of product waste material

End-of-Life (EoL) management of product waste in Pakistan faces several significant challenges, however, looking from the perspective of material circularity, all interviewees mentioned that Pakistan has good material recovery rates primarily due to the informal sector. The interviewee from Waste Aid UK shared his experience that, "In 2018, I visited landfills of Islamabad and Rawalpindi and there was nothing of value left behind. It was all organic waste and LDPE. Compared to Somalian landfills, where there is no market, there were PET bottles everywhere, the rivers were flooded with PET bottles". Another interview from the waste management company mentioned that dumpsites and landfills despite no source segregation or material recovery facilities receive organic mostly along with no or low-value waste, e.g. LDPE and multi-layer packaging (MLP). An interviewee from the municipality shared that LWMC conducted an internal report and found that "barely 2% of the recoverable (excluding organic) ends up in the landfill". Several interviewees mention that the informal recyclers and existence of a market for recyclables in Pakistan contribute significantly to the existing good recovery rates, "recovery is pretty good like I said the informal sector is efficient but not safe". However, these too good to claim recovery rates curtain various issues such as responsible supply chain, adequate waste management, quality recycling, counterfeit products, among many. This could also be taken as anecdotal evidence and information via interviews to assess the effectiveness of the informal sector.

5.2.2. Social Sustainability in EoL Management and Supply Chains

The focus on the social sustainability aspects of the supply chain remains scarce in Pakistan, like many other emerging economies (Morais & Silvestre, 2018). According to the interviewee from NGO, the desynchronization of the service chain and supply further the manipulation of various actors in the waste and material streams. Nonetheless, Responsibility *beyond the walls of the factory* remains sporadic to scarce and moot. An interviewee from a formal recycling company explaining their procurement process commented that they are aware that women, children, and marginalized groups are the core of the informal sector but it does not bother them since "we have no child-labor policy in our factory". The interviewee added that when actors further intervene in the supply chain for social sustainability compliance, more difficult it gets to track and monitor, "the percentage of compliance to no-child labor would be very low because they [wholesalers, suppliers] won't be able to control the whole supply chain and the activities involved". Another interviewee referred to the structuralist school of thought explaining the reason for limited compliance that both parties make rational decision i.e. to "carry on with their business or livelihood strategies".

Several key social sustainability issues, e.g. child labor, health and safety, working conditions, marginalized people, and gender were observed during the field survey and are very evident in EoL management throughout Pakistan - see Yawar & Seuring (2017) for a detailed account on the social sustainability issues in EoL management). One of the survey respondents shared that getting injured from needles is the most occurring incident since the mixing of medical waste is common. Another survey respondent mentioned that due to inadequate or no vehicle, they must walk miles every day. Therefore, having body aches is common in this business. Several interviewees mentioned that waste picking is mostly done by Afghan children. All survey respondents [waste pickers and small junk dealers] complained about the price volatility and low profit. Another survey respondent at the informal sorting area complained about long working hours and working conditions - he was 72 years old and working under the sun.

According to several interviewees, this is primarily due to the unequal gains in the supply and not beyond the wall of factory outlook.

The formal recycling companies do not engage with the waste pickers and scavengers, their point of intervention with the informal waste economy is wholesalers, who can meet their supply demands. While municipalities and private waste service providers tend to outsource or hire informal workers. Analysis of points of interventions of various actors shows a pattern of not *beyond the walls of the factory* manifesting in the EoL product management (see **Figure 12**), which if synced together or expanded in their horizons would complement each other while contributing to achieving diverse SDGs.

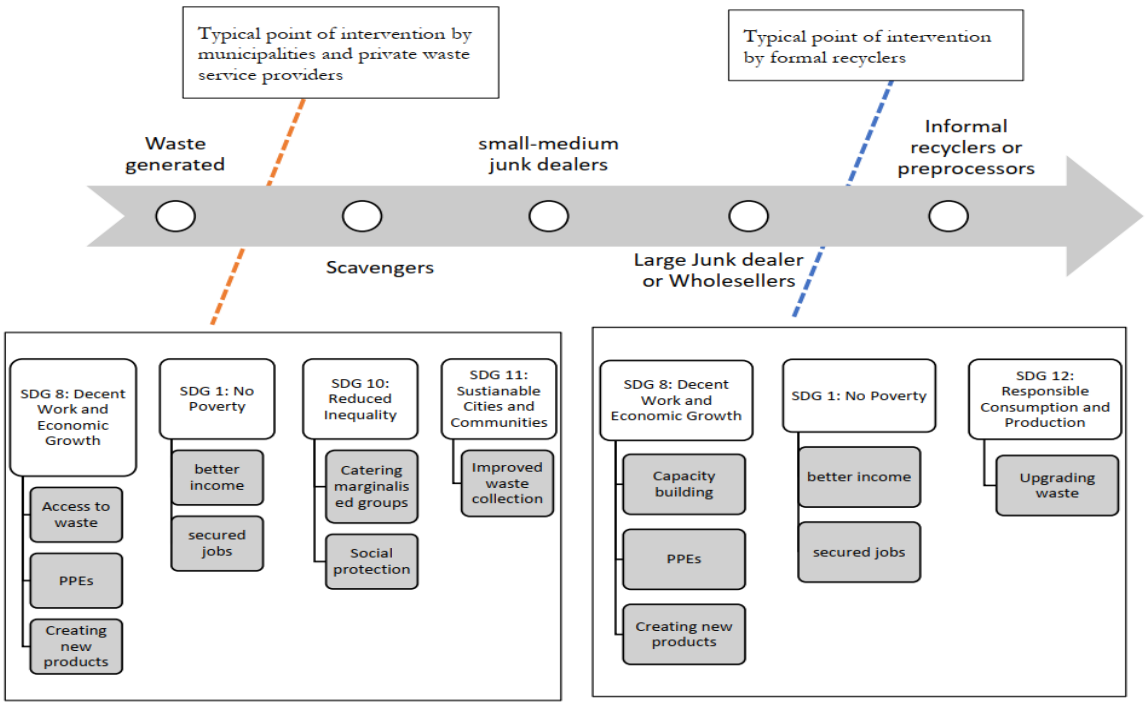

Figure 12: Point of intervention by stakeholder and untapped potential to achieve SDGs

5.2.3. Cascading Recycling

As emphasized earlier, recovery rates of recyclable materials, typically aluminum, glass, paper and cardboard, plastics (except LDPE), and metal are significantly high, however, it is later part that is inefficient and needs special attention, i.e. when moving further down the EoL actions chain (see **Figure 13**) for an overview of post-consumer plastic[6] waste flows and cascading effects at various stages).

[6] For simplicity, only plastic waste as product waste is considered to make relevant points and to explain the logic flows.

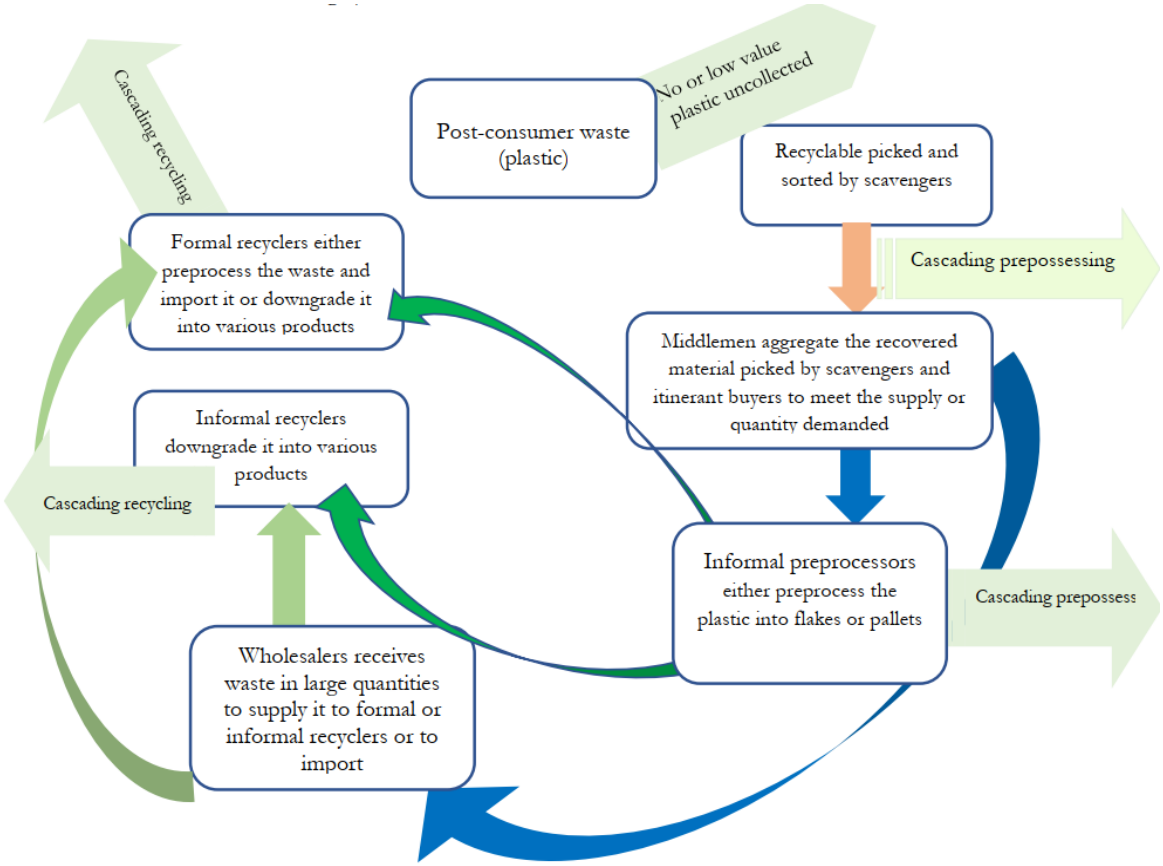

Figure 13: Post-consumer plastic waste flows

According to the interviewee from a formal recycling company, the first cascading liable to producers is observed in their practice, "we sometimes face issues in the quality of waste material. For instance, we informed Nestle that their juice bottles were not completely transparent but rather reddish, possibly color bleeding or design attempt. It affected our end-product (flakes)". Thus, a need for improved upstream and downstream communication was stressed. Lindqvist (2000, p 50) quoting McCarthy (1993) refers to this first cascading effect starts as the root of the problem:

Manufacturers are free to introduce new packages without concern for their impact on waste management. Not having to recycle the material, some use packages that interfere with the quality of what is collected. In recent years, waste management officials have complained about such packages … soft drink and water bottles that use PVC plastic. PVC is incompatible with the more common PET in recycling processes and is difficult to identify and separate.

The second down-cycling or cascading effect appears with cross-contamination which is highly pronounced due to lack of source segregation (even with source segregation contamination remains, however, the possibility and significance of contamination are reduced) or when a material is contaminated with lower quality/grade material or undesirable elements – aluminum is an example (see Koffler & Florin, 2013). Two interviewees from recycling company sided with the former reason that the issues with the quality of recycled material are pronounced more due to cross-contamination that occurs due to poor collection system and practices, "keeping Pakistan's waste management in context, we tend to get dirtier material as compared to the rest of the world". This cascading effect was commonly observed during the field survey. As, scavengers pick recyclable material from communal bins, commercial areas, and disposal sites. It was observed during the field survey that the informal workers were a knowledgeable

decline in the quality of material due to the mixing of lower quality material. According to a formal recycler, the price and associated profit to pre-processed PET and resin are directly linked to their quality; therefore, the informal sector is mindful of practices that affect their profitability. Several survey respondents explained how to sustain an appropriate quality of rPET, e.g. it requires removing of contaminants (labels, glue, ink, etc.) since other kinds of plastic (caps, labels, bottleneck rings, other plastic contaminants) have different types of polymers and do not always play well together, transparent HDPE has the highest price for its wider range for end-uses.

The next cascading effect comes in with a lack of capacity and variable recycling practices. According to the interviewee from the recycling company, the informal sector is huge and have varying practices which varies with locality and cities, affecting the end-use, "mostly are not aware that manufacturing end-product requires consistent and the highest quality". According to the interviewee from NGO, the informal recyclers use greater quantities of additives and have variable processes, resulting in low-quality products[7] - see Awaja & Pavel (2005) for a detailed account of the down-cycling of plastic. An interviewee from the recycling company explained that there are quality standards and set requirements that should be met for the processing of PET into flakes and resin to be recycled, while it is not hard to expect that the informal sector would not have such knowledge[8] due to limited resources and capacities. Another interviewee emphasized that it is important to note that shedding of plastic into flakes after washing is the very first prepossessing step, although washing has its intricacies as well (hot wash, cold wash, temperature, use of solvents, and washing agents, etc.). Therefore, if flakes are not of good quality it downgrades other recycling end-products and their further recyclability.

5.2.4. Issues with counterfeit products?

Counterfeit products and the black market have been very challenging to address across the world, considering the technicalities and resources involved in the tracing and monitoring of the products. According to the interviewee from the recycling company, counterfeit products thrive because of the profit it entails, not just from selling the bottle/product buy also "money off the product [brand] itself". According to one of the interviewees, any defect or default due to counterfeiting is reflected poorly on the principle company. Since consumers do not know if the product is counterfeit or not. However, the impact of counterfeit products is not limited to brands and manufacturing companies but EoL managers and recyclers. An interviewee from a PET recycling company explained that usually high-quality plastic (recycled PET, HDP, etc.) is used for the counterfeit product which is also required by manufacturing companies for their repackaging. This entails to a pull from two areas, pushing the recycling industry to suffer, "the quality that is required for recycling is not provided by the market because it is being used for something else". Issues with counterfeiting are potentially translated into quality issues since defaults in the counterfeit product packaging are frequent and manufacturing companies often do not address this issue due to various reasons (brand reputation, pressure from stakeholders, etc.). As one of the PET recyclers shared that they sometimes face issues in the quality of waste

[7] The technology and quality of recycled PET despite being inappropriate for food grade rPET, the demand for rPET is already sufficiently high due to variety of end-uses. (Anton Nahman, 2010b)

[8] During the field survey, one the informal worker involved in making plastic pallet chewed the pallet (the feed material could be medical waste plastic as was in many cases observed) to show how safe the whole process is.

material procured, e.g. Nestle juice bottles which they suspect as counterfeit products, "We did inform however received no response from them and still not fully managed or controlled"

5.2.5. Database

Currently, there is no database system in place either at provincial levels or national. Few reports are released occasionally due to external funding projects like the World Bank, JICA, etc. Producers do not share how many products they place in the market.

5.2.6. Market creation

There is a huge plastic industry in Pakistan, according to several interviewees, there is 'almost' no such plastic product that is not being recycled from bottles to car parts. The only plastic that is not being recycled is single-use plastic bags, LDPE, and the products which are made of multiple layers (MLP). An interviewee from NGO mentioned that 55 billion plastic bags are produced annually and thrown in Pakistan. According to the interviewee from consultancy the reasons for low scavenging rate hence, the recycling rate, is mainly due to the recycling cost compared to the profit from recycling these materials, although they are technically recyclable. Another interviewee mentioned that waste pickers do not bother to collect MLP or LDP because heavy contamination, "sometimes it is wet, or has dirt on it so it is of no use to them". Interviewee added that some organizations are taking initiatives to manage such waste, e.g. as RDF but they are being done on a very small scale, for the similar reasons mentioned above. According to the interviewee packaging with low recyclability and market value should be an onus to producers, "It is the packaging material that is a problem because that is not being recycled". Example of Tetra Pack was shared by two interviewees as a referral to creating market demand for such material (MLP) adapting the principle of EPR (see details of the case in **Section 5.6.1**)

5.3. Analysis of Relevancy for EPR in Pakistan

End-of-Life (EoL) management of product waste in Pakistan faces several significant challenges, ranging from the inadequate performance of waste service providers and municipalities, issues surrounding the informal economy, and lack of enabling environment to encourage moving up the hierarchy in the waste management. Despite the critical challenges, product producers are being looked up to own greater responsibility and to support the existing systems to facilitate capacity building, overcoming resource constraints, and fostering the development of EoL management processes and methods.

Collection Coverage and Collection Rate: Producer responsibility initiatives (mandatory or voluntary) correspond to its specified purpose and the program target such as collection rate, recycling rate[9], or both (Tojo et al., 2001). Relating to the fact that the waste captured by the system is 60% with a service coverage of as low as 43%, the likelihood that product waste is illegally dumped and openly burned is significantly high, increasing externalities associated with the product's overall life cycle. Particularly, in the existing setting, where Pakistan lacks basic recovery facilities and infrastructures while the informal sector contributes significantly to the waste recovery and recycling. It has been recognized that municipalities without the support from producers have 'too much' of a burden or responsibility on them. Thus, making municipalities entitled to charge (positive or negative cost) or assign responsibility to producers,

[9] Recycling rate may not necessarily focus on the quality of recycled/recovered material, downgrading of material (cascading recycling) remains point of consideration when setting such target, however, requires greater resources.

the *beneficiary*[10] of the product (Jacobs & Subramanian, 2012) conforming to the *polluter pays principle*. The quality of collected/return and recycled material could be argued to be of greater emphasis, as setting collection rates without considering the quality can create leeway for producers to skip the support/involvement for material recovery facilities and buying collected material from contractors[11]. Moreover, neglecting the quality of return would compromise the adequate EoL treatment and disposal method – e-waste is an example (Atasu et al., 2008; Gui et al., 2013). However, it is debaTable considering the EPR principle gives the producers the flexibility to develop a mechanism of implementation. The case study of South Africa shows that the industry-led initiatives have been environmentally effective i.e. maintaining relative consistent and decent collection for recycling rates without involving municipalities or including waste pickers. Nonetheless, reliance on the informal sector for collection for recycling does not address the other critical EoL management issues in Pakistan, e.g. cascading recycling, social sustainability in the supply chain, and downstream management infrastructure (see **Section 5.2**) which could be attributed to the negligence of producers on their part regarding the *liability* of product waste i.e. core principle of extended producer responsibility.

Social Issues: The question of the appropriate strategies for product recovery and EoL management remains critical. As the Structuralist point out, producers may maximize on the *pro-cyclical* role of the informal sector to the economy i.e. reduced recovery and labor costs, allowing producers to take advantage of these social issues as an added value to their net profit (Meagher, 2013; Navarrete-Hernandez & Navarrete-Hernandez, 2018) – as have been the observation of the author and reported by several interviewees. However, the EPR principle does not address these issues rather leave it to the implementation mechanism established for the context. The author believes that social sustainability issues of the supply chain should be added to the core liability principles of the EPR principle. A triple bottom approach under the scope of EPR should be further explored.

Cascading Effects and Communication between Upstream and Downstream: Three consecutive cascading effects were reported by interviewees 1) issues in product design, 2) cross-contamination due to inadequate collection system and mixing of material with lower grade material due to limited capacity of the informal sector, and 3) varying recycling practices and limited technical knowledge of the informal sector. EPR corresponds to all three of these cascading effects under its intermediate and long-term objects. Empirical evidence shows that assigning producer responsibility to the producer improves communication between downstream and upstream thus realizing the cascading effect and encouraging consideration of design changes (Oecd, 2016; Tojo, 2004a).

Logistic Issues: Competition for Recyclables and Perception of Waste: EoL management through EPR assigns the responsibility of product waste to producers, but not necessarily the ownership, therefore, logistics are designed, and economic incentives are created to recover and recycle materials. The profit from the recovered/recycled material is normally kept with recyclers. This marginal profit from recycling or/and reusing activities actuates the informal sector to claim ownership via performance (early collection and valorization) and out-competes the formal collection system if cornered or seeing them as a rival (competitor). Second, the formal recycling

[10] Since producers are not the only beneficiaries, therefore, cost is often passed onto consumers as internalized cost (price tag) or tax.

[11] This fragmented approach is contended in support for producer responsibility initiatives concerning e-waste in countries with the informal sector since e-waste is not normally thrown in bins, therefore, involvement of waste pickers in the value chain of e-waste remains relatively low.

firms in Pakistan are few, thus, questioning the recycling capacity in ratio to the product waste being produced. EPR principle sought this as the intended outcomes (immediate outcome followed by improved collection rate and collection system). For example, the EPR scheme of e-waste in India set its recovery target as 10% of total EEE sold in the past ten years, with a gradual increment of 2% every year (Manchandia, 2019). Adapting EPR principle financial support to the formal recyclers is provided in scaling up their business, developing the capacity of the informal recyclers and SMEs involved in the recycling. The case of South Africa serves a good example – see **Section 4.1**.

Market Creation: Considering the unofficially stated recovery and recycling rates of most of the product waste (PET, glass, aluminum, metal, paper, board), Pakistan is relatively industrialized and has the existing market with varying demand for the recovered materials. However, as pointed out in the **Section 5.5.2**, market instability and price fluctuations have been the foremost concern of the informal recyclers, correlating to their efforts put in the recovery and recycling of the waste material. The prices for aluminum and metal has been relatively sTable and better profit, however, little or no value exists for the recovery of multi-layer packaging (MLP) and most of the LDPE[12]. Thus, having the lowest rates of recovery for these materials (see **Section 5.2.6**). Essentially, the problem of securing (creation and stability) a market for recovered and recycled waste materials is of economics (Lindhqvist, 2000). It is important to have means for economizing product waste to be recycled and diverted away from inadequate and inappropriate disposal methods like landfilling (non-engineered), open burning, and dumping (Eichner & Pethig, 2000).

The extended producer responsibility principle with its underlying motivation and intended outcomes is analyzed to be relevant in addressing various EoL management issues in Pakistan. Since several contemporary EoL management issues and needs are linked to the intended outcomes and objectives of the EPR principle – see **Table 7**.

Table 7: Assessment of relevance of EPR in addressing EoL product management issues in Pakistan. Source (Author)

Contextual Problems	Intended Outcomes of EPR	Comments
Low waste collection coverage	Immediate Outcomes: Physical/financial responsibility	
Low municipal waste collection rate		Depends upon the EPR implementation model/way to involve municipalities
Lack of source segregation	Intermediate Outcomes: Best EoL management practices	
social sustainability aspects of the supply chain		Depends upon the EPR implementation model/way
cascading effect 1: design issues	Immediate Outcomes: Design changes	Could be pushed to intermediate outcomes or long-term goals
cascading effect 2: cross-contamination	Intermediate Outcomes: Best EoL management practices	
cascading effect 3: Limited capacity of the informal recyclers		Depends upon the EPR implementation model/way. It could become an immediate goal if formal capacity is insufficient to meet the recycling rate.

[12] The prices for other types of plastic also subjected to frequent fluctuation due its dependency on the oil market, lower oil prices imply cheaper virgin plastic, thus, reducing the demand for rPET etc. corresponding to free market.

variable recycling practices	Intermediate Outcomes: Best EoL management practices	
Few formal recyclers	Immediate Outcomes: Organizing infrastructure	
Counterfeit products		EPR implementation issue
Competition for recyclable products: logistic issues	Immediate Outcomes: Physical/financial responsibility	Responsibility of producers to meet the recycling rate by supporting recycling companies and initiatives
Poor upstream and downstream communication	Immediate Outcomes: Improved communication	
Lack of database and information	Immediate Outcomes: Improved communication	Information Liability
No to poor market for LDPE, MLP, and single-use plastic bags	Immediate Outcomes: Physical/financial responsibility	

5.4. Political Feasibility of EPR

5.4.1. Municipality

Motivation: Collection and recovery of the material present a greater chunk of cost and responsibility associated with EoL management of product waste (see **Section 5.2.1**). Relating to the fact that the waste captured by the system is 60% with a service coverage of as low as 43% (see **Section 2.1**) indicates the limited capacities of the municipalities. It was stressed by interviewees that municipalities without the support from producers have 'too much' of a burden or responsibility on them. Thus, motivating municipalities to charge (positive or negative cost) to producers, the *beneficiary*[13] of the product, conforming to the *polluter pays principle* under the EPR principle. According to the interviewee from NGO, municipalities are also interested in improving waste collection. An interviewee from municipality commented that the vested interest of the municipalities will motivate to favor EPR however, may create constraints for other actors, "when they start asking for money for waste service, thing go wrong". Case of refuse-derived fuel (RDF) was shared that despite the poor disposal practices and inadequate performance of the municipality in Lahore, the owner of RDF plant was charged with "50 rupees/ton for unsorted waste, from which he recovers material and rest sent to disposal site" – the RDF plant was shut after some time.

Resources: Municipalities for their long history, established network, and understanding of the ground realities serves as their main asset. According to the interviewee from NGO, the role of municipalities is critical as they have the entire cities and union councils mapped, with whereabouts of the informal sector and waste-related activities, "there are certain places where we could not get access unless we had government representatives with us".

5.4.2. Informal Sector

Motivation: The informal waste pickers I met during the field survey, had waste picking as their sole source of income to meet the needs of their families. Their activities varied from being individual to the family-based however unlike other parts of the world their activities did not organize collectively or part of any workers cooperatives. The livelihood-oriented approach of

[13] Since producers are not the only beneficiaries, therefore, cost is often passed onto consumers as internalized cost (price tag) or tax.

the informal sector is their primary motive for their role in the waste sphere. In the later groups i.e. junk-dealer, contactors, preprocessors, and recyclers most of them do not pay taxes which creates disinclination on part of the informal sector to bridge formal-informal links, viewing them cut in their profit margin. During the field survey, market instability and price fluctuations were emphasized as the foremost concern of the informal recyclers, indicating their desire to achieve stability by agreeable means possible – political feasibility of the inclusion of informal sector is analyzed separately in detail, see **Section 5.5**.

Resources: The strategic advantage of the informal sector due to their dominance in the collection and network services as their main asset – which if not properly accommodated, makes official schemes to encounter significant challenges, under a similar tone, some of the municipal officials[14] mention that "the scavengers make our job harder such that we cannot have a revenue-based project such as material recovery facilities because they leave nothing for us to make a profit off". Official schemes and projects in China reported confronting various common and critical challenges, e.g. financial deficits, overcapacity issue upon excluded them from planning (See **Table 8**).

Table 8: WEEE pilot projects in China and their reason to cease or fail

Source	Project description	Reason to cease or fail
(Ardi & Leisten, 2016)	A pilot project initiated in 2004 by Nanjing Jinze Metallic Material Co. Ltd. And Motorola ceased	- Overcapacity - Unable to compensate household in exchange of WEEE
(Steuer, 2017)	pilot projects in 2003-2005 failed	- Overcapacity: 47 collection stations barely recovered 1/16 of the yearly expected quantities
(Wei & Liu, 2012)	National pilot projects capacity to handle and process 600,000 WEEE items/annum in Qingdao (city-level project), aimed at testing a *producer-owned* model for recycling facilities. The total investment of US$1.3 million (15% by the government)	- Overcapacity issue: Haier (one of the major partners running the pilot project) barely processed 8000 home appliances by 2007.
(Yu et al., 2010)	UNEP's project in Suzhou, launched in 2006, serving as a technological part for WEEE management. Established to process 5000 tones/annum of selective WEEE items, e.g. CPU motherboards, and Li-ion batteries.	- Overcapacity, even though more than 400,000 WEEE in the area was discarded, the informal sector took care of most of them, leaving the formal recycling center with overcapacity issues. - Formal facilities could not compensate the consumers in exchange of WEEE collection equivalent to IS – IS offering 150-200 RMB while formal ones could pay merely 50 RMB

[14] officials were not interviewed but had short conversation during the field work

(Gu et al., 2016)	take-back system strategy as *old for new*, providing 10% discount on new EEE	- Significant financial deficit: The sharing of funds for WEEE collection formally increased IS profitability and bargaining power - Overcapacity - valuable parts/components from WEEE missing or replaced with cheaper ones – reducing the profitability of formal facilities

Second, the informal sector has a relatively low operating cost and a widespread network to their advantage. They need low capital to set up their business and to rely on their livelihood[15] assets. The tax evasion and lack of compliance of the informal sector have evolved them to work as a hidden economy, which creates market entrance barriers for formal entities and limits their business expansion and access to facilities and services. When planning EoL management system, it is important to realize that even if there are MRFs and waste pickers are hired or outsourced for sorting, few issues are likely to persist 1) pre-collection of the material before it gets to the MRF due to itinerant buyers, maids, and waste pickers that are not acquainted with MRF or such programs, 2) right to access to waste could be evoked, considering the thousands of livelihood depends upon, if not address strategically perhaps may lead to violence (worst case scenario), as reported by Kaza & Banna (2014) in the case of Jamaica.

5.4.3. Formal Recycler

Motivation: One the interviewees mentioned that the adoption of the EPR principle would play a significant role if PRO or interface organization is established so that the logistic issues and resources (time and finances) they invest in establishing symbiotic relations the informal sector would be taken by them. The other major motivation for the formal recyclers is their pro-business approach, a formal recycler interviewed mentioned that, if under the scope of EPR, producer would invest in capacity building in the informal sector, it will increase their profit (incentive) since they will be able to procure better quality product. Thus, minimizing the cascading effect (down-cycling of material). According to the interviewee from the recycling company, the workers involved in the informal sector are "mostly uneducated and not aware that manufacturing end-product demands the highest quality". Another interviewee shared that the informal sector involved in preprocessing, e.g. PET flakes and resins, use additives heavily and practice variable processes, resulting in low-quality products, "I could buy an extra 50 tons for recycling processes, however, the 40 tons up for sell in the market because the quality is poor, effecting my end-use". The other motivation mentioned by the formal recyclers is the price stability as rPET is sensitive to oil prices, affecting their supply and demand, "the market has a daily price this and that so whoever able to beat you about on 5o cent or 1 rupee wins the material - highly competitive". One formal recycler also indicated the availability of funds as a motive, since the informal sector works on advance payments (liquid flows) which is prone to scam– see details in **Section 5.5.4.**

Resources: Having a registered and licensed waste recycling is the main asset of the formal recyclers. Second, they have contacts in the informal economy which lowers the market entry barrier for the formal entities, "you need to develop a relationship with your vendor and buyer, which is your contract".

[15] The concept of livelihood encompasses assets, capabilities, and ways (activities, interactions, meaning, contribution) of living - which tend to be context specific (location, geography, time, background), dynamic, and people centric (Kanji et al., 2005).

5.4.4. Private Waste Sector

Motivation: According to an interviewee from a private waste service provider the profit margin offered by the producers is often not worth the effort, e.g. to set sorting facility, hire or outsource new employees and train them, "we rather do that under our name and earn more revenue".

Resources: Like municipalities, the private waste sector is equipped with the necessary resources to facilitate physical collection and knowledge of the areas under service.

5.4.5. Producers

Motivation: Global communities realizing the impact of EoL management of waste are prompting cities and countries around the globe to prioritize the issues of waste management and pushing the resource conservation approaches in the waste agenda. According to two interviewees, such influence is increasingly being observed in the corporate world as well, therefore responding to these exogenous factors, businesses are now integrating sustainability aspects into their core value chains, including end-of-life product management – serving as their motivation to adopt EPR principle. While, other of the interviewees mentioned that the EoL product management has not truly translated into the sustainability principles of businesses in Pakistan, such that producers play an occasional role, primarily in raising awareness in post-consumer waste management cycle, "Bringing producers to own the responsibility would only happen if they are legally bound". As EPR to producers would mean less profit margin. According to the interviewee from local NGO, producers are comfortable doing it as a CSR project than a legislative regulation.

Resources: MNCs in Pakistan enjoys a respectable status and influence. According to the interviewee from MNCs, their engagement with municipalities and government have been positive which is interesting to them, reason being is their status, "we asked them the reason for their cooperation, they replied, you are an MNCs". Similarly, better relations with NGOs as involving them for their CSR projects. MNCs also enjoy greater freedom and autonomy in their decision-making process while having greater budget for CSR that could be directed towards EoL product management.

5.4.6. Analysis

The existing capacities and performance of the municipalities (human, technological, and financial) leave room for producers to support and contribute to various means. Producers under the scope of their extended responsibility may opt for setting up collection systems and associated logistics separate from municipalities and tempted not to get involved in the tedious administration and political issues (see **Sections 5.4.1 and 5.5.1**). However, the empirical evidence shows separate and product-specific take-back or collection systems tend to be very expensive (see Eichner & Pethig, 2000). The municipality shared responsibility serves two benefits 1) the collection would be relatively cost-effective, no upfront cost for set up and operation, more of a service acquisition 2) municipalities have greater experience and understanding of the ground realities and informal functioning in the waste sphere. This shared approach, however, does not fully eradicate the social sustainability aspects of waste management. But very much like the financial and physical responsibility sharing, producers and municipalities both would need each other's support in developing capacity building and implementing inclusive approaches, which need to be very thorough and strategic.

The proposition of meeting collection rates and not particularly setting up the system for collection is likely to be put forth by the producers in the context of Pakistan, following the

pattern of the formal recyclers. However, such propositions are laid on the typical intervention point within the value chain i.e. reaching out to wholesalers and contractors for the supply of recovered (sorted or processed) material while leaving waste pickers under business as usual scenario. This intervention is a reliance on the existing competitive market for efficient waste collection (Jacobs & Subramanian, 2012), which has two limitation or setbacks; 1) This leaves the potential of activating *virtuous cycle* untapped i.e. initial success enables an environment for further improvement and success (Rogers, 2008) since waste picking is linked to various EoL management activities, e.g. the quality of collected/recovered material, 2) competitive markets and negative prices (artificial demand to meet the supply for particular product waste) are likely to have high inefficiencies (Jacobs & Subramanian, 2012; Lindhqvist, 2000).

The financial constraint and unwillingness of some producers to participate will significantly influence the scope of EPR, e.g. setting collection and recovery target, reliance, and inclusion of the informal sector, the role of the PRO. Such that producers will be key play, the adaption of EPR is likely but would significantly depend upon how the corporate sector will react and what sort of responsibilities be assigned onto them -emphasis on the laws and regulations to clarify the roles and responsibilities was given. It was emphasized that the successful execution of EPR would be very much dependent on those producers and the existing capacities of the municipalities and related institutions. For instance, the issues of covering the cost of free riders, counterfeit products, and orphan products would likely be asked to be taken by the state or share the cost. If the producers do not agree to bear the full cost of EoL management but partial, who will bear the rest of cost since existing capacity tells that municipalities are already limited in their resources. And if the cost is to be passed on to consumers, what mechanism would be to follow? Would producers be agreeing to it considering it may affect their sale? And many other technical and financial feasibility related concerns that are critical to the implementation mechanism of the EPR principle which requires considerable resources and time at all levels.

5.5. Role of the Informal Sector in the EoL Product Management, Is Inclusion Feasible? Why and for Whom?

The informal sector in waste management sphere is dominant throughout the post-consumer phases, from collection to end-uses. Thus, reinforcing the observations and findings presented in the **Section 2.3** of literature review. During my research, I noticed that waste pickers and scavengers were not always taken as the informal waste sector, almost all the respondents asked for clarification when referring to the informal sector in general, dividing informal waste sector into two broad groups: 1) waste pickers, and 2) others i.e. junk dealer, middlemen, wholesalers, recyclers, and processors – all together. This grouping was also because of the nature and type of waste service provision interviews were involved in and their interactions with the informal sector hierarchy. In general, municipalities and waste collection service providers interact more with waste pickers while formal recyclers and business entities interact with the informal groups beyond the middlemen in the informal sector hierarchy. The similar grouping has been observed in other countries with the informal sector (Wilson et al., 2006a). These interactions led to various beliefs and motivations for or against the inclusion of the informal sector in the EoL product management, as explained in detail in the subsequent Sections.

5.5.1. Municipalities

Motivation: The informal sector has long been involved in the waste industry. The informal sector provides collection services to areas that are not catered by formal service providers and municipalities. Sorting and segregation that technically should be the responsibility of

municipalities and service providers are done by waste pickers and scavengers mostly. These positive contributions of the informal community were well acknowledged by all interviewees – waste pickers and scavengers being appreciated the most. According to the interviewee from the municipality, 'scavengers do a service', as they minimize waste going to landfills and dumpsites without any charges. The role of the waste pickers was emphasized in sorting, as one of the interviewees mentioned, "we do not do sorting at the source, so waste pickers take the initiative and sort and select metal, paper, cardboard, aluminum, glass, Tetra Pak, carton". Despite the recognition, translation of believes and motives into practice for inclusion remains scarce.

Several interviewees pointed out the issues behind the lack of inclusion of the informal sector under the scope of municipalities are embedded in political and institutional feasibility than that of the recognition of the informal sector. According to the interviewee from the municipality, "they have not yet been included because there are bigger issues, issues of corruption and making money, who would think of waste pickers, it's more of a political issue than recognition from municipalities". Another interviewee mentioned that municipalities do not formally include waste pickers rather outsource them as mean of cheap labor so that they do not have to pay full salary and to insure them. Although, "all these expenses and finances are being provided by the government to the third-party contractors they put them under their profit margin and outsource their labor". Furthermore, it was mentioned by two interviewees that establishing links with higher officials and bureaucracy often manifests as the key motive opposing the inclusion program. One of the interviewee from recycling industry emphasized that the vested interests of the elected officials hold significant sway in the waste sector and exercise a relative control over the waste stream, such that "the ownership of the area kind of means the ownership of waste stream".

Interviewees from the municipalities and NGOs shared their experience that power-authority relations and political economy in the waste sector have been a struggle for decades, hindering public-private partnerships, let alone the inclusion of the informal sector. One of the interviewees from the municipality commented that 'the public sector behaves as they own the space and the private sector should work under us so that we can monitor them'. Referring to that the public sector has an 'inherent manufacturing default' that they prefer not to share their domain, Thus, leading to the lack of recognition of the informal sector and making inclusion 'next to impossible'.

Resources: According to one the interviewee from municipality, the authority that municipalities enjoy serves as a 'double-edge sword', on one hand, they have control over the area they serve, but on the other, are circumscribed by power structures. He commented that "board of these municipal waste management companies are not independent, making the decisions harder", therefore, often the proposal of inclusion or other projects are put off the Table considering 'too ambitious'. Besides, power-structure relations, the limited institutional capacity of municipalities hinders the transition of waste management systems to be more inclusive. An interviewee from the municipality shared that "under one of the LWMC's internal studies, we found out that the waste pickers are earning more than formally employed waste workers. So, they don't find any advantage to becoming more formalized or coming under our umbrella", suggesting municipality often does not have the sufficient resources to cater waste pickers' demands or to provide them with adequate incentive to assure them of the inclusive approaches. This position is reinforced by Nzeadibe & Ajaero (2011) showing a comparison between average monthly income of waste pickers against the minimum wage in Nigeria i.e. 153 $ vs 75 $ in 2009.

5.5.2. Informal Sector

Motivation: The informal sector has long been involved in the waste management and livelihood of thousands of the informal workers depends upon it. However, this motive alone does not make them a proponent of inclusion. Few interviewees mentioned that like the public sector does not want to lose its authority, the informal sector doesn't want to lose its freedom, "many of them enjoy the freedom especially when corporative have no financial incentives to offer". The other motive to oppose inclusion is feeling of loyalty and indebtedness. It was observed during the field survey that the dependence of waste pickers on middlemen was expressed as loyalty and indebtedness by the informal workers (waste pickers mainly) – reinforcing the observations reported by others (Fergutz et al., 2011; Medina, 2007; Rosa & Cirelli, 2018; Wilson et al., 2006a). Such that when asked about doing business with other than their dealer when provided with a greater price and incentives or asked to bargain price with their dealers, almost all denied right away, except few, "No, we won't give (recovered material) to anybody else, we don't do that because they facilitate us, this four-wheeler is provided by them, they help us a lot". Another survey respondent commented that it would be 'betrayal' to the middlemen as "he has been supporting since the beginning". Several survey respondents mentioned that middleman helped them start this earning, therefore, out of respect and recognition to their favor they will not engage with other than him [middlemen]. One the survey respondent referred to empathy that other actors in the informal economy have to make they are earning "he also has to provide for his family and take care of the business", therefore, opt to not bargain, suggesting there is not much profit in small waste transactions.

Resources:

Strategic Advantage in collection phase: Several interviewees mentioned that the dominance of the informal sector in the collection phase gives them a *strategic* advantage, "have you ever seen a newspaper or PET bottles going to the bin? The maids and residents sell it to Kabariwalas so if you introduce a material recovery facility you will be breaking this chain, but can you break it? Not really, because you cannot reach and compete at household and grass-root levels". Any material in the waste stream that has little value is picked and sorted by the waste pickers and put in the informal material economy. Junk dealers shared that maids are usually their second-highest waste supplier[16]. Maids and itinerant waste buyers appear to provide iron and aluminum, particularly to junk dealers. Given that these materials come directly from within households, it can be assumed that there is source segregation taking place in those households (Wilson et al., 2006b). However, unlike the type of source segregation required by municipal waste operations, this one is based on economic incentives only, exclusively involving the informal sector.

Inhibitor: Lack of other livelihood assets limit the ability of the informal workers to engage in inclusive approaches. One of the interviewee shared her experience that the Lahore Waste Management Company made efforts to include the scavengers in different union councils and formalize them. However, they were unable since most the informal workers involved in scavenging are afghans (war immigrants) who are poor and very limited in resources, such that do not even have identity cards, " they are scared of registration that they will have to pay taxes and it's already a difficult task for us (waste pickers) to earn a living". Another interviewee commented that the fact that informal workers do not even have ID card, creates mistrust for municipalities and government, making them reluctant to favor formal process. Another

[16] Questions related to female waste pickers role in selling not included in the survey. Data gaps make it difficult to calculate how many maids are associated both with IWPs and Middle Dealers

interviewee from NGO mentioned that the informal sector in Pakistan has no legal recognition nor do they pay taxes which creates disinclination on part of the informal sector to bridge formal-informal links, *"they (junk dealers and recyclers) are reluctant to interact, taking you as somebody from the EPA or the or that you are coming for an audit or call to down their business".*[17]

The unattended issues of war immigrants (Afghans) such as not being able to register or have identity cards were more pronounced by the informal groups during field surveys. Many responded during field surveys reported that they "don't have the right of access to bank account", thus, limiting the capacity to upscale and improve the income levels. This creates a vicious cycle that traps generations after generations into the waste picking business – a group of afghan waste pickers (more than 50 waste pickers) shared that they were in this business for past 40 years, their fathers used to do the same and now children of many are involved in the same business (See **Annex E** for the snapshots of these waste pickers).

The Exploitation of Groups in the Informal Waste Hierarchy: The bottom groups in the informal hierarchy, typically waste pickers, are exploited and conditioned that even if the waste pickers would prefer inclusion, middlemen would oppose. This reluctance manifests in various ways, e.g. limited negotiation and bargaining power, bonded wage, debt. One of the survey respondents shared his experience that "if we would deal with anybody else (to get a greater bargain), they (middlemen) will take away the facilities, so a lot of times we even cut our profit margin to keep the relations intact so that they don't doubt us that we have dealt with others". Few of the interviewees mentioned that **facilities** (e.g. transport, loan, credits) provided by middlemen possibly end up as a bond, "he [waste picker] dares defy the dealer". It is typically the nature of the informal waste economy that as the material moves up the informal supply chain it gets expensive, but Waste Pickers gets the least share. The unequal gains in the supply chain have been re-echoed by many authors (Dias, 2016; Fergutz et al., 2011; Navarrete-Hernandez & Navarrete-Hernandez, 2018; Wilson D, Velis C, 2013; Wilson, 2007a). Moreover, two of the interviewees from the private waste management sector mentioned that within the informal dynamics, individuals are cheated and deceived using various tricks such as replacing the valuables with look-alike substances and pre-sorting of recyclables from the circuits and products. It was well noted during the field survey that the waste pickers who showed a willingness to engage with inclusion approaches or formal-informal linkages had the usual basic facilities of their own. (See **Figure 14** for the facilitation flow with the informal sector – manifesting as top-bottom approach).

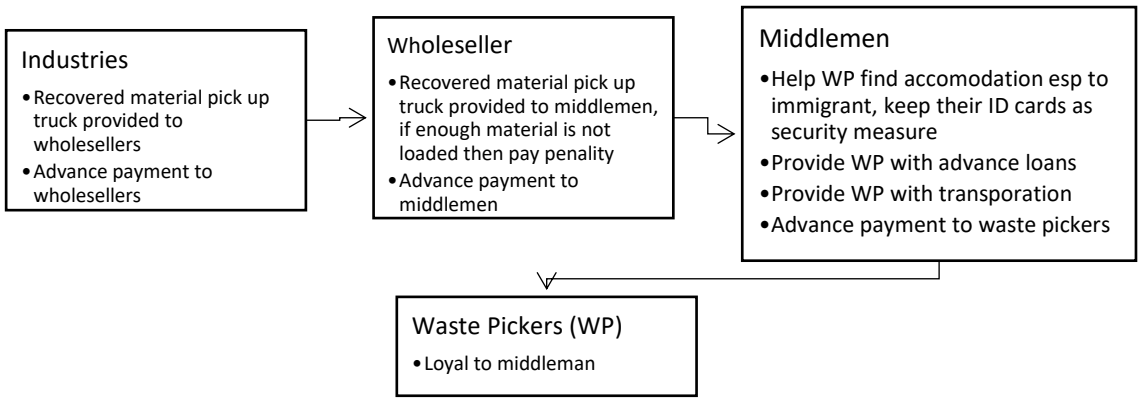

Figure 14: Top-bottom flow of facilities provided to different groups in the hierarchy of the informal waste sector

[17] This has also been my personal observation and experience when conducting field surveys

Ownership of transportation and storage space were observed to be critical factors regarding waste pickers' bargaining power, independence in decision-making, and business deals, and level of income. Most waste pickers transport recyclable materials in sacks, while some have access to wheelbarrows, donkey carts, bicycles, or retrofitted motorcycles – in most cases vehicles were provided by a middleman. Those with greater carrying capacity have higher productivity, thereby having a higher income (survey respondents). In general, both the waste pickers and small junk dealer (middleman) face various challenges (see **Figure 15**), which should be considered when planning EoL product management.

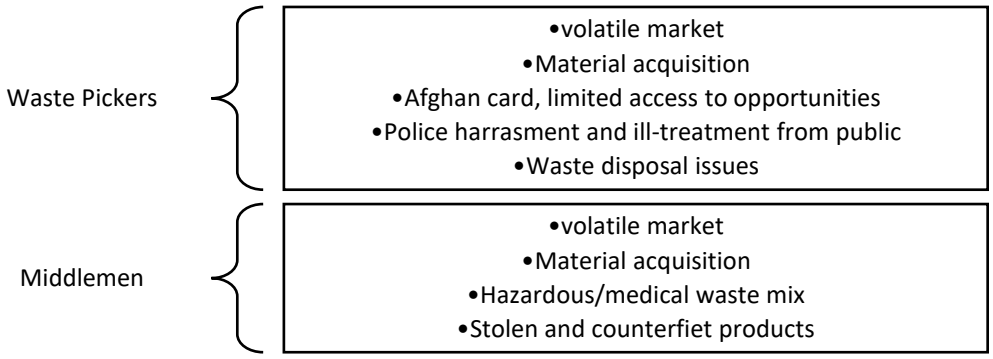

Figure 15: Challenges and problems faced by waster pickers and middlemen

5.5.3. Waste Management Companies

Motivation: An interviewee referred to the pro-poor sentiment as the motive to allow the informal sector do their activities in his delegated premises that "if informal workers were to pick recyclable, they (earlier generation in waste business)[18] would not interfere or limit their activities due to sentiments for the informal workers, knowing it is their only means of livelihood". Another interviewee from private sector echoing the narrative of the structuralist school of thought mentioned that the inclusive business strategies on part of private service providers could be reflected differently, many benefits from outsourcing the informal sector, a means of cheap labor, and low compliance. Lack of legislation and policies pertinent to waste management and the informal waste workers leave room for manipulation and corruption.

Resources: Waste management companies as private sector enjoy their convenience in operating waste management systems and not to be bothered about power structures as much as the municipalities do. All interviewees from private sector expressed similar recognition to the contribution of the waste pickers as the municipalities did. However, their relative freedom and resources allow them to translate their motives accordingly. One of the owners of the private management company shared his community-based project (still ongoing) wherewith informal waste collection service providers, who earlier had been providing the collection services to the residents (door to door collection) and would pick the recyclable material and were dumping the rest of unwanted waste into Rawal dam [waterbody] and in the vicinity Margllа forest area (protected area). However, now these informal workers work with him, "we converted them from informal service providers to subcontractors, on terms that they will continue providing the door to door services to the residents but will not dump the left-out waste rather dispose at our designated points. Also, they were not to charge any collection fee from the resident since they were under our contract". According to the interviewee from private sector, the time and capacity-building commitments when working with the informal sector often becomes a tedious task, making formal entities reluctant to work

[18] Clarification to earlier generation was made to point out the younger generations upon having better access to global trends and best practices are putting efforts to have more inclusive approaches.

with them. He shared his experience for hiring the Afghan workers for street cleaning jobs that the lack of IDs presented them with a set of issues, such that a normal task of paying the wage to the informal sector became a time-intensive process and make auditing prone to setbacks, *"we tackle this problem of payment by taking photographic evidence of the individual waste picker [when contracted on the monthly or longer period]"*. Which together with a low level of education, becomes a tedious task since waste service provision is not a task of few employees and monitoring their actives (attendance, performance) becomes onerous: "*it took me two months to teach them [employed informal workers as sanitary workers] how to use WhatsApp to share pictures (photographic evidence)*".

5.5.4. Formal Recyclers

Motivation: Pro-business attitude was observed to be the main motivation for engaging with the informal groups. However, none of the formal recycler engages with the waste pickers due to their low supply capacity. As one of the interviewees mentioned "we procure PET bottles in tons on a weekly or monthly basis. Hundred bottles are usually equal to one kg so, you can imagine how much they can collect per day". According to the interviewee from formal recycling company, the strategic advantage of the informal sector in the collection phase pulls the formal sector to interact and perhaps depends upon the informal sector, which then leads to the informal sector having great bargaining capacity, "I can't compete with them (waste pickers), and they work efficiently just not safe. If I need ten tons a day, I will go to a vendor that picks up or has the capacity of ten tons a day". Another interviewee mentioned that "we rely on them", therefore, the formal recyclers tend to establish a *symbiotic* relationship with the informal sector. The other major motivation for the formal recyclers is their pro-business approach to intervening with the informal economy so that better quality product is procured to minimize cascading effect (down-cycling of material) – see **Sections 5.2.3 and 5.4.3**.

Resources: Interviewees from the formal recycling companies mentioned that unless the waste flows are from business to business (B2B), competing with the informal sector is next to impossible for the collection for recycling purposes. Since Pakistan does not have an adequate waste management system established that would allow formal recycling to procure required waste material from/with municipalities, the reliance on the informal sector will remain, "without them [informal sector], you have made your supply chain or raw material very expensive to get collect". Another interviewee from recycling company mentioned that although, "they are backbone of industry", the hidden nature of the informal economy due to limited resources, lack of registration, no contract, and lack of compliance to regulations limits the resources and motivation to engage with the informal sector, "it took me five years to understand the whole supply chain, pricing the vendors, and dealing… there is no registration, you cannot reach online or formally through authority or representative, it is hidden so I've had to go through a reference every time". Subsequently, it sets business dealings prone to scam and cheat. One of the formal recyclers reported to be the victim of fraud, "I have lost a bit of money giving in advance payments to buy material to process". Another aspect of the informal economy is the cash flows, for formal entities like recyclers it acts as 'top-down method, limiting their resources to engage with them. Under this top-down model, the whole supply chain works on advance payments, "Somebody already pledged their waste to the person above" (the informal groups consider this as facilitation, see **Section 5.5.2**). For instance, waste picker already pledges their waste to the middleman, who has either pledged to a bigger junk dealer or has already taken money in advance – the waste/material is already pledged up to the manufacturing. So, when a formal entity partakes in the supply chain, with prior contact or reference, it creates market entrance barrier for the formal recyclers. It is to be noted that the issues that the formal recyclers confront when dealing with the informal sector would be transferred to the PRO when EPR principle is adapted.

5.5.5. Producers

Motivation: Recent progress by some of the multi-national companies (MNCs) towards sustainability, push from local NGOs, and raising awareness in public has led them to get more involved in the waste sphere, which is creating a bridge between MNCs and the informal sector. An interviewee from an MNC shared that according to the initial feasibility for their upcoming project (for details see **Section 5.6.2**) to address their plastic waste, they will be working with the informal sector since they are "very efficient". According to the interviewee from municipality, the international and national experience shows that competing against the informal sector brings significant logistic and cost-related challenges which the producers will strategize to avoid. Hence will be their motivation to engage with the informal sector. Pro-poor sentiments were also mentioned by the interviewee from an MNC as their other main motivation for inclusive approaches, "we don't go for scavengers because there is a large percentage of child labor involved and since most of our clients are professional companies MNCs, FMCGs, they do not want to come even close to any sort of child labor in the process". Another interview commented that such approaches of cornering and neglecting the informal groups/workers do not solve the issue, "there are different types of child labor, at times you will find kids helping their family after school – while multinational companies could come and say we don't want any sort of child labor. So, do we preclude from working with these people? I thought we wanted help and work with marginalized groups".

Resources: Relatively, they have greater flexibility to invest due to the corporate social responsibility (CSR) budgets, as one of the interviewees from local NGO commented, "they have internal targets to meet". Another interviewee shared their plans for material recovery facility and recycling funds, suggesting a stronger footing in the resource area.

5.5.6. Political Feasibility of Inclusion of the Informal Sector in the EoL product Management

The issues with lack of inclusion of the informal sector in the waste industry could be categorized into two broad groups – it was observed that 'integration' and 'formalization' had no standard definition, therefore the scope of integration varied. Nonetheless, municipalities' view of integration was found to be limited to the issues of waste pickers and scavengers while formal entities (recyclers and industry) more concerned with later hierarchical groups within the informal economy i.e. middlemen and whole sellers. See **Figure 16** for the overview of the reasons (motives and resource challenges) behind the lack of inclusion of the informal sector in the waste industry in Pakistan.

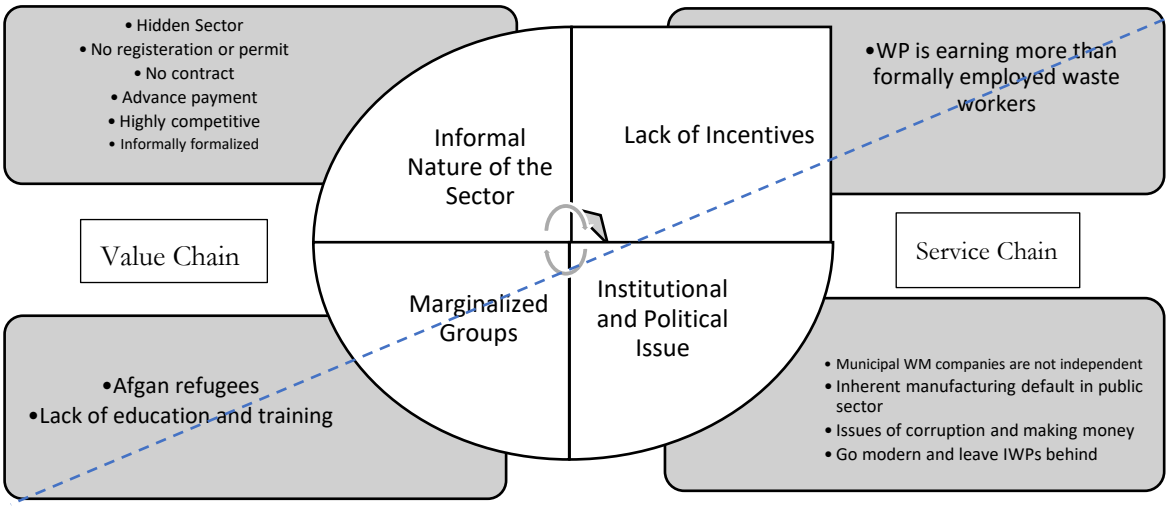

Figure 16: Reasons behind the lack of inclusion of the informal sector in the waste sphere in Pakistan

Municipalities: Inadequate performance and limited capacities of the municipalities create opportunities for the informal sector to intervene in the waste stream very early on. This intervention, however, not desired due to various health and environmental issues as explained in **Section 2.3**, takes place nonetheless and is considered as a *service* for their positive contribution. Despite, the acknowledgment, the effort for inclusion had been very limited by the municipalities. As one of the interviewees from the municipality mentioned that, municipalities such as of Lahore (Lahore Waste Management Company) and Gujranwala had made some efforts towards the inclusion of the informal sector, however, were limited to case studies – while not even a single pilot project has officially been reported on this issue. The reasons are embedded in political and institutional feasibility than that of the recognition of the informal sector. As power-authority relations and political economy in the waste sector have been a struggle for decades. Resource constraints owning to these institutional inadequacies and money-making interests, unable to meet waste pickers' demands, or to provide them with adequate incentive to assure them of the inclusive approaches. This conveys that for municipalities to get involved in the inclusive approaches will need support and push from producers, else owing to their tedious administration and political issues the possibility to engage the informal sector remains very low.

Informal Sector: As mentioned earlier, the categorization of the informal sector into waste pickers and other groups by the interviewees presented a rather different *appreciative system* i.e. view of the issue, *different attitudes to what is a 'fact'* (Hudson, 1995). Therefore, motivation and resource strengths and weaknesses manifested differently. Waste pickers due to their limited capacity, exploitation, and sense of loyalty were found to have lower political feasibility, however, it is subjected to change if provided with an adequate incentive, in case of actors who cannot engage due to their circumstances, e.g. debt, bonds. The later groups as a *facilitator* to the lower bottom group have relatively more resources and less motive to engage unless considered as business actors and equivalent stakeholders. The later groups are less likely to be accommodated into material recovery facilities and take-back systems, rather the practice of technical upgrading and technical capacity building is common in countries with the informal sector to increase political feasibility of such intervention (Akenji et al., 2011; Williams et al., 2013b; Yu et al., 2010).

Formal Recyclers: The efficiency of the informal sector in the collection phase owing to their strong social asset gives them a strategic advantage that creates mutual dependencies between the informal and formal sectors, although the formal sector at times is more reliant on the informal sector. So, the inclusion informally is already happening, the formal recyclers have adapted their ways around the informal economy to sustain their supply-demand. The fact that

formal recyclers already have well established relationships and linkages with the informal sector conveys that they be in favor of a more institutionalized market.

Producers: Considering the multifaceted and complex nature of supply chain social responsibility issues, MNCs tend to go by not *beyond the factory wall* rules will cause some reluctance among producers. However, owing to various exogenous factors and sustainability targets of the MNCs, producers are more likely to engage the informal sector.

5.6. Voluntary Extended Producer Responsibility Initiatives in Pakistan

5.6.1. Case of Tetra Pack

Green Earth Recycling (GER) has been involved in recycling since 1992 with the mandate to recycle various kinds of post-consumer and post-industrial materials i.e. laminated and non-laminated paper and plastic products. Thus, leading to a diverse portfolio of clients, however, few interviewees mentioned the case of Tetra Pak exclusively as an example of voluntary EPR initiative in Pakistan. Tetra Pak claims to recycle 32% of the total beverage carton every year. In 2013, Tetra Pak contracted with GER to recover and recycle its used beverage cartons (UBCs), applying the principle of EPR. GER informed that before Tetra Pak Pakistan was working with local paper mills to pulp the UBCs while paying a 50% plus subsidy to make the paper pulping viable. Since paper mills could not recycle all components due to their technical limitation. The unrecycled components were inadequately disposed of; therefore, tetra Pak then initiated a new collaboration with GER. GER source UBCs from factories including Tetra Pak itself, 'pretty much' every small and big filler, contractors, and collectors (informal wholesalers).

GER representative mentioned that given the status of the current waste collection system, they tend to get 'dirtier' material, therefore, now they are planning to involve municipalities and waste management companies to assist in cleaner procurement. GER in the absence of an interface/logistics organization also serves the purpose of PRO if required, "we negotiate deals separately with different suppliers and producers, depending on how difficult and costly it will be for that particular materials to be recovered and what is the intended degree of recycling or end-user utility asked for. It also depends on whether the client wants us to collect from the market or they will supply materials themselves that plays a role as well". This theoretically could be argued to bring upstream design changes of DfE (Design for the environment) considering that manufacturers are working closely with the recycling industry and getting feedback (monetary) from recyclers about their products and to analyze what changes could cost them less, however, continuous improvement may not occur. GER representative mentioned that their clients (MNCs and FMGCs, including Tetra Pak) are concerned about, but 'recycling does not seem to be the main motivation behind'. The most producers do is to make material changes with ones that have existing recycling market value so that it is taken care of by the informal sector, "but if to put recycling in perspective, e.g. make it thicker, bulkier, so it is easier to collect or easier to recycle – we were not there yet". The interviewee from WWF-Pakistan mentioned that WWF is the technical partner of Tetra Pak and have set up another recycling set up 'Decent Packaging'. Tetra Pak provided subsidies to import recycling machinery.

5.6.1.1. Analyzing Outcomes: Environmental Effectiveness of the Tetra Pak Initiatives in Pakistan

In the evaluation, the collection rate is used as a proxy for environmental effectiveness as a measure for the immediate outcome of the EPR-based initiative. The data for the collection of material for recovery is sourced from a GER itself (see **Figure 17**). The data represented below are project projections of Tetra Pak, however, GER mentioned that the actual rate varies *slightly*. The collection of 9400 tons of UBCs was reported was the interviewee from the local NGO, who conducted a joint study with Tetra Pak. This project was also covered news media, therefore, triangulation only for this data point was possible. There is no legal demand for set targets therefore, hard to assess these rates for their performance against a benchmark. The allocation of recycling fees varies with changes with end-use product specification and the volume of UBCs provided by the Tetra Pak itself to meet the set target. The performance of GER is measured in terms of volume of material collected for recycling, verified by independent audit (audit details were not disclosed). According to GER, these rates are representative of collection and recycling, both. The end goal and time frame were not mentioned.

A gradual improvement in the collection rates was observed for all packaging types. Before this particular initiative, the 9400 tons i.e. 12-20% of total UBCs were already being recycled informally due to the high paper content i.e. as much as 75%, in the UBCs (The News, 2011). However, only the recovery of the paper or pulp portion of the packet was targeted while leaving the Poly Aluminum or PolyAl (together 25%; polyethylene 20% and aluminum 5%) to be openly burned to recover aluminum. The GER/Tetra Pak seems to be struggling with its continuous improvement as the collection rate since 0% increment is reported in 2017-2020. Considering, Tetra Pak has attained a relatively consistent increment in the recovery rates from 12,500 tons of UBCs in 2013 to 20,000 tons of UBCs in 2020 i.e. 32% of total UBCs collected (this percentage was retrieved from Tetra Pak's marketing video - GER commented that it Tetra Pak's claim since they know how much of the product they put in the market). Considering the before this intervention, the informal sector was recycling 12-20%, the 12% increment (although it is not verified that if this 32% is inclusive of the informal recycling, the author assumed it to be formal recycling only) is modest. The transparency and information sharing on part of Tetra Pak are significantly low. Nonetheless, considering increment in more tons of UBCs being recycled formally by GER conveys that the environmental effectiveness voluntary intervention of Tetra Pak had been modest.

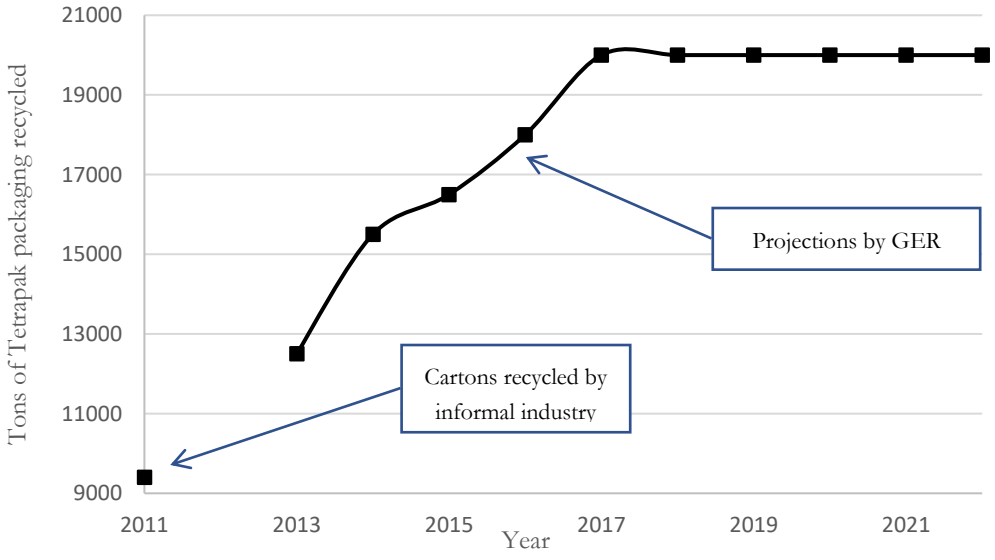

Figure 17: Recovery for recycling quantum (reported for 2011 and projection by GER for 2013-2022)

5.6.2. CORE Alliance

CORE is a project initiated as an alliance of multinational companies i.e. Nestle, Coca Cola, Unilever, Tetra pack, Engro, and packages in collaboration with non-profit organizations, e.g. WWF Pakistan. It is an industry-led voluntary initiative, having elements of the EPR principle. The representative of WWF Pakistan explained the scope of the project as "the idea is to recover, recycle, use a vending machine mechanism [at specific points, generally for awareness], and to add the commercial value to the waste". The manager circular economy at Engro explained that the motivation behind the alliance is intrinsic and extrinsic both, e.g. internal sustainability targets, globalization, and global pressure, and environmental awareness of issues. A representative from WWF-Pakistan mentioned that MNCs are *inspired* by the issues of ocean leakages and single-use plastics, therefore, a quick assessment of the issues was conducted which shaped the project focus areas including 1) sorting and sources segregating of waste, and 2) the informal recycling industry. The scope of the project is relatively broad and has several components to it: "we realized that if we have small intervention it may look nice and optimistic, but it would not solve the waste problem". Therefore, has a spectrum of ideas such as setting up material recovery facility, recycling funds, incubation unit, establishing circular plastic institution and data-driven system, among others.

Project CORE is a co-investment and collaborative initiative; however, the funding mechanisms and assignment of responsibility are yet to be formally put forth. Nonetheless, the concerns for limited financial resources were raised against the significance and breadth of EoL management in Pakistan. A representative from WWF-Pakistan explained that the implementation approach to recovery of the product waste (plastic waste stream with the focus on PET) is to set up a semi-technical material recovery facility with conveyor belts and waste-pickers hired as sorters. The project does not intend to facilitate permanent jobs for collectors/waste pickers but to provide collectors with the opportunity to get supplement income and assisting in setting up recycling-related entrepreneurial operations: "the plan is to make small businesses work whereby they do not need much education and its skill that is required, which they already have".

5.6.2.1. Theory-Based Evaluation

These initiatives in their rudimentary form lack certain fundamental constituents that the author believes are minimum requirements to hold to the theory and implementation mechanism of EPR (see **Section 6.3**). For instance, project CORE, although yet in its planning phase, was unclear in its immediate and intermediate goals/outcomes. Also, the community-based monitoring approach that "it's just going to be run by the junk dealer" lacks the fundamental link to the long-term goal of the EPR principle i.e. cleaner product system, design for environmental, and sustainable production and consumption. CORE project appeared to be lacking the monitoring and sustainability indicators in its theory of EPR implementation. This also raises concerns for the reported exploitation of waste pickers by middlemen, Medina (2007, pg 257) indicates three sources of exploitation, 1) middlemen (junk-dealers), 2) corrupt leader (this could also be extended to companies where lack of active leadership and negligence contribute to persistence social issues in supply chain and EoL management), and 3) repressive attitude and policies from the government. The issue of exploitation of waste pickers by junk dealers is explained in detail in **Sections 5.2.2 and 5.5.2**. Many authors are of the view that the challenge is not only to encourage partnerships and co-production but also to ensure equiTable distribution of gains to waste-pickers through capacity building and technical upgrading (Navarrete-Hernandez & Navarrete-Hernandez, 2018; Wilson D, Velis C, 2013; Fergutz et al., 2011; Wilson et al., 2006a).

Figure 18 shows Material flow analysis (MFA) for physical flows of product waste under existing EPR based intervention in Pakistan. Note that although the voluntary EPR based initiative by tetra Pak shows a moderate level of environmental effectiveness when recycling rate is used as a proxy, the MFA points to the lack of synergy between service chain and value chain questions the environmental soundness and social sustainability of this intervention. Given the status of the current waste collection system and reliance on the waste pickers for the recovery of material, the quality of the recovered material is not of priority, considering inadequate waste collection tends to produce 'dirtier' material. Furthermore, paying attention to the actors involved in the EoL product management, the waste pickers are not included in the scope of resource allocation (collector remained as the net bottom stakeholder in the supply of recovered materials), besides the significant contribution of waste pickers in the recovery rates. The project CORE, however, in its rudimentary planning mentioned the inclusion of the waste pickers at material recovery facilities while the confidence to the initial planning could only be assessed upon implementation and degree of success.

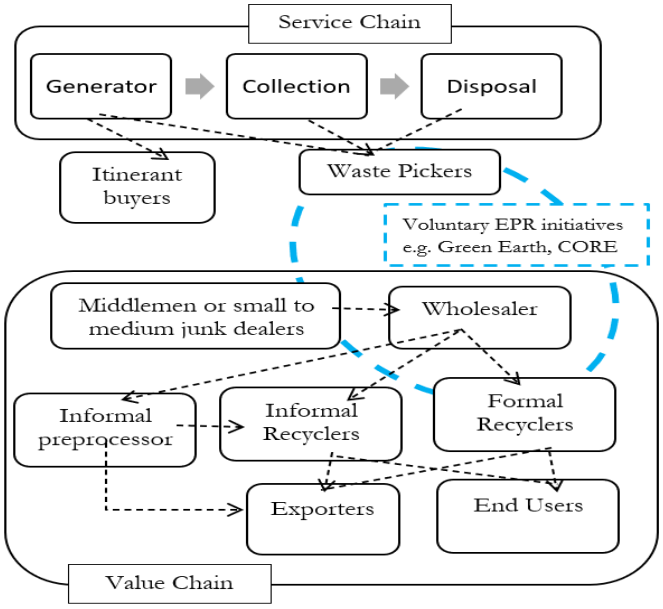

Figure 18: Material flow analysis (MFA) of existing EPR based intervention in Pakistan

6. Discussion

This chapter critically discusses the findings and analysis of the **Result Chapters** – the discussion on the findings and analysis is explained by proposing two models of EPR implementation in Pakistan. This Chapter also critically analyze the research methodology, analytical framework and theories, and their influence on the results of this research.

Two models of implementation are proposed considering the political feasibility of the EPR acceptability and inclusion of the informal sector (see **Sections 5.4 and 5.5**). These models are developed considering the contextual issues of EoL management relevant to the EPR goals and the *subjected to implementation mechanism* concerns as identified under the analysis of relevancy (see **Section 5.3**) and learnings from the case study of South Africa (see **Section 5.1**) and literature review. The models are framed following theory-based evaluation (TBE) (see **Section 3.2**) and Manomaivibool (2009) framework (see **Section 4.8.1**). **Figure 19** shows the graphical representation of the models.

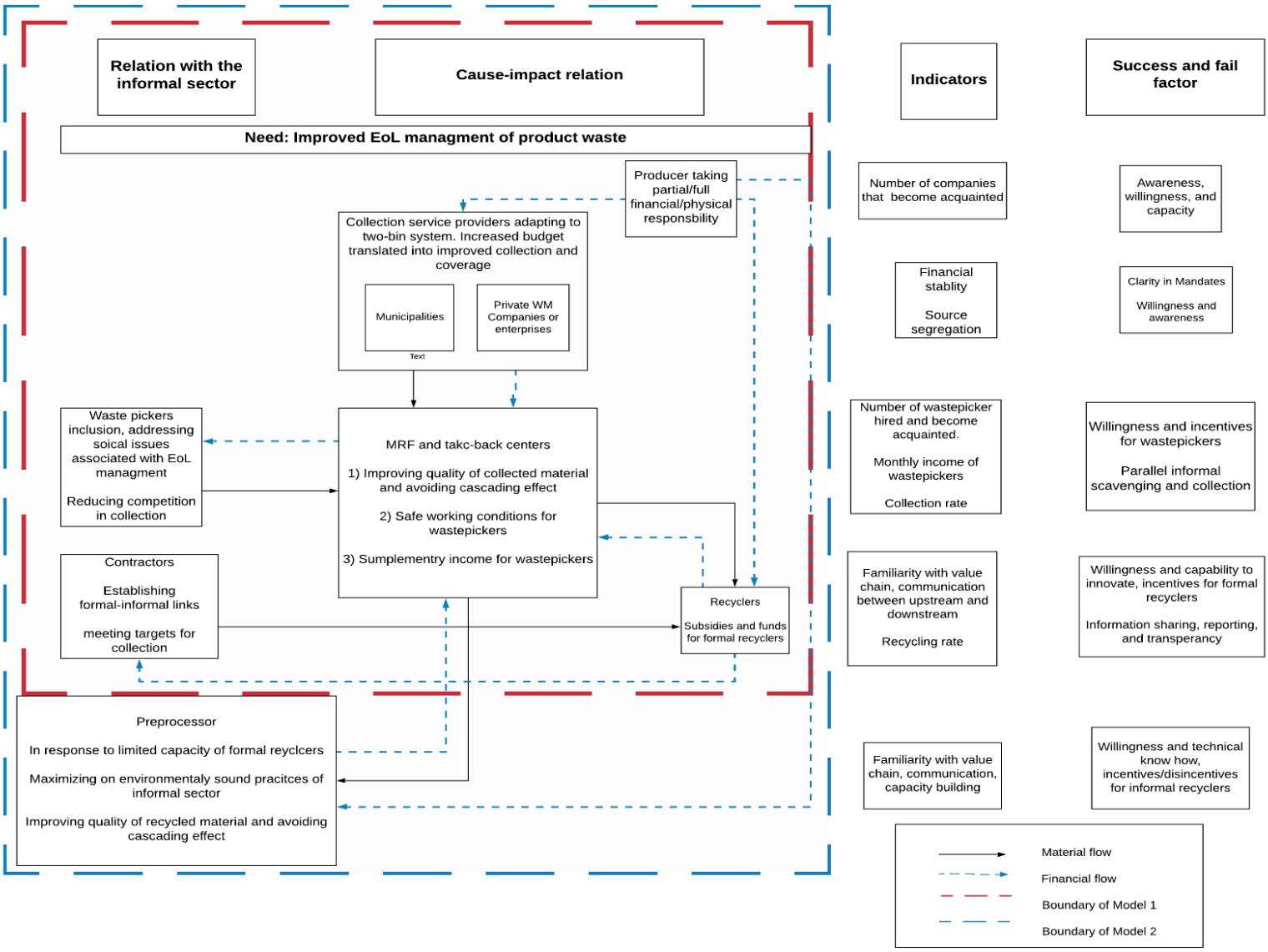

Figure 19: Theory of change and potential impact area subjected to Extended Producer Responsibility in Pakistan showing cause–impact relations, indicators, success and failure factors, and interactions with the informal sector.

The models presented above is a simplified version since in realities and as identified (see **Section 5.1 to 5.6**), each sub-component involves additional actors and linkages, e.g. maid and itinerant buyers, exploitation of waste pickers, immigrant and registration issues, institutional inadequacies, corruption, hidden nature of the informal economy, counterfeit products, among others. Also note that upstream changes and issues are not emphasized since it is the understanding of the author that considering the realm of contemporary issues in EoL management in Pakistan, basic essential targets such collection and quality of return needs to be met before pushing the principles for the design for environment (DfE) into the agenda. As explained in **Section 3.1.2**, a phase-in approach should be considered. Each model reacts to a different scenario political analysis and corresponds to the understanding that having *several* decision models reduces *the risk caused by the analyst presenting the wrong* model (Meltsner, 1972).

6.1. Model One: A Way Forward for EPR implementation

The salient feature of model 1 is its emphasis on the quality of recovered material. Setting targets i.e. collection and recycling rates for countries with the informal sector is of concern since, despite the inadequacies in the performance of formal waste management system, the informal sector is efficient in the collection of various recyclables (metal, glass, HDPE, PET, paper, cardboard) - unofficial reports, see **Section 5.2.1**. Under the business as usual scenario, product waste is either recovered by waste pickers, maids, or itinerant buyers. In the case of maids and itinerant buyers, these materials come directly from within households, it can be assumed that there is source segregation taking place in those households (Wilson et al., 2006b). However, unlike the type of source segregation required by municipal waste operations, this one is based on economic incentives only, exclusively involving the informal sector. While waste pickers recover material from communal bins, dumpsite, and landfill which are heavily cross-contaminated. Such unsustainable practices create critical issues including 1) Significant cascading effects, 2) poor working conditions for waste pickers, and 3) unequal gains, waste pickers, and itinerant buyers are only paid for the recyclable materials but not for their collection and sorting service. The business as usual scenario conforms to the structuralist school thought i.e. maximize on the *pro-cyclical* role of the informal sector to the economy i.e. reduced labor and recovery costs, allowing producers to take advantage of these social issues as an added value to their net profit (Meagher, 2013; Navarrete-Hernandez & Navarrete-Hernandez, 2018). Thus, working against various SDGs (see **Section 5.2.2**).

This model proposes to include waste pickers as an implicit aspect within the implementation mechanism while keeping other groups of the informal involved on transactional basis i.e. offering services at take-back centers, developing entrepreneurs out of small informal business - model of South Africa is adopted for strategically approaching the *other* group of the informal sector. Hence, encouraging the principle of take-back centers and direct contacts between the producer/recyclers and the informal groups by offering higher prices than market rates. This approach does preserve the activities and nature of the existing informal economy to maintain the political feasibility of the proposed mechanism and lesson learned from the project and schemes of other countries. It is also the belief of the author that when society opts to cultivate system changes and evolving for improvement, the change is slow, and the enviro-economic efficiency *may not be optimal during this transition phase* (Tojo, 2004b). A strategic proposition for the inclusion of the informal sector and to establish a symbiotic relationship with them is to incentivize them in strengthening their other four assets, as seen in case of Philippine (Paul et al., 2012), in Chile (Navarrete-Hernandez & Navarrete-Hernandez, 2018), and Brazil (Fergutz et al., 2011). The inclusion of the waste pickers is inspired by the co-production school of thought (see **Section 3.1**). The other feature is the role of municipalities which to improve the political feasibility of the model as municipalities have the resources necessary, considering waste management is an expensive and dynamic process. Second is their relatively strong

motivation to be part of the system (see **Section 5.4.1**). However, Material recovery facilities and take-back centers operation should be out-sourced so to avoid or manage institutional corruption or vested interest of municipalities. The role of municipalities should be highlighted in the collection and setting a two-bin system, a system like Quebec (Vermette, 2019) i.e. one bag for residual and one bag for collective recyclable, recyclables are processed at a material recovery facility (MRFs) and then sent to recycling facilities. It suggested that a take-back centers waste pickers should be allowed to bring and sell collected material other than deployed at MRF at the pre-requisite for certain quantity should be removed, as *research has found that workers paid by the piece are more productive than workers receiving wages* (Madina. 2007 quoted in Navarrete-Hernandez & Navarrete-Hernandez, 2018) but also be the strategy to address the exploitation of waste pickers by junk dealers. Model one proposes that recovered material at MRF to be sent to formal recyclers only, considering the concerns that producers may put forth concerning their stakeholders and exogenous factors. (Williams et al., 2013a) proposed a similar model by introducing interface org. in response to the failing EPR initiatives in China (insufficient collection issues).

6.2. Model Two: Expanding the Horizon of Implementation

Model two is a continuum of model one. It follows the same program theory except that informal recyclers/preprocessors are drawn under the scope to establish adequate EoL management. The earlier model had a *legalist* approach for later groups in the informal economy i.e. neglect by no intervention directed towards either repressive or expansion and consider them as micro-entrepreneur when engaging at take-back centers. This model adapts approaches of the co-production school of thought for later groups as well. The justification to involve informal recyclers/preprocessors is that the ratio of existing formal recycling capacity against the product waste to be managed is very low. This creates a critical concern for the successful implementation and execution of the EPR principle i.e. the low existing formal recycling capacity will disregard the collection and sorting efforts. For instance, X amount of product is collected while the capacity of formal recyclers is Y (i.e. $Y<X$), how will the unattended quantum of recovered material Z i.e. ($X-Y=Z$) be managed? One proposition could be to set a collection target equivalent to the formal capacity. However, this approach undermines the externalities associated with product waste and inadequate waste disposal nor will it minimize the movement of recovered material to the informal pre-processors and recyclers. The other proposition, preferred by the author, is that resources should be dedicated to building capacities of SMEs and informal recyclers so that they can contribute on a similar footing as that of formal entities. Hence, addressing the issues of limited formal capacities against product waste generation. It is to be noted some processes, e.g. crushing and making flakes is relatively environmentally safe practices as mentioned by two of the formal recyclers interviewed. They may need low resources or perhaps certifications only (Wilson et al., 2006a). One the interviewee mentioned that what they need is not always monetary incentives, considering them equal stakeholders is also important to them, "a few of our informal suppliers call themselves as Businessmen and entrepreneur" – suggesting they may just need the opportunity to partake in a competitive market. On the similar footing, Wilson et al. (2006a) stated that *one of the aims of modern waste management is to move 'up the waste hierarchy,' i.e. reduce the reliance on disposal and increase recycling: it would seem ironic to move forward by deliberately eliminating what can be a rather efficient, existing recycling system*". Involving the informal recyclers is also subjected to address the cascading recycling effect that occurs potentially due to their limited capacities. (Akenji et al., 2011) recommend a similar phase-in approach towards EPR: *upgrading their [informal recyclers] technical know-how as well as upgrading their infrastructure.* Excluding the later informal groups would not only create a rivalry i.e. more competition but also lowers the political feasibility of the

implementation mechanism, *those engaged in recycling will be displaced by redirection to the formal sector* (Wilson et al., 2006a). Model two requires more resources and greater planning as compared to model one.

6.3. Minimum Requirements for Both Models: Generalizability of Findings and Analysis

The research revealed that for effective implementation and successful execution of policy, it is not just the measure of outcomes in a policy that is to be gauged but also the logic of arriving at those outcomes i.e. implementation mechanism. Outcomes depend upon the degree of resources and treatment dedicated to them and may affect the intermediary process. Therefore, certain aspects of identified to be critical which if neglected would have greater negative spill over and hinder intended outcomes.

Sustainable cost and coverage mechanism: In industrialized countries, the post-consumer product is considered *waste* and of no value, while in countries like Pakistan, the post-consumer waste may still hold value, therefore, the incentive and financial logistics differ. Hence, it is important to realize the differences in the value chains and product type when developing schemes based on the EPR principle. For instance, e-waste is rarely thrown out in the bins since the residents see it as of some value, therefore, the point/source of the collection is not the waste pickers or maids (in the informal groups) but itinerant buyers or secondhand markets. Whereas the perception for packaging waste[19] is very different, it is more readily thrown, hence waste pickers and maids become the usual source/point of collection. Partnership and alliances remain a key element to the sustainability of EoL initiatives and systems themselves.

Transparency and Monitoring: Annual reports and data sharing about product put on market along with composition and material information to process accountability and adequate planning by recyclers. For instance, Tetra Pak claims it recycles 32% of the total beverage cartons, however, no information is disclosed on the total statistics on the generation and put on the market, therefore, hard to see the legitimacy of such claims. Very much like the proxies to be used for evaluation, indicators measuring social sustainability should be well thought, limitations, and biases of each must be acknowledged.

Information sharing and improved communication: Share product packaging composition information with recyclers. Formal recyclers pointed out that unaccepted design changes affect their recycled product and the potential range of their end-users. Information sharing and reporting can serve as a basic starting link to address the issues of free riders, orphan products, and counterfeit products.

Allocation of roles and responsibilities: The social sustainability in the EoL management of product waste corresponds to the clarity in the roles and responsibilities assigned or taken by producers, hence it would be more appropriate to deal with it as a legal problem under legislation or collaborative contracts. If the social sustainability issues remain unaddressed, there is potential labor right violation and exploitation of lower bottom groups, as the Structuralist thought of school points out to.

Target setting and compliance: Setting targets i.e. collection and recycling rates for countries with the informal sector are of concern since, despite the inadequacies in the performance of formal waste management systems, the informal sector is efficient in the collection of various

[19] Even within packaging waste some packaging is more readily reused and not thrown away e.g. glass jars and PET bottles to some extent.

recyclables. Setting a target and short terms goals along with future transition need to be thoroughly planned because if the goals are too ambitious while the formal capacity of the recyclers remains low, it will push producers and recyclers to rely on the informal recyclers to meet the set targets -suggesting two things, monitoring mechanism, and capacity of formal recyclers. Therefore, 1) set targets and clear goals with their respective timeline, and 2) select appropriate effectiveness and efficiency measure to ensure compliance with recovery rate and material quality.

Role of PRO: PROs are encouraged, as this would show the intrinsic motivation of the companies to make EoL as an integral part of their businesses rather than a corporate social responsibility project. Its relevance to reporting, transparency, and monitoring mechanisms emphasize its importance. PROs will have greater flexibility to reach out to small-medium scale enterprises (SMEs) for greater recovery as authorities do not have full waste service coverage in Pakistan and SMEs tend to bring innovation due to the relative freedom and adaptive capacity. Formal recyclers serving as the role of PRO (logistics and collection) do not ensure the great reach to SMEs. Equal treatment of producers is also linked to PRO as it will provide greater collaboration or access to small-medium producers who if be interested in sustainability and EoL could benefit from the relative greater investment of MNCs in establishing systems for EoL management

Understanding of Value Chain: Value chain understanding to know which processor component of EoL product management requires intervention. It is the understanding of the author that mere incentive for capacity as awareness and information that lacks economic and prospective reasons would not interest the informal sector in general, need strategic approaches to inclusion and understanding of value chain. Careful assessment for the capacity building and incentives for waste pickers vs capacity building of the informal recycler, both groups (waste pickers and informal recyclers) need different support such as technical, recycling processes, bookkeeping, etc.)

Inclusion Strategies for the Informal Sector: The informal sector is one of the most dominate and challenging aspect of the value chain which require strategic and through planning. Lessons learnt from the cases and best practices should be mapped. The recommendation and strategies mapped in **Section 3.1** are critical to the inclusion of the informal sector needs serious consideration.

6.4. Research Design and Analytical Framework

The research methodology for this research is framed by theory-based evaluation (TBE). TBE is an evidence-based policymaking and evaluation tool that not only assess the outcomes and performance of a program/intervention but also provide the casual linkages to the success or failure of the program. TBE is used in addressing all **four Research Questions** while applying different proxies and criteria; environmental effectiveness, political feasibility, and relevance. TBE has a long history of utilization and has been applied in various fields to analyze implementation mechanisms and success or failure of intervention i.e. gauging outcomes. Hence, it is a well-accepted methodology.

This research followed a *case study strategy*. The contextual case of EPR implementation in South Africa is analyzed and environmental effectiveness criteria are utilized for its ex-post evaluation, together, answering **Research Question 1.** The case study of South Africa was based on a systematic literature review and subjected to the framework adopted from (Manomaivibool,

2009), explained in detail in **Section 4.8.1**. The context study of Pakistan, following (Manomaivibool (2009) framework, explored the range and extent of issues of the contemporary EoL product management issues in Pakistan to answer **Research Question 2.** A short case studies of existing EPR initiatives in Pakistan to support the analysis for **Research Question 3**. In addition to these cases studies, political feasibility and relevance criteria are used for ex-ante evaluation of the EPR interventions supporting the answers to **Research Question 2, 3, and 4**.

Theory-based evaluation as a well-accepted analytical framework and frequently used in developing and evaluating programs and interventions. TBE brings clarity and encourages program developers to be more focused on goals and intended outcomes by providing a clear understanding and a broader view of the problem (Rogers, 2008). It signifies the root causes behind issues and inefficiencies in the system along with the forces and factors that may resist or hinder change in/of the system, thus maintaining the status-quo (Sharpe & Bay, 2011). Therefore, it was highly relevant in addressing **RQ 2, 3, and 4**. TBE brought attention to several key factors and their interdependencies, e.g. impact and role of *producers*, dependencies, and interrelationships among the components of the system, and exogenous factors (social, economic, regulatory, etc.). Such a *pluralist* approach (Gutberlet, Kain, et al., 2017) assist in strategizing systematic interventions which contributed to the discussion of the research.

The frameworks and criteria (environmental effectiveness, policy relevance, and political feasibility) shaped the flow of information, revealing patterns, and bringing key aspects of the research under focus. environmental effectiveness criteria are the most dominant criteria used in the intervention evaluation field as the measurement of outcomes (Hildén et al., 2002). While proxies used to measure the criteria corresponded to the availability of the data, which had its limitation. For instance, the collection rate as a proxy for assessing the environmental effectiveness did not bring forth the quality issues associated with unsustainable collection practices in countries with the informal sector – emphasize the needs for careful proxy and indicator selection but also the importance of the availability of data. Exploratory and normative approaches were supplemented to highlight these respective issues, e.g. **RQ 1 and 2**, in the case study of South Africa and contemporary EoL product management issues in Pakistan – TBE made these distinctions clear.

6.5. Reliability of Findings and Analysis

The data pertinent to the case of the Tetra Pak case study likely to have error since the data shared was projected data and not the actual collection for recovery rates and triangulation of data was not possible as could not get in touch with Tetra Pak representative. This can affect the environmental effectiveness analysis of this short case study of existing EPR initiatives in Pakistan. However, it is highly unlikely to affect the overall research and other analyses throughout the thesis. The research covers two political feasibility analyses, answering different questions but for similar contextual background, to avoid the overlapping and bias in the selection of information gathered for each analysis, cross-referencing was frequently done to preserve the integrity of the research.

Due to COVID-19, I was unable to reach a few of the formal recyclers in Pakistan. Also, three of the interviewees were available just 2 weeks before the thesis deadline which causes some delays in my analysis and subsequent Sections and chapters.

7. Conclusion

This chapter summarizes the primary findings of the study, as well as providing final reflections and suggestions for further research. This research has three main objectives 1) to assess the feasibility of the EPR principle in addressing the contemporary EoL product management issues in Pakistan, 2) to understand the implementation mechanism for successful execution of EPR-based intervention in the countries with dominant informal sector in the waste sphere, and 3) to assess the feasibility of inclusion of the informal sector in the EoL product management. To explore these the understanding and issues concerning these objective theory-based evaluations were utilized together with three different assessment criteria environmental effectiveness, policy relevance, and political feasibility. To guide the reader to the conclusions generated from the research, summaries of the findings and analysis, answering each of the research questions are presented below.

RQ1: How can an EPR function when implemented in a country with an informal sector?

To answer this question, the case of South Africa was explored, as discussed in **Section 5.1**. In South Africa, the transition from voluntary to legislative EPR program served as a threat to the producers to incentivize better collection and recycling rates. Against these settings, the PET and glass industry established two voluntary producer responsibility organizations (PRO), namely PETCO and GRC, to manage PET and glass product waste. In the assessment of immediate outcomes, using the collection for recycling as a proxy, all three voluntary EPR initiatives were evaluated to be the environmental effectiveness. While the legislative EPR scheme performed poorly. The analysis of the allocation of resources and environmental effectiveness revealed that the development of legislative EPR policy was politically feasible. However, it could not remain politically sustainable, subjected to corruption, and low collection rate. Whereas the voluntary EPR initiatives are evaluated to be politically sustainable and environmentally effective. The research revealed that the relative success of an industry-led EPR initiative is due to their cost-efficiency and relative independence, i.e. producers are involved in establishing the EoL management infrastructure while maintaining symbiotic relations with other actors in the society. The producers perhaps enjoy the convenience of setting up buy-back centers and banks as their collection system. However, the issues of quality of recovered material are not of exclusive concern to any of the EPR schemes - when it comes to separate collection, sorting and recycling, rules and results decide what producers have to do and what is beneficial from economic point of view to do. In conclusion, the voluntary EPR schemes in the context of South Africa have shown considerable success considering the recovery rates. However, the social aspects of these initiatives remain questionable. None of such initiatives exclusively included the waste pickers in their scope of resource allocation (collector remained as the net bottom stakeholder in the supply of recovered materials), besides the significant contribution of waste pickers in the recovery rates. The flexibility to design the EPR implementation mechanism provides room for unequal gains in the supply chain and to use performance indicators for advantage and ease e.g. recycling rate vs quality of the recycled products.

RQ2: What are the contemporary EoL product management issues in Pakistan?

The research reveals that the End-of-Life (EoL) management of product waste in Pakistan faces several significant challenges, ranging from the inadequate performance of waste service providers and municipalities, issues surrounding the informal economy, and lack of enabling environment to encourage moving up the hierarchy in the waste management. Pakistan has a poor infrastructure for EoL management, e.g. no material recovery facility (facility for sorting)

exists at the moment (except in some cases for private waste management service providers and NGOs, but they are small scale with very limited capacity, e.g. Waste busters, Ghulam Hussain and Sons, Garbage Can, and Gul Bahao). The lack of infrastructure and facilities for waste management relate to the current situation where account the social issues and quality of waste recovered are not considered. The formal waste collection is of 60% capacity with no source segregation of any type whatsoever (see **Section 2.1 and 5.2**). Municipalities are the major formal actors in the supply chain of waste management, however, due to lack of transparency, corruption, and power plays, as well as, inadequate resource utilization, the performance of municipalities remains unsatisfactory (see **Section 5.2.1)**. However, the recovery rates for recyclables with market prices are high due to the efficient informal sector, except for material that has little to no market value, e.g. LDPE, MLP. Behavior change and the role of waste pickers are identified as the key *virtuous* steps, considering their linkages and dependencies with other actors and components of the waste sphere (see **Section 5.2 and 5.5**). Analysis of points of interventions of various actors shows a pattern of not *beyond the walls of the factory* manifesting in the EoL product management (see **Section 5.2.2**). Three consecutive cascading effects were reported by interviewees 1) issues in product design, 2) cross-contamination due to inadequate collection system and mixing of material with lower grade material due to limited capacity of the informal sector, and 3) varying recycling practices and limited technical knowledge of the informal sector (see **Section 5.2.2**). The recycling of counterfeit products creates further issues, e.g. harming sales, net demand, and profit, ethical issue, traceability, monitoring, performance issues (see **Section 5.2.3**).

RQ3: What is the feasibility of implementing the EPR principle in Pakistan?

The analysis of policy relevance revealed that several contemporary EoL product management issues and needs are linked to the intended outcomes and objectives of the EPR principle. Among these are 1) reduction of public spending on waste management by providing financial support to municipalities, 2) data collection and better logistics, 3) improved collection and recycling rates by improving infrastructure for downstream management of product waste including collection and recycling systems: providing subsidies to support formal recycling businesses or/and create new recycling enterprises, 4) reduction in overall waste management costs by diverting product waste away from landfill, and 5) market creation for material that have a low or unstable price in the market (e.g. LDPE, MLP) (see **Section 5.3**). However, the political feasibility analysis revealed that the implementation mechanism is surrounded by constraints and challenged (see **Section 5.4**). While the existence of voluntary EPR initiatives (i.e. case of Tetra Pack and Project CORE) support the case for mandatory or more developed EPR initiatives (see **Section 5.6.1 and 5.6.2)**. In conclusion, producers aiming for circular approaches (see **Section 5.7.2**) will need to establish system evaluation processes and support municipalities in implementing source segregation, as closed-loop strategies cannot sustain when down cycling/cascading is so rampant. The political feasibility analysis under the TBE framework showed some general factors to be considered in program design and implementation of the EPR principle (voluntary or mandatory) (see **Sections 6.1, 6.2, and 6.3**).

RQ4: What is the feasibility of including the informal sector in EoL product management under the EPR principle in Pakistan?

The political feasibility analysis revealed that the informal sector is not one homogeneous group, rather it has a hierarchy, different groups, and actors within. The resources and influence typically grow as one moves up the informal hierarchy (see **Section 2.1 and 5.5.2**). Therefore, the actors/groups within the informal sector have their concerns and issues associated with inclusion, motivating them to act as an opponent or proponent for the inclusive. Municipalities owing to resource constraints, institutional inadequacies, and money-making interests, are

unable to meet waste pickers' demands or to provide them with adequate incentive to assure them of the inclusive approaches (see **Section 5.5.1**). Formal recyclers were found to have existing well-established relationships and linkages with the informal sector convey that they be in favor of a more institutionalized market (see **Section 5.5.4**). Producers tend to go by not *beyond the factory wall* rules will cause some reluctance among producers. However, owing to various exogenous factors and sustainability targets of the MNCs, producers are more likely to engage the informal sector (see **Section 5.5.5**). In conclusion, the feasibility of including the informal sector EoL remains contested. Formal recyclers and private sector already engage with the informal sector, while producers are likely to engage due to their internal sustainability targets, exogenous factors, and the *strategic* advantage, i.e. dominance of the informal sector in the collection phase and the fact that it is a cheap solution to reach results such as separate collection, sorting and recycling. Under the business as usual scenario, product waste is recovered by waste pickers, maids, and itinerant buyers. Waste pickers recover material from communal bins, dumpsite, and landfill which are heavily cross-contaminated. Such unsustainable practices create critical issues including 1) Significant cascading effects (downgrading of material), 2) poor working conditions for waste pickers, and 3) unequal gains; waste pickers, and itinerant buyers are only paid for the recyclable materials but not for their collection and sorting service. Furthermore, informal recyclers add to the overall cascading effects due to their lack of capacity and variable recycling practices e.g. use greater quantities of additives and have variable processes, resulting in low-quality products.

However, the flexibility in the implementation of the EPR principle is likely to encourage actors to engage selective informal groups in the EoL product waste. This creates a critical concern for the successful implementation and execution of the EPR concept i.e. the low existing formal recycling capacity will disregard the collection and sorting efforts. Since the ratio of existing formal recycling capacity against the product waste to be managed in developing countries is very low. For municipalities to get involved in the inclusive approaches will need support and push from producers. The recommendation and strategies mapped in **Section 2.3** are critical to the inclusion of the informal sector needs serious consideration from policymakers, municipalities, and producers. Overall, strategically planned feasibility of inclusion is medium to high.

Contributions and Recommendations for Future Research: This main contribution of this research is to the first step towards developing an implementation mechanism for the execution of the EPR principle in countries with the informal sector (see **Sections 6.1 and 6.2**). The first of a kind of assessment for the policy relevance and political feasibility in context to Pakistan is done. The study also contributed to investigating the contemporary EoL product management issues in Pakistan through the framework of theory-based evaluation, providing detailed exploratory and normative analysis to the issues. The feasibility of industry-led voluntary EPR schemes and contested issues of socially sustainable EoL product management elucidated that issue of setting targets and limitation of proxies used to evaluate the performance of EPR initiatives. It also highlights the role of the informal sector in the EoL product management contributing to the literature in the informal economy. It also endorses that the informal sector is a critical player when developing an implementation mechanism for EPR principle-based policies. It also provides anecdotal evidence of the environmental effects of the informal sector. It demonstrates the weak political and institutional feasibility of municipalities resulting in inadequate waste services and EoL management.

Recommendation for Policymaker and Producers: It is important to have an in-depth understanding of the value chain, including the potential inadequacies and cascading effects that occur

throughout the value chain of product waste. It is recommended for producers to investigate and document the intricacies within the value chain in Pakistan (or countries with the informal sector) and gaps that need to be filled for better planning of initiatives. Policy/program evaluation or/and performance indicator should be thoroughly analyzed with their biases and limitation well thought before the planning or/and during the implementation phase (if not done earlier, indicators should be revised) e.g. collection rate as a proxy for environmental effectiveness of program/intervention overlooks the quality and social sustainability aspects (see **Sections 6.1 and 6.2**). The recommendation and strategies mapped in **Section 3.1** are critical to the inclusion of the informal sector needs serious consideration from policymakers, municipalities, and producers.

Suggestion for Future Research: The socially sustainable EoL product management is a re-occurring theme throughout the study. Current literature in context to developing and emerging economies was found lacking. It will be useful to develop a framework to help producers in deciding this. It is observed that even in cases when the informal sector is integrated, a direct link to industries and producers is not that visible. This impedes the transition towards material circularity and improved market access. The role of the informal economy in the circular economy and closing the loop is useful to explore while viewing the political feasibility of the ways forward. The role and models of producer responsibility organization in the context of the informal sector is important but were found underdeveloped and unexplored. Re-structuring of value chains to distribute gains among all stakeholders remains a potential research gap. The triple bottom approaches in context to EPR needs to be explored.

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Appendix A - List of interviews

Date	Organization	Category	Interviewees	Format
9 Jan 2020	Project Gijz	Consultant/Waste Management Company	Principal consultant - Solid waste and resource management	Semi-structured, Skype, voice recorded
1 April 2020	Ouroboros Waste Management	Recycler	CEO	Semi-structured, Zoom, voice recorded
14 Feb 2020	Shazil	Recycler	Senior Executive	Semi-structured, face-to-face, note-taking
30 March 2020	Independent Consultant and senior executive GHS waste management	Consultant/Waste Management Company	Senior Environmental Consultant	Structured, email
30 April 2020	WWF Pakistan	NGO	Manager Climate and Energy Program	Semi-structured, Zoom, voice recorded
29 April 2020	Gujranwala Waste Management Company	Government	Ex-Managing Director	Semi-structured, Zoom, voice recorded
	Lahore Waste Management Company (LWMC)	Government	Ex-Managing Director	Semi-structured, Zoom, voice recorded
2 Feb 2020	University of Sao Paulo	Researcher	Researcher	Semi-structured, Zoom, voice recorded
15 Feb 2020	NJC Waste Management Company	Waste management company	General Manager	Semi-structured, Zoom, voice recorded
2 May 2020	Engro Polymer & Chemicals Ltd	Producer	Deputy Manager Circular Plastics	Semi-structured, Zoom, voice recorded
12 May 2020	Waste Aid UK / SystemIQ Ltd.	NGO	Chief Executive officer / Chief of waste operations – Project STOP	Semi-structured, Zoom, voice recorded
16 May 2020	Green Earth Recycling Pakistan	Recycler	Director	Structured, email
25 May 2020	WIEGO	NGO	Waste Specialist	Semi-structured, Skype, voice recorded

Appendix B – Survey Guideline

7.1.1. Questionnaire for WP

1.1. Age of Waste Pickers
1.2. Number of dependent family members
1.3. How long have you engaged in?
1.4. How many people engaged in waste picking in your working area?
1.5. From where do you collect the recyclables? (Container, street, household, etc.)
1.6. To whom do you sell the recyclables? Why not somebody else?
1.7. What is the mode of transporting recyclable materials to the dealer? Do you own them?
1.8. How much do you earn per day or month from selling the recyclables?
1.9. Do you get to bargain? How the prices are decided?
1.10. Do you think you are paid less than the price of waste in the market? What do you think that is the case?
1.11. Are there any concerns/problems in your work?
1.12. How is your relationship with police or municipal authorities?
1.13. Have you observed getting sick doing this job (self-awareness level?)
1.14. Do some get fetal injury?
1.15. Are you provided with PPE by your middleman (if there is any?)
1.16. How would you react if PPE is provided under some conditions (working or selling waste to formal)?
1.17. Do you buy Waste? How much per day do you spend on that?
1.18. How do you feel about your job as a waste picker? Will you continue to work as Waste Picker?
1.19. What do you think could improve this profitability scenarios?

7.1.2. Questionnaire for small/ medium scrap shops study Karachi 2020

1. Name of the shop owner: _____
3. Type of scrap shop: **Small** (less than 300 kg/day) **Medium** (300 Kg - 1 ton/ day)
4. Length of time in business: a. Less than 5 year's b. 5-10 years c. above 10 years
5. Scrap shop space is: Owned Rented
6. Number of workers in the shop:
7. Main type of materials you trade and daily volume of trade:

Main type of material (tick)	Quantity/kg/day	Price/kg
Newspaper		
White & color paper		
Cardboard		
Plastic • 1st-grade plastic (milk cover, shampoo, Harpic bottles, etc.) • Kadak (plastic cups, food container, etc.) • Super (carry bags)		
Pet bottles (water & Pepsi etc...)		
Glass bottles /piece		
Aluminum can		
Any other (tetra Pak etc...)		

8. Who are your main suppliers of waste (please tick)
- Itinerant waste buyers (person who buys from the Households and sells to scrap shops)

- Waste pickers
- Housemaids
- Residents
- contract workers
- Other traders

9. Sale of materials
    a. Frequency of sale of materials to dealers:
    b. Name of the wholesale market:
    c. Transportation: Own transportation Hired Sent by dealers
10. Challenges and problems faced by the scrap shops
11. Average income (profit) per month _____

7.1.3. Questionnaire for informal Preprocessor/recycler

1. When did you start the business?
2. What type of waste materials do you source for reprocessing?
3. What are the products manufactured?
4. What type of machinery do you use?
5. How many employees work in the unit?
6. Is it a value-added process or do you manufacture a product for the end-user?
7. What is your daily requirement of waste material?
8. How do you source it?
9. What are the challenges faced by you in sourcing the raw material?
10. Are there any seasonal variations in the sourcing and production processes?
11. With what authority is your unit registered?

Appendix C - Interview Guideline

7.2. Formal Recycler

Background Information

- What were the driving forces or motives for getting into recycling business? (e.g. customers' demands, economic benefit, industry associations and industry trends, personnel's individual awareness and others)
- What is the scope of your organization? (Material streams, end products, clients).

Experience with the Informal Sector

- Does your organization deal with informal sector? If yes, how has been your experience so far? (issues, challenges, and merits dealing with informal sector)
- Which groups within informal sector do you deal with (waste pickers, middleman, preprocessors)
- How do u recognize informal sector? (Competitors or symbiotic relationship)
- Do you hire waste pickers or outsource them?
- Have your organization ever worked with the informal sector in helping them upgrade their operations? If yes, what are the achievements and major obstacles?

Impacts of Inadequate Waste Management System

- What are the factors of inadequate WMS that hinder or affect recycling business? (collection and recovery challenges, e.g. costs (please specify whose and what costs))
- How does lack of legislation and regulations affect your organization ((lack of regulatory pressure, lack of top management commitment, lack of available technology, lack of demand from customers/retailers/society and others)
- What are advantages and disadvantages of the existing system? What support do you believe municipal waste management should be providing to achieve greater recycling rates and better quality of recyclables?

Responsible Business

- When it comes to material/waste procurement do you consider the sustainability aspects of supply chain? (Child labor, bonded wage, non-compliance to HSE and occupational health). Can you identify and describe shared norms/values/rules of the organization?
- How your company taken any social initiatives (intrinsic or extrinsic) e.g.: creation of a platform to foster volunteering; training suppliers; redirecting purchases focused on suppliers aligned with social standards; and developing mentoring programs for supplier diversity and gender equity or information exchange.
- If the supplier (informal sector) pushed to comply with HSE and other standards to continue business with you, how likely they will agree?
- What are some of the procurement issues/challenges faced in past or occur?
- Has the organization changed its positions/directions regarding the sustainability aspects of supply chain? (e.g. relaxed outlook towards the issue, changing cooperative strategies)

About the industry / Business

- Have you ever faced issues with counterfeit products? How does it affect your organization?

- What do you perceive as main obstacles for the development of such a capacity, for the investment in recycling facilities? (examples: financial resources, low return, uncertainty of the supply, small scale, lack of legal framework, authorization process, lack of technologies)

Reaction to Extended Producer Responsibility

- Have your organization experienced design or quality of waste products affecting your recycling or product? If yes, how do you convey that to producer and how likely and frequently they respond and take care of the issue?
- To manage packaging waste there is need for a formal treatment infrastructure, how such an infrastructure can be developed? Who can take the lead, especially in contributing endowment?
- Is there a need for the act from the Federal Government to ensure unity?
- What do you expect as a consequent on the business from the implement of EPR?
- Is it possible to establish a producer responsibility organization in Pakistan? What issues do you think it will likely to overcome (informal sector, collection, and recovery challenges, managing stakeholders, power structure, transparency, cross subsidization)
- Do you think producers should have physical responsibility or other responsibilities beyond the financial responsibility?

7.3. Waste Consultant / Municipality Official

Informal Sector

- What does municipality think of the informal sector? (Hostile or symbiotic relation). What factors led the municipalities to develop such relation?
- How has been your experience dealing with informal sector so far? (issues, challenges, and merits)?
- Do government or municipalities feel the pressure to provide alternative livelihoods to waste pickers when introducing policies that will threaten their current livelihood mean?
- Do you see a change in trend in waste management (co-production, organized waste picker organizations)?
- What model for material recovery facilities would work (waste pickers hired or outsourced, who would own the recovered material municipalities or waste worker, 'right to waste)?
- What would MRF intervention mean to other groups within informal waste community?
- How to track recycling rates and material quality data under any proposed model?

EoL Management

- To manage packaging waste there is need for a formal treatment infrastructure, how such an infrastructure can be developed? Who can take the lead, especially in contributing endowment?
- Do you think the government should run a recycling plant(s)? If yes, in which form, a governmental agency, public enterprise, public organization, public private partnership? Or the investment and physical operation should be rested upon the private sector (possibly with some subsidies)?
- Some practitioners suggest that we do not really need recycling plants or Material recovery facilities because informal sector is very efficient, all we need to do is to formalize them, what is your opinion on this take?
- What do you perceive as main obstacles for the development of such a capacity, for the investment in recycling facilities? (examples: financial resources, low return, uncertainty of the supply, small scale, lack of legal framework, authorization process, lack of technologies)

Producers' responsibility

- What do you expect as a consequent on the business from the implement of extended producer responsibility?

- Is it possible to establish a producer responsibility organization in Pakistan? What issues do you think it will likely to overcome (informal sector, collection, and recovery challenges, managing stakeholders, power structure, transparency, cross subsidization)
- Do you think producers should have physical responsibility or other responsibilities beyond the financial responsibility?

7.4. International/National NGOs

Background

- Have your organization ever worked with the informal sector in waste industry in helping them upgrade their operations? If yes, what are the achievements and major obstacles?
- When advocating, does your organization support and promote 'inclusive growth' and 'co-management' approaches to tackle plastic and packaging waste? Or consider informal sector as parasite and/or competitors to formal entities?
- How do you address the issues of environmental compliance and child labor when promoting the agenda of inclusion?

Impacts of Inadequate Waste Management System (WMS)

- What are the factors of inadequate WMS that hinder or affect recycling businesses and startups? (collection and recovery challenges, e.g. costs (please specify whose and what costs))
- How does lack of legislation and regulations affect your organization ((lack of regulatory pressure, lack of top management commitment)
- What are advantages and disadvantages of the existing system? What support do you believe municipal waste management should be providing to achieve greater recycling rates and better quality of recyclables?

Advocacy for Responsible Businesses and Startups

- How do you advocate MNCs and recycling industry on sustainability aspects of supply chain? (Child labor, bonded wage, non-compliance to HSE and occupational health).
- Have your organization advocated startups and producers on the design or quality of waste products affecting end of life management of their products? If yes, how do you convey that to producer and how likely and frequently they respond and take care of the issue? Examples and initiatives by companies.

EoL Management

- To manage packaging waste there is need for a formal treatment infrastructure, how such an infrastructure can be developed? Who can take the lead, especially in contributing endowment?
- Do you think the government should run a recycling plant(s)? If yes, in which form, a governmental agency, public enterprise, public organization, public private partnership? Or the investment and physical operation should be rested upon the private sector (possibly with some subsidies)?
- Some practitioners suggest that we do not really need recycling plants or Material recovery facilities because informal sector is very efficient, all we need to do is to formalize them, what is your opinion on this take?
- What do you perceive as main obstacles for the development of such a capacity, for the investment in recycling facilities? (examples: financial resources, low return, uncertainty of the supply, small scale, lack of legal framework, authorization process, lack of technologies)

Producers' responsibility

- What do you expect as a consequent on the business from the implement of Extended Producer Responsibility?

- Is it possible to establish a producer responsibility organization in Pakistan? What issues do you think it will likely to overcome (informal sector, collection, and recovery challenges, managing stakeholders, power structure, transparency, cross subsidization)
- Do you think producers should have physical responsibility or other responsibilities beyond the financial responsibility?

2. Appendix D

Benchmark Indicators for Physical Components

7.5. Public health - waste collection

Name	Description	Grading criteria			Score	Comments
Waste Collection Coverage.	Percentage of households in the city that receive a reliable waste collection service.	Low	red	0 – 49%	43.00 %	(World Bank, 2019)
		Low/Medium	red/orange	50 – 69%		
		Medium	orange	70 – 89%		
		Medium/High	Orange or green	90 – 98%		
		High	green	99 - 100%		
verdict		Low	red	0 – 49%	43.00 %	
Waste captured by system.	Waste captured by the system represents all the waste materials that are delivered to an official treatment /disposal facility.	Low	red	0 – 49%	60.00 %	Sialkot 25% (Kaza et al., 2018); Gujranwala 34.28% (Ali et al., 2019; JICA, 2015); Karachi 60% (Kaza et al., 2018); Multan 56% (Bank, 2010); Lahore 68% (Kaza et al., 2018); Pakistan 60% (PEPA, 2004),
		Low/Medium	red/orange	50 – 69%		
		Medium	orange	70 – 89%		
		Medium/High	Orange or green	90 – 98%		
		High	green	99 - 100%		
verdict		Low /Medium	red/orange	50 – 69%	60.00 %	
Quality of waste collection service.	i. Presence of waste around collection bins.	a. Very high incidence		0	5	
		b. High incidence		5		

	c. Medium incidence	10		Waste scatter around bins due to their smaller size (Masood et al., 2014); Not enough bins in the densely populated areas (Majeed et al., 2018); overflowing of skips and containers being common (Ali et al., 2019)
	d. Low incidence	15		
	e. Very low incidence	20		
ii. Presence of waste around popular places & streets.	a. Very high incidence	0	5	Waste thrown in the streets due to inadequate collection (JICA, 2015); 25% of the waste left unattended in Lahore (Ashraf et al., 2018); waste dumped along roads is common practice (Bank, 2010; Korai et al., 2017)
	b. High incidence	5		
	c. Medium incidence	10		
	d. Low incidence	15		
	e. Very low incidence	20		
iii. Presence of illegal dumps/open burning.	a. Very high incidence	0	0	Nearly 800 illegal dumping sites in Gujranwala City (JICA, 2017); 20 dumpsites in Multan (Bank 2010); 3000 open dumps all over Lahore (Majeed et al., 2018); open dumps and official dumpsites common in Pakistan (Korai et al, 2017), massive dumpsites in Karachi (World Bank, 2019), Illegal Burning common practice (Kaza et al, 2018), waste burning second major air pollution contributor (World Bank, 2019)
	b. High incidence	5		
	c. Medium incidence	10		
	d. Low incidence	15		
	e. Very low incidence	20		
iv. Appropriate transport compliant with rules.	a. No compliance	0	5	Vehicle drivers dumping waste other than official disposal sites due to allocation of insufficient fuel ((Majeed et al., 2018); waste being burnt, illegally, both by scavengers to retrieve metals, but also by the SWM authorities themselves to reduce waste volume (Masood et al., 2014). Unsatisfactory transport compliance in Pakistan (Ashraf et al., 2016; JICA 2015; Korai et al., 2017), collection Vehicles often not covered (Kaza et al., 2018) resulting in waste slippage.

	b. Low compliance 5 c. Medium compliance 10 d. Medium High compliance 15 e. High compliance 20			
v. Appropriate management & supervision.	a. No compliance 0 b. Low compliance 5 c. Medium compliance 10 d. Medium High compliance 15 e. High compliance 20		5	There is no proper system of planning and monitoring the efficiency of the collection routes (Masood et al, 2014; Majeed et al, 2018), inadequate service provision in Multan prevalent (Bank, 2010), Inadequate administration and management capacity in Pakistan to handle waste ((KOICA-WORLD BANK, 2007; Ashraf et al., 2016, Korai et al 2017)
vi. Use of appropriate personal protective equipment	a. No compliance 0 b. Low compliance 5 c. Medium compliance 10 d. Medium High compliance 15 e. High compliance 20		0	Poor working condition, PPE not provided, health hazard common among SWM employees (Bank, 2010; Ashraf et al., 2016; Masood et al., 2014), Sanitary workers at high risk (World Bank, 2019; Korai et al., 2017).
Total	Low	red 0 – 49%	16.667	sum of scores divided by total possible score

		Low/Medium	red/orange	50 – 69%		
		Medium	orange	70 – 89%		
		Medium/High	orange/green	90 – 98%		
		High	green	99 - 100%		
verdict		Low	red	0 – 49%	16.67 %	

7.6. Environment - waste treatment & disposal

Name	Description	Grading criteria			Score	
Controlled treatment or disposal.	Percentage of the total municipal solid waste	Low	red	0 – 49%	5.00%	
						nearly 800 illegal dumping sites in Gujranwala City (JICA, 2017); 20 dumpsites in Multan (Bank 2010); 3000 open dumps all over Lahore (Majeed et al., 2018); open dumps and official dumpsites common in Pakistan (Korai et al, 2017), massive dumpsites in Karachi (World Bank, 2019), Illegal Burning common practice (Kaza et al, 2018), 10 disposal sites in Karachi however non is sanitary or engineered (Abbasi, Lu, & Zhao, 2016), waste burning second major air pollution contributor (World Bank, 2019)
	destined for treatment or disposal in either a	Low/Medium	red/orange	50 – 69%		
	state of-the-art, engineered facility or a	Medium	orange	70 – 89%		
	'controlled' treatment or disposal site.	Medium/High	orange/green	90 – 98%		First scientific disposal facility in Pakistan, namely Lakhodair landfill, which occupies 43 ha of land (Azam et al., 2020).
		High	green	99 - 100%		
verdict		Low	red	0 – 49%	5.00%	
Degree of environmental protection	i. Degree of control over waste reception at the	a. No control		0	0	
in waste treatment & disposal.	disposal site.	b. Low control		5		Anyone could throw waste at the open-air dumping site (Ali et al., 2019),

		c. Medium control	10		
		d. Medium high control	15		
		e. High control	20		
	ii. Degree of control over waste treatment & disposal.	a. No control	0	0	a sizable quantity (2000 t/day) of refuse is dumped in natural drains and/or water bodies by sweepers and municipal staff (Ahmed, 2009), Two more sites are also being unofficially used by LWMC to dispose of waste, namely Saagian dumpsite and Bagrian/Tiba dumpsite (Masood et al., 2014) , Official disposal site have status of 'dumps' (JICA 2017; World Bank 2019), The existing landfills have long reached their maximum capacity and have transformed into dumpsites Ashraf et al., 2016; Korai et al., 2018)
		b. Low control	5		
		c. Medium control	10		
		d. Medium high control	15		
		e. High control	20		
	iii. Degree of monitoring & verification of environmental controls.	a. No compliance	0	5	Presence of weighing bridge. No other controls present (Ali et al., 2019). No mechanism of monitoring in place in Multan (Bank 2010), no proper system of planning and monitoring in place (Masood et al., 2014; KOICA-World Bank, 2007), insufficient monitoring mechanism in Pakistan (World Bank 2019, Karoi et al., 2017)
		b. Low compliance	5		
		c. Medium compliance	10		
		d. Medium High compliance	15		
		e. High compliance	20		

	iv. Degree of technical competence in planning, management & operation of treatment & disposal.	a. No compliance b. Low compliance c. Medium compliance d. Medium High compliance e. High compliance		0 5 10 15 20	5	Technical staff recruited for future developments. Competent management due to experience & relevant education (Masood et al., 2014; Ali et al., 2019). However, only megacities like Karachi, Lahore, Islamabad have such capacity (Bank 2010; JICA 2017). Many cities do not even have the dedicated organizations to deal SW issues.
	v. Occupational health & safety.	a. No compliance b. Low compliance c. Medium compliance d. Medium High compliance e. High compliance		0 5 10 15 20	0	Poor working condition, PPE not provided, health hazard common among SWM employees (Bank, 2010; Ashraf et al., 2016; Masood et al., 2014), Sanitary workers at high risk (World Bank, 2019; Korai et al., 2017).
	Total	Low Low/Medium Medium Medium/High High	red red/orange orange orange/green green	0 – 49% 50 – 69% 70 – 89% 90 – 98% 99 - 100%	8.3333	sum of scores divided by total possible score
verdict		Low	red	0 – 49%	8.34%	

7.7. Resource management - reduce, reuse, recycle

Name	Description	Grading criteria			Score	Source
Recycling rate.	Percentage of total municipal waste that is recycled.	Low	red	0 – 9%	20.00%	13.51% of municipal waste is recycled by Informal sector in Karachi (Ghauri, 2018). 35% recycled in Lahore i.e. 27% of the waste generated in the city is recycled informally and 8% organic by LWMC (Masood et al., 2014), 14.74% of total waste recycled in Gujranwala (JICA 2017, Ali et al., 2019). In Pakistan 20-30% waste is recycled informally (Korai et al., 2017)
		Low/Medium	red/orange	10 – 24%		
		Medium	orange	25 – 44%		
		Medium/High	orange/green	45 – 64%		"Scavengers collect almost all the metal and glass, 95 per cent of paper and about 60 per cent of plastic waste. They are providing an environmental benefit which is largely undocumented and unrecognized," (Shiza Malik, 2019)
		High	green	>65%		
verdict		Low/Medium	red/orange	10 - 24%	20.00%	
Quality of 3Rs - reduce, reuse, recycle-provision.	i. Source separation of dry recyclables.	a. 0-1%		0	5	
		b. 1-25%		5		
		c. 26-65%		10		10% of the generated waste is already separated at source for reuse or recycling in Lahore (Batool and Chaudhary, 2009), 5.31% of materials were in recyclable condition in Multan (Ali et al., 2019), 10% of the uncollected waste is removed from the city by the waste pickers (LWMC, 2012)
		d. 65-95%		15		
		e. 96-100%		20		
	ii. Quality of recycled organic materials	a. No segregation		0	5	No segregation for organics in Gujranwala (Ali et al., 2019), LWMC recycles 8% of organics (Masood et al., 2014), no recycling of organics done in Karachi (World Bank, 2019), no focus on recycling either organic or non-organic in Multan (Bank, 2010). Informal sector, however, collects certain organics (personal communication and interviews with waste pickers, 2020)
		b. Some segregation		5		

	c. Thorough segregation	10		
	d. Source separation	15		
	e. Qualitative source sep.	20		
iii. Degree of official focus on promoting 3R through targets.	a. No focus	0	0	No official quantified targets (Ali et al., 2017; World Bank, 2019; JICA 2015; KOICA-World Bank 2007)
	b. Low focus	5		
	c. Medium focus	10		Recent tenders for waste management only focused on collection (CDA website, SSWMB, Personal communication)
	d. Medium High focus	15		
	e. High focus	20		
iv. Degree of focus on involving . community/informal sector in formal solid waste management system.	a. No focus	0	0	No incentives provided. Informal sector or scavengers operate on their own without any support or guidance (Masood et al., 2014; Ali et al., 2017; World Bank, 2019; JICA 2015; KOICA-World Bank 2007; Batool and Chaudhary, 2009; Ghauri, 2018)
	b. Low focus	5		
	c. Medium focus	10		
	d. Medium High focus	15		
	e. High focus	20		
v. Degree of focus on environmental impacts of recycling activities.	a. No compliance	0	0	Recycling was carried out by the Informal sector. Hazardous waste was also reported to have been recycled (Ali et al., 2017; JICA 2015; Korai et al., 2017)
	b. Low compliance	5		
	c. Medium compliance	10		

		d. Medium High compliance		15		
		e. High compliance		20		
	vi. Use of appropriate personal protective equipment	a. No compliance		0	0	No scavenger uses PPE
		b. Low compliance		5		
		c. Medium compliance		10		
		d. Medium High compliance		15		
		e. High compliance		20		
	Total	Low	red	0 – 49%	8.3333	sum of scores divided by total possible score
		Low/Medium	red/orange	50 – 69%		
		Medium	orange	70 – 89%		
		Medium/High	orange/green	90 – 98%		
		High	green	99 - 100%		
verdict		Low	red	0 – 49%	8.34%	

Benchmark Indicators for Governance Aspects

7.8. Inclusivity

Name	Description	Grading criteria		Score	Comments
User inclusivity.	i. Extent to which all citizens receive good solid waste management service.	a. No compliance	0	5	Rural counties were not served. Partial coverage for urban counties (Ali et al., 2019; Masood et al., 2014; Karoi et al., 2017; World Bank, 2019; Kaza et al., 2018)
		b. Low compliance	5		
		c. Medium compliance	10		
		d. Medium High compliance	15		
		e. High compliance	20		
	ii. Do authorities have a legal obligation to consult with and involve citizens in decisions affecting them.	a. No compliance	0	5	Citizens' rights existed but were constrained due to limited coverage (Ali et al., 2019) Complaints could be registered. In Pakistan there are no specific laws that ensures people are made a part of the decision-making process through consultation (Masood et al., 2014)
		b. Low compliance	5		
		c. Medium compliance	10		
		d. Medium High compliance	15		
		e. High compliance	20		
	iii. Evidence of actual public participation in decision making.	a. No compliance	0	5	Public participation usually existed only in the from of complaints.
		b. Low compliance	5		
		c. Medium compliance	10		
		d. Medium High compliance	15		
		e. High compliance	20		
	iv. Existence & use of public feedback mechanism on solid waste management services.	a. No compliance	0	5	Telephonic complaint handling. Online services available. However, citizen is not aware of the services (Masood et al., 2014)
		b. Low compliance	5		
		c. Medium compliance	10		
		d. Medium High compliance	15		
		e. High compliance	20		
	v. Implementation of public	a. No compliance	0	5	Campaigns and outreach activities for waste prevention and proper disposal of waste are held only occasionally

	education programs.	b. Low compliance c. Medium compliance d. Medium High compliance e. High compliance	5 10 15 20		
	vi. Change in habits and behavior of public towards more responsible waste management practices.	a. No compliance b. Low compliance c. Medium compliance d. Medium High compliance e. High compliance	0 5 10 15 20	0	Little to no evidence existed.
	Total	Low Low/Medium Medium Medium/High High	0 – 49% 50 – 69% 70 – 89% 90 – 98% 99 - 100%	20.833333	sum of scores divided by total possible score
verdict		**Low**	**0 – 49%**	20.84%	
Provider inclusivity.	i. Extent to which laws are in place and implemented for solid waste management service.	a. No compliance b. Low compliance c. Medium compliance d. Medium High compliance e. High compliance	0 5 10 15 20	10	Laws are in place Limited monitoring resulting in mixing of hazardous medical waste with municipal waste.
	ii. Extent to which organizations are in place to represent private sector in solid waste management activities.	a. No compliance b. Low compliance c. Medium compliance d. Medium High compliance e. High compliance	0 5 10 15 20	10	Relatively high cost paid SWM to private operators for waste collection (at around US$30 per ton) which is financed fully by transfers from Govt of Sindh (World Bank, 2019), 2 Turkish companies pvt. in Lahore (LWMC), NJC in Karachi. This trend is mainly in mega cities.

	iii. Evidence of recognition of informal sector in the waste management service.	a. No compliance b. Low compliance c. Medium compliance d. Medium High compliance e. High compliance	0 5 10 15 20	0	There is a need to better understand the organization of informal sector, identify opportunities for professionalization to leverage job opportunities and revenue generation, and improve communication about waste management (World Bank, 2019; Masood et al., 2014, Karoi et al., 2017, JICA, 2017)
	iv.Existence of a balance between public and private entities in providing solid waste management services.	a. No compliance b. Low compliance c. Medium compliance d. Medium High compliance e. High compliance	0 5 10 15 20	10	relatively high cost paid SWM to private operators for waste collection (at around US$30 per ton) which is financed fully by transfers from Govt of Sindh (World Bank, 2019), 2 Turkish companies pvt. in Lahore (LWMC), NJC in Karachi. This trend is mainly in mega cities.
	v. Open and transparent bidding for the award of contracts related to waste management.	a. No compliance b. Low compliance c. Medium compliance d. Medium High compliance e. High compliance	0 5 10 15 20	10	tenders were advertised in print media. However, if political influence is decision making intentional barriers/ dropout instance in bidding proposal (Personal Communication; Masood et al, 2014)
	Total	Low Low/Medium Medium Medium/High High	0 – 49% 50 – 69% 70 – 89% 90 – 98% 99 - 100%	40	sum of scores divided by total possible score
verdict		Low	0 - 49%	40.00%	

7.9. Financial stability

Name	Description	Grading criteria		Score	
Degree of environmental protection in waste treatment & disposal.	i. Degree to which accounts for solid waste management service is open to public scrutiny.	a. No compliance	0	0	SSWMB do not disclose its account on its official site. Also, pvt. contractors do not open their accounts to public. LWMC audit account information available on the website till 2015 (LWMC website) Basic systems for planning and transparency are weak and revenues are inadequate (World Bank 2019; JICA, 2017; Bank, 2010)
		b. Low compliance	5		
		c. Medium compliance	10		
		d. Medium High compliance	15		
		e. High compliance	20		
	ii. Percentage of households paying for waste management services	a. none	0	10	Since waste management services are charged indirectly the percentage. The waste management charge is 21.45% of the water bills of households (Masood et al., 2014). estimated to be 68% for Lahore, as 68% of the population is both using and paying for the service (Masood et al., 2014) 43% for Karachi (world Bank, 2019).
		b.25%<	5		
		c. 25%-49%	10		
		d. 50%-74%	15		
		e. 75%-100%	20		
	iii. Degree of support for people who can least afford to pay for waste management services.	a. No compliance	0	0	
		b. Low compliance	5		The city administration does not assign any priority of services provision. It is generally assumed that since a large number of residents in squatter settlements do not pay any taxes, they are not entitled to receive any service
		c. Medium compliance	10		

		d. Medium High compliance	15		(Ahmed, 2009), No such controls or policy in place (Ali et al., 2019), waste fee may account 1.6%-2% in Lahore (Masood et al., 2014) which should not exceed 1% (Wilson et al., 2012)
		e. High compliance	20		
	iv. Degree of funding for future capital investments in waste management services.	a. No compliance	0	15	Recently approved funding of 230$ million from world bank in Karachi (World bank, 2019), various plans under consideration in Gujranwala (Ali et al., 2019), Pakistan often seek technical assistance from World bank to manage SW (Korai et al., 2017)
		b. Low compliance	5		
		c. Medium compliance	10		
		d. Medium High compliance	15		
		e. High compliance	20		
	Total	Low	0 – 49%	31.25	sum of scores divided by total possible score
		Low/Medium	50 – 69%		
		Medium	70 – 89%		
		Medium/High	90 – 98%		
		High	99 - 100%		
verdict		Low	0 – 49%	31.25%	

7.10. Sound institutions - proactive policies

Name	Description	Grading criteria		Score	
Adequacy of national framework	i. Degree to which regulations are in place for solid waste management.	a. No compliance	0	10	Legislations exists but falls short (World Bank, 2019), Although regulations exist however they are not strictly enforced (Koari et al., 2017; Ashraf et al., 2016), Poor enforcement of existing laws is also a major reason for the current state of waste management Ali et al., 2019), the national picture, the SWM legislation and regulations in Pakistan are inadequate, outdated and not target oriented (Masood et al., 2014)
		b. Low compliance	5		
		c. Medium compliance	10		

	d. Medium High compliance 15 e. High compliance 20			
ii. Approved recent strategy for solid waste management	a. No compliance 0 b. Low compliance 5 c. Medium compliance 10 d. Medium High compliance 15 e. High compliance 20		15	no standardization laws for solid waste collection and disposal processes exist (Korai et al., 2017; Masood et al., 2014). Guidelines by Environmental Protection Agency of Pakistan exist. However, these rules do not cover all kinds of solid waste comprehensively (Ali et al., 2019)
iii. Presence of clear guidelines for local authorities for implementation of rules.	a. No compliance 0 b. Low compliance 5 c. Medium compliance 10 d. Medium High compliance 15 e. High compliance 20		10	The legislation, however, falls short of the following key elements: (a) technical prescriptions for the design of SWM facilities (collection points, garbage transfer stations (GTS), sanitary landfills, etc.); (b) financial tools specific to the management of waste in general; (c) waste master planning; (d) waste minimization and diversion policies; and (e) overall surveillance and enforcement. There are opportunities for relative quick wins through TA to address some of these shortfalls (Masood et al., 2014; World Bank, 2019; JICA, 2017; Korai et al, 2017).
iv. Clear presence of a national institution for implementation and coordination of the policy.	a. No compliance 0 b. Low compliance 5 c. Medium compliance 10 d. Medium High compliance 15 e. High compliance 20		15	EPA is charged with policy implementation.

	v. Level of resources available for the regulatory authority.	a. No compliance 0 b. Low compliance 5 c. Medium compliance 10 d. Medium High compliance 15 e. High compliance 20	10	Resource constraints exist (World Bank, 2019; Ali et al., 2019; JICA, 2017; Bank, 2010; Masood et al., 2014)
	vi. Extent of extended producer responsibility regime.	a. No compliance 0 b. Low compliance 5 c. Medium compliance 10 d. Medium High compliance 15 e. High compliance 20	0	Companies do not assume responsibility for product stewardship or reverse logistics. However, Part of recent approved project, Sindh Govt 2019; (World Bank, 2019)
	Total	Low 0 – 49% Low/Medium 50 – 69% Medium 70 – 89% Medium/High 90 – 98% High 99 - 100%	50	sum of scores divided by total possible score
verdict		Low/Medium 50– 69%	50.00%	
Local institutional coherence	i. Presence of a specific organization in the local municipality for waste management services.	a. No compliance 0 b. Low compliance 5 c. Medium compliance 10 d. Medium High compliance 15 e. High compliance 20	10	Local Municipalities for SWM exists in megacities of Pakistan e.g. Karachi, Lahore, Multan, Gujranwala. However, most of smaller cities do not have such bodies, municipality members without expertise deal with SW
	ii. Strength and organizational capacity of the local organization for waste management.	a. No compliance 0 b. Low compliance 5	10	Financing and staffing needs are not fully met in Karachi, with SSWMB receiving only half of its budgeted financing for operations (World Bank, 2019), Staff in Lahore are well trained (Masood et al., 2014). However, most of smaller cities do not have such bodies, municipality members without expertise deal with SW

		c. Medium compliance d. Medium High compliance e. High compliance	10 15 20		Also, provisional govt contract private companies relatively higher cost
	iii. Recent guidelines for the city's waste management plan.	a. No compliance b. Low compliance c. Medium compliance d. Medium High compliance e. High compliance	0 5 10 15 20	5	the national picture, the SWM legislation and regulations in Pakistan are inadequate, outdated and not target oriented (Masood et al., 2014)
	iv. Existence of management information system for recent data availability.	a. No compliance b. Low compliance c. Medium compliance d. Medium High compliance e. High compliance	0 5 10 15 20	5	Limited information exists (World Bank, 2019). unavailability of reliable data on waste generation rates, impacts of open dumping on the local environment, impact of illegal dumping on water bodies and amount of waste recycled or that can potentially be recycled (Masood et al., 2014; Kaori et al., 2017)
	v. Level of supervision of local waste management activities	a. No compliance b. Low compliance c. Medium compliance d. Medium High compliance e. High compliance	0 5 10 15 20	15	
	vi. Extent of inter municipal cooperation.	a. No compliance b. Low compliance c. Medium compliance d. Medium High compliance e. High compliance	0 5 10 15 20	15	Personal Communication
	Total	Low Low/Medium Medium Medium/High High	0 – 49% 50 – 69% 70 – 89% 90 – 98% 99 - 100%	50	sum of scores divided by total possible score
verdict		Medium	70-89%	50.00%	

Annex E: Glimpse of Field Survey

Figure: A child busy in waste picking activity with the donkey cart provided by the middleman in Allah Ditta Colony.

Figure20: A group of more than 50 Afghan waste pickers who also owned storage space and basic transport vehicles. They showed relatively greater autonomy to engage with other businesses (Gizri Area).

Figure21: A waste pickers in the hub of waste market in Sher Shah Colony.

Figure: Kids picking waste in Sher Shah Colony.

Figure: Kid picking waste from Kachra Kundi (communal dump) in Allah Ditta Colony.

Figure: Afghan waste pickers sharing their issues concerning ID cards and price volatility. (Gizri Area)

Figures: Informal workers engaged in the informal recyclers (resins) of the HDPE plastic waste in Sher Shah Colony.

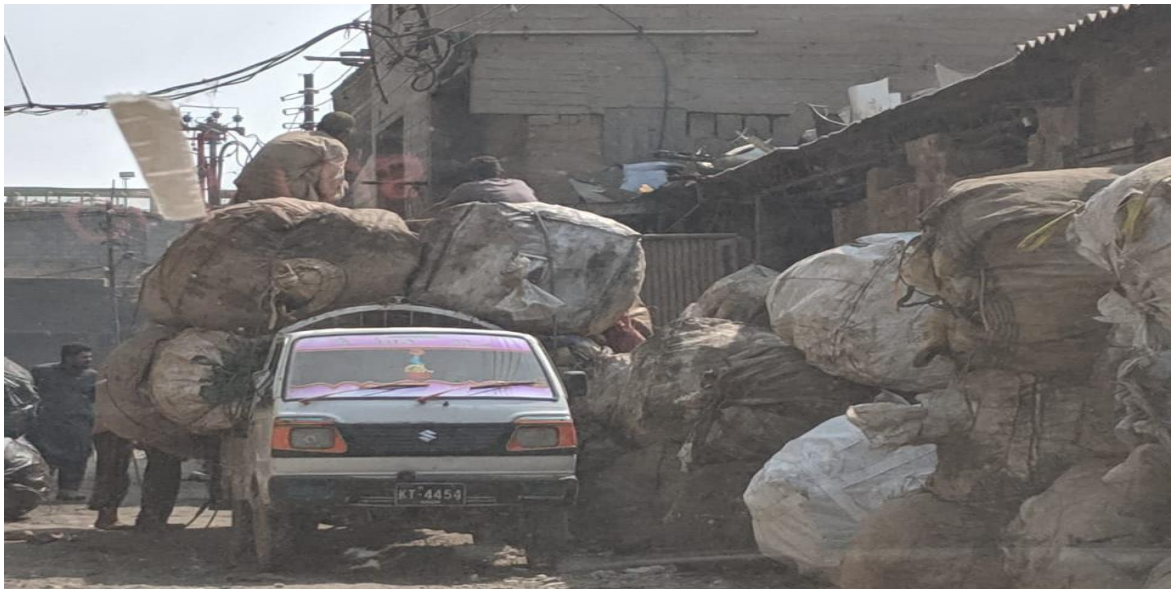

Figure: Plastic waste being procured by the informal recyclers (resin or pallet makers) in Sher Shah Colony.

Figure: workers sorting plastic into seven different categories at a wholesaler facility, working under the sun for long hours. (Sher Shah Colony)

Figures: A middleman in Allah Ditta Colony, supplying waste to Sher Shah wholesalers and providing facilities to four waste pickers/iterant buyers.

Figure: Kid selling product waste to a middleman on behalf of his employer in Allah Ditta Colony.

Figures: A wholesaler known as "Coke Wala" (Coke man) since he one gathers PET bottles. (Sher Shah Colony)

Figures: Waste pickers using sides of road as storage area for their collected waste. (Gizri Area)

Figure: A middleman receiving product waste from waste pickers and itinerant buyers, complaining about the injuries due to mix medical waste (Allah Ditta Town).