

EPR as a mechanism for integrating the informal sector

An evaluation of post-consumer PET waste management in South Africa

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Abstract

This thesis evaluates the performance of an EPR programme for post-consumer PET waste management by PET recycling company (PETCO) in South Africa. It analyses waste management policies of South Africa that are relevant to EPR. Using a set of evaluative tools, the thesis reveals areas for improvement in the EPR scheme. It also identifies areas in informal sector interventions where EPR can contribute in the gradual transition of the sector to formal waste management system. From the findings it is seen that integration of the informal sector into EPR programmes is profitable. This is because it is cheaper than investments in infrastructure and it subsidises the collection costs for producers. Despite the lack of adequate solid waste infrastructure, PETCO is still able to achieve high collection and recycling rates as a result of informal sector activities. Moreover, in informal sector interventions the areas that face the biggest challenges in informal sector interventions are the social aspects that deal with the recognition and acceptance of the informal sector. This is because there are limited policy considerations that address issues in this interface or it could be due to limited availability of information for the evaluation in this thesis. The other area for improvement is in the solid waste management aspects that deal with how the informal sector can be involved in formal solid waste management activities. For both solid waste management and social aspects, the difficulty is in generating practical solutions that are acceptable to stakeholders. The thesis concludes that the ideal situation for EPR and the informal sector in South Africa is that of collaboration. This has the advantage of ensuring that PETCO continues achieving high collection and recycling rates while also ensuring that the welfare of the informal sector is secured and improved.

Keywords: Extended Producer Responsibility, informal sector, integration, inclusion, waste management

Executive Summary

In emerging economies, the changing habits of consumption associated with rising incomes is increasing the complexity and volume of waste. This creates challenges for waste management systems that may not be well developed in these countries. This is particularly evident for plastic packaging such as PET, which is commonly used due to its favourable characteristics of durability and light weight. Poor management of PET waste has negative implications on the environment.

PET waste management using EPR approaches has been successfully implemented in developed countries through programmes such as deposit refund systems for PET bottles. Following these successes, emerging economies are looking into EPR as a policy option that could ease the burden of waste management for local authorities and also improve solid waste management infrastructure. However, when considering EPR, emerging economies face the challenge of the presence of a large informal sector that is active in waste management of valuable materials such as PET.

EPR in non-OECD contexts has not been extensively studied and the few studies that exist are mostly on electrical and electronic waste. The informal sector in these studies are perceived negatively as it undermines EPR programmes by diverting valuable waste materials and their activities contribute to environmental degradation. On the contrary, the informal sector is seen in a more positive light in the packaging sector as it is responsible for most of the collection of plastic waste in countries where the waste management infrastructure is inadequate or entirely lacking.

There are several studies that show the positive contribution of the informal sector in solid waste management but few actually address how this should be done in practice. Therefore, this research seeks to address how formal waste management programmes such as EPR can contribute to the improvement of the informal sector through job creation and formalisation without undermining its own overall performance.

Research questions and methodology

South Africa is one of the countries that is actively implementing EPR for packaging waste while considering the welfare of the informal sector. The informal sector is responsible for most of the collection of solid waste in South Africa. Unemployment is also a major problem for the country. Thus the focus is on both improving waste management and job creation for the informal sector. This thesis evaluates a case study of an EPR programme in South Africa for post-consumer PET waste management implemented by PETCO. The aim is to identify areas of improvement for the EPR scheme and to identify areas in which interventions for the informal sector need to be improved. The research questions asked are;

1. How has EPR for post-consumer PET waste been implemented in South Africa?
2. What is the performance of PETCO in the management of post-consumer PET waste?
3. What are the barriers to successful inclusion of the informal sector?

To answer the research questions, a deductive approach is used where theories and frameworks developed for both EPR and the informal sector respectively, are used. The EPR evaluation model developed by (Tojo, 2004) has been utilised in the thesis. The main criteria used in evaluation is *goal achievement* and *acceptability*. Goal achievement has been used to determine whether PETCO has managed to achieve the EPR goals of design improvement and effective collection and re-use/recycling. To determine this, the EPR evaluation tool developed by

Lindhqvist & Van Rossem (2005) has been used to determine the extent to which these goals have been achieved and the reasons for the performance values.

For the informal sector, the InteRA methodological tool has been used to determine the extent to which informal sector intervention aspects have been addressed by both waste policies in South Africa and PETCO activities. The evaluation also highlights areas for improvement. *Acceptability* has been used as a criterion to determine the extent to which the main actors (municipalities, waste pickers and producers) accept the inclusion of the informal sector into EPR programmes.

Findings

From the evaluation conducted for EPR, the main findings illustrated below are that PETCO performs well in the goal of high utilisation of products and material quality. There are adequate financial incentives to achieve high collection and recycling rates, there are targets for collection and recycling and the results are measured and reported. Though there are no penalties for failing to achieve set targets for collection and recycling, the fear of promulgation of legislation by producers has been enough to ensure compliance.

GOAL	SUB GOALS	CRITERIA AND SCORE	AGGREGATE SCORE			
			PETCO (packaging)	Ontario Blue Box Program (packaging)	Electronics Recycling Alberta	Quebec Songhu Oil Program
<i>System and Product design improvements</i>	Will individual producers benefit from product design improvements?	For some producers, levies are paid according to per tonne of resin. This kind of system offers incentive to use lighter materials. (2)	0.7 (2/3)	1.7	0.3	1.7
	Will a producer benefit directly from system design improvements?	There are no direct financial benefits because it is costly and everyone will benefit from system design improvements resulting to a limited extent of free riding (0)				
	Will producers collectively benefit from product and design improvements?	Producers will not collectively benefit. In this case the EPR levies will go up especially in the short term. (0)				
<i>High utilisation of products and material quality</i> a) Collection	Does PETCO have measures to secure achievement of goals and targets?	There are set targets. Though there are no penalties for failure to reach targets there is threat of mandatory requirements should voluntary initiatives not work (2)	2.5 (5/2)	1.5	1.5	3
	Are there tangible financial benefits for striving towards higher collection?	Collectors are paid per tonne of material collected which gives them financial benefits when they achieve higher collection rates (3)				

b) Re-use and recycling	Is recycling and re-use measured?	Results are verified by an independent auditor on a quarterly basis but there are no sanctions for non-achievement of targets (2)	1.7 (5/3)	1	0.7	0.5
	Are there measures to secure goal achievement for stated goals re-use and recycling targets?	Failure to meet recycling and re-use targets may result in regulation considered which is considered to cost more for producers than voluntary schemes (2)				
	Are there incentives for high re-use and recycling?	There are incentives for promoting re-use and recycling but these have limited economic benefits (1)				

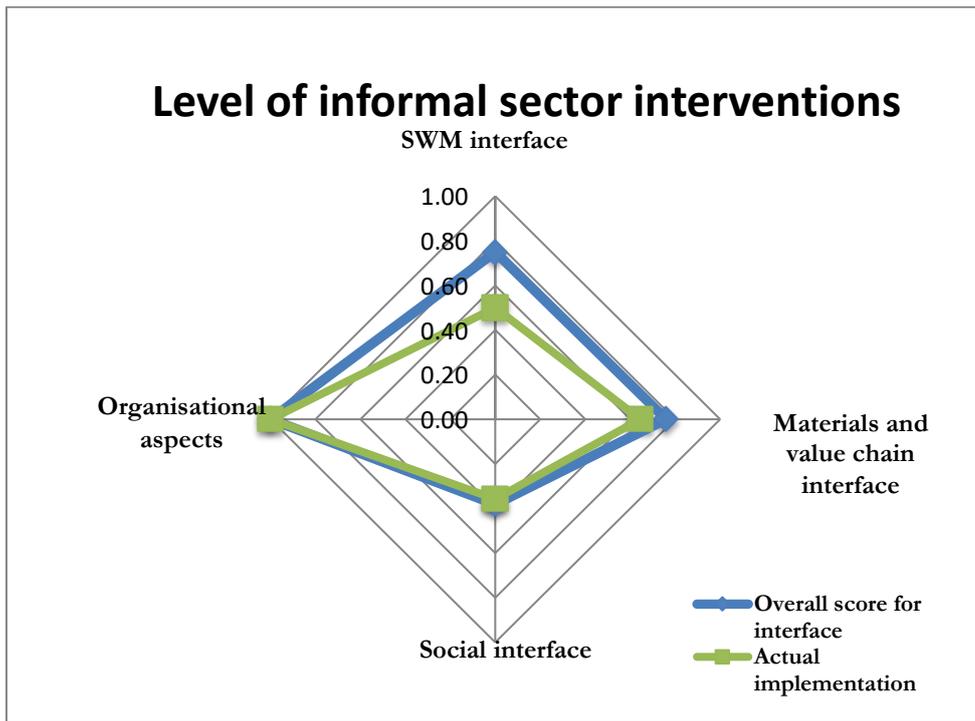
For system and product design improvements PETCO does not perform well. However, this is common across several studies that have been reviewed in the thesis. There are limited financial incentives for producers to improve the design of products and product systems. Despite these lack of financial incentives, PETCO has initiated design for recycling for economic reasons and to enhance the recycling performance of the programme. This is different from the other cases reviewed in the thesis where financial incentives are the main influencing factor for design changes.

From literature, free riding is a common problem for EPR in non-OECD countries especially where there are many small producers and a presence of the informal sector. In the case of PETCO, the impact of this free riding on the EPR scheme is not that significant. This is because the scheme has a high compliance rate with about 68% of total PET market actors participating.

In the case of the informal sector, previous research shows that informal sector interventions usually focus on particular interfaces depending on the priorities of a country. This thesis finds that the South African waste management policy to a large extent addresses most of the informal sector intervention interfaces (solid waste management, materials and value chain, social and organisational aspects). In other case studies to which the InteRA tool has been applied, the solid waste management interface that deals with the creation of a role for the informal sector in formal waste management is usually the least considered. This is due to the difficulty of getting practical solutions and engaging different actors. However, in South Africa it is the social interface which deals with promoting the legal recognition and acceptance of the informal sector that is least considered. This could also be attributed to lack of information by the author. The only similarity in the South African case with literature is in organisational aspects (empowerment and organisation of the informal sector) which receives considerable attention in both cases.

When it comes to actual implementation of policy and other actions in informal sector interventions by PETCO and other relevant actors, there is a gap between policy considerations and implementation. The gap is especially big in the solid waste management interface that involves creating a role for the informal sector in formal solid waste management. For organisational aspects that concern organisation and empowerment of the informal sector, policy considerations and implementation match.

Illustration of the level of policy focus and implementation for the four categories of interventions



In the formalisation process through the formation of cooperatives there are several barriers. These include; lack of infrastructure for collection and storage of materials, lack of integration of cooperatives into waste management plans of municipalities, transportation problems that limit access to markets and lack of skills to run cooperatives among other barriers.

Prior to the introduction of legislation to make producers include the informal sector into formal waste management there were different opinions by municipalities and producers. There was a general expectation that EPR would be an ideal tool to help in the transition of the informal sector into formal waste management. For municipalities, there are difficulties in taking responsibility for this transition due to limitations in finances and expertise. Further, municipalities are confined to collection and do not benefit from recycling activities. This justifies their proposal that responsibility for the informal sector transition should be delegated to producers who have both the financial capacity to facilitate the transition and who also benefit directly from recycling activities. The role that the municipalities could instead play in aiding the transition to formal waste management is by creating an enabling environment for both EPR to thrive and for the transition of the informal sector to take place.

From both literature and interviews there is a general perception that the informal sector does not want to be formalised. However, this is disputed by one South African government report that says that the informal sector would like to be formalised. The difference in opinions is attributed to the method of framing questions in surveys. The informal sector is also perceived negatively especially for products such as electrical and electronic waste due to the negative impacts on the environment. The reverse is true for packaging where informal sector involvement has positive benefits for the environment due to high collection rates.

For producers, the general opinion is that a shift from a voluntary to a mandatory EPR programme would raise costs and would not be as effective as voluntary programmes. There is

a feeling that mandatory programmes might impact future industry survival and this will have negative impacts on job creation that is so important especially in contexts like South Africa. Research however shows that these concerns may not be as significant in practice.

Conclusions

From literature, the ideal situation is one where the informal sector does not exist. However, for South Africa an ideal situation is where there is a symbiotic relationship between the informal and formal sector to avoid the negative implications of exclusion of the informal sector. South Africa through its waste policy is trying to harness both the benefits of EPR and the informal sector and the measures put in place are supposed to ultimately result in the transition of the informal sector into formal organisations.

From the evaluation, the main areas that should be considered for PETCO are improvements in the design of products and product systems. The financial incentives to producers should be able to drive the changes in design of products and their systems. In the case of PETCO, the guidelines for design for recycling rather than financial incentives are motivating changes in product design.

For the informal sector, there is need to improve on aspects such as acceptance and legal recognition of the sector. In addition, as part of speeding up the integration process, formalised waste organisations such as cooperatives should be given a role in formal waste management system.

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Abbreviations

EPR – Extended Producer Responsibility

DEA- Department of Environmental Affairs

DST- Department of Science and Technology

EEE -Waste Electrical & Electronic Equipment

IndWMP- Industry Waste Management Plan

IRS- Informal (collection and) Recycling Sector

ISWM- Integrated Solid waste management

LCA- Life Cycle Analysis

MSW- Municipal solid waste

NWMS- National Waste Management Strategy

OECD- Organization for Economic Cooperation and Development

PET- Polyethylene terephthalate

PPE- Personal Protective Equipment

rPET- Recycled Polyethylene terephthalate

SMME- Small Medium and Micro-Sized Enterprises

SWM- Solid waste management

WEEE -Waste Electrical & Electronic Equipment

1 Introduction

Increasing global population and changing habits of consumption are creating solid waste management challenges for municipalities, organisations and individuals (Marshall & Farahbakhsh, 2013). In emerging economies, there is an increase in the volume of waste and its complexity as incomes rise. Furthermore, waste management systems of these countries may not be well developed and the waste management chain maybe undergoing transition (OECD, 2015, p. 175). Therefore, involvement of the private sector and implementation of Extended Producer Responsibility (EPR) may help improve waste management in these countries (Engel, Stuchtey, & Vanthournout, 2016). This is because private actors tend to increase efficiency of waste management practices like transport logistics, especially when not subsidised (Van Rossem, Tojo, & Lindhqvist, 2006). The authors further state that EPR programmes also help reduce the financial and physical burden of waste management authorities that normally have inadequate waste management facilities and technologies.

According to the OECD (2015), EPR was developed in response to challenges of increasing volume and complexity of waste, difficulties in mobilising technical and managerial skills in the private sector, and opposition by the public to siting of landfills and incinerators in the 1980s. It was established to reduce volume of waste going to final disposal, to increase rates of recycling and to provide incentives for waste prevention and reduction at source. It has been widely implemented in several OECD countries. Some non-OECD countries are considering initiating or expanding EPR systems as part of modernisation of their waste management systems. However, the significant presence of the informal sector, estimated at 20 million globally, poses a major challenge to EPR initiatives in these countries (OECD, 2015, p. 14). This is because the informal sector (*individuals or enterprises that operate outside the formal waste management systems*) may be in competition with formal authorities for materials or may be in violation of set regulations (Scheinberg, Simpson, & Gupt, 2010; Velis et al., 2012). The sector may divert waste materials covered by EPR schemes into informal channels. Further, its failure to comply with health, safety and environmental standards may make its operations cheaper than those of official recyclers which, may undermine the operations of EPR schemes (OECD, 2014).

Despite the challenges posed by the informal sector, it also plays an important role in solid waste management in low and middle income countries. The sector fills the gap left by the formal sector in the collection and recovery of valuable materials (OECD, 2015). Formalising solid waste management without considering the informal sector may reduce cost efficiency of cities as the informal sector reduces collection, transport and disposal costs for municipalities (Gupta, 2012). In addition, recognition of the informal sector may result in increased valorisation of materials and general solid waste management may improve (Scheinberg et al., 2010). Therefore, the major challenge for policymakers has been how to ensure livelihoods of those working in the informal sector while transitioning into formalised solid waste management like an EPR based system.

1.1 Problem Definition

Plastics are increasingly being used and plastic packaging volumes are expected to continue their strong growth. Between 2000 and 2015, the share of plastics in global packaging volumes rose from 17% to 25% with an annual growth of 5%. Further, about 72% of plastic packaging is not recovered at all, with 40% being landfilled while the remaining 32% leaks out of the collection system (World Economic Forum, Ellen MacArthur Foundation, & McKinsey & Company, 2016). This poor management of plastic waste has led to environmental pollution and health concerns for waste pickers. In addition, for Polyethylene Terephthalate (PET) in

particular, there is a low utilisation efficiency for reclaimed bottles (Zhang & Wen, 2014). For example, despite PET having a higher recycling rate than other plastics, globally half of it is not collected for recycling. Only 7% is closed loop recycled, that is, bottle to bottle recycling (World Economic Forum et al., 2016).

Recycling PET has the potential to conserve fossil fuels, reduce energy use and greenhouse gas emissions (Zhang & Wen, 2014). It has been in practice for a long time with private incentives driving re-use and recycling of products. However, these incentives have been inadequate for management of disposed products necessitating the use of EPR to achieve more optimal levels of responsibility (Kaffine & O'Reilly, 2013). Implementation of EPR may help reduce waste generation if consumers become aware that they pay for end life management of the product. Also, the demand by EPR programmes for separation and recycling may induce the development of separation and recycling technology (Van Rossem et al., 2006).

Though EPR has been widely implemented and extensively studied in the OECD countries, relatively less has been studied about it within a non-OECD context (Manomaivibool, Lindhqvist, & Tojo, 2008). In those few studies, mostly on electrical and electronic waste, the informal sector is said to have a negative impact on EPR especially on collection of materials (Gupt & Sahay, 2015; Manomaivibool et al., 2008). In addition, the municipalities' perception of the informal sector is usually negative, especially in cities that aspire to modernise their solid waste management systems (Wilson, Araba, Chinwah, & Cheeseman, 2009). Despite this negative perception, the informal sector continues to play an important role. For instance in Brazil, PET bottles are entirely recycled by the informal sector (Zhang & Wen, 2014).

In an investigation on the interaction of informal and formal recovery waste systems, it was found that symbiotic relationships of both formal and informal sectors are more effective than competitive relationships (Besiou, Georgiadis, & Van Wassenhove, 2012). In Bulgaria, the informal sector was not consulted when a new EPR system for packaging was being established. As a result, the EPR system failed to benefit from networks and activities of the informal pickers. Retaliation by the informal sector through vandalism of infrastructure led to little capture of materials and high financial costs for the EPR system (OECD, 2015). Therefore, inclusive waste management, especially in countries with large informal sectors, is important.

Most studies on PET have been about Life Cycle Assessments (LCA) evaluating various impacts of the processing and recycling chain of PET. They have also been comparing the economic and environmental impacts of different recycling methods. Few studies have focused on recycling and collection systems of PET (Zhang & Wen, 2014). When it comes to programmes for managing PET waste, well designed mandatory administrative instruments have been favourably recognised by researchers. However, for voluntary initiatives there is doubt over their effectiveness and efficiency creating need for more evaluation (Tojo, 2004).

Majority of the research and literature that has been found and reviewed for this thesis on EPR and the informal sector in middle income countries focuses mostly on electrical and electronic waste in Asia. There is minimal research on the same for packaging waste such as PET especially in Africa. Since the author has a particular interest in EPR implementation in Africa, South Africa is selected as a case study. This is because a general review revealed it as one of the few African countries actively implementing EPR in several waste streams. Further, the situation in South Africa is typical of that of several middle and low income countries that wish to implement EPR in the presence of an informal sector. The choice of a single case study approach for this thesis was adopted because it generates detailed knowledge that enables not only the adequate testing of EPR theory, but also alternative explanations to existing variations (Yin, 2009). The use of a multiple case study approach is not preferable because the different

designs of EPR in different countries makes comparison difficult. Moreover, obtaining data for different contexts is challenging (OECD, 2015).

There are research gaps in both the area of EPR for post-consumer PET waste and, in whether or how the informal sector should be included into an EPR scheme. Research can make a contribution in this by revealing areas that need improvement in intervention policies for both EPR and the informal sector. It can also help increase knowledge available on these two topics. Further, it can also offer some critical and independent insights into the interactions of the different stakeholders involved in both EPR and the informal sector.

This research consists of an ex-post evaluation of EPR policy which constitutes of waste legislation, actions by Government and guidelines that influence the implementation of EPR in South Africa. The unit of analysis is a Producer Responsibility Organisation (PRO) called PETCO, formed through a voluntary industry initiative, which handles post-consumer PET waste in South Africa. The research also considers the integration of the informal sector which plays a prominent role in South Africa's waste management.

Due to the complexity of solid waste management and informal sector issues, the research is aimed at informing policy decisions rather than prescribing solutions. It attempts to highlight factors to be considered so as to avoid negative impacts that may arise from the exclusion of the informal sector in waste management programmes for post-consumer PET waste. The purpose is to identify challenges encountered in the integration of the informal sector that have practical implications for EPR system design. This is done through the aid of the InteRA methodological tool. The research, through the use of the EPR evaluation model developed by Tojo (2004), also seeks to reveal what elements of EPR exist and are effective in the existing PETCO scheme and what elements should be further developed in future EPR policy.

1.2 Research Question and Objectives

Given the problem stated, the research aims to identify how EPR for post-consumer PET waste has been implemented in South Africa. Given the important role of the informal sector in solid waste management, the research explores the process of inclusion of the informal sector into the EPR system and the associated barriers to successful inclusion. This is achieved through the following questions.

1. How has EPR for post-consumer PET waste been implemented in South Africa?
 - a. What are the existing policies in place for implementation of EPR?
 - b. How has the informal sector been included in the EPR scheme?
2. What is the performance of PETCO in the management of post-consumer PET waste?
 - a. How do the outcomes of PETCO match with goals of EPR theory?
 - b. To what extent do waste management interventions address integration of the informal sector?
3. What are the barriers to successful inclusion of the informal sector?

1.3 Limitations and Scope

The main case study is the EPR programme for post-consumer PET waste in South Africa. Policies and approaches that influence both the implementation of EPR and the integration of the informal sector into formal solid waste management are considered. In the analysis of the outcomes of EPR, there is emphasis on downstream EPR activities as this is where the informal

sector is most active. Analysis is focused on immediate outcomes of EPR outlined in the EPR evaluation model.

Though the Industry Waste Management Plan (IndWMP) requires producers to be actively involved in the integration of the informal sector, not much is said about its implementation in this research. This is because it was recently released and then later withdrawn. Therefore, not much can be said about its outcomes. It is mentioned without any extensive analysis. The nature of this research is mostly descriptive and exploratory as opposed to prescriptive as explained in detail in chapter 3. This approach has been adopted due to the complex nature of the topic and limitations in the capacity of the author to prescribe solutions within the case study's context.

Single case studies are considered to be a poor basis for generalisability (Yin, 2009). In this research generalisability may be limited, to some extent, by the context specific nature of the results. This is however not uncommon to EPR case studies because as mentioned by the OECD, the varying nature of EPR designs make it difficult to carry out a comparison. A multiple case study approach on the other hand, is thought to produce more robust results because it employs the replication logic to generate knowledge that eventually leads to the development of a theoretical framework (Yin, 2009). To overcome limitations of single case studies, an EPR evaluation model is used to determine the degree to which this case study supports EPR theory. A comparison with existing literature on EPR is also done to give external validity to the results. Through these methods results generated from this case study can be comparable to other cases that employ the same EPR evaluation model.

Validity is established in case studies through the use of multiple sources of data/triangulation (Vedung, 2009; Yin, 2009). For this research, only two methods are used, that is, documentary and interrogative methods. Although observation methods would have made understanding of the context easier, resource constraints made it difficult to carry out any observation. As a result, bias in the research may not be completely eliminated. Collecting data far from the geographical setting of the research made it particularly difficult to evaluate the criterion of *acceptability*. This is because getting a complete forum of actors relevant to the research proved challenging via the available means of communication. Some of the potential interviewees that were contacted did not respond. For public authority actors such as municipalities, it was difficult to establish who and in which location of the country could be contacted. The country is not only large but also its different locations vary in circumstances. The task of identifying a representative location or getting public officials and their contact details proved challenging given the author's limited knowledge of the country.

1.4 Ethical Considerations

The topic is the author's own choice. Part of the case study was developed for one of the author's study papers where two interviews were carried out. Permission to use information from that paper was requested from the two interviewees before starting this research. Verification of the case study results was done by sending the developed case study to two interviewees who work directly with PETCO. Interview transcripts were also sent to 3 of the interviewees.

The author has taken care to respect the wishes of the interviewees with regard to how information should be disclosed. Further, precaution has been taken to ensure they are not quoted out of context. Permission was requested to record the interviews and to use illustrations from government publications such as in figure 5-1. Publications and data received are properly acknowledged and only used for intended purposes. The research proposal has been reviewed

against the criteria for research requiring to go through the ethics review board at Lund University and has been found not to require a statement from the ethics committee.

1.5 Audience

The research is mainly aimed at stakeholders involved in EPR schemes in countries that have a large presence of the informal sector. These include PROs, municipalities, waste policy makers, researchers, informal sector organisations, producers and other funding organisations involved in these programmes. It is also meant for an academic audience to increase knowledge about EPR in a non-OECD context and to stimulate research in this area which could lead to further development of EPR theory.

1.6 Disposition

Chapter 1 gives the background to the research problem, outlines research questions, objectives, limitations of the research, intended audience and ethical considerations.

Chapter 2 reviews and analyses literature on EPR and the informal sector and describes the analytical framework used in the research.

Chapter 3 describes the methodology used to collect and analyse data.

Chapter 4 explains the implementation of EPR for post-consumer PET waste in South Africa and the integration of the informal sector.

Chapter 5 analyses the results and reflects on the research.

Chapter 6 contains the conclusions to the research, recommendations and suggestions for further research.

2 EPR in a non-OECD context and the inclusion of the informal sector

This chapter explores the concept of EPR and how it has been applied in a non-OECD context. The informal sector and the effect of its activities on EPR schemes is also explored. Measures of effectively involving the informal sector in EPR programmes are examined and the chapter concludes with examples of evaluations that have been done for EPR, the informal sector and PET.

2.1 Extended Producer Responsibility

Background and definition

EPR as a policy strategy was first introduced by Thomas Lindhqvist in a report to the Swedish Ministry of Environment. The concept shifted the responsibility of waste management to producers since they possess unique knowledge and opportunity to change the characteristics of their products (Lindhqvist, 2000). It was then first applied in packaging waste in German Packaging Ordinance and Dutch Packaging Covenant in 1991. It later spilled to other waste streams and spread through the OECD guidance manual (Manomaivibool et al., 2008).

The most common definition of EPR is by the OECD (2001, p. 18) that states:

“EPR is an environmental policy approach in which a producer’s responsibility, physical and/or financial, for a product is extended to the post-consumer stage of a product’s lifecycle. There are two related features of EPR policy: (1) the shifting of responsibility (physically and/or economically; fully or partially) upstream to the producer and away from municipalities, and (2) to provide incentives to producers to incorporate environmental considerations in the design of their products.”

Another definition by Lindhqvist (2000, p. 154) defines EPR as:

“A policy principle to promote total life cycle environmental improvements of product systems by extending the responsibilities of the manufacturers 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 in some instances is considered to be neither a policy tool nor strategy but on the same level as concepts such as polluters pay principle. Moreover, it is considered a crucial condition for reflecting the essential life cycle costs in the prices of products (Lifset, Atasu, & Tojo, 2013, p. 162; Lindhqvist, 2000).

Implementation of EPR

The implementation of EPR is based on several goals which can be achieved by designating different kinds of responsibility and the use of various policy instruments and approaches.

Goals

The main goals of EPR include source reduction, waste prevention and closure of material loops (Lindhqvist, 2000; OECD, 2001, p. 28). According to Lindhqvist (2000), the important goal of an EPR system is the ability to create incentives for continuous product improvement. These can be achieved through creating incentives for eco design of packages and products, utilising private sector expertise, internalising costs of waste management into product prices, and shifting the burden of waste management from municipalities and taxpayers to firms and

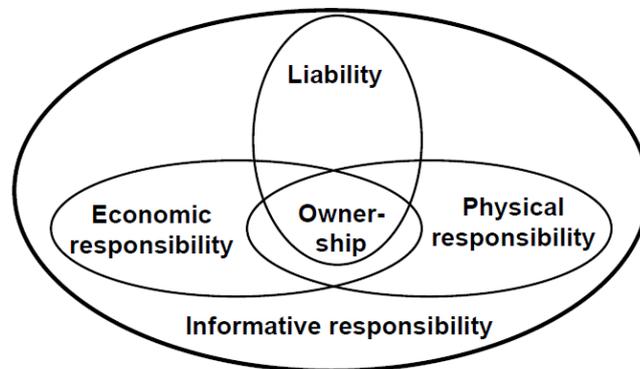
consumers (Lifset et al., 2013). Moreover, EPR also provides a basis for selection of policy instruments such as fees, subsidies, ban/restrictions, permits, targets, standards, labels and information campaigns (Lindhqvist, 2000).

Responsibility

EPR has become a mechanism for shifting costs and occasionally the operational responsibility for recycling different kinds of waste (Lifset et al., 2013). There are different forms of EPR responsibility. The two main ones are physical and financial responsibility, while Lindhqvist (2000) identifies three more (liability, ownership and informative) explained below.

- *Physical Responsibility* occurs when producers are responsible for the physical management of their products and/or their effects while in some cases maintaining *ownership* of the product throughout its life cycle.
- *Economic responsibility* is where a producer meets all or part of costs of managing the end life of a product.
- *Liability* refers to responsibility for proven environmental damage caused by a product at any part of its life cycle. The level of responsibility is determined by law.
- *Informative responsibility* refers to producers giving information on environmental properties of their products.

Table 2-1: Models for EPR



Source: *Extended producer responsibility in cleaner production*, Lindhqvist (2000, p. 38)

Though EPR is meant to shift responsibility for end of life management of products and materials to producers, others argue that responsibility of producers should extend beyond waste management to include issues of material choice and toxics reduction (Lifset et al., 2013). This is in relation to the RoHS (Restriction of Hazardous Substances) legislation being proposed along with the WEEE Directive. In many cases however, EPR has not been designed to incentivise eco design of products. Instead, it has been used to fund, create or expand infrastructure for post-consumer recycling (Lifset et al., 2013).

EPR based policy instruments

Public policy instruments are a set of methods that public sector authorities use to effect social change or obtain support. The basic instruments governments use are regulation, economic means and information (Vedung, 2009). In the implementation of EPR, administrative, economic and informative policy instruments are used (Lindhqvist, 2000). EPR programmes

usually comprise of more than one EPR based policy instrument. The combination of instruments varies but most include at least a take-back requirement for post-consumer products (Van Rossem et al., 2006). The different types of policy based instruments used in implementing EPR are listed in table 2-2.

Table 2-2 EPR based policy instruments

Administrative instruments	Collection and/or take-back of discarded products, substance and landfill restrictions, ^a achievement of collection, re-use (refill) and recycling targets, fulfilment of environmentally sound treatment standards, fulfilment of minimum recycled material content standards, product standard, utilisation mandates ^b
Economic instruments	Material/product taxes, subsidies, advance disposal fee systems, deposit-refund systems, upstream combined tax/subsidies, tradable recycling credits
Informative instruments	Reporting to authorities, marking/labelling of products and components, consultation with local governments about the collection network, information provision to consumers about producer responsibility/source separation, information provision to recyclers about the structure and substances used in products

a) Some exclude substance and landfill bans from EPR-based policy instruments.

b) Utilisation mandates is where producers have to achieve certain re-use and/or recycling targets, but do not have to use them within their own activities.

Source: Tojo, Lindqvist, & Dalhammar (2006, p. 228)

EPR approaches

The adoption of EPR has been driven mainly by legislation and most schemes are mandatory rather than voluntary (OECD, 2015). However, in some cases the civil society has pushed for its adoption. For instance, the civil society in India put pressure on multi-national corporations to be globally consistent with their producer responsibility policies and practices. The same pressure was applied to local companies to ensure responsibility for entire life cycle of products is taken (Manomaivibool, 2009a). EPR programmes can be mandatory, voluntary or a combination of the two that results in negotiated agreements. This is discussed below.

Mandatory programmes

For mandatory programmes to be established, a suitable authority has to be identified, or an enabling legislation, regulation or ordinance has to be developed. Additionally, a formal oversight role may be needed and sanctions set up to ensure compliance. For this reason, costs of implementing mandatory programmes may be quite significant (OECD, 2001). In situations where only well established players are forced to take a voluntary step, mandatory EPR may even out the playing field in the industry. However depending on its design, it could either facilitate or hinder existing voluntary initiatives (Manomaivibool et al., 2008). There is usually some resistance by stakeholders whenever environmental economic instruments such as mandatory programmes are introduced (Tojo, 2004). For example, when a mechanism to implement a national buy-back scheme for WEEE was proposed in Thailand some producers raised concern that such a model might discourage producers and could be inefficient. Others argued for an opportunity to use their resources in organising efficient individual or collective systems (Manomaivibool et al., 2008).

Voluntary programmes

Voluntary programmes take a variety of forms such as unilateral commitments by industry, negotiated agreements between industry and public authorities, voluntary programmes developed by public authorities that individual firms are invited to participate in, and agreements between the polluter and the afflicted party (OECD, 2001). As cited by Lindhqvist (2000, pp. 33, 46 & 48), the voluntary approach is preferred to achieve good prevention and recycling results and to avoid resistance from actors. Further, a voluntary approach allows for the flexible adaptation of markets of collection and recycling systems. However, a framework of penalties has to be created to avoid such policies from failing. An example of this kind of programme is the German Packaging Ordinance where the private sector was allowed to make product changes and manage waste. However, there was a provision for Government to force implementation of collection in shops for a specified material if pre-set recycling levels were not reached.

In the case of unilateral commitments by industry, there are several drivers for their establishment. These include economic reasons to recover high-value items, boosting of public relations, avoidance of government intervention, and expansion of market share for products. Often, such programmes result in a reduction of resource and energy use, less operational costs, and increased credibility with shareholders (OECD, 2001). Voluntary programmes may end up being mandatory programmes. This is due to societal demand, failure to achieve collection and recycling/re-use targets and free riding problems. An example is the Swedish deposit refund system (Tojo, 2011; Tojo et al., 2006).

Producer Responsibility Organisations

The most dominant method of implementing EPR is through single or competing PROs (Lindhqvist, 2000). These are third party organisations formed to enable producers to collectively manage take-back of products and sometimes arrange for the treatment of products. They normally collect fees from the producers based on a specified fee structure. An example of a PRO for packaging is the German Duales System Deutschland (DSD) (OECD, 2001). PROs could be a group of companies obligated by law to meet collection or recycling requirements, or service contractors servicing the obligated companies (Lifset et al., 2013). They can be found in both mandatory and voluntary EPR programmes.

2.2 EPR in a non-OECD context

There has been an emerging interest in EPR outside OECD countries. This could be explained by the fact that EPR provides financing solutions, without the need to raise taxes and municipal charges, to governments that seek to improve the waste management and recycling standards in their countries (Lindhqvist, 2000). Furthermore, the wide gap between poor and wealthier consumers in non-OECD countries makes the introduction of EPR programmes a good policy choice. This is because responsibility for end life management of products falls on the producer and actual consumer instead of the general taxpayer (Van Rossem et al., 2006).

Producers in developed countries tend to bear more financial responsibility and very little physical responsibility for recycling. This is when compared to producers in developing countries who tend to bear both financial and physical responsibility, especially if there is a very active informal sector (Gupt & Sahay, 2015). Though in both cases producers may contract physical responsibility out to municipal waste organisations and subcontractors, producers in developing countries have to play a relatively bigger role in this area. This is because waste management systems in these countries may be inadequate or entirely absent requiring

producers to get actively involved in developing these waste systems. The provision of incentives in EPR in the form of recycling fees or deposits when products are returned, has enabled consumers and retailers to play a greater role in recycling (Gupt & Sahay, 2015). The participation of retailers is in some instances a legal requirement. For example, the WEEE Directive outlines that collection is to be set up by distributors of Electrical and Electronic Equipment (EEE) at retail shops. Retailers are then required to accept small WEEE free of charge from consumers, who are not obliged to buy a similar item in return. This is done as to enhance convenience for consumers.

According to (Manomaivibool, 2009; Manomaivibool et al., 2008; Nahman, 2010, p. 157, the solid waste management systems in non-OECD countries are characterised by the following:

- Numerous producers, some of whom are in semi-regulated or unregulated sectors that lead to unbranded products. These small and medium producers may be disadvantaged when EPR is introduced, as they have fewer resources to make design improvements. Thus external help may be required. Their big numbers may also overwhelm registration and monitoring systems.
- Lucrative downstream business dominated by the informal sector. This is facilitated by low labour and operating costs, lax health, safety and environmental standards and lack of enforcement mechanism for regulations.
- Historically low penetration rates of products (electric and electronic equipment especially) and current expanding markets.
- Extensive use and re-use of products that lengthens lifespan of products. It is however feared that introduction of EPR could lead to the collapse of re-use businesses.
- In the case of WEEE, there is a hoarding effect where products are not in use but they are still stored.
- Under developed solid waste management systems with mixed waste and there are insufficient funds for recycling.
- Lack of willingness by households to not only return goods for recycling, but also to pay for waste disposal.
- Lack of awareness by both consumers and collectors of the negative effects of poor waste management and the potential financial benefits of recycling.

2.3 EPR and the Informal Sector

As mentioned, the implementation of EPR in non-OECD countries is difficult because the large presence of the informal sector undermines its environmental performance. For instance, backyard recycling of the informal sector in WEEE management in India is a major concern due to its limited regard for human health and the environment. The sector also competes with the Authorised Treatment Facilities (ATF) (Manomaivibool, 2009a). The following sections will explore why the informal sector should be included in formal waste management systems, and how it can be effectively involved in EPR.

Definition of the informal sector

The informal sector as defined by Scheinberg et al. (2010, p. 8) refers to, “individuals or enterprises who are involved in waste management activities, but whose activities are neither organised, sponsored, financed, contracted, recognised, managed, taxed nor reported upon by the formal waste authorities”. Examples of informal sector activities include the extraction of recyclables and re-usable materials from mixed waste by waste pickers (Wilson, Velis, & Cheeseman, 2006). The informal sector is divided into two; the *informal service sector* that comprises of individual and micro-enterprises that earn fees for removal of waste and, the

informal valorisation sector that consists of individuals, co-operatives, families and micro-enterprises that function as an extractive resource industry (Scheinberg et al., 2010). The informal valorisation sector undertakes different activities as outlined by Wilson et al. (2009);

- *Street waste picking* where secondary raw materials are removed from mixed waste found on streets or extracted from communal bins before collection.
- *Itinerant Waste Buyers (IWBs)* who go from door to door to collect specific recyclable materials through buying or bartering items. They have little interaction with the formal sector and thus are rarely considered.
- *Waste picking from dumps* where waste pickers sort through waste before it is covered. It is usually carried out by communities that live near the open dumps.

Waste picking is widespread in many urban areas of low income countries. It is estimated that 2% of the population in Asian and Latin American cities depend on waste picking for their livelihood. It is carried out by poor and marginalised social groups for income generation (Wilson et al., 2006, p. 798).

Role of the informal sector

In a number of countries, the informal sector provides a waste collection service in areas where there is no formal municipal system in place (Wilson et al., 2009). In middle income countries, recycling is confined to valuable fractions of waste while the non-valuable sections are discarded. Furthermore, recycling is usually undertaken by the private sector rather than the municipality (OECD, 2015). In many cases the valuable materials are recovered and recycled by the informal sector. Though the informal sectors' operational costs are usually much higher than that of the formal sector, high revenues from recycling offset their costs leading to a much lower cost per tonne of material (Scheinberg et al., 2010). Moreover, the informal sector achieves high recovery rates because the livelihoods of the pickers is dependent on their ability to recycle (Gunsilius, 2010).

In contrast, the formal sector mainly provides collection and disposal services and revenues from the small quantities recovered and recycled is not enough to offset costs. This leads to much higher costs per tonne of material compared to that of the informal sector (Scheinberg et al., 2010).

There are several challenges that could limit the effectiveness of the informal sector. These include low quantity and quality of recyclables that are influenced by the method of collection and sorting. Secondly, lack of incentives and limited market for recyclables may reduce the potential for improved recycling (Oguntoyinbo, 2012).

Perceptions of the informal sector

The formal waste management sector usually has a negative perception of the informal sector regarding it as, "backward, unhygienic and incompatible with a modern waste management system" (Wilson et al., 2006, p. 798). In general, there is limited social acceptance of informal sector activities and, many cities view them as a social problem and public nuisance (Oguntoyinbo, 2012). In addition, public policies with regards to the informal sector are repressive. Embarrassment and at times concern at their poor living and working conditions has led to instances of police harassment (in Colombia), neglect (in parts of West Africa) or collusion where they are tolerated only if they pay bribes or support political parties (Wilson et al., 2006, p. 805). Lack of data on the economic value of informal sector activities may also make it difficult for the sectors' contribution to be appreciated (Oguntoyinbo, 2012).

In the implementation of EPR, Gupt & Sahay (2015) state that the informal sector has a negative impact on EPR schemes for WEEE. The feedback mechanism of the schemes are interfered with when there are black/grey markets for different product groups and illegal import of used products that disadvantages legal identifiable products (free riding) (Manomaivibool et al., 2008). In a case study of India, the informal sector is considered to contribute to pollution and also performs poorly in resource conservation and social aspects. The illegitimate competitive advantage of the backyard recycling sector has made foreign companies reluctant to invest in WEEE recycling (Manomaivibool, 2009a). On the contrary, the packaging sector case studies of Colombia, South Africa and Ecuador by Van den Berg (2014) conclude that the informal sector is very important to the PET value chain.

Inclusion of the informal sector

Inclusive waste management refers to the complementing activities of the informal sector and formal waste management activities (Oguntoyinbo, 2012). EPR has been identified as one driver that can be used to facilitate formalisation (Manomaivibool, 2009a). Therefore, the subsequent sections will explore the process of achieving this effectively and factors to be considered in the process.

Rationale

The main reason for considering inclusive waste management is that the informal sector provides a major source of livelihood for a significant proportion of the urban poor. Recycling rates are quite high in some developing countries and range from 20-50% and some sources indicate figures as high as 80% (Gunsilius, 2010; Wilson et al., 2009, p. 632). Therefore, prohibiting an industry that supports thousands of livelihoods can result in social deterioration (Ezeah, Fazakerley, & Roberts, 2013).

The informal waste pickers also carry out risky activities with almost no protective gear as occupational health and safety measures are disregarded. Furthermore, scavenging in open dumps is especially detrimental to health because some of the recyclables could be contaminated (Manomaivibool, 2009a; Oguntoyinbo, 2012; Wilson et al., 2006). These poor working conditions create a need for measures to improve the living and working conditions of informal waste pickers.

The informal sector also has positive contributions to formal waste management. The informal sector saves the formal authorities money when materials are collected door to door. The costs of collection, transport and disposal are saved depending on where the material is removed (Scheinberg et al., 2010). In addition, savings in raw materials, energy and transport can be made (Gunsilius, 2010). In some studies, it is estimated that integration could lead to 78% in savings and landfill avoidance costs of 79.5% (Oguntoyinbo, 2012, p. 444). It also encourages the development of new enterprises, trading networks, capital acquisition and investments. Integration of the informal sector could also generate employment. Additionally, informal sector activities are highly adaptable, flexible and can respond fast to demand-driven forces (Gunsilius, 2010).

Factors to consider in inclusion of the informal sector

Successful integration of the informal sector into formal waste management should not only be flexible but should also provide legislative, financial and institutional support. Moreover, it should build on the existing practical experience of the sector (Ezeah et al., 2013). In Egypt, when the private sector got involved in solid waste management the recovery rates dropped. This shows the importance of the informal sector in solid waste management (Gunsilius, 2010).

It is thus important for the informal sector to be included during the development of formal recycling collection systems (Zhang & Wen, 2014).

The level of integration of the informal sector is dependent on the willingness of decision makers to create initiatives with the informal sector (Gunsilius, 2010). Lack of collaboration with the informal sector may result in failure of initiatives such as EPR. For example, in the development of a mandatory EPR system for packaging waste in Bulgaria, the informal sector was neither consulted nor provisions made to include it. This was despite the pre-existence of 1000 informal waste pickers with impressive collection and recycling rates. Ultimately, the informal sector continued to operate in parallel to the EPR system capturing about 90% of all materials while the remaining 10% was captured by the EPR system. Retaliation from the informal sector together with resistance from households and businesses that did not want to abandon their preferred recycling channels, led to failure of the EPR system (OECD, 2015).

A limiting factor for integration of the informal sector are the costs of formalisation and the limited resources for enforcement of legal provisions. In a case study of WEEE in India, though backyard recycling enterprises are run by financially well off owners who can choose to formalise, backyard recycling is dominant because perceived costs outweigh the benefits of formalisation. Staying in the informal sector illegally allows these enterprises to save on pollution abatement costs, taxes and health and safety measures for workers. Resource constraints for legal enforcement make the chances of such enterprises being charged for violation of the law minimal (Manomaivibool, 2009a).

Solutions

One of the solutions proposed for integrating the informal sector is formation of co-operatives. The advantages of co-operatives include; increasing the ability of the informal sector to negotiate for better working conditions, access to financial services, better equipment, market leverage through elimination of middlemen (especially where they do not create value), diversification of activities such as getting into waste service provision, training, and building visibility and better public relations (Ezeah et al., 2013). A good example of this is CEMPRE in Colombia, a registered NGO, which runs a product stewardship programme. It works closely with main ministries, private sector, waste picker associations and other stakeholders. Its activities include promoting public policies, inclusive value chains and inclusive recycling (OECD, 2015).

Other methods for facilitating integration include the creation of public private partnerships. However, these may be problematic due to conflict of interest by both the informal and formal sectors. Ways of solving this could be through creating ownership and commitment, establishing regular business relations and organising sharing of responsibilities. An example is making agreements for the informal sector to service low income neighbourhoods while the formal sector services other areas (Ezeah et al., 2013; Oguntoyinbo, 2012).

For EPR, one way of integrating the informal sector is through national programmes. Integration of the informal sector is dependent not only on national policy but also on underlying attitudes towards the sector (Gunsilius, 2010). Manomaivibool (2009) suggests a national programme that puts collection responsibility on producers so as to scale up the incentive for formalisation. He gives other suggestions for WEEE in India such as, producers could play an enabling role both in advancing existing industrial initiatives and in formalising the informal recycling sector. This can be done through providing additional resources to boost the formal sector and creating incentives for formalisation. Further, he states that producers

should ensure their collected WEEE is sent to the formal sector and reporting and monitoring mechanisms should work properly. According to Van Rossem et al. (2006), existing recyclers, usually with limited access to capital, should be given time to upgrade their operations and continue working when new requirements are issued. For a smooth transition, the government may have to provide financial support in addition to regulation.

General ways of improving the welfare of the informal sector include increasing public participation in separation at source to increase the quality of recyclables and registration and licensing of the sector (Oguntoyinbo, 2012).

2.4 Post consumer PET waste management

PET is a favourable material due to its durability and low weight. It also has high clarity and is a good barrier to oxygen and moisture (Welle, 2011). Bottles for water, carbonated soft drinks, and other beverages account for about 84% of global PET resin demand (Zhang & Wen, 2014, p. 987). Global consumption of PET is forecasted to reach 19.1 million tonnes by 2017 with a 5.2% increase per annum between 2012 and 2017. The systems for managing post-consumer PET waste are highlighted in the following sections.

Systems of collection and recycling

There is a need to focus on post consumer PET waste because those not collected are disposed of poorly. Proper collection is essential as products collected in landfills are usually contaminated. This requires not only more expensive methods to clean, but also devalues the product and reduces earnings for collectors (Coelho, Castro, & Gobbo Jr., 2011).

There are several methods for collecting post-consumer PET waste. One of them includes *kerbside* collection, a waste collection service provided to households. These collections may contain a mixture of food and non-food PET packaging that may be sorted automatically or by hand (Welle, 2011). Another way of collecting post consumer PET is through *bring systems* where consumers can return their waste to a container within their location. They include recycling stations and drop-off centres. *Buy back centres* are also other channels of collection (Lindhqvist, 2000). In countries like Brazil, collection and recycling of PET heavily relies on scavengers and scavenger co-operatives (Coelho et al., 2011). There are also *deposit refund systems* for PET. Deposit refund systems refer to the return of packaging by consumers in exchange of a refund of the consumers' deposit on the container (Lindhqvist, 2000). The advantage of deposit refund systems is that unlike kerbside collection, it contains beverage containers only resulting in less contamination of bottles and reducing need for further sorting (Welle, 2011). An example of deposit refund system is the mandatory scheme in Sweden, managed by Returpack. Returpack is a privately owned company that aims to increase recycling of PET bottles and metal cans in Sweden (Returpack, n.d.).

Recycling has several benefits such as reduction of volume of waste in landfills, employment creation, reduction in energy use, and lower prices for recycled PET (rPET) (Coelho et al., 2011). In a LCA study of open loop systems, it was found that rPET fibre gives 40-85% non-renewable energy savings and 25-75% Global Warming Potential (GWP) savings compared to virgin PET (Shen, Worrell, & Patel, 2010).

The two main methods of recycling are *open loop* and *closed loop* recycling systems. In open loop recycling (bottle to fibre recycling), a product from one type of material is converted to other types of products such as fibre, straps, sheets or containers. In closed loop recycling (bottle to bottle recycling), waste or by products of one system is used to make another product or derived

component. It is considered one of the best environmental options (Coelho et al., 2011; Welle, 2011).

There are several factors that influence the success of collection and recycling schemes for PET. Financial incentives, level of convenience and level of information and awareness influence collection rates. The main influencing factor for recycling is availability of markets (Lindhqvist, 2000). The main challenge of the PET reverse chain (collection, sorting and transportation), is lack of market availability for rPET and its high purchase price (Coelho et al., 2011).

For deposit refund systems specifically, some of the success factors identified by Tojo (2011) in a case study of the Swedish deposit refund system include: government endorsement without involvement in the management of the project, existence of a prior system of collecting containers, customer convenience and the non-profit nature of returpack. Competition from other products such as aluminium cans with a higher financial return, may lead to less participation in the management of PET waste in countries like Brazil that rely heavily on the informal sector (Coelho et al., 2011).

Types of EPR systems for packaging waste

There are different designs of EPR systems that vary in approach (mandatory/voluntary), the instruments used and the allocation of responsibility. Table 2-3 shows and summarises how EPR for packaging has been implemented in different countries, and the division of financial responsibility and physical responsibility for waste among various stakeholders.

Germany: It had one of the first large-scale EPR schemes. Producers take-back their waste individually or join a PRO such as the Duales System Deutschland (DSD) for packaging waste. The fee payable by producers is based on material type and weight. Further, differentiated fees that are low for highly recyclable materials influences the producers' choice of material (Gupt & Sahay, 2015).

Japan: It has a very high recycling rate of PET bottles. The system for PET collection was established in 1993 by the Council of PET bottle recycling. Bottle and beverage manufacturers pay recycling fees to Containers and Packaging Recycling Association (CPRA) which then contracts recyclers (Zhang & Wen, 2014). Three approaches can be used by producers in handling their waste. The most common is the PRO route, where producers pay PROs to collect and recycle packaging on their behalf. The second method is where producers collect and recycle packaging on their own. The third method involves contracting recycling agencies other than PROs to collect and recycle on their behalf. Separation is done at source and the municipality does selective collection to ensure sorting meets required standards. Failure of producers to fulfil their obligations results in recommendations being issued to the producer. Further non-compliance leads to public disclosure of the culprit's name along with orders to recycle. The last option is a monetary fine (Gupt & Sahay, 2015).

Slovakia: It has a deposit refund system for beverage containers. Producers pay Advance Disposal fees (ADF) to the recycling fund to cover their financial responsibility. They also pay fees to PROs which carry out collection/recycling and recovery activities on their behalf (Gupt & Sahay, 2015).

Taiwan: It has a mandatory deposit refund system. PET manufacturers and importers pay into recycling funds according to their sales. These funds are used to finance deposit refunds to the consumers (Gupt & Sahay, 2015).

United Kingdom (UK): Its system is based on tradeable recycling credits to provide incentives for manufacturers to collect and recycle waste. Sellers/retailers have the highest responsibility followed by packers/fillers, converters then manufacturers. Companies earning more than 2 million pounds are allowed to participate in the credit trading. The system allows for trading of the packaging waste recovery note (PRN) at the environment exchange. For packaging waste for export, a Packaging Export Recovery Note (PERN) equivalent to a PRN is issued by accredited exporters only. For every one tonne of waste recycled, one PRN is issued (Gupt & Sahay, 2015).

Table 2-3: EPR schemes for packaging waste

Country	EPR regulation (s)	Producer responsibility (Upstream segment)			Stakeholders role (Downstream)		
		Financial	Physical	Recycling/recovery target	Collection/recycling organisation	Retailers	Consumers
Germany	Avoidance of Packaging Ordinance, 1991 (Green dot programme)	Annual license fee paid to PRO (DSD)	-	Defined target	DSD responsible for collection and recycling	Collect waste	Return waste to collecting agency
Japan	Packaging Recycling Act	Recycling fees paid to CPRA	-	-	Producer or PRO or recycling agency	-	Sort at source
Slovakia	EU Directives on Packaging and packaging waste	Fees paid by manufacturers and importers to the recycling fund. An ADF is also paid to the PRO responsible for recycling.	Producers collect or recycle on their own or outsource from PRO	Defined target	PRO collects/recycles/recovers or co-operates with municipality to fulfill obligations	Return containers in return of deposit	Pay flat yearly fee to the municipality for waste collection
Taiwan (PET bottles)	Waste Disposal Act	Recycling fees paid to Government recycling funds	-	Targets defined	Certified collectors and recyclers managed by the Recycling Fund Management Committee	Buy back waste and sell to certified collectors and recyclers	Refund given upon return of PET bottles at assigned locations
UK	Producer Responsibility Obligations (Packaging Waste) Regulations, 1997 Packaging (Essential Requirements) Regulations, 1998	Join 'compliance scheme' and buy PRN or a fee is paid to the scheme to do the recycling for the producer	-	Targets revised every 5 years	Reprocessors responsible for collection and recycling to meet target set by Government	Collect waste	-

Source: Adapted from (Gupt & Sahay, 2015).

Management of packaging waste in South Africa

Packaging waste has been targeted as a priority waste stream by the South African Government which is to be managed through EPR. For this reason, legislation for plastic bags was enacted and Memorandums of Understanding (MOUs) were signed for some materials such as glass in the paper and packaging industry. However, PETCO did not sign an MOU but adheres to requirements. In 2003, legislation regulating the thickness and printing on plastic bags was initiated through a plastic bag tax to consumers. The aim was to reduce consumption and encourage re-use of plastic bags. Further, an MOU for the use of a minimum percentage of

reprocessed polymer content in end products was made, to create a market for recycled polymers. However, this government initiative neither yielded the anticipated employment opportunities nor created a feasible recycling industry. In fact, there was a decline in plastic bags demand that eroded the tax base of the levy in addition to loss of jobs in the plastics industry. Moreover, most of the levies collected ended up in general government funds instead of being utilised to support the activities of *Buyisa*, a joint initiative by government, private sector and labour unions meant to boost recycling (Nahman, 2010).

To avoid government legislation and the resulting effects as in the case for plastic bags, the paper and packaging sector started voluntary initiatives for recycling and recovery. Collect –a-can was established in 1993 for metal, Glass Recycling Company (GRC) in 2006 for glass and PETCO in 2000 for PET (Nahman, 2010).

The main instruments used in solid waste management in South Africa are administrative and economic instruments. The administrative instruments include the establishment of recycling and collection targets by the government and industry initiated buy back schemes (Nahman & Godfrey, 2010). Economic instruments include product taxes for plastic bags, advance disposal fee systems used in PROs such as PETCO, and deposit refund schemes for beer bottle, glass and large PET bottles. There is a favourable perception of the effectiveness of deposit refund systems when compared to quantity based charges and product taxes in South Africa. The impact of quantity based charges and product taxes on the poor and business is likely to create resistance from business and communities especially in regard to how revenues generated from these instruments are used. Quantity based charges are more preferable to product taxes. However, the charges are feared to incentivise illegal dumping due to the likely payment of higher charges if set quantity limits are exceeded (Nahman & Godfrey, 2010).

2.5 Approaches used in the evaluation of EPR, PET and the informal sector in waste management

Environmental problems in general are difficult to solve because of knowledge deficit, technical difficulties and uncertainty, and time lags between activities and appearance of effects, among others. This has an impact on the choice of evaluation design, model, criteria and the use of evaluations (Hildén et al., 2002, p. 15). Evaluation, especially of recently introduced policy instruments, might be difficult due to lack of information (Kautto & Similä, 2005). These challenges have been anticipated in this research and therefore the scope has been limited and criteria carefully selected to ensure the generation of results that can be used to inform policy decisions. The approaches used for analysis focus on methods used in the evaluation of EPR, PET and the informal sector explained in the sections below.

EPR

There are several approaches that have been used to evaluate EPR systems. The ones used in this research are the *EPR evaluation tool* and *intervention theories*.

EPR Evaluation tool

To assess the level of success of an EPR scheme, various variables of measuring the performance of the system need to be identified. The following measures of effectiveness have been identified by Gupt & Sahay (2015) & Manomaivibool (2009):

- Provision of incentives to identifiable producers to enable design for environment
- Effective collection, treatment and re-use/recycling of products

- Controlled downstream activities to ensure they are carried out in an environmentally sound acceptable way
- Setting targets and monitoring upstream financial and physical responsibilities
- Clear outline of roles of stakeholders and guidelines for producers
- In the case of WEEE, prevention of the occurrence of new orphan products and free riders in the system. Additionally, an acceptable distribution of costs related to historical waste
- Imposing sanctions to ensure producers fulfil their responsibility
- Support with other tools such as a regulatory framework
- Monitoring and reporting mechanisms

Most of the above variables have been used in the EPR evaluation tool developed by Lindhqvist & Van Rossem (2005) for the evaluation of three product stewardship programmes in Canada. The tool focuses on environmental issues and its main purpose is to measure the extent to which the principles and elements of EPR have been addressed. The tool assigns ratings from 0 to 3 which show the level of EPR implementation. 0 represents the lowest level and 3 represents the highest level of implementation. The criteria for allocating the scores for each EPR goal are summarised in appendix 1. The EPR evaluation tool addresses two main issues;

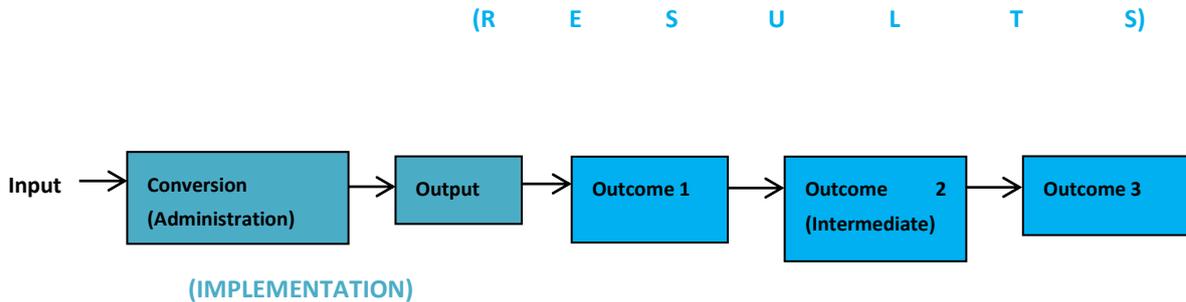
- a) *Design improvements* of products where the EPR system should provide enough incentives to enable producers to improve products and the systems of products during their whole lifecycle.
- b) *Effective collection and re-use / recycling* to ensure high utilisation of products and material quality, which can be divided into three further goals;
 - High collection rates to avoid littering and to also ensure that discarded products and their materials are separated from the general waste stream and properly treated and utilised.
 - Environmentally sound treatment of products to make sure there is proper treatment of hazardous components and materials, and to improve the possibilities of re-use and recycling.
 - High re-use and recycling to substitute the use of virgin materials so as to limit the environmental impacts of extraction and processing of these materials

Intervention theories

Public intervention refers to government action or measure. Intervention theories are thus, “all empirical and normative suppositions that public interventions rest upon” (Vedung, 2009, p. 301). The aim of intervention theories is to describe how policies are intended to be implemented and function and not how they actually work (Hildén et al., 2002, p. 16). Intervention theories are useful in situations where evidence of the final outcome is not available and is also useful to designers of a policy instrument since they may not be able to consider all relevant factors during the design phase (Hildén et al., 2002; Kautto & Similä, 2005).

According to Vedung (2009, p. 3), effectiveness is the most dominant criterion in evaluation of government interventions. He defines effectiveness as “careful retrospective assessment of the merit, worth and value of administration output, and the outcome of government interventions, which is intended to play a role in future, practical situations”. He illustrates this using a system model that has been adapted to government intervention in figure 2-1. In this model, *implementation* covers conversion and output while *results* summarise outputs and outcomes.

Figure 2-1: Systems model for Government Intervention



Hildén et al. (2002), further developed the above systems model for government intervention and outlined the elements of intervention theories as follows;

- *Actors* include decision making entities (authorities, companies and individuals), implementing agencies and targets of the instrument.
- *Inputs*: Resources such as personnel and finance. It also includes matters arising from the targets of the instrument which agencies should take into account or respond to e.g. applications for documentation.
- *Outputs*: Matters that the targets of the instrument are faced with such as conditions for permits.
- *Outcomes*: Actions taken by the targets of the policy instrument because they are faced with conditions and the consequences of the actions taken. Outcomes can be immediate, intermediate or ultimate.

In addition, evaluation criteria such as impact, relevance, efficiency and effectiveness among others can be used to specify the dimensions/aspects of the policy instruments that are to be studied (Hildén et al., 2002, p. 17).

Based on an adaptation of the evaluation criteria by Hildén et al.(2002) and the reconstruction of the theory of EPR for complex products, Tojo (2004) developed a model for EPR evaluation (illustrated in figure 2-2). The criteria focused only on intended outcomes of EPR as the side effects of the intervention were not considered. She used intervention theories to ascertain whether interventions incorporating the EPR environmental principle contribute to environmental improvement as assumed in EPR theory. Her thesis investigated mandatory EPR programmes for complex products such as EEE. The criteria used for evaluation were legitimacy, attributability, goal achievement and relevance. The scope included immediate outcomes of EPR such as design change, organising infrastructure and communication between upstream and downstream. One of the conclusions was that EPR is a definite factor that can promote upstream changes for the total life cycle environmental impacts of product systems. However, this is dependent on information and communication between downstream and product designers.

A simplified version of the model (figure 2-2) is used for this thesis and includes only two criteria that is *acceptability* and *goal attainment*. Similar to the study done by Tojo (2004), the focus is on immediate outcomes and these are explained below;

- *Organisation of infrastructure*: Establishment of infrastructure for separate collection and recovery of discarded products under EPR improves the chance of closing material

loops. Manufacturers are also able to get back products and components for their own re-use and recycling. In addition, a sufficient and reliable supply of high quality materials would boost demand for recycled materials (Van Rossem et al., 2006).

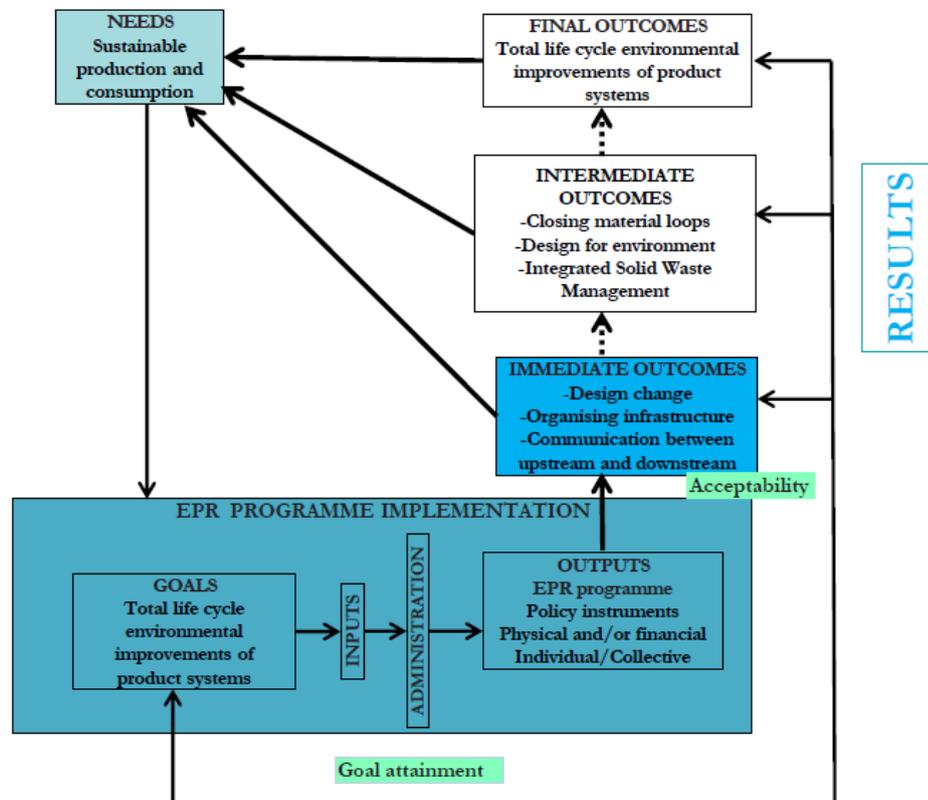
- *Downstream activities* of collection and recycling/re-use reduce environmental impacts (Tojo et al., 2006). The role of the informal sector is investigated here.
- *Upstream activities* (source prevention) such as the change in design of products and their systems that contribute to improvement in end of life management of products and total life cycle improvement (Tojo et al., 2006).

Goal achievement is one of the two criteria used in the EPR evaluation model for this thesis. It is normally used to establish if the results are in accordance with the program goals and whether the results are produced by the programme (impact assessment). The evaluation involves three steps; identification of goals of the programme and turning them into measurable objectives, determining the extent the goals have been realised in practice and ascertaining the degree to which the program has promoted or dampened the goal (Vedung, 2009). In EPR the main goal is total life cycle improvement and the objectives include design improvements and effective collection and recycling/re-use (Lindhqvist, 2000; Lindhqvist & Van Rossem, 2005; OECD, 2001). To determine goal achievement of PETCO, the EPR evaluation tool developed by Lindhqvist & Van Rossem (2005) is used (see appendix 1).

Acceptability is the other criteria used and is defined as the degree to which individuals and organisations accept a policy instrument (Hildén et al., 2002). Opposition to a government intervention may occur due to the different views of different actors and problems with acceptability of an intervention may occur at any stage (Hildén et al., 2002, p. 17; Tojo, 2004). For example, during the initial introduction of a mandatory deposit refund system in Sweden, there was resistance from manufacturers, retailers and breweries (Tojo, 2011). Thus, acceptability of an intervention is important to consider. This thesis uses the criterion of acceptability to evaluate the willingness of different actors to accept the integration of the informal sector into formal waste management. Past reactions to this issue (from documents and interviews) have been used. This is because the requirements of the IndWMP are very recent and have also been recalled pending further consultation with relevant industries. Therefore, it has not been possible to capture any reactions to it within the duration of the research.

Similarly, (Manomaivibool, 2009b, p. 5), used intervention theory to review policies and programmes for the management of WEEE in East Asia. He observes that there is likelihood for intervention programmes to be identified with legislation. This might lead to the exclusion of voluntary programmes that don't have a clear legal framework as in the case of South Africa.

Figure 2-2: An EPR evaluation model based on its intervention theory



Source: Adapted from (Hildén et al., 2002, p. 19; Kautto & Similä, 2005, p. 57; Tojo, 2004, p. 52)

PET

The most common method of assessing environmental impacts associated with PET has been LCA studies on open and closed systems of recycling. For example, an LCA by Shen et al. (2010) of bottle to fibre recycling found that rPET has more benefits than virgin PET in terms of reducing environmental impacts. However, LCA is criticised for being unable to take dynamic factors into consideration (Lindhqvist, 2000).

Other studies have tried to examine different systems of collection and recycling in different countries. For example, Zhang & Wen (2014) assessed the collection and recycling systems for PET in Brazil, Japan and the USA with an aim to generate lessons for China which wants to formalise its PET collection and recycling system. Some of the lessons from the study were that: monitoring and reporting is important, national wide policies (as in the case of Japan) can be effective, and incentives and convenience (as per US case study) improves the results of collection and recycling systems. Finally, from the Brazilian case study the conclusion was that the informal sector is effective.

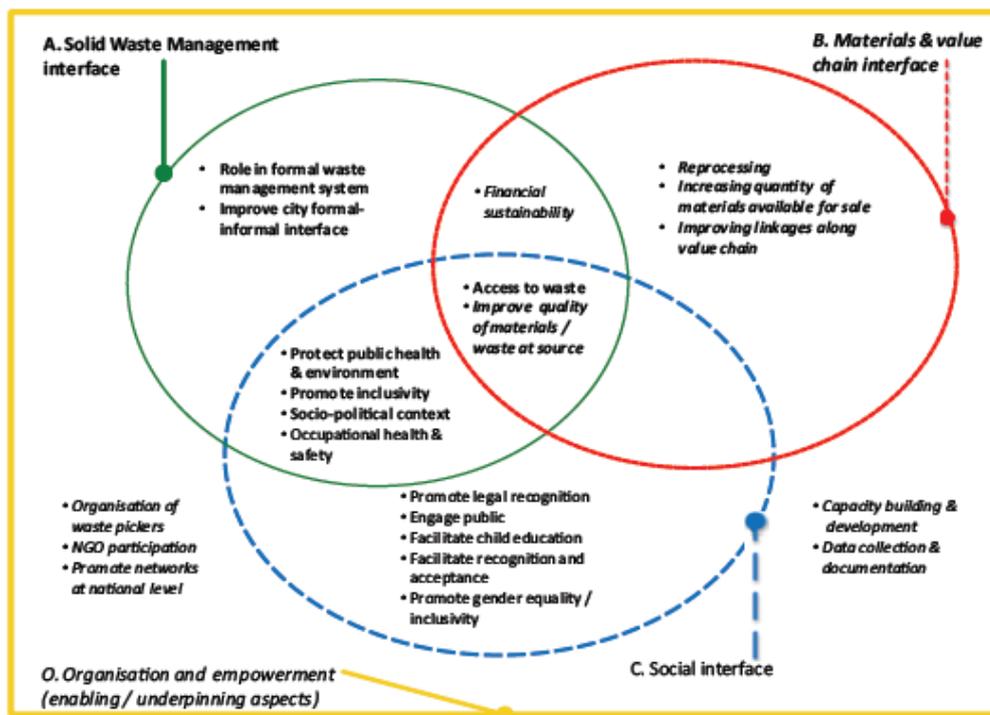
Informal sector

There have been several studies on the how the informal sector can be improved using different approaches. Most of the studies focus on the characteristics and role of the informal sector in solid waste management, how to build recycling rates and barriers to integration. From literature

review, two studies were found to be relevant for EPR as a mechanism for integration and these form the basis for evaluation of the South African case study. One of the studies describes the relationship between informal and formal systems while the other provides a framework for analysing the extent to which the informal sector has been integrated into solid waste management.

Velis et al. (2012) have analysed several studies that have been conducted on the informal sector and developed a methodological tool known as *InteRA*. The tool is meant to be used in the evaluation of four aspects considered to be important for integration/formalisation of the informal sector, illustrated in figure 2-3. These include interface with solid waste management, interface with the materials value chain, interface with society and organisation and empowerment.

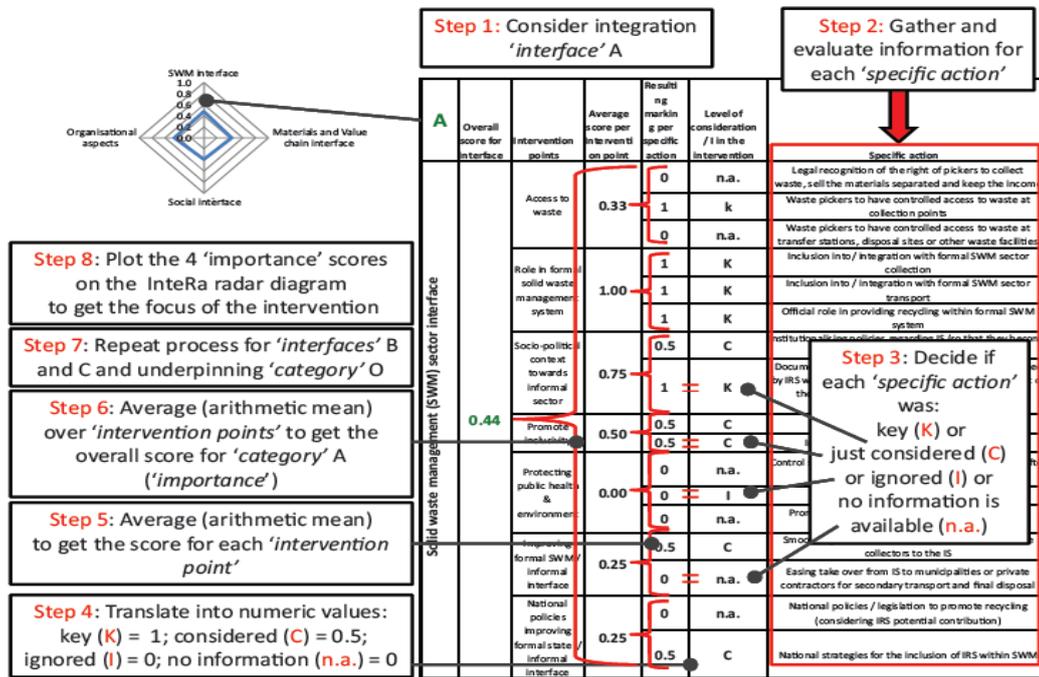
Figure 2-3: *InteRA* analytical framework



Source: Velis et al. (2012, p. 47)

It can be applied *priori*, that is, when a new intervention is planned /designed to ensure that a comprehensive and well balanced approach is used. It can also be used *posteriori*, that is, the evaluation of current interventions to identify areas for improvement, which has been the approach applied in this thesis. The tool identifies points of intervention and specific actions that need to be done to achieve each intervention point. Each action is rated depending on whether the action is treated as a key action (K=1), or considered to a medium degree (C=0.5), or whether it has been ignored (I=0) in the intervention of the informal sector. In instances where there is no information available the value given is (n. a=0). For each intervention point, specific actions are given values between 0 and 1 and their arithmetic mean is calculated. These arithmetic mean of all the intervention points are then averaged to give the overall score of an interface. The resulting score shows the importance the category has been given (Velis et al., 2012). This scoring method is illustrated below in figure 2-4 and appendix 2. The final output is a web diagram that illustrates the extent to which the different aspects have been considered.

Figure 2-4 Key to interpretation of the framework of the InteRA framework



Source: Velis et al. (2012, p. 66)

In the analysis section (chapter 5) of the thesis, the tool is modified to determine how the current projects being implemented in South Africa compare to the expectations of the waste management policy in South Africa. The policy considerations that have been implemented are given a label of $K=1$, those that are mentioned in policy documents but yet to be implemented are given the label of $C=0.5$. Items labelled I stand for what has not been implemented or considered by policy and $n.a$ stands for no information available on the intervention point. Both are given a score of zero. Unlike in the actual tool, two evaluations are done. One evaluation considers all scores in an interface while the second evaluation considers only what has been implemented ($K=1$). The difference in the evaluations demonstrates the gap between the level of expectation of policy and the actual outcomes of implementation as illustrated in the web diagram in table 5-1. It shows the overall score for each interface and actual implementation of informal sector interventions in South Africa. It also demonstrates the areas that need improvement.

An example of how the InteRA tool has been used is in the thesis by Sturve (2013) in which he performed a *posteriori* evaluation on cooperatives in Brazil. The aim of his research was to highlight challenges and opportunities of inclusion of the informal waste collectors into formal waste management systems. Some of his findings were that the support of NGOs, Government and corporations is important to the organisational development of cooperatives. Challenges identified were, among others, corruption and lack of capacity. The identified benefits of integration through cooperatives were economic benefits through tax revenues and environmental benefits from reduced poor waste disposal.

A study by Besiou et al., (2012), uses systems dynamics methodology to investigate the interaction of the formal and informal waste recovery systems in a closed loop supply chain,

using Greece as an example. Interaction of the two systems is studied under three scenarios. The *real* scenario is where there is competition between the formal and informal sectors. In this scenario, the formal sector collects very little material while the informal sector collects much more. Moreover, as the informal sector expands, pollution increases which the formal sector is made to pay for through fines. This is because the formal sector is held responsible for products. In the *ideal* scenario, the informal sector is non-existent. There are no fines since there is no pollution by the informal sector resulting in lower total costs than in the real situation. In the *alternative* system, there is a symbiotic relationship between the formal and informal systems. The formal sector is able to achieve collection targets much more easily due to support from the informal sector. There are also no fines since it is easier for the formal sector to comply with regulation. However, profitability remains the same as the informal sectors' operational costs add to the existing costs. In this scenario, there are better employment opportunities for the informal sector and profits are higher than in the real situation. Further, there is less pollution and more system availability of natural resources.

Summary of literature review

From the literature review, it is evident that EPR is increasingly becoming a preferable approach for the management of waste. Non-OECD countries are gaining interest in this approach and are in the process of either initiating or improving their EPR programmes. However, these countries face the challenge of coping with a large informal sector. There is need to improve the living and working conditions of the informal sector and a need to change the negative perception towards the sector. EPR is seen as one of the drivers of formalisation in these countries.

There are several suggestions for initiating nationwide EPR policies. This is to enable the effective management of the informal sector while enabling existing EPR schemes to counter problems like competition, free riding and loss of materials arising from the informal sector. Despite the challenges posed by the informal sector, there is evidence that it plays a crucial role in collection and recycling of valuable materials such as PET. Failure to involve the informal sector during the process of formalisation may result in failure of an EPR initiative, as in the case of Bulgaria. From the study on interaction of the informal and formal sector, it is noted that a symbiotic relationship has the best outcome for both sides.

In terms of the approach to be used in implementing EPR, mandatory approaches are preferred when dealing with the informal sector. However, this is bound to generate a lot of resistance from actors as it may reduce the flexibility of producers and even undermine existing voluntary initiatives. In addition, mandatory initiatives may be costly to implement due to the cost of monitoring and administration. However, voluntary initiatives may not be effective enough to achieve the goals set by government especially if sanctions are not well established.

In conclusion, the inclusion of the informal sector is important in waste management and the improvement of the informal sector is a major goal in waste management. However, it is a challenge to ensure the welfare of the informal sector during the formalisation of solid waste management.

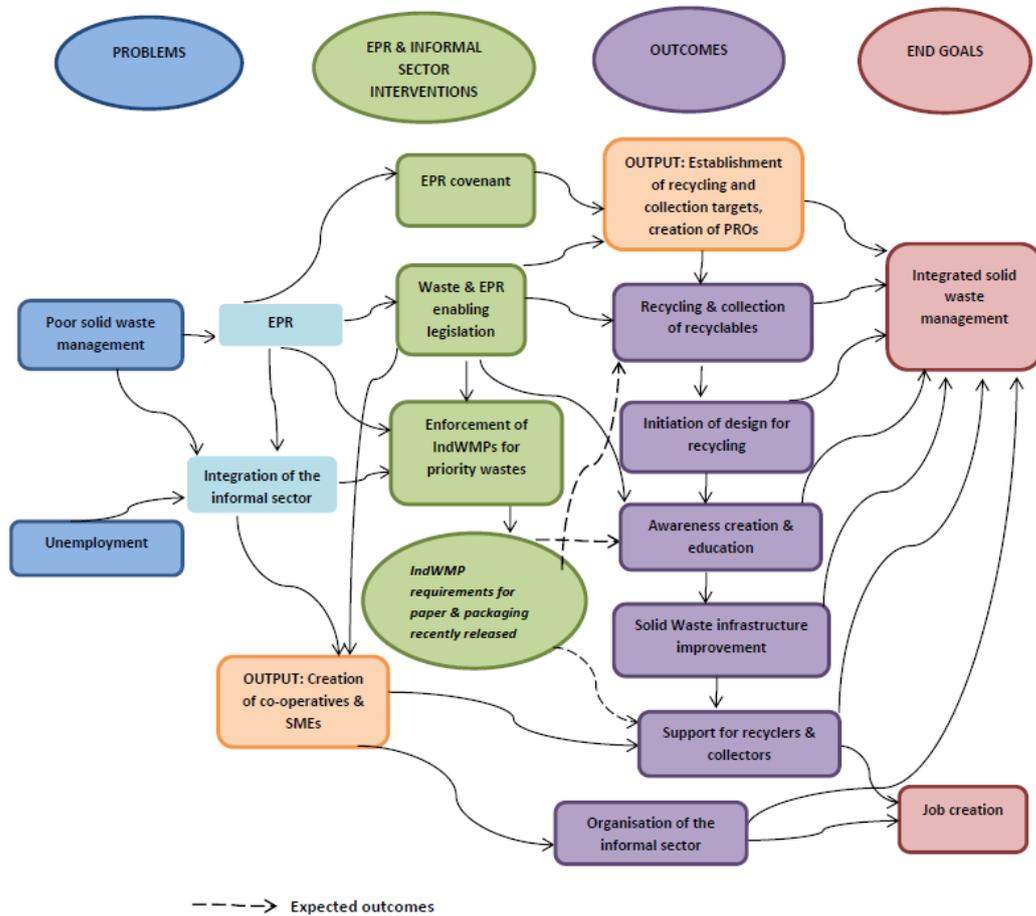
2.6 Analytical framework

From literature, there is a general perception that the informal sector could undermine EPR and likewise that PROs could undermine the role of the informal sector in solid waste management. In the case study of Bulgaria, there are indications that the informal sector should be involved in the planning and implementation of EPR programmes to prevent conflict and the undermining of EPR programmes. Though the author has not found other strong examples to

showcase why the informal sector should be integrated into EPR schemes, this single example of Bulgaria shows that inclusion of the informal sector is the ideal approach. As the main case study is a non-OECD country in which the informal sector plays a big role in waste management, legislation and other initiatives such as efforts to support the informal sector by PETCO, NGOs, government agencies and other actors have been considered.

Figure 2-5 illustrates the framework that has been used by the author to understand how EPR and the informal sector interact in South Africa. This has been adapted from the intervention theory design by Vedung (2009, p. 225), program theory for Community Supported Fisheries (CSF) by Witter (2012, p. 26) and from the EPR evaluation model by Tojo (2004).

Figure 2-5: Illustration of EPR and informal sector interventions in South Africa



3 Methodology

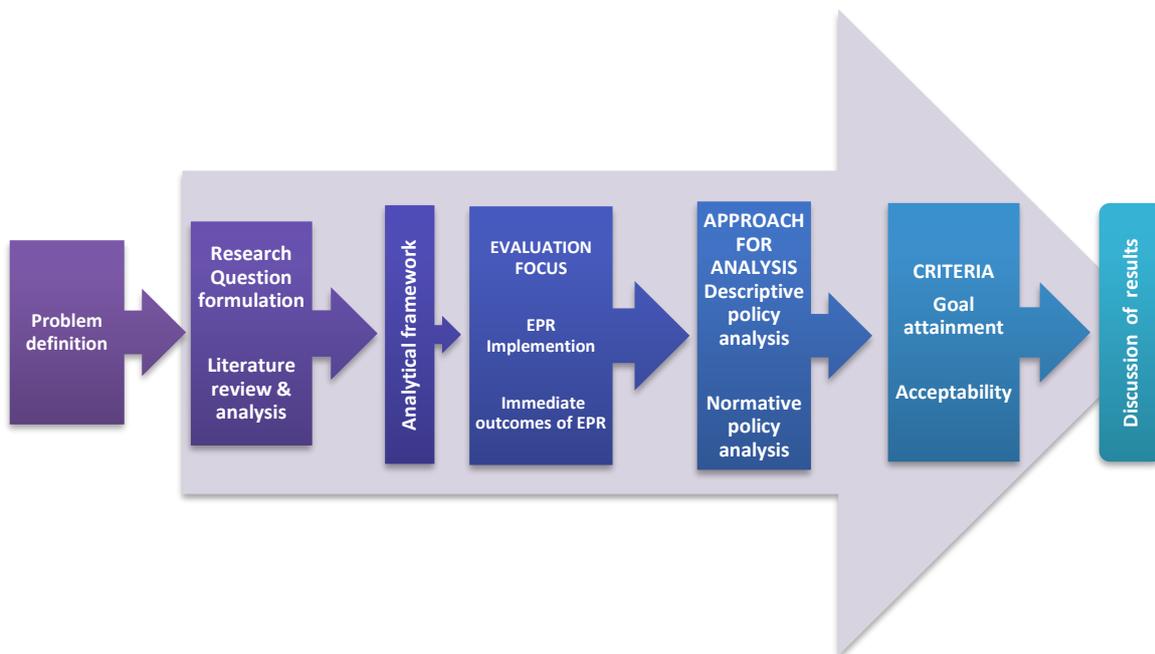
3.1 Overview of methodology

This chapter describes the methodology that has been applied in this research. The research is deductive in that it is, “guided by the theory which precedes it” (Walliman, 2006). In this case the theory used is an existing EPR theory reconstructed into an EPR evaluation model by Tojo (2004). The methodology is based on policy analysis which is defined as, “a process of multidisciplinary enquiry aiming at the creation, critical assessment, and communication of policy relevant information. As a problem solving discipline, it draws on social science methods, theories, and substantive findings to solve practical problems” (Dunn, 2015, p. 2). According to Vedung (2009), policy analysis is mainly focused on ex-ante evaluation. However, for this particular case, the focus is on ex-post evaluation with an aim of identifying areas in the case study’s EPR policy design that need to be improved and to inform future policy changes and implementation.

3.2 Methodological approach

Figure 3-1 summarises the overall approach used in the thesis. The thesis uses a case study design as a basis for undertaking policy analysis. According to Yin (2009), five important components for case studies are study questions, propositions, unit of analysis, logic linking data to propositions and criteria for interpreting findings. For public policy evaluation, Vedung (2009) lists eight points that should be considered. The points considered in this research are: the definition of the problem, the characterisation and description of the intervention being evaluated, how the intervention is implemented, the results of the intervention, factors that explain the results, the criteria for assessing the intervention and lastly, how the evaluation is to be utilised.

Figure 3-1: Overview of the research methodology



Source: Author’s own

The research problem is defined in chapter 1.1 from which research questions are formulated in chapter 1.2 to guide in solving the problem. The unit of analysis is the South African EPR policy intervention for post-consumer PET waste. In chapter 2.6, an analytical framework is derived from literature review to aid in the collection and analysis of relevant data. The EPR evaluation model by Tojo (2004) outlines the logical steps for evaluating the EPR public intervention and highlights the outcomes that should be focused on. The basis of selection of the criteria of goal attainment and acceptability is explained and their descriptions are also provided in the same chapter.

3.3 Methods of data collection and analysis

Most of the data collected is qualitative though quantitative data on consumed and collected amounts of waste for the paper and packaging sector has also been obtained. The use of several sources and methods is usually recommended in research to correctly illuminate issues and to avoid bias (Vedung, 2009, p. 147). This process, also known as triangulation, is used to some extent in this research. The main methods of data collection include observation, documentary and interrogative methods but only the latter two have been used in this thesis. These are discussed later on in the literature review and interview sections.

Observation methods could not be used due to resource limitations of the author. Otherwise, observation methods are more reliable than interviews in generating in depth insights (Vedung, 2009). In this instance, it could have greatly assisted in understanding the context of the case study faster and enhanced interaction with the actors involved with EPR in South Africa. Despite the incomplete triangulation, the two methods still suffice in getting a comprehensive understanding of the case study. The absence of direct observations was compensated for by the availability of a wide range of documentary evidence on South Africa's solid waste management and the informal sector, though there is relatively less on EPR. Interviews played a big role in verifying data through revelations of any revisions, updates and verifying the accuracy and relevance of documents. For example, the content in some of the documents was outdated or redundant such as the 2014 Industry Waste Management Plan (IndWMP) for the paper and packaging sector. Similarly, the documents helped to confirm data collected through interviews which helped avoid bias. Unlike interviews that were tailor made specifically for this research, the documents available were produced for other purposes (Vedung, 2009; Yin, 2009). However, these were adapted to suit the needs of the thesis.

Literature review

Literature review has been used throughout the thesis to formulate the research problem, gather data on the topic and in the development of an analytical framework for analysis of findings. Various types of literature such as journals, reports, legislation, web materials and books have been reviewed and analysed. These materials, even governments ones, were accessible through internet searches in online databases and public domain websites. Some of the documents such as current annual reports of PETCO, reports on integration of the informal sector and the PETCO position paper on deposit refund systems for PET were obtained from the interviewees. Key words such as *EPR, the informal sector, integration, inclusion, solid waste management in developing countries* were used in internet searches to get relevant documents. Bibliographies of reports were also scanned to identify relevant legislation and documents that have been used in the reports on South Africa's solid waste management. Literature review of documents has been used to answer all the research questions especially where getting some interviewees for the evaluation proved difficult.

Interviews

Interviews have been used to mostly generate opinions on the informal sector and EPR. A total of 7 interviews were conducted with four key informants directly involved with South African waste management issues and the other two interviewees have experience on waste management in a non-OECD context. A follow up interview was also carried out with one of the key informants to clarify some issues that emerged during the research. The key informants include PETCO representatives, a representative of Packaging South Africa and a researcher with broad knowledge of solid waste management issues in South Africa. The interview conducted with the researcher especially helped to fill in the gap of knowledge created by failing to get interviews with public officials and informal sector actors. The information obtained gave a thorough and broad picture of how EPR and the informal sector issues are handled in South Africa. The list of interviewees is contained in appendix 3.

Two interviews were informal in-depth interviews meant to get background knowledge on EPR and the informal sector in a middle or low income country context. The rest of the interviews were semi-structured. The interview guides as shown in appendix 4, differed from one respondent to the other since different types of information were required from each interviewee. The questions asked at times deviated from the interview guide in instances where the author detected interesting facts that needed further probing.

The structure of the EPR evaluation model and the criteria in both the EPR evaluation tool and the InteRA methodological tool were instrumental in guiding the formulation of the questions in the interview guide. Some questions however, were formulated based on gaps identified while trying to answer the research questions. Only 3 of the interviews were transcribed while the rest were in the form of notes and audio recordings for which prior permission for use had been granted. The transcribed interviews were sent to the interviewees for verification to ensure accuracy.

3.4 Approaches and methods for Analysis

As is typical of policy analysis, this research employs descriptive and normative approaches of analysis as shown in Chapter 5 (Dunn, 2015). Descriptions are placed alongside analysis to give background knowledge and to make the analysis easier to understand.

Descriptive policy analysis is defined as ‘a set of logically consistent propositions that describe or explain action. The aim is to explain, understand and predict policies by identifying patterns of causalities’ (Dunn, 2015, p. 13). To apply this approach, the EPR evaluation model is tested against South Africa’s case study so as to describe and explain the implementation results of EPR intervention.

A *normative policy analysis* is, ‘a set of logically consistent propositions that evaluate or prescribe action. It provides information about policy performance and preferred policies’ (Dunn, 2015, p. 13). As outlined in chapter 1.3 in limitations to the study, evaluation forms the bulk of the research as the prescription of solutions maybe beyond the capacity of the author at the moment. The criteria of the EPR evaluation model and its pre-conceived intervention goals are used as a basis for evaluation of PETCO’s EPR programme. This type of analysis therefore creates value judgements of how the EPR policy for post-consumer PET waste in South Africa is supposed to work (Vedung, 2009, p. 294).

Evaluation methods are used to “produce information about the value or utility of observed policy outcomes and their contribution to policy performance”(Dunn, 2015, p. 8). To estimate the value of existing waste policies and how they have contributed to improved waste

management, two evaluation tools are applied to both EPR and the informal sector. The EPR evaluation tool by Lindhqvist & Van Rossem (2005) and the InteRA methodological tool, mentioned in Chapter 2.5, have been utilised to evaluate the immediate outcomes of EPR and to illustrate the level of interventions implemented in improving the informal sector. The main methods used within these tools are *coding* and *discourse analysis* explained below.

Coding

Coding is a method used in the analysis of texts (Kvale & Brinkmann, 2009). It has been used in this research to analyse literature and the notes and transcriptions from interviews. A concept driven approach is used where codes derived from the EPR evaluation model, the EPR evaluation tool and InteRA tool are used. This is done to ensure both reliability of the results should there be a need to replicate the study. Thus the limitations mentioned in chapter 1.3 of a single case study approach have to a large extent been overcome. Concept-driven coding is used in question 1 and 2 to develop the case study of EPR for post-consumer PET waste management in South Africa and to evaluate its performance. Open coding defined as “the process of breaking down, examining, comparing, conceptualising and categorising data” is used in question 3 to identify barriers to inclusion of the informal sector into EPR (Kvale & Brinkmann, 2009, p. 202).

Discourse analysis

Given the sensitive and controversial nature of issues surrounding the informal sector in solid waste management, discourse analysis is used to be able to generate a candid analysis of opinions regarding the informal sector from interviews. It is used to explore how EPR within a non-OECD context, especially in the presence of an informal sector, works in practice and to what extent it matches with established EPR theory (Kvale & Brinkmann, 2009). Table 3-1 summarises the approaches and methods used for data collection and analysis for each research question.

Table 3-1: Research questions and their corresponding approaches and methods of data collection & analysis

Research Question	Approaches and methods of data analysis	Method of data collection
<i>RQ.1 How has EPR for post-consumer PET waste been implemented in South Africa?</i>	Descriptive method using the EPR evaluation model (Tojo, 2004) Method: Concept –driven coding	Interviews Literature review
<i>RQ.2 What is the performance of PETCO in the management of post-consumer PET waste?</i>	Normative <i>Tools:</i> EPR evaluation tool (Lindhqvist & Van Rossem, 2005), InteRA tool (Velis et al., 2012). <i>Methods:</i> Discourse analysis, concept-driven coding	
<i>RQ.3 What are the barriers to successful inclusion of the informal sector?</i>	Normative Method: Open coding	

4 Case study of interventions for South Africa's post-consumer PET waste

4.1 Background

South Africa is located at the southern tip of Africa. It covers a total surface area of 1 219 090 km² and has an estimated population of 53 675 563 people. Economically, it is considered a middle income emerging market (The world fact book, n.d). The following sections focus on the status of South Africa's waste management and how EPR for post-consumer PET waste has been implemented. For this research, one South African Rand is estimated to be equivalent to \$ 0.07 USD and € 0.06 as at 25/08/2016.

Status of solid waste management

The main drivers of waste management in South Africa are: economic reasons in response to resource scarcity, legislation, job creation and energy security (there is an interest in waste-to-energy projects). Landfilling is the predominant method of waste management because alternatives to landfilling are perceived to have a higher cost. In addition, landfills are not constructed to required standards resulting in tipping fees being artificially low. This makes landfilling, in financial terms, the most viable option of waste management (DST, 2014a, p. 1; Nahman, 2010). Almost 90% of all solid waste generated is landfilled and only about 10% is recycled and treated (DST, 2014a, p. 7).

Currently, about 62% of households have access to weekly refuse collection services while informal settlements, rural and peri-urban areas lack these services (Godfrey, Muswema, Strydom, Mamafa, & Mapako, 2015). Local resource-based collection initiatives offer waste collection services in areas lacking these services. A national source separation programme is yet to be implemented except for pilot projects in areas such as Cape Town (Godfrey, Strydom, & Phukubye, 2016a).

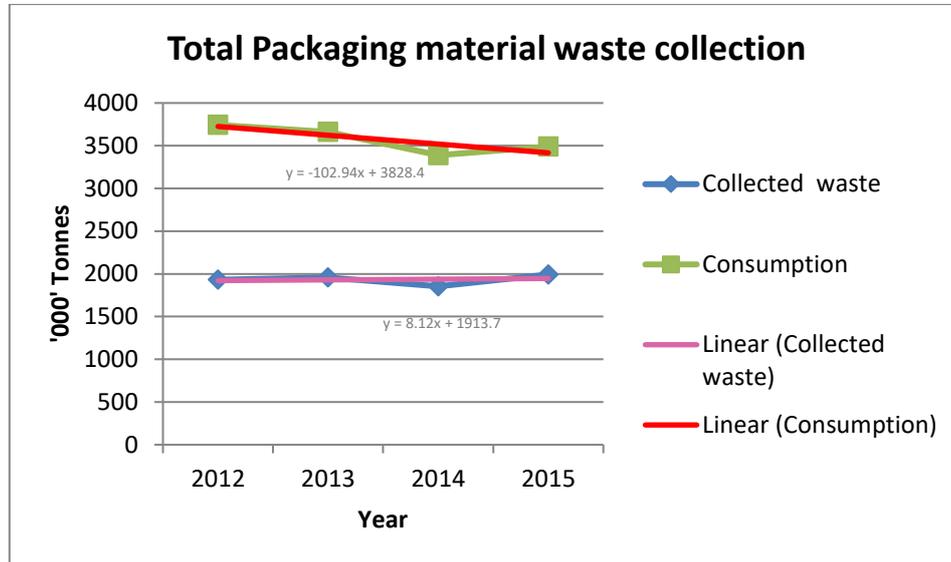
Waste recycling and recovery is the main focus of integrated waste management particularly in South Africa. Recycling is mainly driven by the informal sector currently estimated at 60 000-90 000 people (DST, 2014a, p. 7). The large and unregulated presence of the informal sector has made it difficult to accurately quantify their number. However, a recent report estimated that there are 62 147 waste pickers, with 36 680 operating from landfills and 25 467 operating as trolley pushers (DEA, 2016). The informal sector collects recyclables from landfills or by rummaging in municipal bins and waste bags placed by kerbsides. Since the informal sector is market driven and relies on income from selling recyclable materials, recycling is limited to only economically viable materials such as PET, paper and ferrous metals (Godfrey et al., 2016a). The informal sector is estimated to collect about 80% of all the glass collected, 90% of PET that is collected and most of the recyclable paper that is collected (DST, 2014b).

In 2014, the paper and packaging industry realised a recycling rate of 52.6%. This was attributed mostly to the informal sector that collected 80-90 % by weight of the packaging waste collected for recycling (Godfrey et al., 2016a). Though it has been confirmed that most recyclables are collected by the informal sector, exact amounts and origin of waste collected by individual waste pickers is difficult to determine because there are currently no established methods to register them and to capture data on their collection amounts.

Table 4-1 illustrates the performance of the paper and packaging industry over the years. The sector has registered a modest increase in the collection of packaging waste for recycling while there have been marginal decreases in consumption of packaging material. The decrease in

consumption could be attributed to an actual decrease in packaging material consumption or it could also be as a result of the production of lighter packaging materials (Packaging SA, n.d.-a).

Table 4-1: Packaging material collected for recycling 2012-2015



Based on data from Packaging SA

Plastic waste recycling

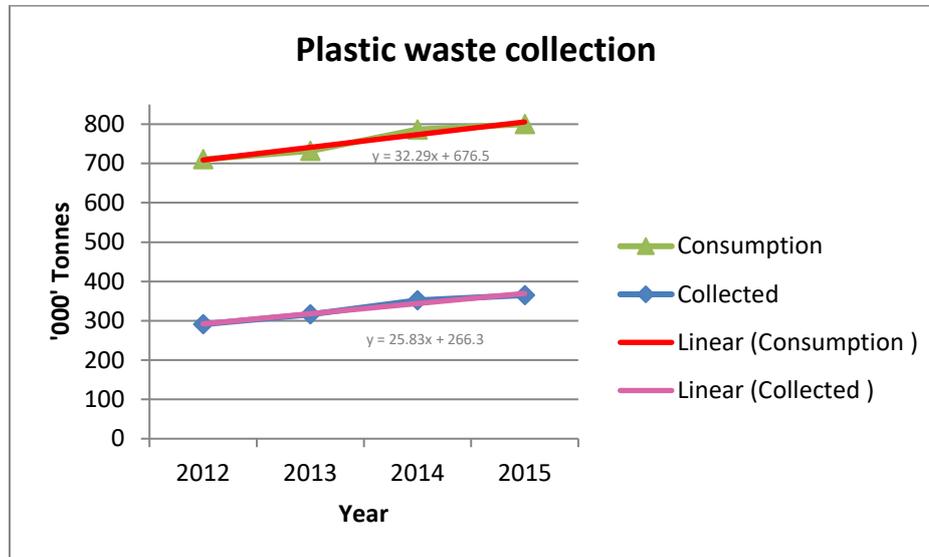
Waste plastic though largely visible in the environment comprises only 6% of total waste in South Africa and is more common in urban than rural areas (DST, 2014b). South Africa has a low national recycling rate of around 10% (DST, 2014a). Reasons for this low recycling rate include: lack of access to waste streams, lack of markets for recovered resources, lack of infrastructure and technology to recover resources, the price of recyclates being more expensive than virgin materials and costs of recovery that exceed benefits (DST, 2014a).

In stakeholder workshops held to identify current trends in waste management and priority waste streams, plastic waste was placed fifth as a priority waste stream after organic waste, tyres, municipal waste and mineral waste. Further, the participants suggested a goal of zero waste to landfill by 2030 with the likelihood of realisation estimated as *high* for pre-consumer plastic waste, but *low to medium* for post-consumer plastic waste (DST, 2014b). The difference in likelihood of realisation is due to the fact that pre-consumer waste is easier to collect due to its homogeneity and availability in large quantities.

For the waste plastic sector, some of the key needs highlighted for the present and immediate future (3-10 years) include awareness raising, research and development and infrastructure. To meet these needs several measures such as public-private partnerships, valuing of waste, improved political will, technology, legislation and stable economic conditions have to be effected (DST, 2014b).

In contrast to the combined results for the plastic and packaging sector of materials collected for recycling, plastic waste shows both increased consumption and recycling of plastic packaging materials as illustrated in figure 4-2.

Table 4-2: Plastic waste collection 2012-2015



Based on data from Packaging SA

There are several barriers that may limit the progress of plastic waste management. These include lack of waste infrastructure due to budgetary constraints and improper planning that does not prioritise waste infrastructure. There is also the perception by actors in the sector that there is over regulation of the sector and poor implementation of legislation. A common example cited is the case of product taxes for plastic bags which became a hindrance to the sector. Moreover, markets face numerous problems such as poor economic viability of waste, a competitive market and low levels of public awareness on solid waste management. Also, bureaucratic procedures and restrictions by municipalities in issues such as licenses for investments in solid waste are an obstacle. Lastly, obtaining funding externally is also difficult due to lack of knowledge on how such funding can be obtained (DST, 2014b).

4.2 EPR and informal sector interventions in South Africa

As mentioned earlier, there is a major concern by different stakeholders that the implementation of EPR may result in loss of jobs in the informal sector. The framework, in figure 2-5 addresses this by placing unemployment alongside poor waste management as the problems that need to be solved by EPR interventions. There are overlapping policies that seek to implement EPR and to integrate the informal sector. For example, updates on section 28(1) and 28(5) of the National Environmental Management: Waste Act of (2008). Besides waste regulations that are relevant to EPR implementation, other interventions include the EPR covenant with the paper and packaging sector. The requirements of the IndWMP which were recently released have also been included but they were recalled pending further consultation.

The resulting outputs of the implementation process are the creation of PROs, like PETCO, and the establishment of cooperatives and SMMEs. The main focus of this thesis is on cooperatives as they have been cited continuously in literature review as being effective mechanisms for integrating the informal sector. The immediate outcomes considered include collection and recycling, design for recycling, awareness creation, support for collectors and recyclers and the organisation of the informal sector. A background of the case study is given in Chapter 4. Further description of the case study and an analysis is then done in Chapter 5 to

determine whether interventions meant to solve the problems of poor solid waste management and unemployment have achieved their intended outcomes of integrated solid waste management and job creation.

Based on the EPR evaluation model developed by Tojo (2004) figure 2-5 is used as a guide in to answer the question;

Q1. How has EPR for post-consumer PET waste been implemented in South Africa?

- a. What are the existing policies in place for implementation of EPR?
- b. How has the informal sector been included in the EPR scheme?

Goals

Intervention theories are usually identified using official documents concerning the instrument (Hildén et al., 2002). This section reviews legislation relevant to EPR and the integration of the informal sector to derive goals for evaluation.

Legislation

1. National Environment Act 107 of 1998:

In Chapter 1 (4e), EPR is included as one of the national environment management principles whereby responsibility for environmental, health and safety consequences is considered to exist in the entire lifecycle of a policy, programme, project, product, process or service.

2. National Environment Management, Waste Act No.59 of 2008 (amended by the Environmental Management Waste Amendment (NEMWA) Act 26 of 2014):

Section 18 outlines the roles of the Minister in relation to EPR. It also provides for consultation with the scientific community and producers affected during amendments. The roles of the Minister include;

- a) Identification of products or class of products subject to EPR and specification of measures to be taken with respect to these products.
- b) Identification of a person/category of persons responsible for implementation.
- c) Specifying requirements for implementation and operations of an EPR programme
- d) With respect to waste minimisation programmes, specification of financial and institutional arrangements and percentage of products that must be recovered.
- e) Specifying requirements for labelling with respect to waste.
- f) Specifying standards for the carrying out of a life cycle assessment by the producer and the requirements for design, composition and production of a product or packaging.

The Act has provisions for mandatory and voluntary industry waste management plans. Section 30 specifies minimum requirements for the plan but the Minister may add more requirements. Industry Waste Management Plans (IndWPMPs) can include voluntary producer responsibility schemes but if these fail to manage a waste stream effectively, mandatory EPR schemes can be declared (DEA, 2011). A Paper and Packaging Industry Plan was submitted to the DEA in August 2011. It was then updated in 2014 and submitted the same year for discussion purposes. It was neither discussed further nor adopted hence it became redundant (Executive Director, Packaging SA, 2016).

3. *Schedule 28 (1) and 28(5) of NEMWA 2008*

As at 12th of August 2016, an update to schedule 28 (1) and 28(5) of NEMWA 2008 introduced new mandatory requirements for the creation of IndWMPs. According to Godfrey et al. (2016), mandatory EPR is being implemented through IndWMPs. The requirements for IndWMP apply to *paper and packaging, lighting equipment, electrical and electronic equipment and importers of goods wrapped in primary or secondary packaging*. Additionally, “any person or category of persons engaged in the commercial manufacture, conversion, refurbishment or import of new and/or used” products for the above mentioned sectors is defined as a producer (Department of Environmental Affairs, 2016a, p. 5). An example of a mandatory IndWMP is the Integrated Waste Tyre Management Plan that outlines how a nationwide collection and recycling scheme for tyres is to be implemented (REDISA, n.d.).

Prior to its introduction, there was no standard definition of a ‘producer’ therefore the definition varied and thus the enforcement of EPR varied from one material organisation to another. There is now a standard definition of a producer that is applicable to the sectors targeted by the guideline.

It requires among other things that producers should register with the Minister, submit IndWMP for approval and consult with all relevant stakeholders, especially those from the informal sector. Some of the contents that have to be in the IndWMP for the targeted sectors such as paper and packaging include: indications of the number of jobs and business opportunities to be created along the value chain, how this will be achieved, how the informal sector and ‘previously disadvantaged’ people will be integrated into waste management.

If those defined as “producers” fail to register with the minister, fail to submit a plan or are not part of an IndWMP, penalties will be imposed. The penalties include imprisonment not exceeding 15 years, an appropriate fine or both.

It should be noted that as of 12th September 2016, the notice to submit industry waste management plans was withdrawn pending further consultation with relevant industries (DEA, 2016b).

4. *The National Waste Management Strategy (NWMS)*

It identifies EPR as one of its implementing instruments. It has eight goals for waste management complete with objectives and targets. The goals relevant for this research include; *promotion of re-use, recycling and recovery* with a target set for the diversion of 25% of recyclables from landfills by 2015, initiation of source separation programmes in metropolitan cities, secondary cities and large towns by 2015, and *creation of 69 000 jobs* in the waste sector (DEA, 2011). Specifically, there is also a goal that by 2016, 2600 additional small and medium enterprises and cooperatives taking part in solid waste management should be created.

Summary of Goals

In summary, the goals relevant to EPR are job creation and promotion of re-use and recovery. The specific targets are: to create 69 000 jobs and 2600 SMMEs and cooperatives, integrate the informal sector, divert 25% of solid waste from landfill and initiate source separation in metropolitan cities.

In the EPR covenant implemented by PETCO only operational goals are defined. For the overall paper and packaging sector the main objectives of its waste management plan is to increase recycling rates to over 54% by 2018 or over 2.1 million tonnes (Packaging SA, n.d.-b). PETCO has a provisional target of 70% for beverages and 43% for total PET to be recycled by

2022 according to their draft MOU that is yet to be signed by the government (PETCO, 2014). There are no goals for system or product design improvements as in EPR theory.

Inputs

This refers to the resources that are needed to run an EPR scheme. Voluntary initiatives for post-consumer PET waste management were started by the PET committee (representatives of brand owners, resin manufacturers, converters and bottlers) in 1999. In 2004 PETCO was formed. In 2006, PETCO had a workshop with the DEA and an MOU was drafted by PETCO which the government did not sign. PETCO reports its collection and recycling results annually though they are not obligated to report to the DEA. Further, the Minister has not set any targets for the paper and packaging sector (CEO-PETCO, 2016).

To finance the EPR scheme, a levy system was formulated to achieve voluntary participation by players in the industry. The resin producer reports to PETCO how much resin has been purchased and PETCO then invoices the purchasers directly for levies (CEO-PETCO, 2016). The current levy stands at approximately \$ 25. The membership and the levy structure of PETCO are outlined as follows:

- *Resin manufacturer:* Includes Hosaf, a major bottle grade resin manufacturer in South Africa that pays annual grants to the scheme.
- *Converters:* Includes companies like Nampak and Boxmore that make pre-form bottles and bottle tops. They pay recycling levies per tonne of resin bought from Hosaf.
- *Bottlers:* Purchase pre-form bottles, blow them into finished bottles and fill them up with products. They also pay levies and include companies like SAB Miller/ ABI soft drinks and Peninsula Beverages.
- *Brand owners:* Pay annual grants to PETCO and include companies like Coca-Cola, South Africa.
- *PET importers:* Importing agents neither pay levies nor contribute grants. However, converters and bottlers declare and pay levies on their imports.
- *Retailers:* Some retailers pay small grants and ensure that their packaging suppliers buy from PETCO members.

Administration

This refers to all the parties that are part of administering the EPR programme. Actors in the recycling of post-consumer PET waste include government agencies, voluntary industry organisations, and the private sector. The DEA is the government agency that facilitates negotiations with industry on targets to be met, and carries out evaluation and monitoring of industry activities to ensure that obligations agreed upon are fulfilled (Nahman, 2010). Failure of industry to comply has been checked by the threat by government to promulgate legislation if targets are not met.

The paper and packaging sector is represented by Packaging SA, a voluntary industry body, whose membership consists of converters and associates (major raw material suppliers, material organizations, brand owners, retailers and other parties with interests in the packaging sector)(Packaging SA, n.d.-a). In the case of PET, producers participating in the EPR scheme include all those who generate revenue from PET such as resin producers, converters, bottlers, brand owners and retailers (Board Chairman-PETCO, 2016).

PETCO acts on behalf of producers in the PET sector to assist them in meeting their voluntary obligation for collection and recycling of PET. It is governed by eight directors who represent PET converters, bottlers, brand owners, resin producers and retailers.

Output

This refers to the establishment of the EPR scheme. In 1998, the South African PET industry started providing guidance and financial support for the recycling of post-consumer PET. PETCO started with one project in the year 2000 where recyclers with fibre plants were engaged. These recyclers went out into the market and started training and advising people about the value of PET while indicating that they would buy the collected PET. This small project grew to the current seven recycling partners and eleven projects across them. It was officially established in 2004 as a non-profit PRO. Its aim is to promote improved waste management and recycling of post-consumer PET on behalf of its stakeholders in the South African PET industry (CEO-PETCO, 2016).

The producers collectively bear the financial responsibility for management of post-consumer PET waste through funding and facilitating the collection and recycling of post-consumer PET waste. Advance disposal levies are paid in accordance to the structure outlined in section 4.2.2. The funds are used to ensure the constant supply of post-consumer PET as it is prone to major cycles. This is done through supporting recyclers, collectors and reclaimers to ensure constant collection (PETCO, n.d.). Components of funding activities include; funds to maintain present recycling tonnages through adverse economic times such as fluctuating oil prices, exchange rates and to ensure consistent market for the bottles. Investments are also made to enable increased tonnage and increased collection coverage. The following projects are supported by the funds;

- a) *Category A projects*: Focus mainly on increasing collection and recycling of post-consumer PET. The aim is to optimize utilization of existing collection and recycling infrastructure and to establish these where they are absent. Financial assistance is provided to recyclers per tonne of PET recycled. In addition, transport subsidies are given where transport cost may inhibit collection (PETCO, n.d.). About 70-80% of the annual budget is used to support recycling projects and subsidies are issued based on varying criteria. To ensure the funds are well utilized, independent audits are conducted on a quarterly basis (PETCO, 2015a).
- b) *Category B projects*: These are projects or activities that contribute to the visible recycling of PET. They are conducted as part of contractual relationships and joint ventures with other organisations. These projects or activities are divided into PET recovery and recycling, information and communication, clean up campaigns and litter awareness, education and training, among other joint venture projects (PETCO, n.d.).

The main policy instruments used in the scheme are economic instruments such as product taxes and the setting up of collection and recycling targets. For example, the collection and recycling targets for PETCO in 2015 was 50% rate and the current target for 2016 is 54%.

According to one of the interviewees, there is a possibility of introduction of a product tax to finance mandatory EPR for the paper and packaging sector. This is based on provisions in the NWMS for the establishment of a pricing strategy and Waste Management bureau. Administrative instruments such as buyback programmes have also been initiated to incentivise higher collection rates.

Outcomes

These include design changes, organisation of infrastructure and communication between upstream and downstream. PETCO has achieved these through expanding infrastructure for bottle to bottle recycling and by creating *design for recycling* guidelines.

After the sorting and processing of PET recyclate into pellets, the rPET is sold in end markets for development into products through *bottle to fibre* or *bottle to bottle* processes. In 2015, it achieved a recycling rate of 52% (74 360 tonnes), above the set target of 50% (PETCO, 2016).

- a) *Bottle to fibre*: It involves the production of fibre in making clothes, carpeting, insulation among others and geotextiles that are used to line dams, roads and landfills. The most common use for rPET globally is in the production of polyester fibre. In 2014, PETCO estimated that 52 000 tonnes, 81% of total end-use market for post-consumer PET, was collected (PETCO, 2015a).
- b) *Bottle to Bottle*: It has a growing end-use market. However, most bottles collected for this purpose are not suitable due to stringent health and quality requirements. rPET is currently used as an input for non-food grade packaging like personal care and pharmaceuticals. It has been blended with virgin PET in various ratios since 2009, for use in packaging for sandwich containers, trays and non-carbonated beverages. 19% of total end use market for post-consumer PET, equivalent to 12 000 tonnes of the rPET collected for recycling, was utilized in 2014 (PETCO, 2015a). According to the CEO, the local fibre market is saturated and future growth is in bottle to bottle. To promote bottle to bottle recycling and to open up new end use markets, PETCO has initiated two large projects to produce Africa's first Carbonated Soft Drink (CSD) grade rPET in 2015 using Coca Cola approved technologies (PETCO, 2015a).

In 2015 however, the amount of post-consumer PET recycled into fibre went down to 61% (45 000 tonnes) while there was an increase in bottle to bottle recycling to 30% (22 000 tonnes). The remaining 6 777 tonnes are made up of PET bottles and flakes for export (PETCO, 2016). The gradual shift towards more bottle to bottle recycling shows increasing efforts in high grade recycling and closing of the loop by PETCO. Moreover, all these efforts in recycling are estimated to have created about 50 000 income opportunities for informal collectors (PETCO, 2016).

To further enhance economic feasibility and efficiency of recycling, PETCO works with innovators, designers, packaging decision makers and manufacturers to create awareness on how design decisions affect recyclability. Where feasible, it promotes packaging design that is compatible with existing recycling facilities. Further, it has a *Design for Recycling guideline* that was recently revised to match international standards (PETCO, 2015a).

PETCO also includes educational issues and forms partnerships with other players outside the industry, including other recyclers to broaden recycling efforts and to increase PET collection streams. Lastly, annual reports are published to inform stakeholders about the activities of PETCO and its performance in the collection and recycling of PET (PETCO, n.d.).

The informal sector

The informal sector collects most of the solid waste in South Africa. From literature review there are three different types of informal sector waste collection activities. There is street waste picking, itinerant waste buying and waste picking from dumps. In South Africa, most of the

recyclables are collected from landfills. There are also trolley pushers who collect recyclables in large urban areas prior to its disposal to landfills from residential, commercial and urban areas (Godfrey et al., 2016a).

Unemployment in urban areas is one of the forces that drive people into the informal economy. Entry into the sector has no qualification barriers neither is any permit nor permission required (Schenck & Blaauw, 2011). The waste pickers in South Africa are from different parts of the country as well as neighbouring countries. The issue of illegal immigrants has been mentioned by two interviewees as a problem to formalisation because they lack documents such as identity cards, required for registration into formal organisations. Many waste pickers are unskilled or have low levels of education. In a recent survey it was found that only 40% of the respondents have attended primary school, 39% have attended but not completed secondary school and 15% have no formal education (DEA, 2016).

The informal sector is highly adaptable and responds to market driven forces (Schenck & Blaauw, 2011). For example, in one of the interviews it was found out that the informal waste pickers in Brazil prefer picking aluminium cans as opposed to PET bottles due to the relatively high value for aluminium cans. The activities of waste pickers are mostly influenced by the availability of recyclables in large quantities and markets for collected materials. In South Africa, the most popular packaging materials for collection are plastics at 77%, paper at 69%, metal at 58% and glass bottles at 48% (DST, 2016). The price for materials collected is determined by the material buyers depending on the quality of the materials and market demand. Besides this, other factors that determine earnings depend on individual pace of work and number of hours spent working (Department of Environmental Affairs, 2016c). For this reason, measures to buffer recyclers and collectors during economic fluctuations, as in the case of PETCO helps to make recycling activities financially stable and viable.

South Africa's waste management leans more towards labour intensive recycling as opposed to the use of technology. This not only ensures that jobs are created and maintained, but labour intensive methods are deemed to be more efficient than technology intensive methods (DST, 2014a). Current recycling rates in some developing countries are high, in the range of 20-50%, with contribution almost entirely from the informal sector (Wilson et al., 2009, p. 632). For instance, one of the interviewees implied that waste material collected by the informal sector collection is of higher quality (as they are well sorted) compared to materials from formal collection systems. In addition, a shift to formal collection in some areas has registered a reduction in recycling rates.

The biggest challenge so far in the case of South Africa is what form formalisation should take (Godfrey, 2016). Waste pickers can be organised into waste pickers associations, SMMEs or cooperatives. From a sample of 825 waste pickers, about 89% of waste pickers operate individually, 7.8% are in waste pickers associations and 1.1% are in cooperatives (Department of Environmental Affairs, 2016c). A large portion of the informal sector is therefore not organised. How representative these results are against an estimated population of 62 000 informal waste pickers (Department of Environmental Affairs, 2016c), is debatable. The focus of this thesis is on cooperatives because several case studies reviewed by the author suggest that cooperatives offer one of the best models for organising the informal sector.

The main challenges for waste pickers include: lack of Personal Protective Equipment (PPE) that has led to exposure to safety and health hazards, exploitation by middlemen, lack of infrastructure, poor relationship with the municipalities, transport problems and for those who are not in formal organisations such as cooperatives, there is no financial or operational support (Department of Environmental Affairs, 2016c).

Cooperatives

According to a report on evaluation of cooperatives in South Africa by Godfrey et al. (2015), cooperatives are defined as enterprises and independent associations of persons formed because of a common need intended to be addressed jointly. Cooperatives are viewed as approaches that could help alleviate poverty and reduce unemployment levels. The report notes that most cooperatives operate to create income for members rather than to provide employment and services for communities as anticipated by the Government. Moreover, government driven registration of a large number of new cooperatives led to unintended consequences such as high turnover of members due to unmanageable growth of these cooperatives. The report estimates that as at 2015, 92% of cooperatives had ceased to operate with only 8% still in operation at that time (Godfrey et al., 2015). Most of the cooperatives in that study worked in the area of collection and sorting of recyclables though some managed to integrate into SWM systems. Others have extended their services to city cleaning and also provide free services such as education and awareness to communities.

The report also identifies several barriers that have been experienced in the establishment and operation of cooperatives discussed in detail in Chapter 5. These challenges are not unique to South Africa alone as shown by findings by Sturve (2013). He mentions challenges facing cooperatives in Brazil such as corruption and lack of capacity.

5 Discussion and Analysis

In this section, analysis is done on both PETCO's collection and recycling activities as well as on how the informal sector has been included in these processes. For EPR, the EPR evaluation tool developed by Lindhqvist & Van Rossem (2005) (Appendix 1) is used which outlines the criteria against which scores are given. Treatment of materials has been left out and only system and product design and high utilisation of products and material quality has been considered. This is because packaging is not as hazardous or may not require elaborate treatment for products like WEEE or oil. To assess the inclusion of the informal sector, the InteRA methodological tool (Appendix 2) is utilised. The section answers the following questions;

Q2. What is the performance of PETCO in the management of post-consumer PET waste?

- a. How do the outcomes of PETCO match with goals of EPR theory?
- b. To what extent do waste management interventions address integration of the informal sector?

Q3. What are the barriers to successful inclusion of the informal sector?

5.1 Analysis of PETCO

The analysis is done using the EPR evaluation tool. The categories being evaluated are system and product design improvements and high utilisation of products and material quality. The key for grading is 0 for a very low level of EPR implementation and 3 is for a very high degree of EPR implementation. The results for PETCO are compared with those of Songhu, Ontario blue box and Alberta that are Canadian case studies previously evaluated using the EPR evaluation tool.

Product design improvements

To achieve product design improvements incentives for simple products such as packaging, levies are usually based on the type of packaging material used and/or its weight. Producers are then able to pay levies according to the ease of recyclability of the packaging material or on how light the material is. The following questions have been asked to determine whether PETCO has incentives for product design improvements.

a) Will the individual producer benefit directly from product design improvements?

According to the evaluation by Lindhqvist & Van Rossem (2005), a score of 1 is assigned in cases when individual product design improvements are made and producers benefit collectively but individual producers get no direct benefits. A score of 2 is given in instances where individual producers stand to gain directly from savings made in design improvements. In the case studies evaluated by Lindhqvist & Van Rossem (2005) both Alberta and Songhu have a score of 0 because producers will not benefit directly and if such benefits exist, it will be shared collectively by the producers. Ontario Blue Box has a score of 2 because most of the benefits will accrue to the producer for instance if they reduce weight of packaging. However, not all design improvements will be covered as some costs are covered by the collective system.

For PETCO, the **rating is 2**. This is because some producers in PETCO pay levies per tonne of resin, there is an incentive for them to move towards lighter or other low cost materials. Considerations are being made to pay levies differentiated according to recyclability (CEO-PETCO, 2016). Product design improvements by individual producers will result in reduction of levies and may even lower costs of production for PET bottles. For example, simple product design changes such as shifting from coloured to clear PET bottles and placing branding on

paper instead of the actual bottle, not only saves costs but may result in financial windfalls in some cases. Other times, the nature of the product may make product design changes more expensive for the producer especially if additional investments are required to maintain the quality of the product (Board Chairman- PETCO). In this instance additional costs are a disincentive for product design changes since there is no direct benefit for producers.

In literature, product design changes are seen as positive in that it may lower levies for producers if levies are based on characteristics of products such as weight and recyclability which may create even more incentives to improve product design. However, the author has not found literature that mentions the potential additional costs that may be incurred when designing for recycling as shown in the above example. The impact of these additional costs may need to be investigated to determine to what extent it may hinder product and system design improvements.

System design improvements

This involves improvements made to improve the collection, recycling and sorting of waste products (Lindhqvist & Van Rossem, 2005). For PETCO, this is taking place through its investments in both category A and B projects to improve collection and recycling rates. To evaluate if there are incentives for individual producers for systems improvements the following questions are asked.

b) Will the individual producers benefit directly from system design improvements?

In the case of both Alberta and Songhu there will be no direct benefits of system design improvements for individual producers and any benefits that arise will be shared collectively. Therefore, the score is 0. However, for Ontario blue box the score is 1 because a smaller part of the savings will benefit producers that developed product systems assuming that they are users of certain materials. For Songhu, all benefits will be transferred to individual producer and this will have an impact on EPR fees. This is because regulation allows for individual producers to set up individual systems to fulfil legal obligations. This will enable them to directly capture all the benefits. Hence the score is 3.

For PETCO the **rating is 0** because improvements in systems for collection and recycling of products may not result in direct benefits for an individual producer. However, any such benefits will be collectively shared in the scheme. At the moment, all PET bottles are collected regardless of the whether they belong to producer who is a member of PETCO or not. Thereby any individual investments in collection and recycling systems would benefit all PET producers and would also be costly since basic solid waste infrastructure is lacking. Since the EPR scheme is collective the author sets the score at 0 since benefits from system design improvements will be shared collectively by all producers.

c) Will the producers collectively benefit from product and system design improvements?

According to the previous evaluations, Alberta has a score of 1 because even though cost reductions achieved by design or system improvements may not directly influence costs borne by producers, it may have a long term cost reducing effect. For Ontario blue box and Songhu the score is 2. This is because a substantial part of the cost reductions achieved by design or system improvements will be transferred to the individual producer.

For PETCO, the **score is 0**. Initial investments in product and system design improvements may not yield any savings in the short term though savings may be realised in the long term. Levies paid may increase at present given that there is need to upgrade the existing solid waste

infrastructure. Producers are required to initiate national source separation programmes which may result in substantial costs.

Collection

High collection targets can be achieved through enhancing convenience for consumers, giving financial incentives to producers, imposing sanctions for non-compliance and creating awareness on proper waste management (Lindhqvist & Van Rossem, 2005). The following questions have been used to evaluate the collection rates of PETCO.

d) Does the system include measures to secure goal achievement for the collection targets?

As per previous evaluations, no targets have been established for collection for Alberta hence the score is 0. For Ontario Blue box, targets are given in quantitative form though there is uncertainty about what will happen if the targets are not met and consequences of non-compliance are not worse off when compared to costs of compliance. For Songhu the score is 3 because non-compliance is followed by a sanction that is considered unattractive compared to compliance.

For PETCO, **the score is 2**. The recycling target for PETCO in 2015 was set at 50% of the products placed in the market. Failure to achieve this target could result in the implementation of mandatory EPR which, according to the PETCO Board chairman, could result in much higher financial costs for producers. However, there are no clear sanctions of what would happen if there is non-compliance.

e) Are there tangible incentives in the form of direct or future financial benefits for striving towards higher collection results?

For both Ontario blue box program and Songhu, the score is 3 because even though there are no incentives for producers, there are financial incentives for collectors who achieve high collection rates since payment is based on per kilo collected. For Ontario blue box, the score is 2 because achieving collection rates is important for producers because it leads to less stress from environmental movements and authorities. This makes future legislation a minor concern. Further these collection rates influence the Minister's decision to approve recommended specific targets.

For PETCO, **the score is 3**. This is because publication of individual company reports and even PETCO's annual report may indirectly create benefits for producers through the positive public image created by good collection results. PETCO also has contracts for a certain tonnage of materials to be collected for recycling. So the collectors and recyclers have incentives to achieve higher collection rates as they are paid per tonne of material collected.

Re-use and recycling

To be able to achieve the goals of EPR, measurement and verification of results has to be done together with provision of incentives. Generally, re-use is higher in the waste hierarchy than recycling (Lindhqvist & Van Rossem, 2005). Re-use of electrical and electronic products as mentioned in the characteristics of EPR in a non-OECD context, is common in such countries. However, the extent to which the same is practised for PET bottles is hard to determine. The questions asked are as below.

f) Is re-use and recycling measured?

For both Alberta and Ontario blue box, the score is 2 because the results are measured in a transparent manner but if other methods are used higher levels of accuracy may be achieved. For Songhu, the score is 0 because there are no systems in place for measuring results.

For PETCO, the **score is 2**. The results for collection and recycling are verified on a quarterly basis by an independent auditor. According to a document received from the auditors responsible for verifying collection and recycling quantities for PETCO, the methods used seem robust. However, the score is still 2 because the author is not sure if that is the highest possible level of accuracy that can be achieved.

g) Are there measures to secure goal achievement for stated goals re-use and recycling targets?

For both Alberta and Songhu, the score is 0 because there are no targets established for re-use and recycling. For Ontario blue box, the score is 1 because targets are set in quantitative form but it is unclear what will happen if the targets are not achieved.

For PETCO, **the score is 2**. PETCO sets its own recycling targets. For 2015, the target was 50% and for 2016 it is 52%. There are also goals for diversion of solid waste away from landfills set at 25% (DEA, 2011). As mentioned earlier, failure to meet recycling targets may lead to the enforcement of mandatory EPR that is considered to cost more to producers compared to the current voluntary initiatives.

h) Are there incentives for striving towards high re-use and recycling levels?

The score is 0 for Alberta, Ontario blue box and Songhu (for oil and filters) because there are no incentives for above compliance levels though such levels are technically feasible. For containers in Songhu however, high levels of re-use are promoted and financial benefits from this re-use are higher than the costs. Hence, the score is 3 for Songhu containers.

For PETCO, **the score is 1**. As mentioned in the case study, PETCO is undertaking both bottle to fibre and bottle to bottle recycling. However, there is more growth potential in the bottle to bottle recycling and PETCO's recyclers have been expanding their capacity in bottle to bottle. There seems to be no significant financial benefits at the moment for PETCO's initiative to strive towards higher re-use or high grade recycling but it may benefit from positive image creation. This is supported by Welle (2011) who argues that cost reduction is not always the main driver for PET bottle to bottle recycling. It is mainly driven by sustainability ethic and public concern for the environment.

Table 5-1 shows a summary of an evaluation of the performance of PETCO and a comparison with the three product stewardship programmes from Canada that used the EPR evaluation tool.

Table 5-1: Summary of evaluation of PETCO using the EPR evaluation tool

GOAL	SUB GOALS	CRITERIA AND SCORE	AGGREGATE SCORE			
			PETCO (packaging)	Ontario Blue Box Program (packaging)	Electronics Recycling Alberta	Quebec Songhu Oil Program
<i>System and Product design improvements</i>	Will individual producers benefit from product design improvements?	For some producers, levies are paid according to per tonne of resin. This kind of system offers incentive to use lighter materials. (2)	0.7 (2/3)	1.7	0.3	1.7
	Will a producer benefit directly from system design improvements?	There are no direct financial benefits because it is costly and everyone will benefit from system design improvements resulting to a limited extent of free riding (0)				
	Will producers collectively benefit from product and design improvements?	Producers will not collectively benefit. In this case the EPR levies will go up especially in the short term. (0)				
<i>High utilisation of products and material quality</i> c) Collection	Does PETCO have measures to secure achievement of goals and targets?	There are set targets. Though there are no penalties for failure to reach targets there is threat of mandatory requirements should voluntary initiatives not work (2)	2.5 (5/2)	1.5	1.5	3
	Are there tangible financial benefits for striving towards higher collection?	Collectors are paid per tonne of material collected which gives them financial benefits when they achieve higher collection rates (3)				
d) Re-use and recycling	Is recycling and re-use measured?	Results are verified by an independent auditor on a quarterly basis but there are no sanctions for non-achievement of targets (2)	1.7 (5/3)	1	0.7	0.5
	Are there measures to secure goal achievement for stated goals re-use and recycling targets?	Failure to meet recycling and re-use targets may result in regulation considered which is considered to cost more for producers than voluntary schemes (2)				
	Are there incentives for high re-use and recycling?	There are incentives for promoting re-use and recycling but these have limited economic benefits (1)				

Comparison of EPR policy for PET waste management in South Africa with EPR theory

According to Lindhqvist & Van Rossem (2005) EPR has two primary goals for the achievement of environmental improvement; provision of incentives for design improvements and high utilisation of product and material quality through re-use and recycling. Other goals of EPR include source reduction, closure of material loops and shifting responsibility from municipalities (Lindhqvist, 2000).

From table 5-1 there is a general poor performance on incentives for product and systems design for all the case studies. In the case of PETCO, it is clear that the EPR scheme is designed primarily to finance the collection and recycling of post-consumer PET bottles since there are very few direct financial incentives to promote improvements in the design of products and their systems. As observed by Nahman & Godfrey (2010), this is what makes economic instruments ineffective in South Africa since they are mostly used to recover costs and generate revenue instead of incentivising behaviour change. However, for economic reasons and perhaps to improve the performance of the scheme, PETCO has initiatives to improve product and system design. PETCO through its bottle to bottle recycling programme is on the path to closing material loops.

In the category of high utilisation of materials and through re-use and recycling, PETCO outperforms Ontario Blue Box. It is important to provide incentives to collectors so as to drive up collection rates. The case of PETCO is unique in this case because collection is done by the informal sector which greatly subsidises the costs for producers. It is therefore profitable for industries to incorporate waste pickers into waste recovery systems under EPR. Compared to the other case studies, the inadequacy of solid waste management infrastructure in South Africa may make it more expensive to invest in system design improvements. Providing incentives for the informal sector to move into formal systems is therefore cheaper in this case (Besiou et al., 2012). Capacity for collection and recycling as revealed by one of the interviewees is currently not a problem for the paper and packaging sector. Therefore, the focus for the sector should be to find effective ways to improve the informal sector.

Financial incentives are important in influencing changes in product and system design. The unique aspect of PETCO is that despite lack of direct financial incentives to producers, requirements of the recycling system impose requirements for changes to product design. The challenge of bottles being incompatible with the recycling facilities (such as bright coloured PET bottles) has led to steps being undertaken to improve product design. There is a *design for recycling* guideline and measures have been put in place to engage pro-actively with brand owners to influence product design. A differential levy for producers is also being considered to further incentivise changes in product design (CEO- PETCO, 2016).

Tubs, trays and edible oils are currently not recycled in South Africa though they are the largest end users of recycled PET. Their participation in the scheme is being considered (PETCO, 2016). However, this element of free riding is not considered a substantial problem by interviewees from PETCO. This is because there is a very high compliance rate by the paper and packaging industry of about 68 % of the entire PET market.

5.2 Analysis of the informal sector

Based on literature review, organisation of waste pickers through waste associations, SMMEs and cooperatives is recommended as a way to organise and improve the welfare of the informal

sector. Moreover, organisation of the informal sector increases the level of support that it can receive from other actors (Godfrey et al., 2016a). Ezeah et al., (2013) recommends the formation of cooperatives because it has numerous advantages mentioned under ‘*solutions*’ in chapter 2.3.4. The main focus of the thesis is on cooperatives due to these advantages and because when compared to SMME’s, there is more information available on cooperatives.

The focus of this thesis is on how material organisations such as PETCO have contributed to the activities surrounding the organisation of the informal sector. In addition, there is a focus on barriers that have prevented cooperatives from being the ideal vehicles of informal sector organisation in South Africa. Though the requirements of the IndWMPs have just recently been released and even recalled, these requirements are still analysed to see what particular aspects of informal sector organisation had been addressed by these requirements. The main points of reference are: a report on evaluation of waste cooperatives in South Africa by Godfrey et al. (2015), annual reports by PETCO, interviews and government documents.

Due to the negative perception of the informal sector in solid waste management as mentioned in literature review, Section 5.2.1 looks at the perception different actors have towards the informal sector’s contribution and the extent to which they are willing to accept changes to improve the welfare of the informal sector in South Africa.

Overall evaluation of informal sector interventions in South Africa

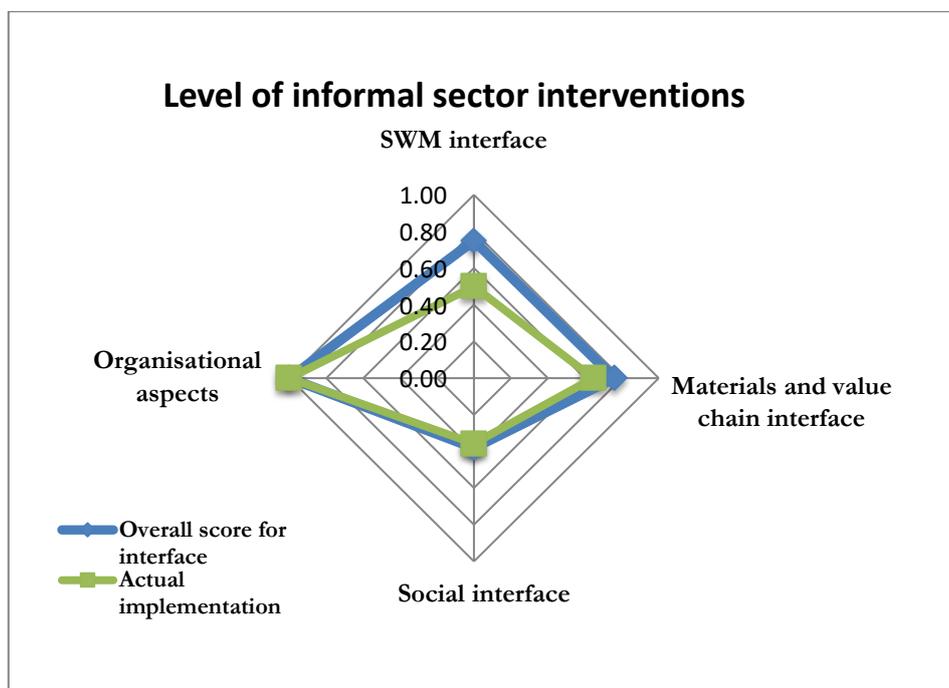
According to Ezeah et al. (2013) successful integration of the informal sector into formal waste management should be flexible and should also build on the existing practical experience of the sector. Legislative, financial and institutional support is also required. The InteRA tool provides a good framework to evaluate whether all these have been considered in the implementation of informal sector interventions. The method of evaluation is explained in section 2.5.3 and the application of the method is demonstrated in sections 5.2.1 to 5.2.4.

For South Africa, policy considerations on integration of the informal sector focus on all interfaces as shown in table 5-2. In many cases interventions focus on specific interventions, depending on the local situation, instead of all four (Velis et al., 2012). This has been the case in several of the case studies from different parts of the world that have used the InteRA tool. It is only in very few cases such as in the example of *Linis Ganda* that has a more balanced profile that tries to address all four categories. Compared to the case studies that use the InteRA tool, South Africa has a relatively high level of policy consideration for all interfaces for informal sector integration except for the social interface. The scores are 0.75 for the solid waste management interface, 0.76 for the material and value chain interface, 0.38 for the social interface and a full mark of 1 for organisational aspects. The analysis behind these scores is explained in the subsequent sections.

For organisation and empowerment, other case studies on informal sector interventions from various parts of the world also have high results which show that this interface receives a lot of attention. There is a lot being done on funding, organisation and NGO participation. However, topics that deal with the solid waste system such as occupational health and safety, protection of the environment, improving formal/informal interface, data collection and documentation among others receive less attention. In many case studies, SWM interface is the least covered as interventions in this area creates tensions among stakeholders (Velis et al., 2012). This is because practical solutions to address issues in this interface have so far been difficult to find. However, for South Africa the social interface is the one that has received the least priority according to the evaluation done.

As illustrated in table 5-2, there is a gap between policy considerations and actual implementation of informal sector integration in South Africa. The biggest gap is in SWM interface with a difference of 0.25 followed by materials and value chain interface that has a gap of 0.12 and the social interface with a gap of 0.02. Meanwhile for organisational aspects, policy considerations and actual implementation match. Therefore, the interfaces that require the most attention with regards to implementation of current policy in order of priority are the SWM interface, the material and value chain interface and lastly the social interface. However, in terms of policy formulation, the social interface requires the most attention. It should be noted that the results of the evaluation of the social interface may not give an accurate impression of the situation in South Africa. This is because a lot of information relating to social aspects was lacking for use in the evaluation.

Table 5-2: Illustration of the level of policy focus and implementation for the four categories of interventions



Solid Waste Management (SWM) sector Interface

In order for the informal recycling sector to be part of the SWM system, it needs not only the legal right to recycle but also the right to collect waste. The kind of interventions needed to facilitate this include: promoting the informal sector's access to waste, recognising their role, controlling the arising impacts of informal sector recycling such as pollution and lastly giving the sector a chance to pick through waste or transport it as long as laws and regulations are not broken (Velis et al., 2012).

The different options available for transport of collected packaging waste by the informal sector include; transporting the materials on foot to a buy back centre or having the materials collected by owners of buy back and recycling centres. Many times they transport the materials at their own cost mainly by walking or hiring a vehicle, manually pushing a cart, public transport and pulling a cart using a bicycle, donkey or horse (Department of Environmental Affairs, 2016c).

Political will is crucial for integration of the informal sector (Gunsilius, 2010). But still in South Africa, many people would rather ignore the informal sector as they are considered a nuisance.

This is because waste pickers leave litter behind after sorting and block roads with trolleys. They are also thought to introduce crime into neighbourhoods (Godfrey et al., 2016a).

The NWMS and IndWMP as listed in chapter 4.2.1 have established goals and measures to facilitate the integration of the informal sector. Table 5-3 summarises the aspects of the solid waste management interface that have been considered by policy or are already being implemented. The table is filled by information gathered from the case study developed in this thesis.

Access to waste

Though the contribution of the informal sector in solid waste management is acknowledged in South Africa, legislation does not grant them explicit rights to collect waste. However, policy measures are sensitive to the fact that the welfare of the informal sector needs to be considered in the process of transitioning towards a formalised solid waste management system. Hence there is a strong focus on job creation both in the NWMS and IndWMP. The IndWMP seeks to strengthen the role of the informal sector in solid waste management by stipulating requirements for producers to actively facilitate the inclusion of the informal sector. The issue of ensuring the informal sector does not lose its livelihood has also come up severally in interviews conducted for this thesis and from the annual reports of PETCO. According to the executive director of Packaging SA, some landfill sites have been fenced off in a bid to keep the informal sector out of landfills. This has proved to be difficult due to the fact that landfills are a source of waste materials that sustain livelihoods for many. With no alternative sources of income, it is difficult to enforce such measures.

The evaluation of waste cooperatives by Godfrey et al. (2015) shows that out of 64 waste cooperatives surveyed, 1905 income opportunities have been created. It is difficult to estimate whether this result comes close to the achieving of the goal of job creation, because it is a sample.

Recognising role in formal waste management system

In South Africa, the role of the informal sector in collection of packaging waste for recycling is highly recognised. It is estimated that 80% of all packaging waste that is collected for recycling is by the informal sector (Godfrey, Strydom, & Phukubye, 2016b). This is mentioned not only in government publications but also in the annual reports of PETCO. The NWMS has set a goal for the integration of the informal sector while the IndWMP through its requirements is supposed to provide a platform for promoting inclusivity of the informal sector. In the consultation process of the IndWMP (currently recalled), producers are required to involve all stakeholders especially the informal sector.

Promoting public health and environment

There are kerbside collection projects that have been rolled out by the municipality to aid in separation at source. PETCO on the other hand helps in enhancing waste sorting and proper disposal through facilitating the participation of consumers in existing kerbside projects and other community projects and drop off sites for waste. An example includes the *Rustenburg* green march that was aimed at creating awareness about illegal dumping and littering (PETCO, 2016).

Waste collection in marginalised areas is mostly done by the informal sector due to the unique mode of their operations that enables them to access areas that are otherwise inaccessible to formal waste collectors. Waste management activities in these areas are also done through

resource based initiatives. The NWMS had set a target for the initiation of source separation programmes in metropolitan cities, secondary cities and large towns by 2015 (DEA, 2011). However, this has not been achieved (Godfrey, 2016).

Strengthening the interfaces

As mentioned before, there is a NWMS that has goals for improving waste management through the promotion of source separation, diverting waste from the landfills, integrating the informal sector among other things. The IndWMP requirements if implemented will further improve the formal-informal sector interface. Most waste pickers walk or use carts to transport solid waste which is not efficient. Already PETCO is contributing to solving this problem through offering transport subsidies to enhance collection in areas where transport is a limiting factor. However, according to information received this has never worked in practice. Also it offers support in the form of trailers, bailers among others that helps to reduce transport costs and enhances access to markets for collected products which boost incomes for collectors. Collectors have also been urged to include more materials to create synergies.

Barriers at the solid waste management interface

Access to waste is important especially for the private sector actors such as SMMEs and cooperatives. The restrictive control the municipality has on access to domestic waste limits investments in waste management by the private sector (DST, 2014b). Further, cooperatives are yet to be integrated into source separation initiatives and the waste management strategies of municipalities. Getting access to recyclables is a big challenge as local government contracts are required. Cooperatives without subsidies or grants or formal contracts like other cooperatives and private companies face unfair competition. Cooperative members also face harassment from the police who may confiscate recyclables. On the other hand, municipalities raise concerns over procurement and contracting with cooperatives due to uncertainties in their reliability. (Godfrey et al., 2015). As mentioned previously, illegal foreigners create additional setbacks by getting recyclables before the cooperatives do.

The collection and transportation stages should be carefully considered because they affect the economic and environmental benefits of recycling (Besiou et al., 2012, p. 297). Cooperatives lack vehicles to transport waste and are forced to hire vehicles which increases expenses for the cooperative. The vehicles are at times inappropriate for transporting waste. Also the drivers allocated to drive these vehicles may be unreliable resulting in lateness for collection of waste leading to minimal collection of valuable materials. Therefore the cooperatives end up using hand drawn trolleys which is limiting for movement of large volumes of waste (Godfrey et al., 2015). This results in lower incomes for waste pickers as they are forced to sell recyclables to small businesses instead of accessing markets directly. They are also unable to bulk up waste for more value (Godfrey, 2016).

Table 5-3: Summary of solid waste management interface

GROUP OF INTERVENTIONS	OVERALL IMPLEMENTATION SCORE	AVERAGE IMPLEMENTATION SCORE	OVERALL SCORE FOR INTERFACE	INTERVENTION POINT	AVERAGE SCORE PER INTERVENTION POINT	RESULTING MARK PER SPECIFIC ACTION	LEVEL OF CONSIDERATION IN THE INTERVENTION	SPECIFIC ACTION
Access to waste	0.5	0.5	0.75	Access to waste	0.75	1	K	The NWMS & IndWMP and stakeholders recognise the need to create jobs and to involve the informal waste sector.
						0.5	C	Waste pickers already collect solid waste in informal settlements. There are intentions of phasing out landfills.
				Role in formal solid waste management	0.5	0.5	C	The role of organised waste pickers is yet to be included in the Integrated SWM plans for some municipalities. Full integration is being considered by policy the NWMS.
Recognising the role of the informal sector in SWM	1			Social political context towards informal sector	1	1	K	There are policies such as NWMS that seeks to improve the welfare of the informal sector.

				1	K	Results of collection and recycling rates are published annually by PETCO. The high rates are attributed to the informal sector.
	0	Involve all stakeholders in SWM planning & Institutionalise inclusivity of informal sector	0.5	0.5	C	The IndWMP (recalled) required consultation of all stakeholders especially the informal sector.
Promoting public health and environment	0	Promoting public health and environment	0.5	0.5	C	Nationwide sorting at source is being considered with some kerbside projects already initiated
				0.5	C	Collection of waste in informal areas is currently being done by the informal sector and their activities are being considered for expansion in these areas.
Strengthening interfaces	1	Improving formal solid waste management/informal interface	1	1	K	Improvements in transport for the informal sector were considered in the IndWMP (recalled).
	1	National policies improving	1	1	K	The IndWMP uses EPR to enhance and

	formal state/informal interface		implement collection and recycling.
		I K	The NWMS has strategies to improve the informal sector by promoting job creation.
	3.5	5.25	

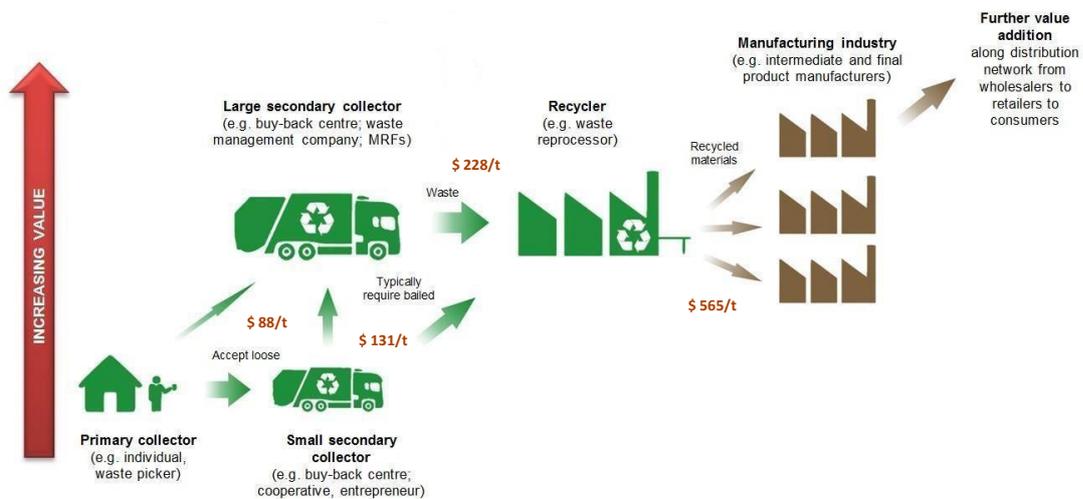
Materials and Value chain interface

Informal sector recycling businesses rely entirely on income derived from materials recovered for operations. Therefore, interventions in this category concern the improvement of the quality of materials recovered so as to boost incomes of waste pickers. Examples of interventions include improving the quality of source material, adding value to products sold and improving linkages along the value chain (Velis et al., 2012).

General ways of improving the welfare of the informal sector include registration and licensing and increasing public participation in separation at source to increase the quality of recyclables (Oguntoyinbo, 2012).

Actors involved in the plastic recycling value chain include waste pickers, private waste companies, recyclers and manufacturers illustrated in figure 5-1. Waste pickers are the primary collectors and they sell loose recyclables to either small or large secondary collectors who bale them for sale to recyclers. The materials are then recycled and sold to manufacturers that process them into final or intermediate products.

Figure 5-1: Recycling value chain of plastics



Source: Adapted from (DST, 2014a, pp. 6 & 20) (Permission to use diagram granted)

From figure 5-1, it is evident that the value of waste plastic increases as one moves further up the chain. There is more income in adding value to waste through recycling or manufacturing intermediate and final products. Source separation also increases the value of waste as the materials are less contaminated. Bulking up is also important but it works best with reliable transport that would provide direct access to markets. Storage facilities not only enable bulking but they also protect the materials from damage by weather elements (Godfrey, 2016). Having direct link with producers is considered to improve linkages along the value chain. EPR is considered one of the approaches that would facilitate this.

Improving quality of materials for recycling at their source

Under this intervention the main issues include improving the quality of source materials through source segregation to reduce cross contamination. It could also involve having contracts with waste generators to operationalise source separation programmes (Velis et al., 2012). Examples of this by PETCO include the provision of a baling machine to *Kruger national park* to enable the implementation of source separation. It has also partnered a 12 member cooperative with the National Zoo to implement a separation at source recycling project (PETCO, 2016). There are also pilot kerbside collection programmes, as mentioned earlier, that have been rolled out by the municipality to implement source separation.

Improving linkages along the value chain

Linkages within the value chain can be improved through strengthening relationships between the recycling companies and the informal sector. PETCO has contracts with recyclers to enable them to invest in downstream activities such as training of collectors and providing support to SMMEs through giving equipment such as balers. It has also partnered with the three polyester fibre companies in South Africa. This provides a reliable market for rPET. It has also invested in plant and equipment to ensure that collection and recycling targets are met. For example, 8 recyclers have been supported to increase recycling capacity (PETCO, 2016).

Barriers at the materials and value chain interface

Cooperatives experience difficulties in securing centrally located premises of the appropriate size. For this reason, cooperative members sort and store materials in their home yards. It is estimated that as of 2009, 53% of all cooperatives operated from residential areas (Godfrey et al., 2015). This limits the amounts of recyclables handled. Further, the less accessible transport is, the bigger the size of premises required to enable storage. Other times, premises provided by the municipalities are either too small or have no shelter resulting in damage of recyclables from weather elements and exposure to risks like waterlogging. Theft of the recyclables by the informal sector is also another risk (Godfrey, 2016).

Another issue is the intermittent supply of electricity that limits opportunities for cooperatives to move from collection to other value adding activities such as recycling and reprocessing. Also for premises with no electricity, costs for installation are very high. In some instances there are even thefts of electricity cables which stall operations (Godfrey et al., 2015).

Lack of personal protective equipment (PPE) may increase risk of exposure from hazardous and health risky waste and the resulting illness may lead to loss of income. Lack of equipment such as balers, compacters and scales makes it difficult to verify weight of materials leading to underpayment to cooperatives. Further, transport costs may rise due to lack of compacters to compact waste resulting in more trips. Also improper use of equipment such as use of balers

meant for plastics on metal, increases maintenance costs and operational disruptions due to frequent breakdowns (Godfrey et al., 2016a).

Even in this interface, transport still remains a challenge for SMMEs and cooperatives which limits their access to end use markets. There is need for premises to bulk up materials before transportation. For informal individual waste pickers, sorting is done in open spaces and underneath flyovers resulting in dumping in open spaces. They leave behind materials that have no value to them which presents a big problem of littering for municipalities.

In addition, according to the national waste management strategy, metros were supposed to have implemented source separation by 2016 but this has not materialised. The DEA is still trying to enforce legislation to enforce source separation (Godfrey, 2016).

Table 5-4: Summary of materials and value chain interface

GROUP OF INTERVENTIONS	OVERALL IMPLEMENTATION SCORE	AVERAGE IMPLEMENTATION SCORE	OVERALL SCORE FOR INTERFACE	INTERVENTION POINT	AVERAGE SCORE PER INTERVENTION POINT	RESULTING MARK PER SPECIFIC ACTION	LEVEL OF CONSIDERATION IN THE INTERVENTION	SPECIFIC ACTION
Improving quality of materials for recycling at their source	0.64	0.33	0.76	Improving quality of the source materials/ reducing cross contamination	0.67	0.5	C	Source separation is being considered with some pilot initiatives implemented
						1	K	Design for recycling has been initiated by PETCO
						0.5	C	Separation at source programs that would enable waste generators to sort waste are still on pilot basis.
Adding value to the secondary raw materials/		0.75		Increasing quantity available for sale	0.87	1	K	Bags have been issued by PETCO to allow bulking up

**products
sold**

			1	K	Trailers provided by PETCO to improve transport and access to markets for recyclables
			1	K	PETCO provided storage facilities to enable expansion of operations
			0.5	C	PETCO is considering processing PET products such as tubs, trays and edible oil containers.
1	Reprocessing	1	1	K	PET materials are sorted by colour then baled
			1	K	The materials are washed and contaminants removed before reprocessing
			1	K	Baling of materials is done and compacters provided to some cooperatives

				1	K	Pellets are produced from the process
				1	K	The pellets manufactured into bottles or fibre
Improving linkages along the value chain	0.5	Improving linkages along the value chain	0.5	1	K	Recyclers are given support to train collectors and are enabled to provide collectors with equipment
				1	K	PETCO has contracts with specific recyclers to provide market for rPET. Investment has been made in infrastructure to ensure capacity for achievement of set targets
				0	n. a	No information on by passing middlemen
				0	n. a	No information on organising middle men
	2.58					3.04

Social aspects and interfaces with society

This interface deals mainly with facilitating recognition and acceptance of the informal sector, working towards gender, education and children and occupational health and safety (Velis et al., 2012).

Facilitating recognition and acceptance of the informal sector

One of the main aspects of facilitating recognition of the informal sector and its acceptance is through legal means. This can be in the form of legal documents such as birth certificates,

national identity cards among others. Also laws that impose light regulations on the informal sector such as organisation into cooperatives and recognition of waste picking as a profession help to increase the rate of acceptance (Velis et al., 2012).

The public can also be engaged in this through awareness campaigns and programmes to facilitate source separation. PETCO facilitates the participation of consumers through promoting the need for the consumers to participate in existing kerbside projects and other community projects and drop off sites for waste. An example includes the *Rustenburg* green march that was aimed at creating awareness about illegal dumping and littering. It also involved the encouragement of school children and local councillors to participate in recycling and waste minimisation (PETCO, 2016).

Work towards children, education and gender equality inclusivity

Many previous interventions in this category focused on child labour and improving work conditions without addressing the social needs of the poor involved in this sector (Wilson et al., 2006, p. 50). In the recently released IndWMP requirements (that have been recalled), there is a provision for producers to consider “previously disadvantaged” people. This when interpreted in the South African context refers to apartheid.

There is no mention in the requirements and even PETCO’s annual report that child education is being facilitated. There are also no indications of incentives to eliminate child labour and encourage school attendance. However, from personal communication it has been found that PETCO supports some schools and in their *Supplier Code of Conduct*, issues of child labour are addressed.

From the PETCO 2015 annual report, there is an indication that there are several efforts being made to include women in waste management of PET. Though a definite approach towards gender inclusion is not indicated, there are examples in the report of the number of women involved in various recycling projects. For example, *K1 recyclers* have 700 women out of a workforce of 1000 people while *Envirowaste recyclers* have 8 women out of 37 employees (PETCO, 2016, p. 13).

Occupational health and safety

This involves maintaining health and safety standards at work, providing safety equipment, enabling access to health care and ensuring that hazardous waste is sorted separately (Velis et al., 2012). Examples of PETCO’s activities in this area include the provision of protective clothing and other equipment such as weigh bridges and trolleys to *Waste Want* (PETCO, 2016).

The author could not determine if access to health care by the informal sector and separating sorting of hazardous waste is being implemented. It has been mentioned numerous times in the interviews conducted that the main challenge in the social interface is the issue of illegal immigrants. It was found that registering them into the formalised waste systems is difficult because they do not possess the necessary identification documents.

Table 5-5: Summary of social interface

GROUP OF INTERVENTIONS	OVERALL IMPLEMENTATION SCORE	AVERAGE IMPLEMENTATION SCORE	OVERALL SCORE FOR INTERFACE	INTERVENTION POINT	AVERAGE SCORE PER INTERVENTION POINT	RESULTING MARK PER SPECIFIC ACTION	LEVEL OF CONSIDERATION IN THE	SPECIFIC ACTION
Facilitating recognition and acceptance of the informal sector	0.36	0	0.38	Promoting legal recognition	0	0	n. a	The process of issuing documents promoting legal recognition is unknown
		0.5		Light regulations	0.5	1	K	There is facilitation of formation of cooperatives
						0	n. a	Waste picking is not recognised legally as a profession
		0		Facilitating recognition and acceptance	0	0	n. a	No information on whether the issuing of identity cards and uniforms is taking place
		1		Engaging the public in the intervention	1	1	K	Awareness raising campaigns are carried out by PETCO and other stakeholders & the public is involved in the promotion of source separation
Work towards children, education, and gender equality and inclusivity		0		Facilitating child education	0	0	n. a	

	0	Promoting gender equality	0.5	0.5	C	Gender is considered in PETCO reports though it is not clear how it is currently being done
Occupational health and safety	1	Ensuring health and safety standards at work	0.67	1	K	There is provision of protective equipment in some cases
				1	K	Access to healthcare could not be verified
				0	n. a	It is not evident if hazardous waste is sorted separately. This is more relevant for WEEE
	2.5		2.67			

Enabling actions-organisation and empowerment

This interface deals mostly with role of organisations in facilitating improvement of the informal sector. These organisations include NGOs, governmental organisations, and private organisations (PETCO). Interventions in this interface include, organisation of the informal sector, financial viability and capacity building (Velis et al., 2012).

The common type of support given includes: equipment (trucks, baling machine, compacter), funding, training and skills, infrastructure (building, fencing, leases), access to waste, recyclates and markets, registration and establishment of cooperatives, mentorship, support with business plans and feasibility studies. There is limited funding as there have been previous experiences of people taking advantage of funding which has made potential sponsors wary (Godfrey et al., 2015).

Organisation of the informal sector

In 2015, PETCO identified and facilitated the formation of cooperatives. It also promoted the establishment and development of waste recycling projects for 17 projects (PETCO, 2016). Besides local authorities, PETCO has collaborated with several partners such as Plastics SA, schools and NGOs to establish about 700 recovery stations (PETCO, 2016).

NGOs such as WIEGO have also participated actively in the organisation of the informal sector. This led to the establishment of South African Waste Pickers Association (SAWPA) in 2009 that operates at a national level based on a cooperative model (Farber, n.d.). SAWPA is also part of the Global Alliance for waste pickers that has networks in Africa, Latin America and Asia which tries to strengthen waste picker associations and improve the visibility of waste pickers (Global Alliance of Waste Pickers, 2011).

Financial viability

This refers to the informal sector's access to capital and the support given to it to reduce vulnerability to market changes in material prices. In addition, it also refers to the dependence of the sector on market incentives rather than government support and NGO assistance (Velis et al., 2012). The money is not paid directly to the informal sector but to recyclers. PETCO offers its recyclers subsidies based on market developments to buffer them against fluctuations in material prices (PETCO, 2016).

Capacity building and development

This refers to training and literacy courses that help the informal sector to run businesses efficiently and to understand buyer requirements (Velis et al., 2012).

In 2015, PETCO undertook 27 workshops in which 2059 collectors and municipality employees participated. The trainings included business management training, skills in waste identification, sorting and transportation. It also offered training to strengthen the collection capacities of more than 20 cooperatives and additionally connected other cooperatives to a buyer (PETCO, 2016).

To maintain accountability and efficiency records of workforce, tonnes collected and costs are important (Velis et al., 2012). In PETCO's annual report there are figure for collection results, the expenses and incomes generated. The recycling companies associated with PETCO also seem to have adequate documentation for their performance and other figures. For instance, the number of people in their workforce as in the examples cited in the social interface section on gender inclusivity.

Local governments have also played an important role in promoting the establishment of cooperatives by facilitating registration through other South African development agencies or organisations (Godfrey et al., 2015).

Barriers

Poor market access affects the saleability of recyclables. Lack of buyers undermines the financial viability of a cooperative. Lack of reliable transport may also limit direct access to markets making cooperatives vulnerable to unreliable and exploitative markets. In addition, there are limited opportunities for sharing knowledge about technologies, operational successes and for getting exposed to networks that could open up access to wider markets (Godfrey et al., 2015).

Most of the members, as mentioned before, lack formal education and skills to run a viable waste business. There is therefore need to train, mentor and create awareness for the cooperative members and employees. Training produces positive results because it has been noted to increase the quality and quantity of recyclables from cooperatives compared to other businesses (Godfrey et al., 2015).

Administrative challenges are common especially where systems are overwhelmed by high numbers of people which increase administrative burdens. Registration of cooperatives is difficult due to challenges in filling out forms. There is also a lot of bureaucracy involved when dealing with local government and public institutions (Godfrey et al., 2015) .

Reasons for failure are challenges created when different people without prior association are made to work together. Cooperatives work best in situations where members have prior knowledge of each other for example family members, friends, etc. Some work harder than others yet they receive the same payment as those who do not work as hard. Some members such as managers believe they are entitled to more money despite doing less. This creates tension leading to some members going back to individual waste picking (Godfrey et al., 2015; Muller, 2016).

A top down approach where directives are given from government and other organisations instead of responding to the needs of members has also contributed to failure of cooperatives. It has resulted in opportunistic registration by corrupt individuals to access funding and exploit cooperative members. Further, high turnover of staff at local government creates interruptions for cooperatives every time there is a new staff member (Godfrey et al., 2015).

Awareness of available funding and grants is needed as start-up finances and working capital is not easy to obtain for cooperatives. With limited financial knowledge, managing the available finances also proves to be a problem. Due to limited access to banking facilities, cooperatives handle cash which is susceptible to theft. In addition, the profit margins from the cooperatives' activities are minimal threatening the financial viability of the cooperatives (Godfrey et al., 2015).

There is also a trend of people with knowledge of the process taking advantage to obtain finances from the cooperative for other purposes. Giving financial support is also believed to create dependency and is thus not considered a sustainable solution (Godfrey et al., 2015).

Table 5-6: Summary of organisational aspects

GROUP OF INTERVENTIONS	OVERALL IMPLEMENTATION SCORE	AVERAGE IMPLEMENTATION SCORE	OVERALL SCORE FOR INTERFACE	INTERVENTION POINT	AVERAGE SCORE PER INTERVENTION POINT	RESULTING MARK PER SPECIFIC ACTION	LEVEL OF CONSIDERATION IN THE INTERVENTION	SPECIFIC ACTION
Organisation of the informal sector	1	1	1	Organisation of waste pickers	1	1	K	There has been the promotion of organisation of the informal sector into waste cooperatives and SMMEs
		1		NGO participation	1	1	K	WIEGO helped to establish SAWPA

	1	Promote networks at national level	1	1	K	SAWPA operates at a national level and is also part of the Global Alliance of Waste Pickers
Financial viability	1	Financial sustainability	1	1	K	There is some access to capital
				1	K	PETCO buffers recyclers against market shifts in PET prices
				1	K	PET recycling is market driven
Capacity building	1	Capacity building and development	1	1	K	It is done by NGOs, educational institutes, government agencies, etc.
	1	Data collection and documentation	1	1	K	Training on skills such as record keeping, costs and earnings is being carried out
	6		6			

Acceptability

Acceptability as defined in chapter 2.6 refers to the extent to which individuals and organisations accept a policy instrument. New regulations such as the IndWMP requirements (currently recalled) that are supposed to incorporate the informal sector into formal waste management may fail if the program is not managed well. Interventions usually fail because they are not handled as a dynamic processes made up of different actors and processes that generate multiple feedbacks (Besiou et al., 2012). The main actors considered in this section are the waste pickers, municipalities and producers. This section assesses the concern by the different actors regarding the informal sector integration process.

Waste pickers

According to a report by the (Department of Environmental Affairs, 2016c), waste pickers, recycling companies, researchers, NGOs and municipalities had a general agreement that waste picking has a positive contribution to the recycling economy. However, this varies depending on the product and the impact informal collection and recycling activities have on the environment. For example, from literature informal sector in WEEE is perceived negatively than in packaging. In South Africa, especially for PET, informal waste picking is seen as a positive contributor to the achievement of high collection and recycling rates. About 80-90% of packaging waste collected by weight according to Godfrey et al. (2016) is attributed to the informal sector. For PET in South Africa, the need to maintain jobs is more important necessitating a gradual transition from the informal to formal waste management.

It has been noted that many waste pickers do not want to be formalised since they detest rules or structure (Godfrey et al., 2015). This is supported by most of the interviewees and by Zhang & Wen (2014) who mention that the informal sector likes working independently. They also mention that any collaboration requires time and pressure. There is usually minimal participation when trying to make agreements with the informal sector since lengthy meetings results in loss of income for waste pickers (Godfrey et al., 2016a). However, a report on waste picking by the DEA (2016) contradicts this observation. It states that the informal sector would indeed like to be formalised. Discussions with the interviewees on this information revealed that perhaps the manner in which questions for the waste picker survey were framed may be the reason for this contradiction. For instance, asking if waste pickers would like to have access to health may generate results that support formalisation. On the other hand, asking questions to the informal sector about payment of taxes and being part of an organisation may yield different results. It seems that questions should be well framed and a complete picture given to the respondents on what formalisation entails. This would help distinguish between expectations and opinions of waste pickers.

In the two approaches for integrating the informal sector, formalisation through SMMEs and cooperatives is more popular at 44% compared to formalisation through employing waste pickers in private companies at 33% (Godfrey et al., 2016a).

Municipalities

As per the analysis of cooperatives it is clear that when it comes to the solid waste management interface, the municipality has a great role to play. This is because responsibility for waste management, especially for domestic waste, is handled by the municipality. Conventionally, the municipality is supposed to facilitate source separation, provision of waste infrastructure, registration and monitoring of cooperatives and education and training. One limiting factor for municipalities to bear the costs for source separation is lack of incentives. Though municipalities may set up facilities and measures for source separation, they are confined to waste collection and disposal activities while the benefits for recycling go to the private sector (DST, 2014b). Besides lack of financial capacity, lack of incentives could be the other reason why there have been several recommendations in documents reviewed by the author that the responsibility for setting up a national source separation should be delegated to producers.

Lack of financial resources makes it difficult for municipalities to also take on responsibility for the informal sector. Assigning a role for the informal sector within formal waste management is hard because of bureaucratic procedures and procurement requirements that prevent the informal sector from participating. According to a workshop report by Godfrey et al. (2016), municipality actors are of the opinion that involving the informal sector may create expectation of formal employment and there is also no certainty about service delivery by the informal

sector. It is also believed that integration of the informal sector may end up condoning informal activities leading to further growth of the sector. One of the respondents interviewed mentioned that integration may result in waste pickers becoming unionised, which may interfere with service delivery if they go on strike. Workers' unions promote the welfare of workers that reflects some aspects of the social interface of the InteRA tool. However, doubts about service delivery in general and occurrences such as strikes arising from unionisation may further slow efforts aimed at integration.

Producers

From the literature reviewed on South Africa and the interviews carried out, there is a lot of expectation that producers should take over the operational and financial responsibility for waste management activities. Compared to a typical EPR schemes in developed countries, producers in countries like South Africa have an additional burden of not only establishing solid waste infrastructure, which is mostly underdeveloped or absent, but also finding out ways to integrate the informal sector. There is already a perception from the producers' side that the plastic sector, for example, is overregulated (DST, 2014b).

In one of the interviews, there was a discussion on the impact that mandatory requirements may have on job creation which is a major goal of the solid waste policy in South Africa. Industries have been known to relocate to countries with cheap labour costs and lenient environmental regulations among other reasons. It is not clear whether companies in the packaging sector that have closed operations in South Africa have done so due to economic conditions or other factors. It may however not be too farfetched to assume that new stringent regulation may have or will result in relocation or re-organisation of some industries that may result in some job losses. Despite this possibility, from discussions with some of the interviewees, the introduction of stricter environmental regulations is not expected to have a dramatic effect on the paper and packaging sector. Research shows that many times the concerns of producers of job losses or increased costs may not take be as dramatic as anticipated (Panate, 2016).

Though mandatory regulations usually elicit a backlash from industry, it is not clear how the paper and packaging industry will react to the new requirements of the IndWMP. Based on the example of the tyre industry that has so far successfully implemented mandatory IndWMP requirements, perhaps little resistance may be experienced in this case. However, the fact that it has been recalled almost a month since its release points to the fact that the mode of implementation may not have been acceptable to actors in the sectors involved.

According to a position paper by PETCO on implementation of deposit refund systems for PET bottles in South Africa (2015), producers are generally against the establishment of deposit refund systems. This is because it is costly to initiate when compared to the current system that heavily relies on the informal sector for collection and recycling. Also according to the paper, there is a claim that there is no evidence that such a system would increase recycling rates. In addition, there is a view that such a scheme would reduce income opportunities for the informal sector. This is similar to China where recyclers of PET are opposed to auto reverse vending machines and prefer to keep the informal-formal recycling methods as they fear losing their livelihoods (Zhang & Wen, 2014). Other issues mentioned include vandalism and misuse of machines for example when sand is put in bottles so as to increase their actual weight and the amount of deposit paid back.

From the interviews conducted, producers in South Africa prefer voluntary initiatives driven and financed by industry as opposed to regulation. This is because regulation is considered both costly and not nearly as effective as voluntary initiatives in promoting recycling. This is also

supported by literature review where the need to create a formal oversight role to ensure compliance may make costs of mandatory programmes quite high (OECD, 2001). Voluntary approaches are also more flexible in the adaptation of markets of collection and recycling systems (Lindhqvist, 2000). Another example is in Thailand where producers opposed a measure to implement a national buy-back scheme for WEEE because they thought that such a model might discourage producers and could be inefficient (Manomaivibool et al., 2008).

5.3 Reflections on this Research

General reflections

Though the thesis is about South Africa, examples and descriptions from other parts of the world have been used throughout the thesis. This is done to strengthen some arguments made through comparison with other countries. The author recognises that this may at times create confusion but it should be noted that the main case study is South Africa. The focus is on EPR policy as a whole which is then applied to the case study of post-consumer PET waste management.

Prior to the IndWMP guideline, there was no standard definition in the South African waste legislation of who a producer is. Therefore, when looking at several material organisations, the actors constituting the ‘producer’ group kept varying. It was also difficult to decide what constitutes EPR policy in South Africa because EPR is merely mentioned in several legislations without any elaboration. Based on the definition of policy by Vedung (2009), the author settled on EPR policy as all actions or guidelines by the government that affect EPR implementation. Policies affecting the informal sector were also included due to the role it plays in ensuring PROs meet collection and recycling targets.

Distinguishing whether PETCO is under a voluntary or mandatory EPR programme was difficult. This is because though interviewees from PETCO emphasised that their scheme is voluntary, the threat of the DEA imposing mandatory EPR if targets are not achieved makes PETCO, in the author’s opinion, semi-voluntary.

It has also been extremely challenging to merge knowledge about EPR with informal sector issues. In literature the two are handled as distinct subjects. Though literature on EPR mentions the informal sector, it is mostly in a negative way for example as found in literature on WEEE. For packaging on the other hand, the perception towards the informal sector is more positive due to its contribution to high collection and recycling rates in countries where solid waste services are unreliable.

One assumption made at the beginning of the research was that PETCO is working directly with informal waste pickers. Though waste pickers provide most of the collection, they sell the materials to recyclers with whom PETCO has contracts. Thus it does not deal with informal waste pickers directly. It therefore seems that for EPR to be effective in scenarios where the informal sector caters for most of the waste collection, there is no option but for the informal sector to formalise. This realisation informed the decision of the author to focus on cooperatives instead of individual informal waste pickers or SMMEs. Also information on cooperatives in South Africa was readily available.

Reflections on methodology

In the opinion of the author, the questions asked were relevant given the timing of the transition towards a more legislated EPR by the paper and packaging sector in South Africa. Most research on EPR does not tackle the issue of the informal sector extensively. The issue of informal sector inclusion is particularly and relevant for EPR in a non-OECD context. Despite being a single case study and being context specific to South Africa, the research can still apply to other non-OECD countries that wish to learn from South Africa.

The use of an analytical framework made up of several tools and methods of evaluation made the evaluation of PETCO simple. It also enabled the author to generate reliable results and avoid bias. The use of the EPR evaluation model helped to structure and analyse EPR policy of South Africa by providing credible dimensions and criteria for evaluation. These tools and models assisted in analysing whether PETCO had attained the goals of EPR and to highlight areas for improvement in both EPR policy and the integration of the informal sector.

The use of various tools and methods also makes comparison with another country or product material easy especially the EPR evaluation tool that also had cases that could be compared with the case study. However, the values generated from the evaluation are subjective. They are dependent on the author's knowledge, opinions and availability of information. For instance, the author has been changing the results whenever new information is availed. Therefore, for more reliable results the tools are best used when there is consistent and timely supply of information.

One challenge experienced with using goal attainment evaluation was that it was difficult to use the tool given that the EPR scheme being evaluated is voluntary and there is no distinct legal document outlining how it should be implemented. This made it particularly difficult to follow the structure of the model especially where information was missing. Another challenge was that the research was carried out prior to the release of the IndWMP requirements for the paper and packaging sector. The requirements clearly show the interaction of EPR and informal sector interventions. The guidelines were released and then later recalled pending further consultation with relevant industries. However, the IndWMP requirements are still considered in the thesis to illustrate what could have been or what could still be depending on the outcome of consultations.

Given the vital role the informal sector plays in waste management in South Africa, it has been difficult to separate issues of the informal sector or EPR in the analysis and even in policy. There are several overlaps which might create confusion to readers of the thesis. The *InteRA* tool especially makes the distinction of EPR and the informal sector issues difficult during analysis because it covers all aspects of solid waste management including EPR. The *InteRA* tool as used by Velis et al. (2012) does not show how levels of priority for different interfaces were derived. It is not clear whether it was derived from consensus of the authors, or through opinions of different stakeholders or through use of other methods of data analysis. For this reason, the author modified the tool and opted for a simpler method of assessing whether an action has been implemented, considered in policy documents, ignored or if there is no information available. Another weakness of the *InteRA* tool is that it does not measure the sustainability or long term viability of interventions. It only allows for comparison between cases (Velis et al., 2012). In this analysis, it only indicates what is being done or considered. It does not indicate whether the interventions are effective. For this reason, a further evaluation of barriers to implementation of informal sector interventions has been carried out.

Though public officials were not interviewed, the impact of the absence of those interviews is minimal. There were sufficient and reliable government documents that sufficed for the thesis. It would however have been good to corroborate findings from these documents and interviews conducted with observations and interviews with public officials to produce more robust results. Literature review in this thesis has been used as a contribution to fill the gap in literature on EPR and the informal sector. It has been done extensively and the strength of literature review has been used to make up for the lack of direct observations.

Given the complexity of EPR in a non-OECD context especially with regards to the informal sector, the author felt that the research should remain descriptive and evaluative without any attempt to prescribe solutions. Another reason is that since the IndWMP was introduced then withdrawn. There is a lot of uncertainty and hence it is difficult to predict the reaction of different actors in the paper and packaging sector.

Reflections on findings

The main difference between established EPR theory and EPR policy in South Africa is that there is great emphasis on the integration of the informal sector and job creation in South Africa's waste policy that is absent in EPR theory. The ideal scenario of having no informal sector as outlined by Besiou et al. (2012) is not ideal for South Africa because the informal sector is big and waste picking is a source of jobs for many people in South Africa.

PETCO collects and recycles post-consumer PET packaging regardless of whether it is from an individual producer that has paid levies or not. The data collected and used in the analysis of this thesis also captures information mainly from established producers who are members of Packaging South Africa (SA). This raises questions about small scale producers and producers of unbranded products that could create free rider problems for PROs such as PETCO. Most of these small scale producers and producers of unbranded products are not able to initiate product design improvements. Perhaps with government support and imposition of mandatory requirements that had been outlined in the withdrawn requirements of the IndWMP, the playing field may even out for these producers and eliminate free riding for PETCO (Lindhqvist, 2000).

Though there is a positive development in South Africa of increasing rates of collection and recycling, the consumption of PET bottles is however not reducing as shown in table 4-2. The local market for PET consumption excluding imports is expected to grow annually by 6.6% (PETCO, 2015). Despite increasing sales being positive for producers and generating revenue in taxes and even levies for implementing EPR, the trend is still detrimental to the environment if there is increasing number of PET bottles still being discarded. Since 100% collection and recycling rates are not yet feasible, there is need for more environmental friendly alternatives or modifications for PET.

With regards to cooperatives, similar barriers cut across all the interfaces of informal sector intervention. For example, problems of transport, infrastructure, access to waste, markets and capital. All these barriers seem to require the need for active involvement of various organisations and actors, especially municipalities and government agencies, to facilitate the integration process and to provide an enabling environment for cooperatives and SMMEs to thrive. This is all encompassing role of organisations is reflected in the InteRA tool where organisational aspects cut across all the other interfaces.

6 Conclusions

From the analysis, the best scenario for South Africa with regards to EPR and the informal sector is a symbiotic relationship between the formal waste collectors and recyclers, and the informal sector. This is so as to limit competition between the formal sector (PROs, cooperatives and SMMEs) and the informal sector for access to waste. Given the big problem of unemployment in South Africa, this scenario could also minimise the potential negative impact on jobs and welfare of the informal sector. In addition, there is need for more long term support for informal waste pickers who have managed to become organised into cooperatives. This is to enable the newly formed cooperatives to overcome barriers of lack of infrastructure and business skills, limited access to waste and capital, and poor access to markets.

The good performance of PETCO in the absence of adequate solid waste management infrastructure is attributed to the informal sector which enables achievement of good results at a minimal cost. This provides evidence that the informal sector is important in filling the gap left by municipal authorities and the formal sector in solid waste management in middle and low income countries. Therefore, measures should be taken to prevent the exploitation of the sector and to improve their working conditions and general welfare. This can be done through a gradual transition into formal waste management preferably through legal means.

From the analysis of EPR policy and informal sector integration, South Africa covers most of the key elements needed to successfully implement EPR and informal sector integration. The exception is the social interface that could be attributed to lack of information by the author. The general conclusion on EPR policy for South Africa is that though it is still under development it manages to achieve, to some extent, the goals set out in EPR theory. In some instances, such as in PETCO's collection and recycling efforts, it goes beyond compliance levels. Besides just financing collection and recycling of post-consumer PET, it goes further to influence product and system design through its design for recycling guidelines. This is despite the absence of direct financial incentives for above compliance performance. The main task is to find ways of effectively dealing with barriers, such as those experienced by cooperatives, that affect initiatives geared towards ISWM and job creation.

For PROs, municipalities and other organisations along the plastic waste value chain, the thesis highlights opportunities for improvement. For example, there is need for producer organisations to provide more incentives to the formal sector so as to draw informal pickers into formal waste management. Municipalities should also work towards providing a more enabling environment for informal sector integration to take place and for EPR to thrive. This can be done by firstly recognising and accepting their role in solid waste management and providing opportunities for them to participate in formal solid waste management activities. From the analysis, there seems to be an urgent need for all actors to collaborate in improving the solid waste management interface. Though legislation is in place or still under development, more effort needs to be focused on implementation of this interface to enable faster integration of the informal sector and to enhance performance of EPR schemes. For the social interface, there is a need to collaborate with actors from other sectors such as gender, labour, education and human rights so that all intervention points can be achieved.

For policy makers, drawing a lesson from the withdrawal of the IndWMP requirements, there is need to carry out comprehensive consultation before issuing policy. This is so as to avoid opposition and to accurately determine whether the actors for whom the policy action is targeted are able to implement the policy. The reason for this is that for some interventions, the various actors meant to implement the policy may need adequate time to build up capacity to comply with policy requirements.

For academia, this thesis provides groundwork for the carrying out of more evaluations of the performance of EPR schemes established in settings with an active informal sector. This could also be done for other materials such as glass, aluminium and paper. It also provides an opportunity for the creation of better evaluation tools. Improvement of existing tools such as the ones used in this thesis could be done based on weaknesses that have been exposed during the evaluation.

Suggestions for further research

A suggestion for further research for EPR, is looking at innovative approaches for making deposit refund schemes feasible in the context of low and middle income contexts. It has been noted from the “*PETCO position paper on deposit refund for PET bottles in South Africa*” by (PETCO, 2015b), that PET producers in South Africa are generally against the implementation of deposit refund systems for PET bottles. Several reasons have been given for this stand such as, potential job losses for the informal sector and high costs of implementation (mentioned in Chapter 5 under the criteria of acceptability). To some extent, the author agrees with this especially if implementation of a deposit refund system is done using similar approaches as those used in developed countries.

However, the author feels that these arguments are based on traditional approaches for implementing deposit refund schemes where bottles are returned to where they were bought from or on models for developed countries which would be ineffective in low and middle income countries. From the author’s perspective, the reasons given for not implementing deposit refund systems for PET provide interesting problem areas for which research could potentially provide alternative viable and innovative solutions for deposit refund schemes for PET bottles in middle and low income countries.

Due to the high failure rate of waste cooperatives in South Africa (Godfrey et al., 2015), another area of research could be the evaluation of the potential of SMMEs to drive informal sector integration and to support EPR programmes.

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Appendix

Appendix 1: EPR Evaluation tool adapted from Lindqvist and Rossem (2005), p.4 & 5.

Grade 0 indicates a very low degree of EPR implementation with 3 indicating very high level of implementation

Main goals	Sub goals	Set of criteria for determining the scores for each question	Score (0-3)	Aggregate score
System and product design improvements	Will the individual producer benefit directly from product design improvements?	There are no direct financial benefits from the EPR system for individual producers if the product is re-designed. Acknowledged benefits will be shared by all producers irrespective of their individual efforts. (0)		
		A smaller proportion of the savings will benefit the producer. (1)		
		Most of the savings will benefit the producer. However, all design improvements will not be covered because some costs are covered by a collective system. (2)		
		The individual producer will benefit financially from design improvements, at the time of payment or after the end-of-life treatment of the discarded product has been considered. (3)		
	Will the individual producer benefit directly from system design improvements?	There are no direct financial benefits from the EPR system for individual producers product system improvement is initiated. Acknowledged benefits will be shared by all producers irrespective of their individual efforts. (0)		
		A smaller proportion of the savings benefit the producer that developed the system improvements. (1)		
		Some of the savings will be benefit the producer. (2)		
		The individual producer will realise full financial benefits implemented system improvements (3)		
	Will the producers collectively benefit from product and system design improvements?	Fees paid by the producers will not be influenced by design system or improvements. The fees are not directly linked to real costs. (0)		
		Cost reductions achieved by design or system improvements will not directly influence the costs borne by producers, but will likely reduce long term costs. (1)		
		A substantial part of the cost reductions achieved by design or system improvements will be transferred to the individual producer or the producers as a collective and this will influence costs they incur in the EPR scheme. (2)		
		All costs reductions achieved by design or system improvements will be transferred to the individual producer or producers collectively and will fully influence costs they incur in the EPR scheme. (3)		
High utilisation of product and material quality through effective collection & re-use or/recycling	Does the system include measures to secure goal achievement for collection targets?	No targets are established in explicit or implicit form. (0)		
		Targets are given in quantitative form (% or absolute figure), but there is uncertainty on what happens if they are not achieved, or consequences for failure to achieve targets are less than the costs/efforts required to achieve the targets (1)		
		Targets are given in quantitative form and failure to reach targets may lead to consequences that are less attractive than attaining set targets. (2)		
		Sanctions are imposed for non-achievement of collection targets which are less attractive than efforts necessary to reach targets. (3)		
	Are there tangible incentives in the form of direct or future financial benefits for striving towards higher collection results?	No targets are established in explicit or implicit form, or collection targets are substantially lower than those reached by EPR systems for the same product group in other places. (0)		
		Collection targets are published and achieving collection rates (comparable with high international standards) will help to create a good image for the producers collectively or individually. (1)		
		Achieving collection rates (comparable with high international standards) is important for the producers and achieving higher collection rates will lead to less, or no stress, from in particular environmental movements and authorities, making future legislation a minor concern. (2)		
		Producers have financial benefits from higher collection rates and these benefits can be substantiated and are perceived as important drivers for striving towards higher collection results by producers. (3)		

Appendix 2: InteRA evaluation framework

A	Group of interventions	Intervention points	Specific actions	Examples
Solid Waste Management (SWM)sector Interface	Access to waste	Access to waste	<ul style="list-style-type: none"> • Legal recognition of pickers' rights makes an income from collection and recycling of waste • Controlled access by waste pickers to waste collection points 	
		Role in formal SWM	Inclusion into/integration with formal SWM sector: <ul style="list-style-type: none"> • collection • transport Official role in providing recycling within formal SWM	
	Recognising role of informal sector in SWM	Socio-political context towards informal sector	<ul style="list-style-type: none"> • Policies regarding informal recycling sector (IRS) • Documenting and advertising the benefits of IRS 	
		Promote inclusivity	<ul style="list-style-type: none"> • Involve all stakeholders in SWM planning • Institutionalise inclusivity of informal sector 	
	Protecting public health and environment	Protecting Public health and environment	<ul style="list-style-type: none"> • Controlled street sorting and proper disposal of residues • Promotion of collection and disposal of waste from marginalised areas 	
	Strengthening interfaces	Improving SWM/informal interface	Proper logistics for the transfer of waste from households to the IS then to municipalities or private contractors for secondary transport and final disposal	
		National policies improving formal state/informal interface	National Policies /legislation to promote recycling considering IRS contribution	

			National strategies for the inclusion of the IRS within SWM	
B				
Materials and Value chain interface	Improving quality of materials for recycling at their source	Improving quality of the source materials /reducing cross contamination	Source segregation	
			Contracts with waste generators	
	Adding value to the secondary raw materials/products sold	Increasing quantity available for sale	Use of larger bags and containers by IRS Use of wheeled containers by IRS	
			Make storage space available	
			Expanding the range of materials recycled	
		Reprocessing	Segregating collected materials into distinct categories	
			Washing and removing contraries and contaminants	
			Densification to reduce transport costs and increase density	
			Processing to intermediate products	
			Manufacturing final products	
	Improving linkages along the value chain	Improving linkages along the value chain	Strengthening relation between IRS and recycling industries	
			Contracts with specific middlemen/ recycling industry	
			Bypassing middlemen	

			Organising middlemen	
C				
Social aspects and interfaces with society	Facilitating recognition and acceptance of the informal sector	Promoting legal recognition	Issuing of birth certificates and other legal documents	
			Rights and duties: right to vote, land property rights, duty to pay taxes etc.	
			Recognising waste pickers as a profession	
		Facilitating recognition and acceptance	Issuing identity cards	
		Engaging the public in the intervention	Provision of uniforms through awareness raising campaigns and promoting source separation	
	Work towards children, education, and gender equality and inclusivity	Facilitating child education	Work to eliminate child labour	
			Incentives to attend school	
			Providing schools for waste pickers' children	
		Promoting gender equality	Involve women in planning and delivering specific interventions aimed at women	
			Loans accessible to women	
	Occupational health and safety	Ensuring health and safety standards at work	Safety equipment	
			Access to health care	
			Ensure hazardous waste sorted separately	

O				
Enabling actions-organisation and empowerment	Organisation of the informal sector	Organisation of waste pickers	Encourage organisation into groups e.g. co-operatives	
		NGO participation	NGO participation helping the IRS to organise and help themselves	
		Promote networks at national level	Organising national forums and meetings	

Source: Adapted from (Velis et al., 2012)

Appendix 3: List of Interviewees

Name	Position and organisation	Method of interview	Date of phone interview
a) Cheri Scholtz	CEO, PETCO	Phone call	09/03/2016
b) Dr. Casper Durandt	Chairman Board of Directors, PETCO	Skype call	10/03/2016
c) Prof. Linda Godfrey	Principal Scientist, Waste for development- CSIR	Skype call	25/04/2016
		Skype call	13/07/2016
d) Laura Fostinone	Waste management researcher- Brazil	Personal interview	18/05/2016
e) Charles Muller	Executive Director- Packaging South Africa	Skype call	05/07 2016
f) Panate Manomaivibool (Phd)	Lecturer - Natural Resources and Environmental Management Research and Training Center (NREMC)	Skype call	22/07/2016

Interview guides

EPR Evaluation questionnaire 1

Targets

1. What are the current quantitative targets and specified duration for achievement of;

- a) Collection
 - b) Recycling/re-use
2. To what extent has PETCO managed to achieve these targets currently?
- 3.
- a) Are there any penalties imposed for not achieving the set targets for collection and recycling/re-use? Please describe the penalties, if any.
 - b) Would the penalties be considered severe enough to deter non-compliance with the targets?
4. How effective is the household level collection of PET currently?

Measurement of results

1. Is there an established system for measuring and verifying results for re-use and recycling?
2. How transparent (if stated figures are traceable) and accurate are the results?

Others

1. What is the role of the informal sector in PET collection/recycling?
2. What is the current status of bottle to bottle recycling and the general use of rPET in South Africa?
3. What are the PET recovery centres for? Is there any energy recovery taking place?
4. What are some of the challenges that PETCO faces in achieving its targets?
5. What are some of the drivers of PETCO's success?

EPR Evaluation Questionnaire 2

Incentives/Disincentives

Collection

1. Is there any publishing of the achievement of collection targets and if so, does this in any way contribute to the creation of a good image for the producers collectively or individually?
2.
 - a) Are there any measurable financial benefits to producers from higher collection rates?
 - b) Are these benefits substantial enough to act as major drivers for higher collection results by producers?
3.
 - a) Has there been any pressure from Government (legislation) or environmental movements for producers to increase collection? (Please explain)

- b) Has the achievement of higher collection targets reduced these pressures, if any?

Recycling/re-use

1. Are there any incentives (intangible and financial) for above compliance target level of recycling/re-use?
2. Are there any substantial economic benefits of incentives for striving upwards in the waste hierarchy?
3.
 - a) Are there any penalties imposed for not achieving the set targets for collection and recycling/re-use? Please describe the penalties, if any.
 - b) Would the penalties be considered severe enough to deter non-compliance with the targets?

Product and system design

4. To what extent will producers financially benefit (individually or collectively) from product design improvements for example, as outlined in the Design for Recycling guidelines. Please pick one and explain why.
 - a) No direct financial benefit
 - b) Partly
 - c) Fully
5. To what extent will the investments made to improve system design (collection, sorting, recycling) in category A and category B projects of PETCO, reduce the individual or collective costs borne by producers? Please pick one and explain why.
 - a) no influence on cost
 - b) some influence on costs
 - c) complete influence on costs

Others

1. Are there any free-rider problems experienced by PETCO, and how have these problems been addressed?
2. Besides the above mentioned, what are other major drivers and barriers for producers in the management of PET waste?

Interview guide 3

1. What is the current situation of integration of the informal sector into EPR?
2. What is the condition of solid waste management infrastructure?
3. What is the attitude of the informal sector towards formalisation?
4. Is separation at source taking place in South Africa or is waste still being sent to the landfill?
5. Is source separation expensive in your opinion?
6. Are deposit refund systems feasible in South Africa?

7. Has South Africa been successful enough for other countries to be able to emulate it in waste management?
8. Has there been a mapping out of South Africa's process of establishing EPR?

Interview guide 4

1. National programme

- a) How would a national programme that puts the responsibility of collection on producers work in a context with a large informal sector?
- b) Does it mean that such a programme would be a mandatory EPR scheme with requirements to involve the informal sector, or can it also be voluntary?
- c) Does it mean there would be a separate legislation that outlines the process of formalization that producers should adhere to?

2. Performance of EPR

- a) How would formalization of the informal sector through EPR affect the performance of EPR schemes?
- b) If producers send their waste directly to formal sectors, how would that affect the informal sector? How can this be done in an acceptable way to all actors involved in the waste management value chain?

3. Producer responsibility

- a) How willing would producers be to take not only physical and financial responsibility of their products, but also take part in the formalization of the informal sector?
- b) Is there a probability that too much obligations may make producers relocate creating even problems such as job losses?

4. Authorities

What role can authorities such as municipalities play in facilitating formalisation of the informal sector through EPR?

5. Co-operatives

Waste co-operatives are one of the means of organizing the informal sector. However, in some cases such as South Africa, there is a failure rate of about 90%. Despite this, producers are obliged to support them to meet Government requirements. Are there other means for producers to meet Government requirements on the informal sector effectively?

6. Drivers and Barriers

What are the possible drivers or barriers to using EPR as a driver for formalization?