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Reverse logistics and informal valorisation at the Base of the Pyramid: A case study on sustainability synergies and trade-offs

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ABSTRACT

Despite a growing body of research on business with and for the Base of the Pyramid (BoP), ecological aspects of such businesses have not been considered adequately in the literature. We take a holistic view on the social and environmental consequences of a specific case of a BoP business. Water sold in plastic sachets in Africa is a typical BoP product with potentially negative ecological impact caused by littering. Reverse logistics activities could mitigate these consequences. At the same time, such activities provide opportunities for poor people to make a living from collecting waste. This in-depth single case study sheds light on the opportunities and disadvantages of informal valorisation in reverse logistics activities from both social and environmental perspectives. The case offers insights into the potential and actual trade-offs in BoP activities in different pillars of sustainability, which are otherwise rarely discussed in academic literature.

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1. Introduction

Recent research on the so-called 'Base of the Pyramid' (BoP)—the bottom tier of the world income pyramid and thus those people living in extreme and moderate poverty—claims to see the poor not only as consumers but also as active parts of the value chain, thus potentially advancing social sustainability through development. A holistic understanding of 'BoP 2.0' (Simanis, Hart, & Duke, 2008), or 'integrated BoP' (Hahn, 2009), attempts to integrate the population at the BoP in earlier phases of the supply chain to address issues of economic well-being and social improvements for the poor population. However, apart from a few exceptions (e.g. Gold, Hahn, & Seuring, 2013; Hart, 2011; Kandachar & Halme, 2008), the perspective of the ecological environment has been neglected in most BoP articles until now (Kolk, Rivera-Santos, & Rufin, 2014). Similarly, supply chain issues at the BoP are also rather absent from academic discussions (for recent exceptions, see, e.g. Gold et al., 2013; Hall & Matos, 2010; Sodhi & Tang, 2011).

The present paper aims at filling these voids by, first, exploring the reverse logistics (RL) value chain of portable drinking water distributed in so-called 'water sachets' (i.e. bagged water sold in

small quantities of usually up to 500 ml to provide safe and affordable instant drinking water to the public) before, second, critically scrutinising the various sustainability-related outcomes of such a BoP project. To achieve this, we take a holistic and multi-disciplinary view on the sustainability issues of a typical BoP supply chain; illuminate the ways of actively including the BoP population in the value chain and combine this with ecological aspects by considering RL as informal valorisation activities in detail. Most cases that aim to include the BoP usually focus on production or distribution aspects. The inclusion in this case, however, is in the reduction process of the product following the use phase. The concept of informal valorisation (IV), stemming from waste management research (Gunsilius, Chaturvedi, & Scheinberg, 2011; Scheinberg, 2011) emphasises the role of informal waste pickers who extract value from the end-of-life product. Against this background, we aim to explore the inherent complexity of sustainability by providing an in-depth examination of RL as part of the supply chain of a typical BoP product.

In early BoP research, the focus was often multinational enterprises (Kolk et al., 2014). In the present case, however, local industry associations, non-governmental organisations (NGOs) and politicians foster the BoP activities (see also Hahn & Gold, 2014), which helps to reduce the ecological impacts of the respective product by enabling reverse material flows through valorisation incentives for the BoP segment. However, while at first glance the

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valorisation opportunity involves considering the social dimension due to the inclusion of the BoP population, a thorough scrutinisation shows that successful poverty alleviation via this opportunity is not possible for systemic reasons that will be discussed throughout the paper. The case study offers a holistic and critical perspective of sustainability issues in BoP supply chains. We start by exploring the question of how the RL chain of water sachets is organised and then proceed by more specifically illuminating the question of potential sustainability trade-offs of IV at the BoP.

As such, we contribute to the growing BoP research stream by discussing the long-needed ecological perspective while integrating thoughts on social and economic aspects. In doing so, we follow [Kolk et al.'s \(2014\)](#) call for a better understanding of the trade-offs and tensions between the different sustainability dimensions, which again underlines the multidisciplinary approach of this study. Based on an abductive in-depth empirical case study, we provide a rare example of a critical case study in a field that has seen an abundance of best-practice examples which often lacked a critical perspective. From a conceptual perspective, we follow an interdisciplinary approach, introduce the idea of IV (and the broader issue of RL) to the BoP domain and thus advance our understanding of supply chains in developing countries. In this regard, we also provide a fresh lens on BoP ventures by extending the supply chain perspective to the end-of-life phases of specific BoP products.

To achieve these objectives, our paper is structured as follows: In Section 2, we introduce the RL and IV concepts, which serve as our conceptual lenses for analysing the present case study. Then, in Section 3, we describe the method used in our in-depth case study on the supply chains of water sachets in Ghana, especially in terms of data collection and analysis. In Section 4, we provide a detailed picture of the respective supply chain and illustrate our findings with a look at the actors involved before discussing our findings through the conceptual lenses of RL and IV. In Section 5, we illustrate potential influence from IV for BoP businesses. In this section, we also elaborate on the constraints and trade-offs of IV for sustainability at the BoP. Finally, we briefly conclude the paper.

2. Literature review and conceptual background

In the following section, the conceptual elements used for our analysis are derived first from the literature on RL and then from the concept of IV, which therefore widens the theoretical foundation of BoP studies.

2.1. Elements and activities of reverse logistics

RL focuses on the recovery of value from a product after its disposal and is therefore the starting point of a new supply chain ([Guide, Harrison, & Van Wassenhove, 2003](#); [Guide & Van Wassenhove, 2009](#)). It is part of the wider efforts of reducing the (environmental) impact of reused products or waste. The general or ideal sequence of options (e.g. [King, Burgess, Ijomah, & McMahon, 2006](#), p. 258) would be as follows:

1. waste reduction (such as extending product durability);
2. waste re-use (such as remanufacturing products for a second life);
3. waste recovery (such as raw material recycling) and lastly
4. waste landfill (as the last resort).'

With regard to the example discussed in this paper, offering water in plastic bags is a hygienic and comparatively cheap option of supplying water. Waste reduction through not providing such packaged drinking water is not a viable option, as drinking water is a primary need of all human beings and alternative sources are

insufficient. Re-use options of plastic products exist, but require a better upfront quality of the packaging (see, e.g. the analysis of [Ross & Evans, 2003](#)). Hence, waste recovery seems to be the preferred option over contributing to waste landfills. The waste recovery therefore demands that a close-loop supply chain is established, where RL activities form part of the core processes for setting up such a supply chain ([Pagell, Wu, & Murthy, 2007](#); [Pohlen & Theodore Farris, 1992](#)).

RL is characterised by its central activities depicted in [Table 1](#). It is a process of planning, implementing and controlling the efficient and cost-effective flows of product returns management (A), including product acquisition (1) and RL from manufacturing, distribution or the use point to a point of recovery or proper disposal (2). The operational remanufacturing/recovery (B) consists of inspection, sorting and disposition (3) in order to, for example, refurbish, re-use, repair, remanufacture, recycle or dispose (4). A final step of recapturing value is remanufactured product market development (C) and therefore the re-marketing of the remanufactured goods (5).

To summarise, RL includes the idea of a reverse process flow via logistics with the purpose of recapturing value from the point of consumption to the point of origin ([Rogers & Tibben-Lembke, 1999](#)). In a broader understanding, the reverse flows do not necessarily have to end at the (former) point of origin but instead can end at any point of recovery or disposal ([Brito & Dekker, 2004](#)). For the subsequent case study, the RL processes form the backbone of the economic activities and help in structuring and comprehending the reverse flows.

2.2. Characterisation of informal valorisation

In developed countries, waste management is usually a formalised process controlled or even carried out by municipalities. In low-income countries, however, private activity-driven (via informal sector) processes frequently occur ([Ahmed & Ali, 2004](#); [Wilson, Rodic, Scheinberg, Velis, & Alabaster, 2012](#)). In this regard, the term 'informal valorisation' ([Gunsilius et al., 2011](#); [Scheinberg, 2012](#); [Wilson et al., 2012](#)) is derived from the waste management research stream. Valorisation is characterised as '(...) the entire process of extracting, storing, collecting, or processing materials from the waste stream in order to extract and divert value and direct the material to a value-added stream' ([Scheinberg, Wilson, & Rodic-Wiersma, 2010](#), p. 216). According to [Scheinberg \(2012, p. 2\)](#), valorisation encompasses 'all activities commercializing materials found in the waste stream'. Thus, Scheinberg and colleagues conclude that referring to 'recycling and composting' is no longer appropriate due to the extensive commercialisation of valuable waste.

Initially, the mechanism of the concept was addressed and observed in countries like Brazil, where informal and formal waste treatments coexist ([Ahmed & Ali, 2006](#)). Work in the informal sector is small-scale, largely unregulated and unregistered low-technology business without tax payment (see, e.g. [Harriss-White, 2010](#); [Wilson, Velis, & Cheeseman, 2006](#)). The waste pickers who personify IV are part of this informal system because they have no regular income. Their individual income depends on the amount of waste collected. They undergo no regulatory pressures and work with their bare hands. Equipment is a clear difference towards the large-scale state- or company-owned industrialised formal waste management system. IV emphasises the role of waste pickers in a changing environment where there is a push towards a modernisation of the solid waste management system and an attendant formal interest in recycling activities ([Ahmed & Ali, 2004](#); [Scheinberg, Spies, Simpson, & Mol, 2011](#)). Consequently, it is assumed that the pressure on waste pickers

Table 1

Overview of reverse logistics activities (following Guide et al., 2003; Guide & Van Wassenhove, 2009).

Reverse logistics categories	Activities of reverse logistics
(A) Product returns management	(1) Product acquisition (to obtain products from the end-users) (2) Reverse logistic (to move products from point of use to disposition; network for collecting returns)
(B) Remanufacturing operational issues	(3) Testing, sorting and disposition (some returns are unfit for intended process) (4) Refurbishment (re-use, repair, remanufacture, recycle or disposal)
(C) Remanufactured product market development	(5) Re-marketing (of refurbished goods)

increases and that they are marginalised in their livelihoods (Ahmed & Ali, 2004; Scheinberg, Anshütz, & Klunder, 2006). Nevertheless, the concept is also applicable in settings where the formal waste management sector still has a minor role, for example, when there is no collection system established (Wilson et al., 2012). Consequentially, the informal recycling sector forms an essential part of the industrial value chain in developing countries (see the logic in Pagell et al., 2007) and integrates poor people into business activities (Ahmed & Ali, 2004). As such, it is thus at the heart of the BoP approach. In this regard, Gunsilius et al. (2011, p. 12) identified the following main forms of valorisation in the informal recycling sector:

- 'Personal or commercial reuse: Using materials for household maintenance, including as food for persons or animals, or as household, agricultural, or business inputs. Second-hand shops and flea markets are examples of this.
- Reuse with repair: Repairing items and materials and marketing them.
- Recycling: Collecting separately and/or identifying, sorting, processing, storing and trading materials into the global industrial value chain.
- Organics valorization: Collecting separately or sorting and processing kitchen, garden, commercial, agricultural and animal waste and paper, and marketing it as animal feed or compost'.

When disposal is either free or not penalised, any management of waste as a 'resource' relies on the idea that the respective materials still have some sort of resource value (Scheinberg, 2012). Accordingly, Porter (2002) points out that the recycling activities in developing countries are mostly market-driven and for-profit (also Wilson et al., 2012). Furthermore, it is mostly the informal sector, which is associated with poor employment conditions and poverty and which delivers material for the recycling RL (Scheinberg et al., 2011). Consequently, the recycling industries in most developing countries rely on 'value pickers', 'waste pickers', 'scavengers' or 'garbage pickers' who are usually part of the local BoP and who recover value from the waste stream (Ahmed & Ali, 2004; Birkbeck, 1978; Hayami, Dikshit, & Mishra, 2006; Sicular, 1991). Following its collection, the material makes its way from the informal to the formal economy. Private economic activities are driven by revenues from trading recovered materials. The common selection criteria for collecting material are thus its expected value. Therefore, informal recycling is a value chain activity (Scheinberg, 2012; Wilson, Araba, Chinwah, & Cheeseman, 2009; Wilson et al., 2006) or can be interpreted as driving a value or RL (Pagell et al., 2007). It is further suggested that there could be a mutually beneficial cooperation between the formal and informal sector (Ahmed & Ali, 2006). Support for the informal sector could improve efficiency, and with it, recycling rates (Wilson et al., 2009). Another link between the formal and informal sectors, which is in line with the definition of IV, can be seen in the delivering of material by the informal collection system and the payment for the material from the formal sector, which will then process it further (Ahmed & Ali, 2006). The concept of IV is taken up here as a conceptual background informing the subsequent interpretation of empirical material.

3. Method

This paper is based on an in-depth case study of the RL chain for water sachets in the African state of Ghana. The case helps illuminate the following two topics, which have rarely been discussed in BoP literature until now: the ecological environment and RL. The case at hand is a prototypical example of RL and IV as they are found in many other developing country settings (Ahmed & Ali, 2004; Scheinberg et al., 2011). It vividly highlights the necessity of including the population at the BoP into RL for a typical BoP product, which could not otherwise be recycled, as will be illustrated below. Furthermore, the case offers insights into the shortcomings and hindrances of true poverty alleviation. With these characteristics, the case at hand qualifies as a holistic and critical single case study (Siggelkow, 2007; Yin, 2009) which allows for a rich analysis of the given situation.

The empirical fieldwork carried out for data collection in Ghana included observations and semi-structured interviews based on issues identified in the literature review. This includes, for example, questions on the processes, chain characteristics and relationships between stakeholders dealing with water sachets. Eisenhardt and Graebner (2007) proposed using multiple methods or points of data collection to arrive at rich descriptions. Data collection therefore covered almost all stages of the supply chain activities, apart from virgin material producers (which are located outside of Ghana), the water sachet distribution and sellers. Empirical data was collected during a three-month field stay in Ghana (from December 2012 to February 2013). During this time, the first author experienced the daily routine in the case setting, which included accompanying waste buyers on their regular tours while conducting business and own usage and participation in picking. Moreover, she attended NGO workshops, which provided opportunities for reaching out to further partners and obtaining different perspectives. These perspectives also included consumer behaviour and the role of water sachets in daily life. In-depth observations were collected in systematic field notes to establish a complete chain of evidence (Riege, 2003). Furthermore, we used other sources, such as governmental documents, leaflets, online documents, publications from NGOs and the web pages of the companies and initiatives, for data triangulation, thereby ensuring the construct and internal validity of the data collected. In general, a thick description of data during data collection and in the subsequent findings section of this paper contributes to transferability (Lincoln & Guba, 1985).

During the preparation phase of the field study, we identified contact persons through online research. The manager of the Accra Plastic Waste Management Project served as a vital contact, starting a snowballing approach of contacting interviewees. Subsequent contacts included waste buyers, NGOs, water sachet manufacturers, recycling companies, government officials, researchers and several value pickers.¹ Table 2 provides an overview of the broad representation of interview partners from various settings and

¹ The term 'value pickers' was adopted from the predominant NGO jargon expressed in the interviews and is used for individual waste pickers.

Table 2

List of interview partners and their organizations and functions (chronological order).

#	Organization	Position of interviewee
1	Accra Plastic Waste Management Project	Secretary of the board
2	Individual	Waste buyer
3	Buyback centre	Worker
4	Council for Scientific and Industrial Research (CSIR)	Senior researcher
5	Rural water sachet company	Company owner
6	Plastic film manufacturer #1	Company owner
7	Recycling facility and plastic film manufacturer #1	Company owner
8	Kwame Nkrumah University of Science and Technology	Professor for waste management
9	CHF International (now Global Communities), NGO	Senior Environmental Officer
10	Pure Water Waste Collectors Association	Chairman (and value picker)
11	Water sachet producing company	Company owner
12	Water sachet producing company	Product manager
13	Trashy Bags (NGO working on recycling)	Project director
14	Plastic film manufacturer #2	Product manager
15	Plastic film manufacturer #3	Manager
16	Recycling facility and plastic film manufacturer #2	Production manager
17	Recycling facility and plastic film manufacturer #3	Managing director
18	Individual	Value picker
19	Individual	Value picker
20	Individual	Value picker
21	Individual	Value picker
22	Water sachet producing company	Production manager
23	Environmental Protection Agency	Deputy director
24	Ministry of Environment, Science and Technology	National climate change coordinator

stakeholder groups, which enhances the validity of our approach. The broad dissemination of key informants as important sources for in-depth information on the functioning of the entire RL chain for water sachets also helps to enhance reliability. All interviews were conducted face-to-face. The snowball sampling technique was appropriate for our study due to the lack of an alternative database for contact persons along the supply chain. Arranged meetings also contributed to a higher willingness to provide information. Adding to the face validity of the research, we aimed to create a socially desirable environment. Contact persons from one supply chain stage answered questions according to the same interview guidelines, allowing us to reach internal validity among different interviews. The interview data were complemented with extensive field observations.

We transcribed the interviews, digitalised the field notes and collected photos of real-life situations as mnemonic for our analysis. In sum, we recorded our observations as concrete as possible to increase reliability (Riege, 2003). Qualitative data analysis by means of a template analysis (see Saunders, Lewis, & Thornhill, 2012) was used to analyse the transcribed data. This analysis followed an abductive research approach, which is described as a recursive, continuous process leading to a 'form of reasoning through which we perceive the phenomenon as related to other observations' (Timmermans & Tavory, 2012, p. 171). Maanen, Sorensen, and Mitchell (2007) suggest that the data for abductive reasoning 'should be sufficiently detailed, rich, and complex' (p. 1149), which is true in the case of our interviews, observations, field notes etc. Before and after data collection, a literature review generated links to conceptual thinking. We initially applied a rather deductive scheme encompassing general coding categories from the areas of RL (see again Table 1), BoP business strategy (derived from Anderson & Billou, 2007) and sustainability impacts (i.e., social, ecological, and economic impacts; see Elkington, 2002) using MAXQDA 11 as a technical instrument. The coding process then included iterative loops between the conceptual foundations and more open coding, and introducing new codes to refine our concepts (Timmermans & Tavory, 2012). In this process, we identified nodes in passages that we coded in the first phase and then connected them to attributes of other sets of codes as well as to new codes which emerged from the literature (e.g., value-generating

activities in the IV such as storing, collecting, or processing materials; see Scheinberg et al., 2010). Furthermore, some fundamentally new perspectives only surfaces during later stages of the project itself, including data analysis (e.g., trade-offs such as working conditions, health issues, downcycling). We thus constantly shaped the coding through an ongoing analysis, resulting in higher internal validity (Kempster & Parry, 2011). In case of differing judgements, these were assessed and resolved through intensive discussions in the research team to gradually assimilate discrepancies in the coders' mental schemes (Seuring & Gold, 2012). The entire material was carefully checked against the original data. Furthermore, peer debriefing techniques, such as regular internal research seminars, helped to ensure the credibility of our approach (Riege, 2003) which was also discussed with external colleagues during and after the various conference presentations (Gibbert & Ruigrok, 2010).

Based on the described abductive interplay, we were able to close gaps within the identified concepts and arrived at core conceptualisations. This way we identified patterns in an exploratory manner in sustainability synergies and trade-off beyond the initial coding. This moved the analysis to a further level of interpretation, which will be explained in the findings section and related to the literature in the discussion section. This leaves the storyline of the paper closer to the original research and does not change it such that it suffers from the often observed ex-post rationalisation issue, where theoretical arguments are added so that a more deductive approach can be followed.

4. Findings

For a better understanding of the research context, first, a description of the water sachets supply chain in Ghana introduces the case study. Second, we provide a breakdown of activities in the RL chain of the water sachets before finally pointing out sustainability issues in this case study of value in waste picking.

4.1. Description of a water sachet supply chain in Accra, Ghana

Fig. 1 illustrates the entire supply chain of water sachets. The forward supply chain starts with the sourcing of virgin raw

material (from outside Ghana) processed by plastic film manufacturers who act as suppliers for water sachet producers. The ubiquitous water sachets are sold to water sachet sellers (mostly street vendors and shops) who resell them to the end consumer. After consumption, empty packages are often simply dropped on the ground. This leads to plastic menace and eventually waste burning. In some isolated areas of Ghana's capital, Accra, and other locations, a waste collection system exists, but it does not cover all of Accra. However, RL has been established as an alternative solution to the immediate dumping and/or burning of water sachet waste. Value pickers, that is, people who manually pick up waste, gather the litter and sell it either to stationary buyback centres or mobile buyers who drive from house to house. These intermediaries then sell the material to NGO-based or commercial recycling facilities. The commercial recycling industry uses the waste sachets to produce plastic pellets and processes them into, for example, black polythene bags. This prolongs use of the plastic raw material instead of offering full-blown recycling because the pellets are an inferior quality material (downcycling) and thus they eventually also end up being dumped or burned after their secondary use. Alternatively, NGOs like Trashy Bags use the sachets directly to manufacture goods such as bags, purses or wallets sold mainly to tourists. While this puts the waste material to a longer use (compared to the downcycling), this approach can be regarded as raising awareness rather than large-scale recycling because of the low volume of waste being reused. Ideas such as biodegradable plastic, different types of packaging or different recycling, for example towards pellets for energy generation, were addressed by some interviewees from research institutions (Interview #4 and #9) and government (Interview #23 and #24), but at the time of our research none of these ideas were observed on the market.

4.2. Activities and actors in the water sachet supply chain

The next step is to break down and describe the activities that are of interest for our research focus. From the data at hand, a distinct BoP focus became evident in three parts of the described supply chains: water sachet sellers, consumers and value pickers (see Fig. 1). The role of BoP distributors and consumers has already been discussed in the literature (Kolk et al., 2014), so we concentrate on the group of value pickers as enablers of RL. We use the structure of RL processes as outlined above and assign the specific activities in the RL water sachet chain to the five major categories as illustrated in Table 3. We then attach the actors to each activity to illustrate responsibilities.

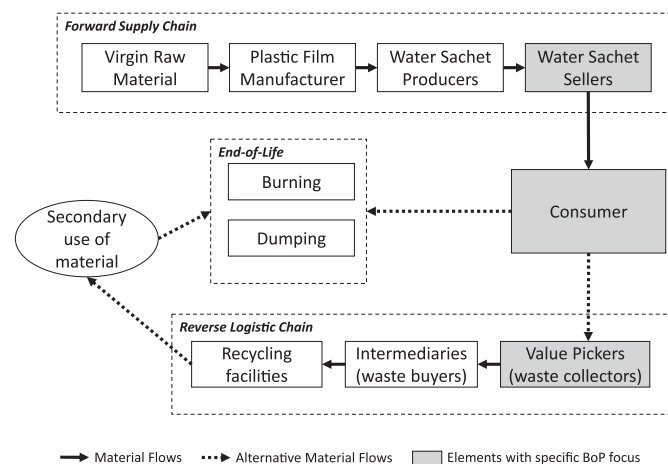


Fig. 1. Illustration of water sachet supply chain.

The entire water sachet supply chain is built upon interdependencies. The water sachet-producing companies, for example, rely on the recycling companies to advocate the possibility of waste minimisation in order to legitimate their product and packaging the eyes of the government: 'The government is not managing all the plastic. Once they ban it, I am losing a lot of money. So we need to come up with workable solutions which actually reduce the impact on the environment. The government is not able to subsidise the recycling companies so we are giving them some of our money. We identified individual recycling companies who are struggling and we see where we can support them' (Water sachet producing company, Interview #11).

Further, the recycling companies depend on the waste buyers, who act as an intermediary between the formal and informal settings (see Table 3). Following the RL activities backwards, the waste buyers depend on the input from the value pickers, who are also situated in informal settings. As pointed out above by the company owner who is producing water sachets and is a representative from the formal environment, it is also his concern to have a working recycling system to keep his business activities going: 'What happens is that now people are collecting but it is not moving fast to the recycling point. There is a pile. So we have to come in there; that is the intervention. We are doing a pilot with the first one' (Interview #11).

In the water sachet case, this system depends on input from the informal environment. As illustrated, the RL activities (#3, 4 and 5 in Table 3) occur in a formal economic setting of registered companies and NGOs who rely heavily on the input from an IV setting, which includes individual value pickers and buyers. The recycling facilities carry out the comparably capital-intensive activities. However, they outsource the labour-intensive manual collection of the input material, which does not require significant investments: 'We have people bringing it. We don't collect waste. People bring it to our factory. We weigh it and then we pay' (Interview #7). The production manager of another company confirmed this common practice: 'We don't go around with cars, but the customers bring it since the price is good' (Recycling facility and plastic film manufacturer, Interview #16). The individual value pickers are not a homogeneous group. We met value pickers with different backgrounds, for example, older people without any other work opportunities, young children who work after school to support their families and other willing workers who most often could not find another job. The work input depends on the area of picking. For example, it is easier to collect in Accra than in rural areas due to the higher population density. Some families begin collecting the waste in their households and sell it after they have accumulated a significant amount; others do some collection in addition to this but not as their main work. However, observations revealed that mere household waste does not provide sufficient income to make a living from value picking.

4.3. Sustainability issues and the value in waste picking

A reoccurring theme in the data was the value associated with waste in the RL chain of water sachets. Interviewees vividly voiced the need to monetarise empty sachets to enable RL flows: 'Main challenge: Do not litter! ... within a short time when people realised we are buying [empty sachets] and then there was value for them, they were no longer throwing them away' (Trashy Bags [NGO working on recycling], Interview #13), or similarly: 'The focus is to manage the sachet water waste. And we are doing this by placing value on the waste, so that people could collect it and send it to recycling companies to make money' (Secretary of the Accra Plastic Waste Management Project, Interview #1).

Apart from the ecological aspects of an improved waste

Table 3
Reverse logistic activities in the water sachet supply chain.

Reverse logistics activities	Specification in the water sachet reverse logistics	Actors environment	
		Informal	Formal
(1) Product acquisition	<ul style="list-style-type: none"> - Street waste picking: Randomly scattered water sachets, littered by the consumer, are picked from the street. - The picking is performed with a metal stick, glove, plastic bag as a glove or barehanded, thus no market barriers. 	Value pickers	
(2) Reverse logistic	<ul style="list-style-type: none"> - Source separation: Water sachets are put in a large transparent rubber bag. - The buyback centres are a stationary collection point as part of a (waste) bring system. Cash is given for the collected thin film plastic material. - Buyers with vehicles pick up the material from buyback centres or from the value picker's house. Cash is given for the collected thin film plastic material. Vehicles are rented or bought with, e.g., a credit from an association (Accra Plastic Waste Management Project). - The buyers transport the collected plastic material to a recycling company, which pays for the supply of plastic waste. 	<ul style="list-style-type: none"> Value pickers, households Buyback centres Buyers Buyers 	
(3) Testing, sorting, disposition	<ul style="list-style-type: none"> - Recycling companies pay depending on the quantity and quality of the delivered materials. 		Recycling companies
(4) Refurbishment: recycle	<ul style="list-style-type: none"> - Recycling companies process the waste. The processing machines include shredding, washing and pelletising. <p>Or</p>		Recycling companies NGO
(5) Re-marketing	<ul style="list-style-type: none"> - NGOs wash, dry and then process the material into items where the structure/origin of the former product is still recognisable. - Pellets are secondary material for a new supply chain. The material is either used by the recycling company itself to create new products, such as black polythene carrier bags, or it is sold as a secondary material to other companies. <p>Or</p> <ul style="list-style-type: none"> - Plastic water sachets packaging is manufactured into art products and sold (mostly to tourists) to raise awareness. 		Recycling companies NGO

management, proponents were eager to voice the economic benefits especially for the value pickers, as illustrated by the chairman of the Pure Water Waste Collectors Association who stated that '200 Cedis a month is possible' (Interview #10). Considering the exchange rate at the time of the interview, this meant that it would be possible to escape extreme poverty. Not surprisingly, political actors supported this type of waste recycling: 'Plastic bags should be collected and sold to recycling plants. This will bring money into the pockets of people and the country' (Deputy Director, Environmental Protection Agency, Interview #23). A company representative proudly mentioned that 'It's rubbish, but rubbish is value' (Interview #7).

Thus, at first glance, a synergetic interplay of ecological and social benefits unfolded and most actors in the RL chain highlighted the positive ecological contribution of their activities. However, beyond quick ecological gains (e.g. less waste on the streets), a deeper analysis of different actors during our analysis and field-work revealed a more nuanced picture of some important (and rather long-term) trade-offs between different sustainability dimensions. Such trade-offs also became apparent for social issues of sustainability at the BoP and of the involved actors. Table 4 provides illustrative quotes from different actors and our own field observations on these issues, which will be at the centre of the following discussion.

5. Discussion

The IV concept could potentially be one part of the puzzle in creating a BoP business model with a more sustainable basis. IV provides a social perspective to RL, meaning the inclusion of the BoP segment in supply chain processes. Furthermore, IV helps in integrating ecological issues into the BoP business approach, which so far has been neglected in the BoP literature (Kolk et al., 2014), though it has been discussed in related papers on waste management (Ahmed & Ali, 2006; Scheinberg, 2011). However, a closer look at the market mechanisms reveals a number of trade-offs

which hamper true sustainability and questions the entire approach of achieving a reduced environmental burden in the water sachet supply chain through IV. In the following discussion, we will highlight potential contributions of IV for sustainable BoP approaches and then critically discuss trade-offs and hindrances for holistic sustainability at the BoP.

5.1. Potential synergies of informal valorisation and sustainable BoP business approaches

A sustainable business approach consists of triple bottom line (economic, social and ecological) performance goals. When looking at the social dimension, one corresponding goal of IV is to trade the recycling material into industrial value chains (Gunsilius et al., 2011), which involves people in related business activities (Ahmed & Ali, 2006). Thus, IV is the means of acquiring material through actors from the informal sector to be processed by companies from the formal sector along the chain. As such, IV can be regarded as an integral part of BoP thinking, yet it has hardly been addressed in this body of literature so far. The initial goal of the BoP business approach was to 'unlock' the potential of the BoP by integrating them into the (global) market and supply chain (Prahalad & Hammond, 2002; Prahalad & Hart, 2002), which is also discussed in the informal sector approaches (Scheinberg et al., 2011). Through IV activities, the BoP is integrated into the supply chain because IV activities involve recovering value and thereby create income for those involved and deliver material to recycling companies for the recycling process. This moves beyond the typical RL implications of recycling in formal(ised) value creation activities (e.g. Pagell et al., 2007). The IV concept thus also serves as a bridge between informal and formal markets (Ahmed & Ali, 2006; Scheinberg et al., 2011). Furthermore, on an overarching level, the value pickers also add value and contribute to society by reducing the need for public expenditure on waste services (similar to Hayami et al., 2006). In sum, these aspects depict the potential synergetic relationship between value generation and BoP

Table 4

Illustrative quotes and observations on the trade-offs in the ecological and social dimensions.

Ecological benefits	Ecological drawbacks
<p>'The focus is to manage the sachet water waste and we are doing this by placing value on the waste, so that people could collect it and send it to recycling companies to make money.' (Accra Plastic Waste Management Project; Interview #1)</p> <p>'... when people realized ... there was value for them [the sachets], they were no longer throwing them away. They were collecting around, so unconsciously they were cleaning the environment at the same time it was providing the people who collected the material some money.' (Trashy Bags, NGO; Interview #13)</p> <p>'I can say we are helping the nation to be clean.' (Chairman and Value Picker from Pure Water Waste Collectors Association, Interview #10)</p> <p>'If we would not be working, than Accra would be really dirty. ... I think when you drive around these days you don't find many sachets on the road.' (Recycling facility; Interview #7)</p> <p>→ RL through IV helps to reduce the environmental burden. However, downcycled material is still harmful to the environment and the RL industry prevents banning harmful plastics altogether to avoid negative social consequences.</p>	<p>'Black rubber bags, you can't recycle them, they don't degrade for 100 years and more, that is why you see them in the environment, so that is a very big problem now. That is why we are looking forward to banning them.' (CSIR, governmental research institution; Interview #4)</p> <p>'The idea that we have is that the black polythene bag has to be taken of the environment, because of the [negative] environmental effects that it has.' (CSIR, governmental research institution; Interview #4)</p> <p>'We don't want black rubber bags in the country because they don't degrade. I think their quality is inferior, you cannot reuse them.' (Environmental Protection Agency; Interview #23)</p> <p>'The government realized the disadvantages of some aspects of recycling, e.g., production of black rubber bags. Nevertheless, if it is decided that the production of black rubber bags is banned, first, they need to come up with a different product, or find alternative working opportunities for the people who are now involved.' (Environmental Protection Agency; Interview #23)</p>
Social benefits	Social drawbacks
<p>'We have people bringing in the money, and they are making good business. They make much more money than people working in firms as employees.' (Recycling facility; Interview #7)</p> <p>'Social sustainability is guaranteed given the fact that the solid waste management sector is now attractive to young people, unlike previous years when the jobs in the sector were viewed as low profile.' (CHF internal report; Provided by interviewee #9)</p> <p>'People do it for a while and after they stop. Why? Because their father or sister tell them 'How can you collect rubbish?' That is their attitude that is the problem. Those who are really willing to make money are still with this.' (Recycling facility; Interview #7)</p> <p>'In Africa, we really need it; it is taking a lot of labour, so these people—we have around 300 people working here—what will they do? Do you want that they go back to the street?' (Recycling facility; Interview #16)</p> <p>→ Perceived social benefits of some actors are in opposition with observed social drawbacks, especially for value pickers.</p>	<p>Stephen, a waste buyer, explained how everything for him started. He had the idea that refugees from a local refugee camp could help pick water sachets. He utilised the weak position of the refugees and offered them some income to improve their living conditions. Nevertheless, he (and the refugees) had to work hard to make this venture economically sustainable. (Observation on a waste buyer from own field notes)</p> <p>The old woman is weak and picks water sachets with her hands. Her granddaughter does not really like that she does this kind of work, but she continues because she needs medication. (Observation on a value picker from own field notes)</p>

inclusion in IV.

This directly connects to the ecological dimension of waste picking. Until now, to the best of our knowledge, the literature on the BoP did not consider the inclusion of business processes relating to reverse material flows. This is interesting because such reverse flows are an important element in improving ecological performance (Guide et al., 2003). The relevance of identifying a means to improve reverse material flows is especially prominent at the BoP where, in general, no formal systems of waste management are in place to reduce the ecological burden of (increased) consumption (Hahn, 2009; Myers & Kent, 2003). Promoting increased consumption while neglecting potential solutions for dealing with increased waste streams is an important shortcoming of many extant BoP projects. As discussed above, the BoP concept often stands for new market exploration by companies and for the integration of the BoP as producers, distributors and entrepreneurs. IV activities now extend this focus on integration by looking at the roles of 'recyclers', emphasising the reverse flow in the respective supply chain.

The reduction process, in particular, is a potential way of moving towards more sustainable business at the BoP. Nevertheless, valorisation is primarily done for economic reasons which contribute to the livelihood of millions of people (Ahmed & Ali, 2004). This is complemented by the perspective of the ecological environment because valorisation activities help to keep streets clean(er) and contribute to a better ecological performance of the overall water sachet supply chain. Such ecological reasons are, of course, not the main concern for the value pickers, but they illustrate potential synergies of value creation and an improved ecological performance. The industry—and in particular the very active association, i.e. Accra Plastic Waste Management Project—seems to engage very

eagerly in this kind of ecological thinking when supporting water sachet collecting efforts, not least as a means to react to governmental pressure threatening to ban their product.

5.2. Trade-offs and constraints of informal valorisation from a sustainability and BoP perspective

In BoP research and practice, synergetic outcomes (especially regarding profit opportunities and poverty alleviation) have often been highlighted to advocate the idea of business for and with the poor (see Prahalad & Hammond, 2002; Prahalad & Hart, 2002). The discussion of trade-offs in sustainability, however, has just recently gained momentum (for a BoP application see, for example, Reiner, Gold, & Hahn, 2015). A sustainability trade-off occurs when the three dimensions of sustainability (i.e. ecology, economy, social) cannot be achieved simultaneously and a gain in one dimension leads to a loss in other dimensions (Hahn, Figge, Pinkse, & Preuss, 2010). Trade-offs and tensions between different aspects of sustainability at the BoP have so far been mostly neglected (for a notable example, see Hahn, 2009). However, reaching the ideal of the triple bottom line approach is the exception, and thus sustainability tensions need to be managed in order to improve corporate sustainability (Hahn, Pinkse, Preuss, & Figge, 2015). A first important step in this regard is to acknowledge trade-offs and to subsequently identify and characterise them.

IV introduces an ecological aspect to the BoP approach. Nevertheless, in the present case, the IV concept can only be regarded as an imperfect transitional solution for (plastic) waste collection. In the end, more efficient methods of recovering material need to be introduced to collect even more of the end-of-life products. The water sachets are processed into plastic pellets, which are

downcycled into low-quality thin plastic bags. While this follows the general RL idea, it does not yet contribute to the sustainability of the water sachet supply chain on a permanent level. Such permanent sustainability instead requires a closed-loop perspective where the materials are not subject to downcycling or disposal (Guide et al., 2003; Guide & Van Wassenhove, 2009). Biodegradable materials would be one option to avoid waste and encourage close-loop supply chains. Further, in the specific case of water sachets, one could even think of an entirely different system of packing and selling water in order to reduce waste generation and consequently the need for recovering value from packaging material. This is especially relevant because water sachets in general are a rather contested product. When looking at social justice concerns (i.e. water as a human right; see Stoler, Weeks, & Fink, 2012), improving the public water supply might be more desirable not only because of the ecological challenges of water sachets but also because of an improved security of supply. If one sees this as a general aim, IV activities in the RL chain of water sachets can even be regarded as detrimental because they help prolong an otherwise undesired system of supplying water to poor consumers.

Other shortcomings for a more holistic BoP approach are connected with social concerns, especially regarding the working conditions of the value pickers. First, general employment issues come to the fore. We observed, for example, a lack of a steady income in our case study resulting from the dependency on quantity performance. An important aspect of BoP inclusion and contribution to poverty alleviation includes working in a more formal work environment that includes regular income which could improve the worker's livelihood (e.g. Gold et al., 2013; Stutz, 2008). However, our case study revealed a classic principal-agent problem in this regard. One buyer indeed attempted to employ value pickers for a small monthly salary. However, this concept was not successful. In a classic moral hazard situation (see, e.g. Prendergast, 1999), the employees took the monthly salary and also sold part of the picked plastic to other buyers in order to increase their salary, which was unprofitable for the buyer.

Meanwhile, the questions remain whether the concept of IV is an upgrade for the BoP population because it offers job opportunities or whether the rather low quality of the respective IV employment is a hindrance for the development of the BoP segment. Despite the potential social benefits associated with informal recycling (e.g. employment provision and a livelihood for impoverished, marginalised and vulnerable individuals or social groups) (Medina, 2000), the discussion of the quality of work and who performs the IV activities is diverse. The collection of sachets by children is regarded by some families as an additional income opportunity and thus as a way to assist the family. This, however, induces concerns of exploitation of children in scavenging, especially when the performed work has noxious effects (e.g. children working on dumpsides) or hinders school attendance (Anschütz, Scheinberg, & Klunder, 2004). While we did not observe such forms of child labour in our case study, one cannot rule out that in dire situations of extreme poverty children might be forced to work fulltime as value pickers. Informal recycling is in some cultures largely carried out by marginalised and outcast groups (Wilson et al., 2006). While we did not observe such patterns ourselves, issues of the esteem of value pickers were, nevertheless, mentioned. For example, some value pickers gave up their work because the family did not like the idea of them working in the waste sector. The involved NGO in Accra also tried to improve the perception of value pickers with their activities. The general idea of most BoP approaches is to include poor people. However, if societies do not accept the specific type of job connected to IV, value picking only brings people closer to the edge of the society rather than fostering integration. Another aspect of job quality can be seen

in a safe working environment. A concrete example from our case study is the health issues connected with picking waste. Although it is necessary to protect themselves from the other waste next to the sachets, not all value pickers used gloves to protect their hands while picking. This could lead to detrimental effects especially in situations when there is no health insurance, as is the case with the value pickers in our study. In this regard, some scholars call for increased public support in the value chain (e.g. Hayami et al., 2006).

Finally, there might be a very general trade-off involved with the idea of IV and BoP business. While IV provides some income to poor people and thus helps to partially alleviate the most desperate kind of poverty, it is only practicable from a business point of view if it is connected with very low wages so that it is financially advantageous for the entire RL chain (similar to Sicular, 1991). This, however, implies that IV in RL can potentially never lead to comprehensive poverty alleviation since this would ultimately lead to its own demise. We therefore see a double trade-off in sustainability. First, a trade-off lies in the outcome level of environmental versus social sustainability (Hahn et al., 2010). Successful poverty alleviation in the project would only be possible through significantly increased wages in the RL chain. However, this would endanger the ecological improvements because waste picking would no longer be profitable for the waste recycling entities, which would cause the reverse material flows to cease. Here, the second trade-off surfaces: in the temporal dimension (Hahn et al., 2010), an increase of value pickers' income would improve their livelihood in the short term but endanger it in the long term because it could destabilise the entire waste picking system. In sum, the water sachet supply chain is thus not a working example of an 'integrated BoP' or 'BoP 2.0' project (see again Hahn, 2009; Simanis et al., 2008), because market forces forbid significant poverty alleviation in the RL chain. From the lens of 'BoP 1.0' approaches (i.e. a focus on the poor as consumers), the project seems to be at least partially successful because it helps supply an essential good to the poor population at a lower cost compared to their previous condition without the sachets (Stoler, 2012). Nevertheless, if we see access to safe drinking water as a human right (Bakker, 2007), even the improved status is probably not sufficient.

6. Conclusion

The present case study provided an in-depth look into real-world issues related to two thus far largely neglected topics in BoP research: the ecological environment and a distinct supply chain (or more specifically, RL) orientation. The contribution of this research is twofold: First, we link RL activities and the concept of IV to the BoP literature, thereby extending its conceptual basis. Second, we discuss related synergies and trade-offs among the three dimensions of sustainability. The analysis identified potential synergies, especially in the short run, for example, the opportunity to simultaneously increase the income at the BoP and provide a cleaner environment. In the long run, however, trade-offs prevail, because the manner in which the packaging is organised is not fully sustainable. While the debate on sustainability synergies and trade-offs is already challenging in developed countries, resolving related tensions among environmental, social and economic objectives seems particularly complicated in BoP cases. Hence, one case cannot solve the related issues in theory and practice immediately, but we open up future research opportunities to further the understanding of when such trade-offs occur and how they might be at least partly resolved.

From a more general perspective, BoP business models were initially discussed in the literature in terms of providing adequate products for the poor (e.g. Prahalad & Hammond, 2002; Prahalad &

Hart, 2002). Subsequently, the approach was further developed into a broader understanding of the poor as active parts of the value chain, i.e. the production system (e.g. Simanis et al., 2008). It is argued that such an inclusion could potentially advance the social dimension of sustainability through development (Hahn, 2009, 2012). This case study provides a glimpse of a next step beyond the extension from the consumption system towards an inclusion of the production system by introducing a reduction perspective to the BoP approach. The reduction system via IV addresses environmental concerns at the BoP and provides initial thoughts on the so far often missing environmental perspective in BoP research. Nevertheless, in addition to resulting in synergies of BoP inclusion and environmental benefits, this approach also leads to trade-offs.

In summary, this study provided a balanced picture of a critical BoP case. On the one hand, the integration of the BoP into the end-of-life supply chain of water sachets can indeed help to reduce the ecological footprint of this typical BoP product, which is used to overcome an insufficient public water supply in rural areas or urban settlements. At the same time, this integration provides employment and income to a substantial number of people. Thus, the ecological and social performances seem to increase compared to a lack of IV and BoP integration into the supply chain. On the other hand, however, the present solution seems to be a workaround for approaching the most pressing issues. True poverty alleviation does not take place; the RL chain is only stable because of the low wages of the value pickers, which are a cornerstone of the entire system. Furthermore, cleaning up some of the remains of an otherwise rather ecologically unsustainable product (plastic sachets for drinking water) is only a temporary and partial relief of the ecological burden caused by the product itself. Thus, we need more work to arrive at truly sustainable solutions. For the present product (water supply), this could, for example, either be improved access to the public water network (if possible) or the use of other materials for the sachets, such as biodegradable plastic (if technically feasible). Overall, further research is needed to address approaches for resolving trade-offs and to explore more sustainable solutions of water supply in the context of a developing country like Ghana.

From a practitioners point of view the present case study underlines the need for a holistic assessment of BoP projects. In the initial steps of the research project, the focus was mainly on positive outcomes of the RL and valorisation activities. Potential tensions and trade-offs manifested only after a thorough analysis and intensive field engagement. This is important because hidden trade-offs can cause (unintended) harmful consequences. The case study illustrates that access to products for people living at the BoP does not automatically imply win-win situations in all sustainability pillars. As a critical case study, it also illuminates difficulties in achieving truly sustainable projects. Companies are advised to carefully and holistically assess project performance to avoid detrimental effects for themselves (e.g., through the media) and for the beneficiaries at the BoP. The same applies to NGOs or governmental agencies supporting sustainable development goals.

Despite providing valuable data and deep insights, an empirical study such as this one is not without limitations. To achieve authenticity (Bryman & Bell, 2011), sampling and data collection should aim at including the viewpoints of various actors/stakeholders in the case along the entire supply chain. While we aimed for a broad coverage, we were not able to extensively consider all parts of the supply chain due to a lack of accessibility and some language barriers. For example, most value pickers did not speak English and a translator would have significantly altered the setting of the conversation. Therefore, only value pickers who spoke English were included. Furthermore, we used the snowball technique for our sampling and so we only approached actors in the

functioning network. Thus, possible problems with the valorisation were only retrieved from participating actors and involved stakeholders. Furthermore, the interviews might be biased by (political) desire and thus do not always represent realistic answers. Finally, the setting of our case study is quite specific since it is a mostly Ghanaian initiative, with no focal company, which is commonly the case in global supply chains. On the one hand, this might limit the generalisability of our findings, and we cannot aim for broad generalisability due to the specific nature of qualitative case-based research. On the other hand, our specific case and data can indeed be regarded as valuable and insightful because we were able to acquire data in a pure BoP setting beyond the common focus on (supposedly) best-practice projects initiated by multinational companies (Kolk et al., 2014). Further research could examine how these limitations could be eliminated, and we think that still more research needs to focus on the ecological aspects of BoP business relationships to arrive at scalable solutions which integrate true poverty alleviation into a holistic sustainable development.

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